History
of Engineering at CCNY

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Contents

0. Preface

This book is a history of the School of Engineering at the City College of New York; its aim is twofold:

- for the School of Engineering community I described our history and achievements: there is reason to be proud of the institution, much more that I knew at the beginning of the project. Among our Alumni, we have many Industry Leaders, 28 Members of the National Academy of Engineering, 2 Members of the National Academy of Science, several University Presidents, a MacArthur Fellow, an Olympic Medalist, and many other remarkable achievements.
- for readers interested in the history of engineering education: I put on record what was done, and how it changed over the years. For this purpose I included much data which might be uninteresting for many readers, but which I believe is necessary to really analyze what happened.

This book project is written in expectation of the 100th anniversary of the Grove School of Engineering in 2019. Work on this project started with the beginning of the summer break 2018; I will finish it in the summer break 2019.

The book is not organized by year, dean, or president; instead, I tried to separate different aspects of the school and show their development. Also it is not a general history of the City College of New York; I concentrate on engineering. The college had many crises which mostly bypassed engineering.

0.1 Sources

The CCNY Bulletins are sources for curricular information and faculty lists; they are not explicitly referenced. From 1933 on the Bulletins had a separate section for the School of Engineering, which contained information on history of the school, admissions, faculty, curriculum, infrastructure etc. Unfortunately, the amount of information contained in the Bulletin decreased over time, and since the sections are not always revised each year, it might contain outdated information; e.g., in 2018 it still states that the School is connected to ARPAnet, which was decommissioned in 1990.

Some other sources are student newspapers, alumni organisation magazines, the CityFacts, the CUNY Student Yearbook maintained by the CUNY Institutional Research, the Grove School of Engineering Annual Report (2002-2012). I tried to identify sources in footnotes. Especially useful were sources available online: the *Tech News*, the *Campus*, and the *New York Times*.

1. General Situation of Engineering Study at CCNY

The City College of New York became active in engineering education comparatively late, establishing its first engineering degree in 1916. For comparison, the Rensselaer Polytechnic Institute started in 1824, the former Brooklyn Polytechnic University started in 1854, the Columbia University School of Mines started 1864, the Worcester Polytechnic Institute started in 1865, Stevens Institute of Technology started 1870, so there was a long established practice for the academic education of Engineers. The City College of New York did offer on and off courses in engineering topics in the first sixty years, but they were typically offered as applied science or applied mathematics. If a student wanted to become engineer, he got an undergraduate degree from City College, and then continued at a different institution for an engineering degree. G.W. Goethals, the most famous engineer coming from those early years of the City College, entered CCNY at age 14, and after three years at CCNY was admitted to West Point, where he became engineer. At CCNY, Alfred G. Compton, Professor of Applied Mathematics, later Physics, offered 1869-1886 postgraduate courses in civil engineering; 1883-1892 a two year non-degree program in Mechanical Arts, and from 1892 on a five year B.S. program in Mechanical Arts [*how long did that exist?*].

1.1 The Founding of the School of Engineering

In 1914, the Trustees appointed Sidney Edward Mezes as President of City College. Mezes had an undergraduate degree in engineering from Berkeley, so he was positively inclined to academic engineering programs[1]. Under Mezes, the first engineering degree programs were introduced. Before that, classes with engineering topics were offered by faculty from the Physics department, Professor Alfred Compton until his retirement 1911, then mainly Professor Charles Parmly and Professor William Fox.

On May 22nd, 1917 the Board of Trustees created a Department of Engineering, which was then extended to a School of Technology in 1919. One of the most active proponents of the creation of the engineering school was Charles Howard Parmly, a professor of Physics, with undergraduate degree and an M.S. from CCNY and a degree in Electrical Engineering from Columbia University. Parmly was a highly respected professor with a deep involvement in the running of the university. Earlier in 1917, the New York City Controller Prendergast asked the Board of Trustees to release Professor Parmly

[1] City College Quarterly vol 20(2) p.23 (1924)

two days per week from his teaching duties to assist in the study of the cost of maintaining the University of Cincinnati and Yale University, to gather comparative data to fix the budget appropriations for the two colleges the city was operating[2]. Parmly was appointed in the May 22nd, 1917, resolution of the Board of Trustees as the chairman of the new department of engineering, and its first professor, effective June 1st[3]. However, just as the new semester started, on September 7, 1917, Charles Parmly died of an embolism, at the age of 49[4][5]. On short notice, the Board hired David Steinman, a CCNY graduate of the class of 1906, who had already taught several semesters in the evening session[6], as Associate Professor of Engineering, to take over Parmly's courses in Civil and Mechanical Engineering[7]. David Steinman had received a PhD from Columbia in 1911; his dissertation already concerned questions of bridge design[8]. After graduating, he took an appointment as professor of civil engineering at the University of Idaho but did not stay there long; at the time of his City College appointment in 1917, he had worked as assistant engineer on the Hell Gate Bridge. In 1920, Steinman left City College again, and started his career as famous builder of bridges.

Two years after the start of the Department of Engineering, in 1919, the Board of Trustees recognized the ever increasing need for engineers, and created the School of Technology. At the same time, and for the same reason, it started the School of Business and Civil Administration. Both new schools shared faculty with Arts and Sciences, thus there is the Department of Engineering, which is only in the School of Technology, but the Departments of Mathematics, Physics, Chemistry, Art, and Hygiene are part of Arts and Sci-

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2 The City College Quarterly Vol 13(2) page 84 (1917)

3 The Department of Physics had sent a letter to the Board, in which they suggested the creation of a Department of Engineering with Charles Parmly as chair: reprinted in Tech News 23(1) September 25, 1968; 50 Years Engineering + Architecture Tech News Supplement

4 The City College Quarterly Vol 13(3) 100–112 (1917). The high respect in which Parmly was held is shown by twelve pages of eulogies, from colleagues, Dean, former president Finley, current President Mezes, and others. The college held a memorial ceremony in the Great Hall

5 The class of 1888, which was Parmly's undergraduate graduating class at CCNY, donated a plaque for him, on the right-hand side of the Great Hall. See City College Quarterly Vol 20(3) 19–21 (1924)

6 according to other sources, he taught the Surveying class 1908-1910

7 The City College Quarterly Vol 13(3) page 129

8 other sources claim the design of the Henry Hudson Bridge, from the northern tip of Manhattan to the Bronx, as his dissertation topic, but that is probably wrong; he designed that Bridge in the 1930s

ences, but have faculty which also belongs to the School of Technology[9]. The initial Department of Engineering is very small; the engineering faculty of the School of Technology in 1919 was David B. Steinman (Associate Professor)

Arthur Bruckner (Assistant Professor)

Alfred N. Goldsmith (Assistant Professor)

Frederick O.X. McLoughlin (Assistant Professor)

Gerardo Immediato (Assistant Professor)

Professor William Fox of the Physics department, who had already for many years taught engineering courses, was appointed as Acting Dean. This, however, did not work out; Professor Fox wanted to return to Physics. After a year, President Mezes stepped in as Pro Tempore Dean, in addition to his presidential duties.

In 1920, one year after the founding of the School, David Steinman resigned, and pursued his career in Bridge-Building, and Frederick Skene was hired as his successor. He was appointed Associate Professor, then the most senior rank among the small number of engineering faculty, and was appointed as Dean in the next year[10]. *insert background of Skene* That turned out to be a stable appointment, he remained Dean of Engineering for eighteen years, the longest-serving Dean in the history of the school. The School of Technology had in 1921 an enrollment of 32 students, out of 1853 in the Day Session, and 1922 an enrollment of 48 students, out of 2509.

1.2 Engineering Degree Programs

The first engineering program established in 1916 led to the degree of "junior civil engineer", with chemical, electrical, and mechanical engineers added 1917. These programs were part of the Division of Vocational Subjects and Civic Administration, and given only in the evening session; so they were clearly viewed as something inferior by the College of Liberal Arts and Sciences, which was the core of CCNY. But in 1919 the Trustees established a separate School of Technology; instead of the degrees as "junior engineer" there were now five-year programs leading to the degrees of "Chemical Engineer", "Civil Engineer", "Electrical Engineer", and "Mechanical Engineer". After the fourth year, the students were awarded a "Bachelor of Science in Engineering". The five-year programs consisted of two years of study of general college subjects, and three years of study in the School of Technology. The first degrees were awarded by Civil Engineering in 1921, by Mechanical Engineering in 1922, by Chemical Engineering in 1923, and Electrical Engineering

9 City College Quarterly Vol 16 (2) page 8 comments that some faculty belongs to three schools

10 In 1922 he was promoted to professor

in 1926[11].

In 1936 the names of the degrees were changed: the "Bachelor of Science in Engineering" became a "Bachelor of Chemical/Civil/Electrical/Mechanical Engineering", and the "Engineer" degrees became Master's degrees (Master of Chemical/Civil/Electrical/Mechanical Engineering). At the same time, the Chemical Engineering program was moved from the Chemistry department to the School of Technology, and the Chemical Engineering department formed.

In 1961 the School of Technology started offering a five-year Bachelor of Architecture. In 1962 the School's name was changed to School of Engineering and Architecture; then in 1968 it was split into the School of Engineering and the School of Architecture.

From 1963 on the School offered a PhD program in all its disciplines. The first Engineering PhD graduates appeared in 1967 (in Chemical Engineering); in 1969 CUNY introduced the Graduate Center as central location of all PhD programs, but the physical location of the engineering program stayed at CCNY.

In 1968 the names were changed again; in an attempt to reduce the number of different degrees awarded, the Bachelor degrees became Bachelor of Engineering (Chemical/Civil/... Engineering) and the Master degrees became Master of Engineering (Chemical/Civil/... Engineering).

In 1968, the School of Engineering started offering a Computer Science program, with a Bachelor of Science (Computer Science) in 1968, and a Master of Science (Computer Science) in 1969. The PhD program in computer science was initially just another specialization in the engineering PhD program; it became a separate program in 1986, and since other CUNY colleges also offer computer science, the physical location of the computer science PhD program is the CUNY Graduate Center.

In 1968, the School of Engineering started offering a Biomedical Engineering Option as add-on for all Bachelor of Engineering Programs.

In 1971 the school started a upper level program in engineering for students who had an Associate of Applied Science degree from a community college. The intention was to give community college students a two-year path to a Bachelor degree in engineering. In 1974 a Department of Technology was founded to offer this program; so clearly it was not just using the same courses as the other engineering programs. This is another reaction to the CUNY Open Admissions decision of 1969; since the students were promised admission to a CUNY college, but not necessarily to the college of their choice, students that did not satisfy the School of Engineering admissions requirements

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11 City College Alumnus 22(5) May 1926, p.199. Electrical Engineering was delayed by staffing problems.

were directed to the Community Colleges. After getting a community college degree, these students needed a path to an engineering degree that should not take another four years of study. However, the engineering programs were not willing to accept these students or grant transfer credit, so a separate program was created for them. To make clear that this was not equivalent to the other engineering degrees, the awarded degree was not a Bachelor of Engineering, but a Bachelor of Technology. The first students graduated from the B.Tech. Program in 1973. The program started with almost 100 students, then continuously decreased in size; in 1993 the program, and the remaining Department of Technology, were transferred to the New York City College of Technology (City Tech). The last students in this program to graduate from CCNY were in 1997.

From 1979 [*earlier?*] on existed four-year combined BE/ME programs; they were discontinued in 1991. A co-op program COOP/ENG existed from 1971[12] until 1993, managed by the Placement Office, later Office of Career Counseling and Placement.

From 1981 to 1991 exited a MS Degree in Information Science; this was offered by the computer science department, and was more business oriented than the MS on Computer Science degree. The degree program had quite high enrollment; it did not assume an undergraduate degree in computer science, or programming background, which was provided, where necessary, by a one-semester undergraduate programming class as non-credit prerequsite. The MS in IS curriculum contained Database and Management Science classes, and a Cobol programming class. A MS in IS program was re-introduced in 2009, now aimed at a market with more technical background.

From 1968 on existed an option of Biomedical Engineering for all engineering majors[13], by 1979 additional options of Clinical Engineering, and a Pre-Medical option, were added. The exact requirements of these options depended on the major. The Clinical Engineering option contained more patient care, the Biomedical Engineering option more biological foundations. All these options were discontinued when Biomedical Engineering was introduced as an independent major. That was introduced top-down: initially a cross-department Center for Biomedical Engineering was created, which from 1999 on offered PhDs in Biomedical Engineering; from Fall 2000 on existed a ME program in Biomedical Engineering, and from Fall 2002 on the BE program in Biomedical Engineering. At the same time, a department of Biomedical Engineering was created.

From Fall 2000 on existed a BE program in Computer Engineering, jointly

12 Tech News Vol 32(1) September 1970

13 Tech News Vol 27(4) March 15, 1968

offered by the departments of Electrical Engineering and Computer Science, using a selection of courses from the BE in Electrical Engineering and BS in Computer Science programs.

[*To Do: CUNY graduation numbers list a Master program in Urban Engineering and a Master in General Engineering, which don't exist in the Bulletin.*]

1.3 Organisation of the College and the School of Engineering

CCNY was organized into the following units[14]:

- *College of Liberal Arts and Science* (CLAS), which was the older and larger part of CCNY,
  as well as the Schools:
- *School of Technology* (founded 1919) becomes *School of Engineering* 1968, then *Grove School of Engineering* in 2005
- *School of Business and Civic Administration* (founded 1919), became in 1953 the *Baruch School of Business*, and left CCNY in 1968 to become *Baruch College* within CUNY.
- *School of Education* (founded 1921),
- *School of Architecture* (founded 1968, split of from School of Engineering via intermediate stage *School of Engineering and Architecture*), became *Spitzer School of Architecture* in 2009
- *School of Nursing* (starts 1969, closed 1995) The School of Nursing existed long before 1969: it was founded at the Mount Sinai Hospital in 1881, then acquired an affiliation first with Hunter College 1967, then became part of CCNY in 1969. It was closed in the fiscal crisis of 1995.
- *Sophie Davis School of Biomedical Education* established in 1973, named in 1977, became the *CUNY School of Medicine* in 2016, which, despite the CUNY name, remains a part of CCNY.
- *Colin Powell School of Civic and Global Leadership* was established in 2013 out of the former Division of Social Sciences within the College of Liberal Arts and Science. Although it is a school, it is still part of CLAS.

Besides these academic units dedicated to specific subjects, there were

- *Division of Vocational Studies and Civic Administration*, as well as
- *Evening Session*, and
- *Summer session*. These were formally separate academic units, whose faculty was mostly borrowed from the schools and CLAS; in 1950 they

[14] there is no logic to the designations of the units: we have a CUNY school, which is part of CCNY, and a college (CLAS), which is part of the college (CCNY), and which itself is divided in one school and two divisions

were merged into the *School of General Studies*, whose most important activity continued to be the management of the evening session.

- *Division of Interdisciplinary Studies at the Center for Worker Education* became a separate unit in 2006. Before that, the Center for Worker Education was a satellite campus of CCNY that offered classes under the supervision of CLAS.

The School of Engineering made several attempts to break away from CCNY, and become directly a unit of CUNY, as the School of Business had done (which became Baruch College). Faculty voted to secede from CCNY in 1987, and again in 1992[15]. The first attempt failed to get the support of the CCNY President Harleston; the second attempt was made after Harleston's resignation, in another period of CCNY upheaval, but did not receive support from CUNY either. The School of Business had a much stronger case, since it was already at a separate location in midtown, whereas the School of Engineering is on the CCNY campus, and needs many courses from the rest of the college. Also Baruch College is financially independent, being entirely tuition-financed, which the School of Engineering cannot be, unless the tuition for engineering students is increased drastically.

The School of Engineering currently has the following departments:

- *Biomedical Engineering* was created in 2002.
- *Chemical Engineering* was created in 1936; before that, chemical engineering was taught by chemistry faculty.
- *Civil Engineering*
- *Computer Science* was created in 1970.
- *Electrical Engineering*
- *Mechanical Engineering*

Two further departments existed in the past

- *Drafting* was created in 1929 as a service department; it did not have its own major. It was recognized that technical drawing skills are necessary for engineers, they are different from what is provided by the Art department, and require different faculty. The Department of Drafting was renamed Architecture and Graphics in 1961, and disappeared in 1968, when its faculty became part of the new School of Architecture[16].

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15 see: School Adopts Bid to Leave City College, New York Times, December 11, 1992

16 However, the untangling was not as easy as expected; in the meeting February 24, 1970, the Board of Higher Education transferred five faculty members and two lecturers back from the School of Architecture to the School of Engineering. Professors Cefola, Cowan, Rappolt, and Silberberg went to Civil Engineering, and Codola to Mechanical Engineering, and the responsibility for the courses in Technical Drawing and Descriptive Geometry went with them back to the School of Engineering

- *Technology* was created in 1974 and was moved in 1993 to the New York City College of Technology (CityTech). It was created to provide the two-year Bachelor in Technology degree as an upgrade path for the students who finished a CUNY community college with an Associate of Applied Science (AAS) degree. It was found that those students are not sufficiently prepared to just enter the normal engineering majors in the junior year[17], so an entirely independent program was created for them. The department was created in 1974, in a time of financial crisis, from faculty transferred from the other departments.

1.4 The Evening Session

In 1909 the Evening Session was established to serve the needs of students who work during the day. And for the first decades there was a strict division between the Day Session and the Evening Session, with the Day Session being more prestigious; the Day Session were the real CCNY degree programs, and the evening session the domain of the Division of Vocational Studies and Civic Administration. Effectively the Evening Session was a separate college that shared some facilities with the Day Session, but students were admitted to either the Day Session or the Evening Session, and most faculty taught only in the Day Session. The Evening Session ultimately gained full equality with the Day Session, but it was a long process, and even in the current employment contracts is a passage that we might be required to teach evening classes, which is probably a legacy of the Evening Session. In 1933, the School of Technology offered a number of classes for professional and vocational training in the Evening Session; these were quite practical topics in civil engineering, e.g. "Reinforced Concrete", "Heating and Ventilation", "Use of Surveying Instruments", "Inspection of Materials in Building Construction", but they were all not for credit. By 1940, the course offerings in the Evening Session were the same as in the Day Session. Applicants for study at CCNY School of Technology had to satisfy the School's admissions requirements; from these, the top, up to a quota, were admitted to the Day Session. These are the matriculated students, for which tuition was free, apart from some fees, and they take classes in the Day Session. Students who satisfied the admission requirements but did not make the cut became "limited matriculated" students who could take classes in the Evening Session, for a low tuition. Everyone else could also take classes in the Evening Session, as non-matriculated students, for a higher tuition. This system was still in place 1950. A student could advance from Evening Session to Day Session by completing a specific program

[17] they could, of course, apply for admission to the engineering majors, but then they would have at least four years ahead of them, and study was not free. Not much credit was transferred.

of 15 credits in one year with B average, but at each moment, the student belongs to one Session, and is not free to take classes in the other. Even in 1950, when classes in Evening Session and Day Session were declared in the City College Bulletin to be fully equivalent in content and level, a day student needed special approval to take a class in the evening, and get the credit transferred. In 1950 the Evening Session and the Summer Session were formally merged into the School of General Studies, which however did not change anything: the School of General Studies did not have its own faculty, but ran the classes with faculty hired for each course, if possible, from the regular schools. In 1970, in an interview with the registrar[18] the transfers from the Evening Session are lumped together with transfer from community colleges, as opposed to transfers from day sessions of other senior colleges. The importance of the Evening Session was further decreased by the Open Admissions policy and the competition of the CUNY community colleges; the School of General Studies stopped in 1950 having its own section in the Bulletin; until 1987 it is still mentioned with at least one paragraph (and in the index), in the 1991 Bulletin it has disappeared. Formally, however, the evening session must have continued to exist, since in 1999 the student parliament of the evening and day sessions were joined. The reason for this might have been financial: there were still separate accounts for the student activities of evening and day session, and the evening session account was not spent, and had accumulated for several years[19].

1.5 Location of the School of Engineering

The City College moved in 1907 to the new campus at Convent Avenue; and on that new campus, already before the start of the School of Technology, was the Mechanical Arts building (with the chimney) as one of the original five buildings: the others were named the Main Building, the Chemical Building, the Academic Building, and the Gymnasium. So when the school was founded, the buildings were still fairly new. Initially, the school was located in the Mechanical Arts Building, which then was named after a City College Engineering professor of the 19th century, and became Compton Hall. During the final year of the first World War, when City College offered classes for soldiers on war-related technologies, especially radio, a building was planned as barracks for the soldier-students next to Compton Hall; however, it did not progress beyond the foundations before the war was over and the need for it had disappeared. Instead a new building for the college, the Vocational

[18] The City College Vector October 1970 p.11

[19] The Messenger, Vol 3(2) November 19, 2000

Building, was planned for this place[20]. *is the Vocational Building the same as Goethals Hall?* In 1932, a second building was added parallel to Compton Hall, on the Amsterdam Ave side; this became Goethals Hall, at the corner of 140th Street and Amsterdam Ave. The engineering departments filled both parts of the Compton-Goethals complex, with chemical engineering still mostly located near the chemistry department, but soon again the space was insufficient.

In 1952 the City of New York approved construction of a new building for the School of Technology. The new building was to replace Bowker Hall, the library building, on the north end of the campus; a new library building was planned further south. The building suffered numerous delays[21]. Construction of the new engineering building started in 1960, and was completed in 1963. The new building was named after David B. Steinman, who was Alumnus of City College, member of the founding faculty of the school, and successful civil engineer. The new building fairly soon had problems[22], and New York State, who was now in charge of the college, approved in 1989 a renovation of Steinman Hall, replacing the exterior, the heating, ventilation and air conditioning, the elevators, and renovating the labs. Also the building was extended from 280,000 sqft to 290,000 sqft[23]. The renovation was finished in 1994. The current steel-clad exterior of Steinman Hall is result of this renovation; before that the outside of Steinman Hall was a kind of glass brick, which started to leak and create dampness and mold in the building. During the renovation of Steinman Hall, departments were moved around, the computer science department had to move to temporary quarters in the Y Building (former building of the Cohen Library), before being moved permamently 1996 *?* to the NAC building, where it occupies rooms on the 7th and 8th floor. The other engineering departments continue in Steinman Hall, but research groups, centers and institutes are located wherever there is space on campus, e.g., CAISS is in Shephard Hall.

1.6 Wartime Changes

The first and second world war each had major impact on the operation of the college in the war and immediate postwar years; each time the college volunteered educational services for soldiers and veterans, and did major changes

[20] City College Quarterly Vol 16(4) December 1920, p2ff

[21] New York Times, February 3, 1958: Engineer School to Rise in Spring

[22] Tech News, October 25, 1966: Steinman Hall Suffers Premature Old Age

[23] The renovation was uncommonly expensive, faculty felt that a new building could be built for the same price; but not all money went into building: new lab facilities and equipment were paid out of the same renovation budget

in its operation to accomodate this in addition to the normal college operation. Also both in first and second world war faculty and leadership of the college were involved in important positions in the post-war negotiations and management.

The Vietnam war had a different impact: the college had no supporting functions in the Vietnam war, neither was it associated with institutions that provided supporting services (like the Columbia University relation to the Institute for Defense Analysis). However, the war was a major concern for the students, both as political issue, and because of the danger to get drafted for military service. And in that, the college did cooperate with the selective service administration, until combined faculty and student protests stopped it.

Details for first World War

Impact of second World War: In 1943, the college became host to a Army Specialized Training Program (ASTP)[24]. The ASTPs were an initiative of the army to produce more technically trained soldiers and junior officers; it was started at the end of 1942. ASTPs were established at more than 200 universities, for more than 200,000 soldiers. During 1944 the ASTP programs were already reduced again, since the Army had immediate need of manpower, and sending the soldier-students to the front lines was an easy administrative decision.

The ASTP at City College was offered in two levels, a basic engineering course with three twelve week sessions, and an advanced engineering course with specializations in civil, electrical, and mechanical engineering. The basic course had seven hours of physics per week, six hours of mathematics, three each of chemistry, english, and history, and two of geography, with engineering drawing replacing chemistry in the last session. The Great Hall was changed into a study space for the soldier-students[25].

To gain space for the soldier-students, CCNY acquired in 1944 the grounds and buildings of the Hebrew Orphan Asylum, which then became "Army Hall", effectively a dormitory for those students, which were in a different situation from the normal students, since they frequently came in only for a short period of re-training. The Hebrew Orphan Asylum had stopped operating a decade earlier; its grounds were the four city blocks between Broadway and Amsterdam Ave and between 136th and 138th street; half of the area was intended for a new NYC public school, the other half for CCNY. After Army Hall was not needed anymore, CCNY exchanged that share for city-owned plot known

[24] Soldiers Courses Set, New York Times March 28, 1943

[25] Vaulted Great Hall at City College Becomes Study Room for Soldiers There, New York Times September 28, 1943

as the Jasper Oval, immediately to the south of Shepard Hall, where now the Wille Building and Marshak Hall stand. The buildings of the Hebrew Orphan Asylum were torn down, the space is now the Jacob Schiff playground, across Amsterdam Ave from the NAC building.

In 1944, not only the ASTP students were sent to the front; also the ROTC students, and many deferments were revoked. Thus the senior class in 1944 and 1945 was severely reduced. Not only the students disappeared, also faculty was drafted into war-related functions. Morris Kolodney, a professor of chemical engineering and specialist in metallurgy, worked for the Manhattan Project on isolating and refining Plutonium. Dean Albert H. Newman, also of chemical engineering, was appointed as temporary colonel to the Chemical Warfare Service of the Army, and later as Chief of the Chemical Industry Section of the United States Group of the Control Council for Germany.

Impact of Vietnam War: The Vietnam war influenced the college in two ways: as global political topic, and as the concrete problem of the draft. As CCNY students are politically active, there were many student events on the politics of the war, but these stayed mostly out of the School of Engineering. Engineering students were very concerned about the draft; starting from October 1965[26], discussion of the draft was a regular topic in the Tech News. The draft existed in principle continuously since the second world war; but although the number of draftees in the Korean war was almost as large as during the Vietnam war, the process became a much more controversial topic during the Vietnam war. This was not only because the politics of the war was rejected, but also because during the Korean war, students could get a deferment fairly easily, but that policy was changed in the Vietnam war. Students who received a draft notice could appeal for deferment to the local draft board. The amount of information passed from the college to the draft booard changed over time, as the intensity of the draft stepped up. In 1965, the registrar's office confirmed all students, including those on probation and part-time students, as draft deferable[27], but then only full-time students in good standing became draft eligible. The students on the Technology Counsil set up a system of Tutoring for the Draft exam[28]. In May 1966, the College started communicating the class rank of students to the Draft Boards, separately for the different schools[29]. That system immediately attracted con-

[26] Tech News, Vol. 22 No. 2, October 6, 1965: You and the Draft

[27] Tech News, November 23, 1965: The Inquiring Technographer

[28] Tech News, March 8, 1966: Tutoring for the Draft Exam; also Tech News, March 22, 1966: Tech Council Battles Over Tutoring

[29] Tech News, May 17, 1966: Averages for Draft

troversy[30]. Faculty in the School of Engieering and the College of Liberal Arts and Sciences voted to provide class rankings to the Draft Board if the student requests it; the School of Education voted against the release of class rankings[31]. The draft system was again changed in fall 1967, to require taking at least 16 credits per semester instead of high class rank[32]; only technical difficulties kept the college from immediately provifing the data. However, in spring 1968, the college wrote a letter to the local draft boards to inform them that the undergraduate engineering programs are five-year programs; the 145 credits required cannot be completed in four years[33]. From 1968 on, local events and crises displaced the Vietnam war from the students' interests.

1.7 Crises at CCNY

CCNY usually had politically active students, and as New York City's flagship public college, CCNY events were more a matter of public interest than other institutions. This led more crises, as well as more external meddling with the college's affairs. However, they usually bypassed the School of Engineering[34], and since this is not a book of general college history, these are just some highlights included for the context.

Bertrand Russell, at that time already a world-famous philosopher, a specialist in analytic philosophy and the foundations of mathematics, accepted an appointment as professor at CCNY in 1940, but the appointment was annulled by a court judgement that pronounced him "morally unfit" to teach at the college[35]. Russell was at that time 68 years old, the third Earl Russell, he had produced highly influential works on the foundations of mathematics (especially Russell/Whitehead: Principia Mathematica) as well as popular science, philosophical, and political writings; another ten years later he would receive a Nobel prize for literature. He was however, at times a pacifist, a socialist, and a critic of the sexual morality of his time. This generated a media outcry, especially led by Bishop William Manning, against Russell as a corrupter of the

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30 Tech News, October 11, 1966: Draft Referendum; see also Tech News, October 25, 1966: Engineering Faculty Urged To Discuss Referendum; Tech News, November 9, 1966: Tech Council Votes to Deny Class Rank to Draft Boards; Tech News, November 15, 1966: Students Sit In at Administration Building — Gallagher is Adamant; Refuses to Yield

31 Tech News, December 20, 1966: Engineering Faculty to Release Grades

32 Tech News, October 6, 1967: Uncle Sam's Stop Watch

33 Tech News, March 15, 1968: College Sends Letter to Local Boards Advising on Five Year Study Program

34 New York Times, May 12, 1969: Art and Engineering Students in Separate Worlds

35 The University of Chicago Law Review, Vol 8(2), 1940, 316–325: The Bertrand Russell Litigation.

youth. In February 1940, Russell's appointment had been by unanimous vote of the Board of Education, in March it announced to reconsider, but then upheld the appointment by eleven to seven vote, but then a suit was filed by Mrs. Jean Kay, a Brooklyn housewife, at the New York Supreme Court asking to order the board to rescind the appointment. The court (Justice John McGeehan) decided after short consideration that the "moral" reason was compelling and Russell was unfit to teach. All the argument was over statements on sexuality in Russell's books on education that even at that time were moderate: that infantile masturbation is not in itself harmful, that children should be allowed to see their parents and siblings without clothes whenever that happens naturally, that homosexual relations with other boys might not be very harmful: that last aspect was interpreted by the judge as a call to violate the New York penal code against homosexuality. The Board of Education, as well as Bertrand Russell himself, tried to appeal, but were denied by some strange legal maneuvers. Russell was denied the right to reply to the accusations, since technically not he was the defendant, but the Board of Education. The corporation counsel serving the Board of Education decided not to assist with the appeal, and the Board was forbidden to use an independent counsel. On April 6, Mayor LaGuardia announced that he had removed funding for the appointment of Russell, and April 24, the City's Board of Estimate imposed a condition on the funding of CCNY that no money may be spent to employ Bertrand Russell. Altogether this was a disgrace for the legal process, showing how political meddling leads to a miscarriage of justice. Many famous scientists, including Albert Einstein, protested against this treatment. The Board of Education had actually done what they could in this affair, and the treatment they received probably caused them not to resist in the Rapp-Coudert hearings, which immediately followed.

The *Rapp-Coudert Committee*, the "Joint Legislative Committee to Investigate the Educational System of the State of New York", was active in 1940–1942, and aimed to remove faculty with communist leanings from New York City's public universities: Brooklyn College, CCNY, Hunter College, and Queens College, with special focus on CCNY. The Rapp-Coudert committee was a New York State analogue of the federal "House Committee on Un-American Activities", which had been occasionally active since the 1920s, at that time known as the Dies committee (1938–1944), and which would later be infamous in the post-war and McCarthy period. The committee interrogated more than 500 faculty, staff, and students; the interrogations were sometimes in private hearings, with no legal counsel and no transcripts of the hearings available to the victims. Technically the Rapp-Coudert committee could not directly terminate instructors, but the New York Board of Higher Eduation (Board of Trustees) decided that being Communist, or refusing to testify, made one unfit to teach, and fired all faculty accused by the committee. Since many resigned before they were dismissed, the exact victims list is unclear; at least fourteen faculty and staff at CCNY were affected, but apparently none from engineering[36]. There were student protests against the dismissals, but without effect. In 1981, the CUNY Board of Trustees passed a resolution of apology for these events. The Rapp-Coudert hearings happened at a time when even many people with socialist sympathies had second thoughts about the communist party: after the Hitler-Stalin Pact 1939, the american communist party did a complete turn, and followed the new Soviet line of friendship with Germany, as well as supporting the Soviet invasion of several east european countries. Thus the Rapp-Coudert hearings met less resistance than they might have a few years earlier. The hearings brought also another issue to light: a graft affair in the chemistry department. Morris U. Cohen, a chemistry instructor[37], was accused by the Rapp-Coudert committee, and tried to protect himself by threatening to expose that three professors in the chemistry department owned and operated a chemistry supply company "Kemkit", and made the department and the students by all their supplies from this company[38]. He knew of this scheme, since he had participated in the company earlier[39]. The Board of Education took immediate action against these professors. In another attempt, Cohen demanded an investigation of the chemistry department buying instruments from Nazi (German) companies[40], but since german companies were major suppliers of scientific instruments, that did not happen.

The *Knickerbocker Affair*. William E. Knickerbocker, Chairman of the Romance Languages Department, was accused of antisemitism, in 1945 by four members of his department, who felt that they were denied a promotion, later also by students. The Board of Education (Board of Trustees) conducted its investigation in 1946 and found the charges unsubstantiated; but the New York City Council's Special Committee on Discrimination conducted its own

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36 Daily Worker, April 23, 1941, p1, gives the following list: Morris U. Schappes (english lecturer), John K. Ackley (Registrar), Arthur R. Braunlich (english tutor), Jetta Alpert (clerk), Lewis Balamuth (physics instructor), Saul Bernstein (biology instructor), David Cohen (library assistant), Morris U. Cohen (chemistry instructor), Sidney Eisenberger (chemistry instructor), Jack D. Foner (history instructor), Louis Lerman (clerk), Samuel Margolis (library assistant), Jesse Mintus (clerk) and Walter S. Neff (psychology instructor)

37 not to be confused with Morris R. Cohen, a highly respected philosopher, after whom the Cohen Library is named

38 The New York Sun, August 14, 1941: Disciplinary Action Looms — City and Brooklyn College Teachers Sold Chemistry Kits to Students

39 PM, August 15, p.18: Professors' Firm Made Big Money

40 PM, August 12, 1941, p.14: CCNY Teacher Charges College Buys Nazi Goods

investigation and came to the opposite conclusion. The City Council accepted the report, and called for Knickerbocker's dismissal[41]. Since the City Council is not the employer, this does not have direct effect, and after a faculty vote in overwhelming support of Knickerbocker, the President and Board of Education did not pursue this matter. At the same time, another discrimination issue surfaced: *William E. Davis*, instructor of Economics and administrator of the Army Hall dormitory, was accused of keeping the dormitory segregated, an issue clearer than the Knickerbocker accusations. These combined issues led to major student protests, perhaps the first general strike of students at a university in New York[42], the students demanding immediate dismissal of Knickerbocker and Davis. Opinions were divided, however: the student council of the School of Business and Civic Administration (later Baruch College) condemned the strike, and the School of Technology had 70% class attendance as opposed to 35% in the rest of the uptown campus. And indeed the Knickerbocker case remained unclear: a year later, an investigative committee of the CCNY Alumni organisation announced that after studying more than 2000 pages of testimony, they were still unable to reach a clear conclusion on the allegations against Knickerbocker[43]. The City College President, Harry N. Wright, relieved Davis from his administrative role as soon as the issue surfaced, but retained him as economics instructor. Knickerbocker, who had already served for several terms as elected chairman of his department, and must therefore have had the support of at least part of his department, did not run for re-election when his term expired in 1950. He retired 1955 and died 1960[44]. Given the apparently unclear evidence, the intensity of the student protests is worrying.

The *Basketball Point Shaving Scandal*. In 1950, City College Basketball was at the top of the nation, winning the National Invitation and the NCAA Division I tournaments. In 1951, a scandal exploded when a widespread system of payoffs to players for "shaving points", that is, winning by a smaller margin than expected, was exposed. The sports betting industry had an interest in this. The scandal ultimately involved seven schools and 32 players. In New York affected were City College, Manhattan College, New York University, and Long Island College, the others were the University of Kentucky, Bradley University, and the University of Toledo. The City College Basketball team was moved from Division I to Division III and banned from playing

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41 New York Times, 23 June 1948: City Council Asks Professor's Ouster

42 New York Times, 12 April 1949: City College Students Clash with Police in 'Bias' Strike

43 New York Times, 17 July 1950: Knickerbocker Case Unsolved by Alumni

44 New York Times, 22 December 1960: William E. Knickerbocker Dies; Taught at City College 48 Years

at the Madison Square Garden. This caused a loss of revenue of the CCNY sports program, which led to the closing of many other sports programs at CCNY. The City College Head Coach, Nat Holman, was ultimately cleared of any wrong-doing, but there is no doubt that at least three star players of CCNY had accepted bribes[45] Many CCNY students and alumni felt this as a humiliation; the self-image of CCNY and its students as a beacon of truth and integrity was shattered[46].

The *South Campus Occupation* of 1969 and the start of *Open Admissions* in 1970 were key events in the history of CCNY, and will be discussed in greater detail in section 2.3. In summary, after a period of increasing racial tensions in the late 1960s, and the campus occupation of Columbia University one year earlier, in April 1969 a group of Black and Puerto Rican students occupied the South Campus of CCNY, which at that time contained mainly the liberal arts, andmade five demands, some of which were easy, and shared by much of the campus community, but two were major: the establishment of a School of Black Studies, and that the racial composition of the entering class of CCNY should follow that of the New York City high schools. The occupation went on for two weeks, and classes at CCNY were suspended for the duration of the conflict. The occupation itself was peaceful, but it set off a wave of violent and destructive conflict on the CCNY campus, including one major and many minor building fires. The CCNY president and faculty ultimately agreed to the occupier's demands, but the president resigned, and the Board of Higher Education (Board of Trustees) rejected all agreements. Instead they accelerated the introduction of Open Admissions, which had been in the Masterplan already for several years, and was planned to be gradually introduced over ten years: increasing college access was recognized as a necessary step to provide the larger and better educated workforce that New York City needed. By introducing it on short notice, starting Fall 1970, the Board showed that they reacted to the concerns of the occupiers and and a partially supportive public. However, it was introduced, almost doubling the student population across CUNY, without building additional infrastructure and with not much additional resources, leading to chaotic first years, and teaching mostly outsourced to graduate students.

The New York City *Fiscal Crisis* of 1975 led to the *Introduction of Tuition* in 1976, as well as to large cuts across CUNY. Starting in the 1960s, New York City had run at a deficit. The deficit in the operating budget was masked by various accounting tricks, and covered by issuing debt. In reaction to various

45 Time Magazine, 26 February 1951: The Big Money

46 These events were even made into a movie: City Dump: The Story of the 1951 CCNY Basketball Scandal, HBO 1998, George Roy and Steven Stern, directors

protests, such as those that led to open admissions, as well as labor actions such as the 1966 transportation workers strike, the 1968 Teachers strike, the 1968 sanitation workers strike, the 1971 sewage workers strike etc., New York City expanded services, and increased salaries, without having additional money coming in; instead each year more short-term debt was issued. The oil crisis of 1973 led to a stock market crash of 1973–1974, which made investors more careful. Various measures to increase the confidence of the investors backfired when they were exposed to be incorrect numbers and "creative" accounting[47]. As a result, in April 1975, New York City was out of money, and unable to borrow more. The New York State Governor Hugh Carey set up the Municipial Assistance Corporation (MAC) as a vehicle to market New York City bonds with a state guarantee, so that even if New York City went bankrupt, the MAC bonds would still be repaid from the New York City sales tax, which was converted into a state tax as security for the MAC bonds. However, the MAC had difficulties marketing its bonds, even though it offered high interest rates, since the New York City policies did not change. To force the changes, the New York State legislature created September 1975 the Emergency Financial Control Board (EFCB) with the power to control all bank accounts of the city, review all its contracts, issue orders to city officials, remove them from office, and press charges against them. Inspite of the measures announced by the EFCB, the City was still unable to solve its immediate financial problems; the MAC was unable to sell the bonds, and on October 16, 1975, it appeared that bankruptcy was imminent. It was averted by a last-minute loan from pension funds, especially from the teacher's retirement funds, endangering thus the retirement funds to save the city. In November finally the federal government under President Ford gave a loan to the city, breaking the cycle of emergency refinancing, and giving the EFCB time to deal with the problems. The loan came with very concrete conditions on how the city needs to reduce its spending; one of the numerous conditions was to introduce tuition for CUNY. The EFCB implemented these conditions, and from 1976 on CUNY required a tuition from all students, in the same way as many other city services were forced to charge their cost. The Ford administration was very concerned that a bail-out for New York City would lead to similar demands from many other cities; in October President Ford had still said that he would veto any plan for financial support of New York City. The concern about the possible impact of a bankruptcy, which was echoed even internationally, by the French President and the German Chancellor, led to a change in the federal policy, but the conditions of the loan were severe. The Securities and Exchange Commission

[47] California Research Bureau, CRB Note Vol 3 Issue 1, March 1, 1995. Overview of New York City's Financial Crisis, prepared by Roger Dunstan

issued in 1977 a report[48], in which it studied the events leading to the crisis, specifically how it was possible that up to March 1975 the City issued bonds it knew it could not repay, the rating agencies gave these bonds good ratings, and the banks marketed and recommended them to thousands of small investors, who then lost much of their investment.

The *Tuition Hike Student Strikes of 1989 and 1991.* In 1989, Governor Mario M. Cuomo planned an increase of the tuition by $200 per year; in protest against this, students occupied campus buildings, and the student strike soon spread to other CUNY campuses[49]. In view ofthe public resistance, Governor Cuomo then vetoed the tuition increase. However, a year later, the same tuition rise happened, without similar protests. Possibly encouraged by this, Governor Cuomo planned for a much larger tuition increase of $500 per year. This again caused students to protest and occupy buildings, across CUNY, but starting at CCNY. On April 8, 1991, the NAC building was occupied by 50-100 CCNY students to protest the tuition increase; initially engineering classes continued, but later the building occupation spread to other buildings, including Steinman Hall[50]. The occupation continues for three weeks[51]; it gradually falls apart, with engineering among the first to resume classes. This time the student protest does not receive much public or administrative support[52]; CCNY extends the semester by two weeks to make up for the missed classes, and the tuition increase does happen.

The *Leonard Jeffries* Affair starting 1991. City College had started the process for beginning a Black Studies program already before the South Campus was occupied in 1969 by Black and Puerto Rican students, who demanded among other things the creation of a School of Black Studies, on a similar basis as the professional schools. This certainly sped up and influenced the creation of the Department of Black Studies; but it turned out to be a controversial process. The professor that president Gallagher had hired in 1968 to lead the process was removed and replaced by interim-president Copeland in 1969, but this led immediately to other conflicts, and so president Marshak in 1971 appointed yet another leader, Leonard Jeffries, to create the Black Studies department. Jeffries had just obtained his PhD from Columbia University in 1971, the year before he had received an appointment at San Jose State College as founding chairman of a black studies department there, which qualified

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48 SEC Staff Report on Transactions in Securities of the City of New York, August 1977

49 New York Times, May 2, 1989: Some at CUNY See Possible Tuition Rise as Albany Betrayal

50 New York Times, April 9, 1991: City College Sit-In Keeps 75% Out of Classes

51 New York Times, April 29, 1991: City College Set for Resumption of Some Classes

52 New York Times, April 24: CUNY Protests Frustrating Even to Students Who Agree

him for the same role at CCNY[53]. For a long time, everything seemed to be going well, Jeffries was a popular teacher within his community, and if occasionally students complained, it was discounted, and criticising his academic content would be violating academic freedom as well as politically incorrect. Then events exploded when in July 1991 Jeffries gave a speech at a Black Arts and Culture Festival, in which he expressed at length his hate of white people in general, and Jews especially. What before was considered as Afrocentrist views, perhaps a bit extreme but still to be tolerated at an academic institution, became a scandal when it became public and outspoken Antisemite. This speech brought a lot of bad publicity to the college; it was harboring an aggressive anti-semite, but if it was critical, it violated Jeffries' freedom of speech and academic freedom. President Harleston tried to navigate the territory, but had limited his options himself by having written just a month earlier a letter congratulating Jeffries to his wonderful work, and to his continuous re-election as chair of the Black Studies department[54] This was followed by a long legal battle whether the President could remove him from the administrative role of department chairman[55], which Jeffries lost after several up-and-downs, and which finally became irrelevant when the department of Black Studies was dissolved in the cuts of 1996, together with the other Ethnic Studies departments (Jewish, Asian, and Hispanic) and the School of Nursing. Jeffries continued to serve as professor in the Black studies program, in the Political Science department, until his retirement in 20??. It is amazing how many other issues were brought up after the explosion, which must have been known, but suppressed, before: that he went around with bodyguards and enforcers, intimidated and made death threats to critics, and had no publications after his PhD. It would have been better for the intellectual health of the college if these things had been brought up before. The Jeffries affair did considerable damage to the public perception of CCNY, and to its relation to alumni and donors.

The *Michael Levin* affair took place at the same time as the Jeffries affair,

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53 Two decades later, it was questioned whether it was wise to appoint a fresh PhD without publications immediately as tenured full professor and department chair; but by that time, it was a pointless question.

54 President Harleston's situation was complex, since he was himself black, and thus subject to special criticism from radical blacks. Like Gallagher before him, his efforts were not appreciated by the radical fraction, and a sequence of disastrous events brought his resignation.

55 which is independent from his faculty appointment, which is protected by tenure. Department chairpersons at CCNY are elected, but can be replaced by the President, which has also happened in other cases

and is considered a counterpart[56], since Levin is a Jew who made anti-black statements[57]. Levin is professor of Philosophy, with a large body of published work, who in some of his writings claimed that, on the average, blacks are less intelligent than whites. Levin in other papers was critical of homosexuality and feminism, and defended torture, but those works did not cause any outcry. Levin did not mention these topics in his classes, but students started to disrupt them, the college was unwilling to discipline the students, and instead offered parallel classes to Levin's classes, with a letter from the Dean to the students, in effect warning them of Levin's classes. Again, after some legal maneuvring, this came to nothing: Levin's opinions, as well as Jeffries', are protected by the freedom of speech[58].

City College Nat Holman Gym Disaster: At a charity basketball game featuring celebrity rap stars on December 29, 1991, a stampede happened at an entrance to the Nat Holman Gymnasium, in which eight students are crushed to death, and 29 injured.[59] The event was managed by the Evening Student Government, with support of a rap promotor and a radio station, and intended to benefit AIDS victims. The space supposed to hold 2,700 people, with 1,500 tickets sold before the event and another 1,200 tickets to be sold at the door. A similar, but smaller, event had been held about a week earlier, and had presented no problems; however, for this event, an estimated 5,000 fans tried to get in. Although the college had hired 38 guards from a private contractor, and the sponsors had hired 20 guards from the Nation of Islam, and the police department had sent 30 officers (who, however, were not to enter campus buildings except in an emergency), they were unable to channel the surge of people, especially since the real problem was out of view. The security tried to maintain lines outside the entrance of Marshak Hall, but after a long wait, an hour after the event should have started, the crowd pushed in, through the corridor into Marshak, around the corner, and down the stairs to the Gym. There was only one door open to the Gym, through which people were admitted one by one, after ticket and security control. When the crowd surged down the stairs to the entrance, other Gym doors could not be opened, since they only open outward, against the crowd. Thus bodies piled up at the bottom of the stairs, in front of the door, and were crushed by others coming down the stair. The victims died by asphyxiation, being unable to breathe because there were too many on top of them. There was

56 Levin actually wrote in defense of Jeffries: New York Times, 26 September 1991: The Lessons of Hate: City College Shouldn't Gag Leonard Jeffries

57 New York Times, 20 April 1990: Professors Theories on Race Stir Turmoil at City College

58 New York Times, 5 September 1991: CUNY Barred from Punishing White Professor

59 New York Times, 30 December 1991: Stampede at City College

apparently no security in this part, on the stair or outside the door, so it took a long time before it became known outside what was happening; and rescue workers could not reach the victims through the crowd. The entrance to the Holman Gym in 2019 still has the same structure: a wide stair turning left from the Marshak corridor, making one turn, and then ending in front of the Gym doors. A later investigation shows that there had been previous events of massive overcrowding, in which the campus security had been unable to control access, with two dance events on June 14 and September 21 with an estimated 2000 and 1500 students in the cafeteria, which is allowed for 500[60]. Also at a party on campus on July 13 there was a deadly shooting incident; neither attacker nor victim were CCNY students. As a result of this, the organizer of the party was barred from organizing further parties on campus; but it shows that the campus security at CCNY events has also to deal with problems brought from the outside into the CCNY community.

The *Financial Crisis of 1995* was, unlike the previous crisis of 1975, not generated by a city-wide or state-wide financial crisis, but by the political decision to reduce CUNY. Early in 1995, Governor Pataki announced a budget which cut $160 million from CUNY; as a result, on February 27, 1995, CUNY declared a fiscal emergency[61]. During a fiscal emergency, ordinary employment rules are suspended, tenured professors can be fired, departments and schools closed, and the colleges reorganized without the restrictions of shared governance[62]. This is what CUNY under Chancellor W. Ann Reynolds, and CCNY under President Yolanda Moses, indeed did: CCNY closed the school of nursing, and a year later the ethnic studies departments, and fired *how many* faculty. Later it became apparent that the emergency was created to give CUNY this power[63]; by June 1995, the budget had already been balanced by a combination of increased tuition, and the Governor restoring half of his cut. But CUNY reorganization under emergency powers proceeded, anyway, and the New York State Supreme Court decision a year later was too late to make a difference. While the decisions of the 1995 Fiscal Emergency were re-

60 New York Times, February 8, 1992: CUNY Inquiry Finds History of Problems

61 New York Times, February 28, 1995: CUNY Professors, Fearing Worst, Rush out their Résumés

62 declaration of fiscal emergency had become a standard tool of restructuring under chancellor Reynolds; four years earlier, in 1991, a fiscal emergency was created to restructure John Jay College and the New York City College of Technology: New York Times, August 2, 1991: Mass Layoff Authorized by CUNY for 2 Colleges. Then in 1992, again a fiscal emergency was declared: New York Times, April 9, 1992: CUNY and SUNY See 1,000 Dismissals

63 New York Times, May 3, 1996: CUNY Misused Fiscal 'Emergency' to Cut Staff and Costs, Judge Rules

viewed by a court, Governor Pataki announced further cuts, and CUNY again declared a financial emergency in March 1996; again the cuts were restored in the adopted state budget on July 15[64]. The Appellate Court reversed the earlier decision and confirmed the faculty firings[65].

An Institution Adrift[66] was the title of a report on CUNY that Mayor Giuliani had commissioned, and that was published 1999. The background was that the performance of CUNY had come under increasing criticism: a very small number of the entering students actually graduated, and those that did graduate failed in large numbers professional licensing tests. The report mentions that only 1% of students entering a two-year (Associate) program at CUNY graduate in two years, and only 17% graduate in four years. For the four-year (Bachelor) programs, only 7% of the entering students graduate in four years, and only 30% (CUNY senior colleges average) graduate in six years. The situation at CCNY was even worse, with a six-year graduation rate of 21% (1991 entering class),[67], comparing with 60% at peer institutions. The poor success of the students graduating from CUNY teacher programs had especially gained publicity; it was only 62% in 1996, with City College again worse, at 40%[68]. Clearly, education at CUNY was not working as intended. The report found many reasons for that crisis, but the main issue became that CUNY was spending an ever-increasing portion of its time on remediation, and students used up their time and money in a remediation cycle without advancing to the studies they intended. And reasons for this were the optimistic way in which the open Admissions promise was implemented, and the falling standards of the New York Public School System. Thus the report actually makes multiple recommendations on a variety of topics, including the New York Public School System, and the relation between CUNY and the New York Public Schools. But the recommendation which was taken up by the CUNY Board of Trustees, which was implemented, and which generated an outcry among the CUNY community, was to end remediation at senior colleges. Students that require remediation should go to community colleges. This clearly diminishes the promise of Open Admissions, and moves the load of students insufficiently prepared by the New York Public School System from the senior colleges to the community colleges. The community colleges still

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64 CUNY — A Newsletter for the City University of New York,Special Edition, October 1996: State and City Efforts Strengthen CUNY Budget

65 New York Times, December 21, 1996: Court Allows CUNY Layoffs and Changes

66 Benno C. Schmidt et al.: The City University: An Institution Adrift. Report of the Mayor's Advisory Task Force. June 7, 1999

67 Table 3, page 59 of the report

68 NY Post, March 8, 2004: CUNY grads a class act

struggle with remediation; there is no miracle way to do it. The report also made other recommendations which were not followed: it is very critical of CUNY's budgeting, funding, and financial management processes, notes that there is no planning, that the number of full-time faculty has steadily eroded, and that the salaries are not enough to attract good faculty, especially in fields like engineering, where the market rates are significantly higher[69]. Not much has changed in these issues in the last twenty years. For the School of Engineering, the end of remediation had no impact, since students become engineering students only after the remediation is over.

1.8 Deans of the School

The Dean of the School is appointed by the president; he is not elected by the faculty. Thus the appointment of the Dean is a political statement by the president of the direction he wishes the school to be going, but the success of the Dean depends on the support he received from the faculty: he can lead only in a direction that the faculty wishes to follow. And in periods of financial crisis, which are frequent at CCNY, there are no resources to go in any direction. Some Deans served for a long time, the longest-serving Dean being William Allen, who was Dean for 23 years, and stepped down after the crisis of 1969. The second longest-serving was Frederick Skene, who was the first Dean of the school, and served for 18 years. The third and fourth were Charles Watkins, who served 14 years, and Joseph Barba, who served nine years. Some of the Deans served only a short period, because their career still took them upward: Egon Brenner moved on after two years to an appointment in the CUNY chancellery, eventually becoming Vice Chancellor of CUNY, and then Executive Vice President at Yeshiva University. Mohammad Karim left after four years to become Vice President for Research at Old Dominion University, then Provost of the University of Massachussetts at Dartmouth. David Cheng, after retiring from engineering at CCNY, served on the Board of Trustees of William Paterson University; that university honored him both by a honorary doctorate, and by naming the library building after him. Not all Dean appointments were successful: Richard Marsten was recruited by President Marshak from an administrative position in NASA, but became very unpopular with the faculty[70], leading to his being denied tenure by the Department of Electrical Engineering[71], and suffering a vote of No Confidence

[69] page 84 of the report

[70] The Campus, Vol 143(8) November 17, 1978, p.1: Panel to probe Marsten — faculty split

[71] becoming Dean does not automatically include becoming faculty, this is a separate act, and tenure is mostly under departmental control, although the president can override it. In this case, President Marshak tried to work around the problem by granting tenure in the school of engineering

by the Engineering Faculty, which was a first in the history of the college.

The Deans of the School of Engineering were

- William Fox; Acting Dean of Engineering 1919
- Sidney Edward Mezes; President and Pro Tempore Dean of Engineering, 1920
- Frederick Skene; Dean of Engineering 1921 to 1939
- Albert B. Newman; Dean of Engineering 1939 to 1946 (acting 1939–41, on leave 45–46)
- William Allan; Dean of Engineering 1946 to 1969 (acting 45–46)
- Alois X. Schmidt; Interim Dean of Engineering 1970 to 1971
- Egon Brenner; Dean of Engineering 1971 to 1973
- Paul Karmel; Acting Dean of Engineering 1974
- Richard B. Marsten; Dean of Engineering 1976 to 1979
- David H. Cheng; Dean of Engineering 1979 to 1985
- Demos Eitzer; Interim Dean of Engineering from 1985 to 1986
- Charles Watkins; Dean of Engineering from 1986 to 2000
- Mohammad Karim; Dean of Engineering from 2000 to 2004
- Joseph Barba; Dean of Engineering from 2004 to 2013
- Gilda Barabino; Dean of Engineering from 2013 to now (2019).

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but without departmental affiliation, a singular construct which could be seen in the college bulletins of the subsequent years

2. Admission and Tuition for Engineering Study

2.1 Admission Requirements

A general requirement for study at CCNY was that the student had to be a resident of New York City, and a citizen of the USA. Only when all those had been served could other candidates be considered for admission.

The City College Bulletins of 1917 (1917-18), and 1918 have separate lists of engineering classes, but make no statement on admission; from 1919 there is a School of Technology, but the admission is just the general college admission. City College admission in 1919 required the following high school subjects:

- 3 units English
- 5 units Foreign Laguages (five years total from two languages: French, German, Greek, Italian, Latin or Spanish)
- 1 unit History
- 2 unit Mathematics (Elementary Algebra, Plane Geometry)

and 4 units from a list of electives that contains Mathematics, Physics, Biology, Zoology, Botany, Geography, History, Drawing, Hygiene, and Civics.

In 1925 the School of Technology section contains a separate admission statement, which is worth to quote, since it exactly what Open Admissions aimed to be half a century later:

> "A person holding a diploma of graduation from the four-year course of one of the City High Schools will be admitted without condition as a freshman in the School of Technology; but subjects listed as entrance subjects, which were not pursued successfully in the high school, will be prescribed for the student in college."

The required subjects are still the same for the entire college; the only change was to make Intermediate Algebra ($\frac{1}{2}$ unit) required, which before was an elective.

In 1933, the admission requirements for the School of Technology were high school graduation with a GPA of at least 78% and 15 units including

- 3 units English
- 3 units Foreign Laguages (French, German, Italian, or Spanish; can be replaced by 2 units each in two of these languages)
- 1 unit American History
- 1 unit Elementary Algebra
- 1 unit Plane Geometry
- $\frac{1}{2}$ unit Intermediate Algebra

and $5\frac{1}{2}$ units from a list of electives, mostly mathematics and science, but also containing history, drawing, and shopwork. Thus high school science was not required in 1933.

In 1940, the required part was extended by

$\frac{1}{2}$ unit Advanced Algebra
$\frac{1}{2}$ unit Trigonometry
1 unit Science

for the remaining 3 1/2 units there was the same list of electives.

In 1950, more English and less Foreign Languages were required, and the Science was specified to be Physics or Chemistry; the requirements were

4 units English
2 units Foreign Languages (German or French, with preference to German)
1 unit American History
1 unit Physics or Chemistry
1 unit Elementary Algebra
1 unit Plane Geometry
1/2 unit Intermediate Algebra
1/2 unit Advanced Algebra
1/2 unit Trigonometry

for the remaining 3 1/2 units, the list of electives is replaced by a fairly unspecific statement of eligibility (at least 1 1/2 unit from academic subjects such as Foreign Languages, Mathematics, Social Studies, and Science, and at most 3 units from other subjects such as Art, Music, Technical or Commercial Subjects).

In 1960 the requirements were still the same, only for the Foreign Languages now any language is acceptable.

In 1971, with Open Admissions implemented, the Admission is taken out of the hands of the college. Students apply to the Universal Admissions Processing Center (UAPC) of CUNY, with a wish list, and the UAPC assigns as it sees fit (not necessarily from the wish list). Still the School of Engineering has a list of recommended high school work, which is same as the required list of 1960. However, students are subject to a placement exam, and might have to take preparatory courses before being allowed to enroll in credit-bearing courses of the School of Engineering.

The foreign languages are dropped from the list of recommended high school work in 1975. This list completely disappears in 1977; instead there is just a recommendation that because of the importance of mathematics and science for engineering, prospective students should take as much as they can of these subjects. An Open Admissions revision by the Board (June 1976) makes the admission criteria for CCNY a bit more transparent: at least 80% high school average or upper third of high school graduating class are required from students in New York City[72]. However, this is just a minimum requirement; it is stated that "higher demand programs such as Nursing or Architecture may require a higher average or class rank".

2.2 Admission of Women Students

The admission of women students to CCNY degree programs follows the relation of Day- and Evening Sessions, and the assumed ranking in the prestigiousness of the degree programs. In 1933, women were admitted in the Day Session only to the School of Business and Civic Administration; in the Evening Session, they could attend classes of all schools with the exception of the College of Liberal Arts and Science (CLAS). In 1940, women were admitted in the Day Session by the School of Business and Civic Administration and the School of Technology on the same basis as men, and by the School of Education in the Evening Session only. By 1950 women were admitted on the same basis as men to all Schools in Day- and Evening Session, with the exception of the CLAS, which allowed women to take classes, but not be degree candidates. The CLAS finally followed in 1961, after losing a law suit by a female student.

However, the number of female students in engineering was always small. The Society of Women Engineers was founded in 1947; well ahead of the national society, which was founded only 1952. But because of the small number of female students, it had continuity problems, and was re-established in 1969, again in 1981, and again in 1994.

The School of Technology hired early a female professor of engineering: in 1942, Cecilie Froehlich was appointed in the Department of Electrical Engineering. In 1955, she became the first female department chair in the history of CCNY. That was, however, a singular occurrence: the faculty lists of 1960, 1970, and 1980 do not contain any female faculty.

2.3 Open Admission

Among the crises that affected City College in the last hundred years, the events of 1969, the occupation of the South Campus and later the introduction of Open Admissions for CUNY, were the most dramatic. The School of Engineering, however, was comparatively little affected by it; and with the Evening Session system, admissions to the Evening Session had already been open (but not free) for anyone who paid the non-matriculated fee. The Open Admissions policy would have come anyway; it was announced by the Board

72 Tech News Vol 22(4) November 1965 Interview with Dean Allen states "in 1951, 77% was needed for admission, whereas a high of 85% was reached in 1964. This was lowered in 1965 to 83%."

of Higher Education (Board of Trustees) already in their 1968 Master Plan for CUNY for gradual introduction, to be fully implemented by 1975; only as result of the events at City College, it was introduced immediately. Also, Open Admissions was quite different from what the occupiers of the south campus demanded; the ultimate resolution is a kind of anticlimax to the dramatic events preceding it.

The essence of Open Admissions is the promise that any student who has finished a New York City high school will be admitted to study at CUNY[73]. There is no promise that he will be admitted for the program and college he wants; the authority over admissions is moved from the individual colleges to the CUNY administration. Students now apply to CUNY, with a wishlist of what they want to study; if a student wants to study mechanical engineering at CCNY, he might get admitted instead for an Associate in Applied Science degree at a community college. Open Admissions placed most of the load on the community colleges, and, as the Board of Higher Education had already recognized in their previous resolution, the implementation of Open Admissions required a great expansion in community college capacity; that was the reason they had planned for a gradual introduction. At the senior colleges, and especially at the School of Engineering, the initial impact was small; although direct control over admission standards was removed from the school, it could still make a strong case that its standards were required, possibly even for the professional accreditation. The School of Engineering was here in a much simpler situation than the liberal arts and social sciences.

There was a long buildup of tensions that led to the occupation of the South Campus on Tuesday, April 22, 1969. The five demands made there by Black and Puerto Rican students had, in fact, been already discussed for several months; they were

1. That a School of Black and Puerto Rican Studies be established.
2. That a separate freshman orientation program for Black and Puerto Rican students be established.
3. That students be given a voice in the administration of the SEEK program, including the hiring and firing of personnel.
4. That the number of minority freshmen in the entering class reflect the 40-45 ratios of Blacks and Puerto Ricans in the total school system.
5. That Black and Puerto Rican History courses and Spanish language courses be compulsory for education majors.

On Thursday, February 6th, after a meeting in the NAC Ballroom, the de-

73 The Campus Vol 125 No 2, Spetember 17, 1969: Open Admission:What Does it Mean? The Text of the Board Statement

mands were presented to the City College President Buell Gallagher[74], but they had already received considerable discussion before that, and were on the way to partial fulfillment: already the February 6th issue of the Tech News[75] discusses the planned opening of a Black Studies Center in the Fall semester, and the development of a Black Studies curriculum by Professor Wilfred Cartey, with input from Black students and faculty. Prof. Cartey had just been hired from Columbia University, where he was teaching African Literature. It was hoped that the curriculum would be presented to the faculty council for approvement before the end of the spring semester. Also the need for a reform of the freshman orientation program was recognized, not only black students were unsatisfied; and the administration seemed generally supportive of a separate program for Black students. The School of Education was discussing a Spanish requirement; for the Black history courses they intended to wait on the input from the new Black Studies Center. President Gallagher was in all his previous career concerned with the interests of Black students, having been president of a historically Black college before; but he was bound by many issues of procedure, administrative constraints, finance, politics, and reality. Some demands were easy, others, like the racial quota for admission, or the School of Black Studies, on a level with the School of Engineering, were unrealistic. A group of students occupied the administration building a week later, on February 13th, for one day, and demanded an answer from the president, but he was felt to be evasive. Tensions further built, and on Monday February 17th the college experienced synchronized acts of vandalism in many locations-1[75]; in Steinman Hall, a stack of newspapers was set on fire outside the main lecture hall, one of the big glass windows of the foyer was broken, in the second floor, paint was splashed over clocks and bulletin boards, and many glass display cases were broken all over the building.

The engineering students were at this time especially worried about the upcoming recruiting season[76], since recent recruitment events had been subject to violent disruption. President Gallagher announced that he will use "any measure to insure recruiting", but that it cannot be held in its traditional location in the Finley Student Center Building, since that would require at least a hundred policemen. And Dean Allen of Engineering expressed his worries that holding recruiting meetings in Steinman Hall might attract more vandalism to that building. However, another crisis overtook this: the budget of CUNY experienced a severe cut[77]. CUNY was originally supported only by

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[74] Tech News Vol 29 No 3, 19 February 1969

[75] Tech News Vol 29 No 1-2, 6 February 1969

[76] Tech News Vol 29 No 4, 26 February 1969

[77] Tech News Vol 29 No 5, 5 March 1969

the City of New York, but over the decade 1960-1969, its dependence on state funding had become considerable. from $9 million in 1960 to $100 million in 1969-70. Now Governor Rockefeller planned an 18% cut, and Mayor Lindsay added his own cuts; together, this would eliminate the SEEK program and reduce the number of freshmen students entering CUNY by 10-20%. President Gallagher announced first his intention to close the college[78], then his intention to resign unless a adequate budget were provided in a letter to the Board of Higher Education; and 23 of the college's department chairpersons followed this with a letter of their own on April 2. However, this was viewed[79] as a symbolic action: no date was set, what an adequate budget is was left open, and the chairpersons would resign from their chairmanship, but not from their professorship. The signatures for the letter of chairpersons were collected over the telephone, and the chairmen of chemical and mechanical engineering declined to sign, being unwilling to make such a decision in so short a time. At the same time, on April 16, there was another meeting of the President with students over the five demands, of which the President said he approved four. Student groups continued to call for a strike on Monday, April 21; there were demonstrations, and disruptions or cancellations of some classes, but classes in Steinman Hall on April 21 went mostly on as usual[80].

On Tuesday, April 22, 1969, a group of about 200 students, mostly Black or Puerto Rican, declared the South Campus occupied. The South Campus was where now Aaron Davis Hall, the Architecture Building, The Towers, the new Science Building, and the ASRC are; at that time the South Campus contained buildings from another college, the Manhattanville College of the Sacred Heart, which City College had acquired in 1953 and converted for its use. The South Campus contained mainly liberal arts, and the Finley Student Center, which had been the main building of the previous college, and housed all kinds of student services, placement office, student organisations etc. The occupiers padlocked the main entrances, and did not allow anyone in. They made the same five demands again. In response to these demands, CCNY President Buell Gallagher as well as faculty leaders started to negotiate with the occupiers. President Gallagher tried to navigate the political situation; there were many faculty members who supported the occupiers in principle, although not necessarily in all specific demands, and there was considerable worry in the city about the potential for riots, given the riots in the surrounding Harlem in the previous year and five years ago (Harlem riots of 1964 and

78 The Campus, February 26, 1969: Gallagher Threatens Shutdown because of State Cut in Budget

79 Tech News Vol 29 No 8, 18 April 1969

80 Tech News Vol 29 No 9, 23 April 1969

1968), and the Columbia University protests[81] in the previous year.

The reactions of President Gallagher must be seen especially in the perspective of that Columbia University occupation a year before. President Gallagher suspended all classes at CCNY for the duration of the negotiations; making effectively the other students hostages of the process. At Columbia, after the initial occupation of one building, different groups decided also to occupy a building, so that the occupation had spread over several days, and ultimately a large number of Columbia students got involved, supporting or fighting against the occupation. By immediately suspending all classes, he avoided this[82]. He also did not want to call the police to clear the buildings[83] Against this there were counter-protests; especially engineering students did not see why their studies in the north campus should be interrupted for the events of the south campus[84]. Engineering faculty continued to hold classes, with support of Dean Allan, while outside the engineering building was picketed, and some faculty of other parts of CCNY demanded that President Gallagher should dismiss Dean Allan for his lack of solidarity. The students feared to loose a semester of study; also the spectre of possible loss of accreditation was raised, making students fear that their hard-earned degrees might become worthless. After one-and-a-half week of negotiations, on Friday May 2nd, the president was forced by a restraining order to re-open the college; he called for a faculty meeting on Sunday May 4th, in which it was decided to essentially accept the demands, and on Monday May 5th the occupation ended, and college teaching was resumed. However, classes continued to be disrupted, and there was major fighting between students, who were clearly not all supportive of the occupation, its resolution, and the ongoing disruption. On Tuesday May 6th, the Finley Student Center building was set on fire, and minor fires were

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81 Crisis at Columbia: Report of the Fact-Finding Commission Appointed to Investigate the Disturbances at Columbia University in April and May 1968 (The Cox Commission Report), Random House 1968)

82 As in the year before, the occupation was separated along racial lines. In Columbia, the Students Afro-American Society asked the white students to leave the first occupied building, at CCNY the Black and Puerto Rican students did not let white student groups participate in the occupation. Whereupon one white student group decided to also occupy a building, Klapper Hall, and produce their own demands, which were left rhetoric and unrelated to problems of the college, and had no further influence on the events. Observation Post Vol 45(10) May 12, 1969, 8–9

83 That had been done twice at Columbia, the second time escalating to a massive battle with more than 1000 police officers, students supporting and students rejecting the occupations, resulting in lasting damage to the Columbia community.

84 New York Times, April 26, 1969: 700 Engineering Students Ignore CCNY Closing

discovered at ten locations around the college. Campus violence continued[85], classes were interrupted, the library occupied, and President Gallagher called in the police. Major Lindsay nnounced that he had ordered police to be stationed throughout the campus to maintain safety, and major police presence on the entire campus until the semester came to its end.

President Gallagher announced his resignation May 9th with effect to May 12th[86]. Vandalism and protests continued; on May 21, a fire was discovered in a Goethals classroom[87]. In an effort to close the semester, it is announced that no one will fail this semester: no F grades are to be assigned. New York City Mayor Lindsay found another $80 Million to overcome the budget crisis and keep CUNY going, whereas Governor Rockefeller stated that there will be no higher state support for CUNY unless CUNY imposes a tuition, or becomes incorporated into SUNY[88]. During the summer, on July 9, the Board of Higher Education discarded the agreements of President Gallagher, which he did not have the authority to make, and instead introduced Open Admissions, starting Fall 1970, which was then celebrated as a great victory.

In the aftermath, immediately the reaction sets in. With Acting President Copeland, the Board appointed a hardliner who did not believe in cooperation with faculty or students, or indeed in following governance procedures. He appeared before the US Senate Permanent Investigion Subcommittee, and declared that a list of student organizations he presented were all "inherently treasonous" and "Anti-American". He was criticized by Senators Ribicoff (Connecticut) and Metcalf (South Dakota)[89]. By the end of the summer, the Acting President Copeland got into a conflict with Prof Cartey[90], who had been brought in a semester ago to lead the development of the Center of Black Studies. Copeland brought in his own candidate, without consultation, to chair the new department, which became the Department of Urban and Ethnic Studies[91]. The department went through an amazing evolution of names; the demand was for "Black and Puerto Rican Studies", it was sometimes referenced as "Third-World Studies", then it became "Urban and Ethnic Studies", before it settled on "Black Studies". The department was dissolved in 1996 by President Yolanda Moses, together with several other ethnic stud-

85 New York Times, May 8, 1969: CCNY Shut Down, the Racial Clash Injures 7 Whites. Club-Swinging Negroes Cap Violent Day With Battle on South Campus

86 New York Times, May 10, 1969: Gallagher Quits; Cites 'Intrusion' in CCNY Dispute

87 The Campus, May 22, 1969: Goethals Hit by Fire

88 The Campus, Vol 125 No 2, Sept 17, 1969

89 The Campus, Vol 125 No 1, September 2, 1969: Radicals are 'Treasonous'

90 Tech News Vol 30 No 1, 25 September 1969

91 The Campus, Sep 2, 1969: Urban, Ethnic Studies Department Created

ies departments[92]. Other members of the CCNY community that had been supportive of the campus occupation also suffered from the fallout; a professor was fired by Acting President Copeland, apparently for his involvement in the campus occupation[93]. The former chair of the Economics department, who had served the occupiers as advisor during the negotiations, committed suicide, and a SEEK counselor who had spoken for the occupiers in faculty meetings died in a South Carolina swamp under somewhat unclear circumstances [94].

In the summer 1970, Acting President Copeland was succeeded by President Robert Marshak, who tried to mend relations with students and faculty, make open admissions work, and provide a renewed vision to the college. However, students continued protesting over things mostly out of his control, e.g., the employment practices of the contractor building the new science building, which were perceived as discriminatory. And soon President Marshak had to deal with the increasing financial difficulties leading up to the NYC crisis in 1975.

In the Fall semester 1969, no major student demonstrations happened. Student activism in college affairs declined; the Tech News developed an identity problem; after a column of the Tech Council[95], that the Tech News is no longer representative of the engineers in the school, but has become a general campus newspaper, there was fight over its funding in the student government[96]. The Tech News survived the funding vote in the student government[97], but ultimately ended publication in the fall 1970.

The Finley student center building remained a partial ruin until it was torn down in 1986. The south campus was essentially abandoned, until it was revived in the 2000s.

2.4 Tuition

Until the beginning of the Open Admission period, the students were divided into three classes, and their tuition depended on this classification. The fully matriculated students, who satisified the admission requirements and made the cutoff in the ranking of applicants, were tuition-free; the limited matriculated students, who satisfied the requirements but did not make the cutoff,

[92] The School of Nursing was closed in 1995, at the height of the financial crisis; but further cuts came in 1996

[93] Tech News Vol 31 No 2, 11 February 1970

[94] Tech News Vol 32 No 5, 12 November 1970

[95] Tech News Vol 30 No 9, 18 December 1969

[96] Tech News Vol 30 No 10, 8 January 1970

[97] Tech News Vol 31 No 1, 6 February 1970

paid a tuition, and the non-matriculated students, who did not satisfy the requirements, paid a higher tuition. The tuition for students who had already completed an undergraduate degree was generally at the same level as the tuition for non-matriculated students. Also there was a number of administrative fees, students had to buy their textbooks, and pay for consumables and breakages in the labs.

undergraduate Tuition at CCNY per credit			
Year	fully matriculated	limited matriculated	non-matric
1933	free	\$2.50	\$5.00
1941	free	\$2.50	\$5.00
1951	free	\$5.00	\$9.00
1961	free	\$9.00	\$12.50

After the Open Admission reform, tuition was free for all New York City students, up to the credit requirement of their degree (plus four; but counting also credits from a previous degree at CUNY; so students transfering from community college to a senior college used up their free credits early), but students from New York State were charged tuition. In 1971 the tuition for New York State residents outside New York City was a flat rate of \$200 per semester; at 15 credit per semester this is \$13 per credit. The tuition for out-of-state non-matriculated students was \$35 per credit.

A major change came with the New York City financial crisis of 1975; there was no tuition-free study anymore. When New York state assumed the financial resonsibility for the senior colleges, the state leadership understandably insisted that New York City students pay the same as New York State students. Even for New York state students, the full-time rate doubled from \$200 per semester to around \$400 per semester. The students had instead to rely on a combination of money sources, especially the NY state TAP program, to fund their tuition. The state TAP was expanded when the tuition-free study ended, to continue to provide educational opportunity; but the jump in tuition was considerable. Before, even though study was in fact not free at CCNY for the majority of students (all those who were not fully matriculated), it was cheap. Below is the tuition afterwards; it is now divided according to in-state or out-of-state (including international) students. In the 1970s and 80s, the undergraduate tuition was lower for the first 60 credits.

undergraduate Tuition at CCNY per semester				
	per credit		maximum	
Year	in-state	out-of-state	in-state	out-of-state
1977-1981	\$35-\$40	\$55	\$387-\$462	\$712
1991	\$77	\$187	\$925	\$2225
1993	\$100	\$210	\$1225	\$2525
2001	\$135	\$285	\$1600	\$3400
2018	\$285	\$580	\$3265	—

Graduate study was never free, neither in the beginning, nor in the early open-dmissions period. The per-credit graduate tuition was usually around 2-3 times the undergraduate tuition; in the 1990s the gap almost disappeared, but in the 2000s widened again. Until the 1960s, the graduate tuition was in theory assigned for each graduate course separately, but the tution of lecture courses was just proportional to the credits. Laboratory courses had different tuitions.

graduate Tuition at CCNY per semester				
	per credit		maximum	
Year	in-state	out-of-state	in-state	out-of-state
1933		–	–	–
1941	\$5	–	–	–
1951	\$14	–	–	–
1961	\$25	–	–	–
1971	\$45	–	–	–
1981	\$75	\$95	\$750	\$1000
1991	\$112	\$215	\$1302	\$2550
2001	\$185	\$320	\$2175	\$3800
2018	\$520	\$895	\$6115	–

2.5 The Honors College

In 1971 existed an Engineering Honors Program; selected students were assigned a mentor to lead them to graduation in four years. Some of the basic courses existed in extended “Honors” versions. The mentors were expected to prepare the students to the possibility of graduate study.

CUNY established the William E. Macaulay Honors College as a CUNY-wide honors college in 2001, as a way to recruit high-performing high school students into CUNY, in competition with offers these students get from other universities. This was part of Chancellor Goldstein’s plan to raise the level and profile of CUNY[98], which in the 1980s and 1990s had become, or was at least perceived as, the place to go to when you have no alternatives[99]. With the Macaulay Honors College, CUNY started making offers to students it wanted to attract, and attempted to get students who do have other alternatives[100].

Although the Macaulay Honors College is CUNY-wide, the students of course still study in a specific college and major. Thus the CCNY students of the Macaulay Honors college are selected by CCNY, and study like other students at CCNY. The Honors College students receive a full tuition scholarship, additional mentoring, free access to many NYC cultural institutions, a laptop, and some other activities especially aimed to connect the students to New York City. Macaulay Honors college students must maintain a GPA of at least 3.5 throughout their studies.

The Macaulay Honors College has a central allocation from CUNY, which gives each participating college a certain number of spots in the program. The individual colleges augment their allocation by financing additional students out of their own budget. The Honors program started in 2001 with an initial cohort of 200, of which 22 were from City College. The program grew through all of the 2000s, not at the same rate at different colleges. The Macaulay Honors College was a low priority for President Williams, so the City College allocation grew only slowly, whereas President Coico gave the growth of the Honors college as tool of recruiting high-qualified students a high priority and augmented the allocation from CUNY by a large sum from the CCNY budget. In the financial crisis which followed the departure of President Coico, this additional allocation for the Macaulay Honors College at the City College was cut, so the number of admitted honors college students dropped significantly.

In parallel to the Macaulay Honors College, City College started the City College Honors Program; this is a distinct program, and students can belong only to one of them. However, the Macaulay program comes with larger financial incentives, so it is preferable for the students; but it also comes with a stricter requirement of maintaing the GPA.

The School of Engineering always received a large share of the Honors College admitted students. Many of the highly qualified students entering City College from flagship high schools of the New York City public school system, such as Stuyvesant, Bronx Science, and Brooklyn Tech, choose to major in engineering. About half of the students admitted to either the Macaulay

98 New York Times, 23 May 2000: Plan Approved to Invigorate City University

99 New York Times, 2 February 2002: City College, the Faded Jewel of CUNY, is Recovering its Luster and its Achievers

100 New York Times, 11 May 2002: To Raise Its Image, CUNY Pays for Top Students and Throws in a Laptop

Honors College or the City College Honors Program are engineering students. In 2015 the Grove Honors program was established specifically for engineering students, as a third Honors program at CCNY. This addressed also another problem that engineering has some courses in which even good students sometimes get Bs, which made maintaining the 3.5 GPA requirement difficult for some students admitted in the Macaulay Honors College. Again as a result of the financial crisis, the Grove Honors program was discontinued in 2018.

first-time freshmen in Honors Programs at CCNY			
Year	Macaulay	City College Honors	Grove Honors
2001	22	36	—
2002	34	50	—
2003	32	29	—
2004	50	30	—
2005	35	35	—
2006	36	27	—
2007	38	40	—
2008	43	38	—
2009	42	35	—
2010	40	34	—
2011	72	53	—
2012	88	36	—
2013	108	37	—
2014	99	39	—
2015	96	20	43
2016	98	24	49
2017	67	25	15
2018	78	19	—

2.6 Demographics of the Student Body

From 1967 on CUNY took an annual census 0f the “ethnic” composition of the student body, to comply with the Civil Rights Act of 1964, Article VI. The categories changed several times, they are mostly racial categories, but the word ethnic was preferred. Initially the categories were “White”, “Black”, “Puerto Rican” and “Other”, they changed in 1972 by the addition of “Spanish Surnamed American” , “American Indian”, and “Oriental”. They changed again by 1980 to “Hispanic” and “Asian”.

Below I combined “Puerto Rican” and “Spanish Surnamed American” as Hispanic, and added the American Indian to Other, since the American Indian were always less that 0.4%. There is a separate table for non-matriculated students, which were the students paying tuition because they did not make the cut-off for tuition-free study. I also include a table for the CUNY averages over all CUNY senior college students. The data is from the CUNY student data yearbooks, which are unfortunately not consistent: the numbers reported for the same year change for different editions of the yearbook. However, even with unreliable data it is clear that the demographics of the City College matriculated students changed fundamentally in the short period from 1967, when it was almost 90% white, to 1975 when it was less than 40% white. The non-matriculated students had a separate development; they started with much higher percentage of black students, and the data has even more problems: in 1969, almost a quarter of the students were in the category "Unknown". Non-matriculated students disappeared when from 1976 on everyone had to pay tuition.

The comparison of City College with the CUNY senior college averages shows that City Collegewas always more diverse than CUNY, at times having the smallest percentage of white students among the senior colleges. The changes in CUNY average demographics were slower, and less intense, although following the same trends. It should be noted that these are the total numbers of undergraduate students; to cause these changes, the changes in the demographics of the admitted freshman students must be even stronger. In 1967, CCNY undergraduate students were 87% white, 4% black, hispanic, asian and others making up the rest in unknown percentages. It follows a period of dramatic growth of the black student numbers, and fall of the white student numbers, with the hispanic and asian student numbers growing at a lesser rate. This continues for two-and-a-half decades, until the black student percentage reaches a maximum in the early 1990s (43% in 1992), since then the percentage of black students has been continuously decreasing again, so that it is currently where it was in the early 1970s. However, the percentages of hispanic and asian students continued to grow; by the middle of the 2000s, the percentage of hispanic students overtook the percentage of black students (in 2004 32% hispanic, 31% black), and became the largest student group. The percentage of hispanic students has levelled off in the 2010s, and appears now stable at around 33%. The percentage of asian students has continuous slow growth since their numbers are recorded; in 1992 they overtook the white students, which became the smallest group, around 2010 they overtook the black students. The asian students are the second-largest group, and will on the current trajectory overtake the hispanic students and become the largest group in the early 2020s. The white students had a dramatic decline from 87% in 1967 to 11% in 1996, but since then the numbers are growing slowly again, possibly overtaking the black students in the early 2020s.

CCNY matriculated students					
Year	White	Black	Hispanic	Asian	Other
1967	87.3%	4.2%	1.9%		5.8%
1968	83.8%	7.2%	3.0%		4.2%
1969	75.8%	11.4%	4.6%		6.4%
1970	68.3%	16.4%	5.7%		8.0%
1972	59.1%	19.1%	11.2%	5.8%	8.0%
1975	36.9%	32.9%	15.1%	6.6%	8.7%
1980	33.1%	31.3%	23.6%	10.2%	
1984	26.3%	33.5%	26.9%	11.8%	
1988	%	%	%	%	%
1992	13.8%	43.1%	29.0%	13.9%	
1996	11.0%	40.3%	32.4%	16.0%	
2000	12.3%	39.4%	32.0%	16.0%	
2004	17.8%	31.7%	32.1%	18.3%	
2008	18.5%	26.2%	34.7%	20.4%	
2012	19.3%	21.4%	33.8%	25.4%	
2016	18.1%	19.9%	33.0%	28.9%	

CCNY non-matriculated students					
Year	White	Black	Hispanic	Asian	Other
1967	55.0%	28.0%	8.4%	?	7.4%
1968	62.1%	25.6%	5.1%	?	4.8%
1969	44.1%	22.7%	5.8%	?	4.7%
1970	44.8%	34.2%	9.3%	?	8.6%
1972	32.4%	41.4%	16.0%	5.0%	
1975	26.5%	41.5%	17.7%	7.1%	

The classification "non-matriculated" to distinguish the students who did not make the cut-off for tuition-free study disappeared when from 1976 on everyone had to pay tuition.

CUNY senior college matriculated students					
Year	White	Black	Hispanic	Asian	Other
1967	90.4%	3.6%	1.6%		3.6%
1968	88.6%	5.5%	2.2%		2.3%
1969	84.0%	8.0%	2.9%		3.8%
1970	81.0%	10.1%	3.8%		4.2%
1972	72.7%	14.9%	6.8%	2.4%	
1975	55.5%	25.7%	9.4%	3.3%	
1980	49.8%	27.9%	15.9%	5.5%	
1984	47.3%	26.8%	17.6%	7.2%	
1988	41.7%	28.8%	17.5%	11.7%	
1992	37.8%	29.5%	19.8%	12.7%	
1996	32.9%	32.2%	21.8%	12.9%	
2000	32.2%	31.7%	22.1%	13.8%	
2004	33.2%	28.9%	22.7%	15.1%	
2008	30.6%	26.9%	24.6%	17.7%	
2012	30.4%	24.6%	23.6%	21.2%	
2016	25.0%	24.7%	26.4%	23.7%	

The CUNY student data book provide also other interesting information on the students, unfortunately not every year the same, but I include here interesting samples.

The distribution of the *native language* of first-time freshmen at CCNY in 1996 was 40.8% English, 29.7% Spanish, 4.9% Chinese, 3.2% Creole, 2.8% Bengali, 2.6% Korean, 2.1% French, the remaining languages each less than 2%. For CUNY senior colleges, the numbers of the most frequent languages were 53.9% English, 18.2% Spanish, 4.7% Chinese, 4.4% Russian, 2.3% Creole. This shows again that City College is considerably more diverse than CUNY, and is especially attractive to students from immigrant families.

The *family income* distribution was sometimes included in the data; below I compare CCNY with the CUNY senior college average. Clearly, CCNY students come from poorer families than the CUNY average.

Family Income Distribution 1980: Incomes in $1000							
	0–4	4–8	8–12	12–16	16–20	20–24	24+
CCNY	15.8%	19.1%	19.3%	15.0%	9.9%	9.6%	11.3%
CUNY	14.7%	15.2%	15.5%	14.3%	11.4%	11.8%	17.1%

Family Income Distribution 1984; Incomes in \$1000							
	0–4	4–8	8–12	12–16	16–20	20–24	24+
CCNY	15.6%	14.7%	14.7%	14.1%	10.9%	10.9%	19.1%
CUNY	11.0%	11.9%	11.2%	12.4%	10.9%	11.8%	30.8%

Family Income Distribution 1996; Incomes in \$1000							
	0–10	10–20	20–30	30–40	40–50	50–60	60+
CCNY	14.3%	24.2%	28.3%	12.4%	6.8%	3.5%	10.5%
CUNY	11.9%	24.3%	21.6%	13.7%	7.5%	7.0%	14.1%

But in spite of having a low income, CCNY students are especially dedicated to their studies: in 1992, 53% of CCNY students had a family income of less than $20k, compared with a CUNY average of 33%; this was the second highest number among CUNY senior colleges. And yet 43% of the CCNY students did not work (highest in CUNY), compared to 32% CUNY average, and only 22% of CCNY students worked full-time (lowest at CUNY) compared to 31% CUNY average.

3. Undergraduate Engineering Curricula

In this chapter we discuss the change of the undergraduate engineering curricula over the century. The comparison starts usually 1933, because that was the first year the CCNY Bulletin had a separate engineering section. General trends across all engineering majors is that the study became more theoretical, involving more mathematical models, and that laboratory classes disappeared. Especially by the availability of computers from the 1980s on, problems are now studied in computer models that previously were studied in reality. This has many advantages; it allows to study things which otherwise would have been inaccessible, and it is much cheaper. Another observation is the disappearance of classes shared across the engineering disciplines, like fluid mechanics.

3.1 Common Part of the Engineering Curricula

Before the engineering degree programs existed, students who intended to become an engineer took a Bachelor of Science program, and then continued at a technical school. In 1906, the City College of New York offered a Bachelor of Arts, with specializations "Classical", "Latin-French", and "Modern Languages", and a Bachelor of Science, with specializations "General Science", "Biology-Chemistry", and "Mechanical". Students planning to become civil, electrical, mechanical or mining engineers should take the "Mechanical" specialization, future sanitary engineers should take the "Biology-Chemistry" specialization; chemical engineers are not mentioned. The level of study is characterized by the explanation in the 1906 Bulletin: "None of the Science Courses are in any sense technical, as they all contain subjects which are necessary to a general education course". There were several labs in the "Mechanical" specialization, which all taught very concrete tool use and making skills: use of a forge, a lathe, woodworking and steelworking tools and techniques, soldering, casting metal. There were also labs that explained mechanical machines as motors, steam engines, and turbines, and electrical motors and generators. All this was just a preparation for actual engineering study at a different school.

needs: initial curriculum on establishment of engineering major

In 1933, the Bachelor of Science in Engineering required 134 credits; for comparison, the BS in Science required 128 credit. There was a General Education component, a Engineering Core of 47 credits, and at least 28 credits in the specialization area (Chemical, Civil, Electrical, or Mechanical Engineering). The Engineering Core consisted of the following classes:

10 cr Analysis, Differential and Integral Calculus
4 cr Descriptive Geometry

3 cr Qualitative Analysis (Chemistry)
2 cr General Physics III
4 cr Mechanics
2 cr Mechanical Drawing
3 cr Business Organization
3 cr Power (Mechanical Engineering)
3 cr Elementary Electrical Engineering
4 cr Theory of Surveying
4 cr Mechanics of Materials
1 cr Materials Testing Lab
3 cr Hydraulics
1 cr Hydraulics Lab

Students had also to take 6 semester of Hygiene, which dealt somewhat with health-related subjects, but mostly was a Physical Education class of a rather military type, with wrestling, boxing, swimming, combat exercises, and marching among the topics.

In 1940, there was no separate general education component; the common courses of all engineering bachelor programs were

6 cr Chemistry
3 cr Economics
7 cr English
10 cr Foreign Languages
3 cr History
4 cr Hygiene
10 cr Mathematics (Analytic Geometry and Calculus)
12 cr Physics (General Physics and Mechanics)
3 cr Public Speaking
6 cr Drafting (Descriptive Geometry and Mechanical Drawing)
4 cr Mechanics of Materials
3 cr Materials of Engineering
4 cr Engineering Fluid Mechanics
3 cr Elementary Electrical Engineering (DC)
3 cr Power

The additional classes for each bachelor degree were all required, there were no elective classes. In addition to the classes above,

- Chemical Engineering students had 26 cr of chemical engineering, another 16 cr of chemistry, 3 cr of physics, 3 cr of geology, 2 cr of biology, 4 cr of electrical engineering and 5 cr of mechanical engineering;
- Civil Engineering students had 48 cr of civil engineering, 4 cr of drafting, and 3 cr of geology;

- Electrical Engineering Students had 33 cr electrical engineering, 12 cr of mechanical engineering, 3 cr of mathematics, 3 cr of physics, 2 cr of drafting, and 2 cr of civil engineering;
- Mechanical Engineering students had 36 cr mechanical engineering, 10 cr electrical engineering, 7 cr civil engineering, 3 cr physics 2 cr chemical engineering, 2 cr drafting.

The Masters degree programs were a bit less regulated, with some elective choices. All Masters programs required a 1 cr class in Public Speaking, and chemical engineering had a foreign language requirement: candidates must be able to translate German and French.

In total the credit requirements in 1940 were

Credit Requirements of Degrees in 1940		
	Bachelor	Master
Chemical Engineering	143 cr	35 cr
Civil Engineering	134 cr	33 cr
Electrical Engineering	135 cr	32 cr
Mechanical Engineering	139 cr	31 cr

In 1960, there was a separate pre-engineering curriculum, common to all engineering degrees. It consisted of

8 cr Chemistry
15 cr Physics (General Physics and Mechanics for Engineers)
3 cr one additional science class, physics, chemistry, or geology
13 cr Mathematics (Analytic Geometry, Calculus, and Differential Equations)
4 cr English
6 cr Humanities
9 cr Social Studies
2 cr Health Education
3 cr Speech
4 cr Drafting (Descriptive Geometry and Mechanical Drawing)
2 cr Physical Education

Compared to 1940, Physics, Chemistry and Mathematics all increased; the Foreign Language requirement, which had been a large number of credits, and the economics class were replaced by several social studies classes, and History was replaced by two Humanities classes. Mathematics added Differential Equations to Analytic Geometry and Calculus. The Public Speaking class was replaced by a sequence of Speech classes, possibly the increasing number of immigrant students forced a change there. The Hygiene sequence was split into Health Education and Physical Eduation classes, and the Physical Education classes lost their military preparation aspect. In 1960, there were also engineering classes common with minor variations to all engineering majors:

7 cr	Electrical Engineering
5 cr	Mechanics of Materials
2 cr	Materials of Engineering
3 cr	Engineering Fluid Mechanics

Add total credit requirements of majors in 1960

In 1981, the consensus about a core has further weakened, but still there is a large overlap. Instead of the Humanities and Social Studies classes, students can now freely choose any 14 credits of Liberal Arts (18 cr for Mechanical Engineering, 21 cr for Computer Science). The English requirement shrunk slightly; the sum of Liberal Arts and English stayed constant, so that was probably an accreditation requirement. A new requirement is that all engineers need to take a Computers and Programming class. Chemistry has increased, adding a Laboratory Techniques class. Physics replaced the Mechanics class by a Physics for Engineers class. The Health Education class disappeared. And Drafting has almost disappeared. The only engineering class shared across the departments is Mechanics of Materials. Fluid Mechanics, e.g., although still recognized as important part of much of engineering, is now taught in separate courses: as Transportation Phenomena I in Chemical Engineering, as Fluid Mechanics I and Fluid Mechanics Lab in Civil Engineering, and as Fluid Dynamics I and II in Mechanical Engineering. Chemical Engineering has its own Thermodynamics course, and Mechnical Engineering provides Thermodynamics for themselves and for Civil Engineering, and a special Thermodynamics for Electrical Engineers class. The common courses of all engineering bachelor programs in 1981 were

8 cr	Chemistry (ElE only 3; CSc can replace by Biology)
4 cr	Economics (ME none)
6 cr	English
14 cr	Liberal Arts (18 for ME, 21 for CS)
2 cr	Physical Education
13 cr	Mathematics (Analytic Geometry and Calculus, and Differential Equations; for CSc instead Linear Algebra)
11 cr	Physics (General Physics and Physics for Engineers, CSc only 8)
3 cr	Speech
2 cr	Drawing (ChemE only one, ElE and CSc none)
4 cr	Mechanics of Materials (not ElE and CSc)
2 cr	Computers and Programming

Beyond this, the majors develop separate programs, each of them filling the curriculum almost entirely with required classes. Only the Computer Science curriculum still has free electives.

In addition to these majors, the School of Engineering also offered the Bachelor of Technology, the add-on program for students with an AAS degree from a community college. This program was entirely separate from the engineering programs, offered by a separate department, and not sharing any courses with the engineering majors. Since the students were expected to have already finished their Math, Science, and Lberal Arts requirements as part of their AAS degree, they did not take any of those classes at CCNY either. The B.Tech students had four technical elective classes, three Humanities electives, and one free elective; all other classes were taken within the Department of Technology.

In total the credit requirements in 1981 were

Credit Requirements of Degrees in 1981		
	Bachelor	Master
Chemical Engineering	137 cr	? cr
Civil Engineering	136 cr	? cr
Computer Science	128 cr	? cr
Electrical Engineering	136 cr	? cr
Mechanical Engineering	136 cr	? cr
Technology	AAS + 64cr	—

In 2001 the Mathematics requirement has further increased, adding Linear Algebra and Vector Analysis; Physics is reduced; speech and physical education disappeared, but the Liberal Arts increased, and can now be chosen from a large number of classes, subject to distribution requirements; Drawing and Mechanics of Materials disappeared, but Electrical Circuits and Thermodynamics entered the core. Also there is a class titled Computer Aided Analysis Tools for Electrical Engineers, which is required from all engineers but civil, and which is mostly an introduction to Matlab, and basic mathematics like matrices and complex numbers, which are covered in the mathematics classes only much later, but needed in engineering from the beginning. The mismatch between the time when material is available from the mathematics curriculum, and the time it is needed by the engineering classes, is an increasing problem, as the engineering curricula get more theory-heavy over the decades. The trend is further strengthened by the use of computers, which necessarily work with mathematical models. The common courses of all engineering bachelor programs in 2001 were

6 cr English
18 cr Liberal Arts
3 cr Engineering Economics (not Electrical or Computer Engineering)
16 cr Mathematics (Calculus I/II/III, Differential Equations, Linear Algebra and Vector Analysis; for Computer Science no Differential

Equations, and different Linear Algebra)
- 8 cr Chemistry (Computer, Electrical, and Mechanical Engineering only 3)
- 8 cr Physics (General Physics I/II)
- 1 cr Engineering Design
- 3 cr Programming
- 3 cr Computer-Aided Analysis Tools (not Civil Engineering)
- 3 cr Electrical Circuits (not Chemical Engineering)
- 3 cr Thermodynamics (not Computer Engineering)

3.2 Biomedical Engineering

When the Biomedical Engineering major started, it depended yo a large degree on classes offered for other engineering majors. The required biomedical engineering classes in 2003 were

- ENGR 103 *Computer-Aided Analysis Tools for Electrical Engineers*
- ENGR 204 *Electrical Circuits*
- EE 204 *Linear Systems Analysis* I
- ENGR 230 *Thermodynamics*
- ME 246 *Engineering Mechanics* I
- ME 330 *Mechanics of Materials*
- ChE 341/342 *Transport Phenomena* I/II
- ME 461 *Engineering Materials*
- BME 101 *Introduction to Biomedical Engineering*
- BME 220 *Biomedical Engineering Tools*
- BME 310/410 *Experimental Methods in Biomedical Engineering* I/II
- BME 350 *Biomedical Electronics and Measurement*
- BME 450/460 *Biomedical Engineering Senior Design* I/II
- ENGR 300 *Social, Economic, and Cultural Impact of Biomedical Technology*

and 12 credits of biomedical engineering electives and 3 credit of technical electives. One problem with putting together a degree program from selected courses of other programs is that it requires courses without requiring their prerequisites, e.g., ChE 341 *Transport Phenomena I* has ChE 206 *Chemical Process Concepts and Methodology* as prerequisite, but it is not a required class of the biomedical engineering major.

By 2018, the number of classes imported from other majors has decreased. All the electrical engineering classes have been replaced by classes taught by the biomedical engineering department. The required biomedical engineering classes in 2018 were

- ME 246 *Engineering Mechanics* I

- ME 330 *Mechanics of Materials*
- ChE 229 *Chemical Engineering Thermodynamics* I
- ChE 341 *Transport Phenomena* I
- ME 461 *Engineering Materials*
- BME 101 *Introduction to Biomedical Engineering*
- BME 205 *Bioelectrical Circuits with Laboratory*
- BME 220 *Biostatistics and Research Methods*
- BME 305 *Dynamical Systems and Modeling*
- BME 310 *Experimental Methods in Biomedical Engineering* I
- BME 410 *Biomedical Transducers and Instrumentation*
- BME 450/460 *Biomedical Engineering Senior Design* I/II
- BME 501 *Cell and Tissue Mechanics*
- BME 502 *Cell and Tissue Transport*
- BME 501 *Cell and Tissue-Biomaterials Interactions*
- BME 501 *Image and Signal Processing in Biomedicine*
- ENGR 300 *Social, Economic, and Cultural Impact of Biomedical Technology*

and 9 credits of electives from two lists ("technical" and "engineering"), for a total of 128 credits in the biomedical engineering major. The problem with the missing prerequisites still exists.

3.3 Chemical Engineering

In 1935, the chemical engineering curriculum was a five-year curriculum, with chemical engineering classes only in the fifth year; before that, there was mainly chemistry, mechanical and electrical engineering. The required chemical engineering classes in 1935 were

- ChE 170 *Industrial Electrochemistry and Pyrometry*
- ChE 175 *Theory of Chemical Engineering Processes*
- ChE 182 *Metallurgy and Metallography*
- ChE 246 *Technology of Fuel, Gas, Water, and Lubricants*
- ChE 260 *Chemical Engineering Lab and Industrial Inorganic Chemistry*
- ChE 265 *Industrial Organic Chemistry*
- ChE 298 *Plant Design*

as well as two factory trips (ChE 261 and ChE 266). The Bulletin lists also a class ChE 148 *Engineering Metallurgy*. Metallurgy and Petrochemistry appear to be the central topics of the 1935 curriculum, and the chemical engineering professor Morris Kolodney, who later worked on the Manhattan Project, worked there as metallurgist, on the isolation and refinement of plutonium.

In 1950, the chemical engineering curriculum has become much larger, and mostly separate from mechanical and electrical engineering. The courses on metallurgy and on petroleum products are still there, as well as the courses on electrochemistry and plant design, but now a large number of foundational courses has been added. Also there is a new application area, a course on polymers. The required chemical engineering classes in 1950 were

- ChE 128/129/132 *Chemical Process Principles* I/II/III
- ChE 134/160/163 *Unit Operations Theory* I/II/III
- ChE 260/262 *Unit Operations Lab* I/II
- ChE 161 *Chemical Technology*
- ChE 166 *Principles of High Polymer Theory and Practice*
- ChE 170 *Industrial Electrochemistry and Pyrometry*
- ChE 182 *Physical Metallurgy and Metallography*
- ChE 198 *Plant Design*
- ChE 246 *Fuels and Lubricants*

In 1970, the chemical engineering curriculum has again become larger, the foundational courses split up in more specific areas, and the courses on application areas like metallurgy, electrochemistry, and petroleum products disappeared from the required curriculum. There is some materials science, but metallurgy seems to have disappeared from the interests of the faculty. There is a new interest in control theory and controller design. The required chemical engineering classes in 1970 were

- ChE 128 *Material and Energy Balances*
- ChE 129/130 *Chemical Engineering Thermodynamics* I/II
- ChE 132 *Chemical Reaction Kinetics*
- ChE 141/142 *Transport Phenomena* I/II
- ChE 144/145 *Unit Operations* I/II
- ChE 260/262 *Unit Operations Lab* I/II
- ChE 161 *Chemical Technology*
- ChE 167 *Principles of Nonmetallic Behavior*
- ChE 168 *Nonmetallic Materials Lab*
- ChE 181 *Principles of Metallic Behavior*
- ChE 177 *Measurement and Control of Process Variables*
- ChE 178 *Chemical Engineering Instrumentation Lab*
- ChE 191/192 *Chemical Engineering Design* I/II

In 1985, the curriculum is, apart from renumbering, mostly the same, it got a bit shorter. The three Material Science classes (Principles of Nonmetallic Behavior, Principles of Metallic Behavior, Nonmetallic Materials labs) have disappeared, as well as the second part of the Unit Operations Lab. There is a new introductory class *Landmarks in Chemical Technology*. The required chemical engineering classes in 1985 were

- ChE 200 *Landmarks in Chemical Technology*
- ChE 328 *Material and Energy Balances*

- ChE 329/430 *Chemical Engineering Thermodynamics* I/II
- ChE 432 *Chemical Reaction Kinetics*
- ChE 341/342 *Transport Phenomena* I/II
- ChE 344/445 *Unit Operations* I/II
- ChE 460 *Unit Operations Lab* I
- ChE 477 *Measurement and Control of Process Variables*
- ChE 478 *Chemical Engineering Instrumentation Lab*
- ChE 491/492 *Chemical Engineering Design* I/II

There are now several elective options: Chemical Engineering Design, Materials Science, Chemical Engineering Research, Biochemical Engineering, Biomedical Engineering, and Pre-Medical.

In 2000 again the program has shrunk slightly; the two-semester design project is now one semester, the unit operations lab II, which had become elective, now reappears as required, but is merged with the instrumentation lab. The Materials Science class also returns as required, after a period as elective. Instead of the elective options, the students now choose 11–12 credits from a fairly broad electives list, which includes also classes from other engineering departments, from computer science, and mathematics. The required chemical engineering classes in 2000 were

- ChE 205 *Principles and Practice of Chemical Engineering*
- ChE 206 *Chemical Process Concepts and Methodology*
- ChE 310 *Introduction to Materials Science*
- ChE 430 *Chemical Engineering Thermodynamics*
- ChE 432 *Chemical Reaction Engineering*
- ChE 341/342 *Transport Phenomena* I/II
- ChE 344/445 *Unit Operations* I/II
- ChE 460 *Unit Operations Lab* I
- ChE 462 *Unit Operations and Process Control Lab II*
- ChE 479 *Chemical Process Dynamics and Control*
- ChE 495 *Techniques of Chemical Engineering Design*
- ChE 496 *Chemical Engineering Design Project*

and 12 credits of engineering electives, for a total of 130 credits in the chemical engineering major.

In 2018 again was mostly renumbering and renaming; the Unit Operations I/II sequence became Separations Operations and Transport Operations. But one Lab was lost: the Unit Operations Lab I/II, which already had absorbed the process control lab earlier, became the Separations Operations and Control Lab. From 1970 to 2018, the Lab classes reduced from four to one. The Thermodynamics class, which had shrunk from two to one, re-expanded to a two-semester sequence. The required chemical engineering classes in 2018 were

- ChE 228 *Introduction to Chemical Engineering Principles and Practice*
- ChE 229/330 *Chemical Engineering Thermodynamics* I/II
- ChE 310 *Introduction to Materials Science*
- ChE 311 *Analysis of Chemical Processes*
- ChE 341/342 *Transport Phenomena* I/II
- ChE 345 *Separations Operations*
- ChE 346 *Transport Operations*
- ChE 432 *Chemical Reactions Engineering*
- ChE 462 *Separations Operations and Control Laboratory*
- ChE 479 *Process Control*
- ChE 495 *Techniques of Chemical Engineering Design*
- ChE 496 *Chemical Engineering Design Project*

and 15 credits of technical electives, with at least six from engineering, for a total of 130 credits in the chemical engineering major.

Over fifty years, from 1970 to 2018, the curriculum has been remarkably stable: parts expanded or shrunk, but stayed recognizable.

3.4 Civil Engineering

In 1933 the civil engineering curriculum had surveying as a central component, with three lecture classes and two summer camps to practice surveying in van Cortland Park in the Bronx. The importance of surveying declined over the decades;by 2001 it had completely disappeared from the civil engineering curriculum. But the surveying camp in van Cortland Park was for at least half a century in important part of the civil engineering study at CCNY; indeed Steinman had supervised it before the school existed, and in many memories of Alumni it is mentioned. Most classes sound very applied, and directed at some specific application, like highways, railroads, or water power. The Mechanics of Materials sequence and the Hydraulics class are the most foundational of the classes. The civil engineering curriculum had from the beginning, and still has today, a class on Specifications and Contracts; it is the only of the engineering programs in the school in which the legal aspects of the profession are taught in a class. The required civil engineering classes in 1933 were

- CE 101/201/301 *Theory of Surveying* I/II/III
- CE 102/202 *Summer Surveying Camp* I/II
- CE 110/210 *Mechanics of Materials* I/II
- CE 111 *Materials of Engineering*
- CE 211 *Materials Testing Laboratory*
- CE 120 *Hydraulics*
- CE 221 *Hydraulics Laboratory*
- CE 212 *Engineering Structures*

- CE 222/232/242 *Structures* I/II/III
- CE 213/223 *Specifications and Contracts* I/II
- CE 215 *Reinforced Concrete*
- CE 224 *Highways and Pavements*
- CE 225 *Retaining Walls & Foundations*
- CE 226 *Railroad Engineering*
- CE 233 *Sanitary Engineering*
- CE 235 *Masonry Arches and Dams*
- CE 236 *Water Power Engineering*

By 1950, the role of Surveying has been reduced to two classes and two summer camps; the Hydraulics class became a two-semester Fluid Mechanics sequence; Water Power and Railroad Engineering have disappeared, and Sanitary Engineering split in two: Water Supply and Sewage Treatment. The required civil engineering classes in 1950 were

- CE 101 *Elementary Surveying*
- CE 102/202 *Summer Surveying Camp* I/II
- CE 201 *Advanced Surveying*
- CE 110 *Mechanics of Materials*
- CE 111 *Materials of Engineering*
- CE 120/220 *Engineering Fluid Mechanics* I/II
- CE 221 *Fluid Mechanics Laboratory*
- CE 212 *Structural Planning and Design*
- CE 215 *Reinforced Concrete*
- CE 222/232 *Structures* I/II
- CE 224 *Soil Mechanics & Foundations*
- CE 226 *Curves and Earthwork*
- CE 227 *Contracts and Specifications*
- CE 235 *Masonry Structures*
- CE 236 *Water Supply and Treatment*
- CE 236 *Sewage and Sewage Treatment*
- CE 242 *Structural Design*

In 1970 the curriculum contains 18 credits of electives, which were achieved by making part two of each two-semester sequence an elective. Thus the required Surveying sequence is reduced to Surveying I, the Fluid Mechanics Sequence to Fluid Mechanics I, and so on. A new application is Transportation Engineering. The required civil engineering classes in 1970 were

- CE 106 *Surveying* I
- CE 110 *Mechanics of Materials* I
- CE 114 *Materials of Engineering Laboratory*
- CE 120 *Fluid Mechanics* I
- CE 221 *Fluid Mechanics Laboratory*

- CE 216 *Reinforced Concrete* I
- CE 218 *Engineering Planning and Management*
- CE 223 *Structural Analysis* I
- CE 224 *Soil Mechanics & Foundations* I
- CE 227 *Contracts and Specifications*
- CE 238 *Sanitary Engineering* I
- CE 243 *Structural Engineering*
- CE 262 *Transportation Engineering* I

and 18 credits of engineering electives.

In 1985, there was a general renumbering of classes, and some more classes became recquired, at the expense of electives. The *Sanitary Engineering* class split into *Water Resources* and *Hydraulics*, and *Dynamics of Civil Engineering Structures* is a new required class. The required civil engineering classes in 1985 were

- ME 231 *Thermodynamics* I
- CE 209 *Structural and Site Plans*
- CE 231 *Introduction to Structural Mechanics*
- CE 263 *Surveying* I
- CE 330 *Mechanics of Materials* I
- CE 331 *Mechanics of Materials Laboratory*
- CE 340 *Structural Analysis* I
- CE 345 *Soil Mechanics and Foundations* I
- CE 350 *Fluid Mechanics* I
- CE 351 *Fluid Mechanics Laboratory*
- CE 370 *Economic Planning and Management*
- CE 380 *Water Resources*
- CE 390 *Dynamics of Civil Engineering Systems*
- CE 391 *Contracts and Specifications*
- CE 441 *Reinforced Concrete* I
- CE 442 *Structural Design*
- CE 450 *Hydraulics*
- CE 470 *Transportation Engineering* I

and 12 credits of engineering electives, with at least six from civil engineering.

In 2001, all lab classes have disappeared, instead computer models are used, and there is a class on computational methods in civil engineering. Surveying disappeared from the curriculum; there is only an elective Surveying Camp still available within two of the four specializations. Instead there is a class on Data Analysis. All two-semester sequences, of which only one semester was required, have been reduced to one semester courses; only Water Resources became Environmental Engineering I. The Structural Design class stopped being required. The required civil engineering classes in 2001 were

- ENGR 230 *Thermodynamics*
- ENGR 276 *Engineering Economics*
- CE 209 *Structural and Site Plans*
- CE 231 *Introduction to Structural Mechanics*
- CE 264 *Civil Engineering Data Analysis*
- CE 332 *Mechanics of Deformable Bodies*
- CE 335 *Computational Methods in Civil Engineering*
- CE 340 *Structural Analysis*
- CE 345 *Soil Mechanics*
- CE 350 *Fluid Mechanics*
- CE 361 *Hydraulics*
- CE 375 *Transportation Engineering*
- CE 380 *Environmental Engineering* I
- CE 391 *Contracts and Specifications*
- CE 401 *Review of Civil Engineering Fundamentals*
- CE 435 *Dynamics of Civil Engineering Systems*
- CE 441 *Reinforced Concrete*

and 18 credits of electives from one of the four specialization areas "Environmental/Water Resources", "Structural and Construction Engineering", "Transportation Engineering" and "Biomedical Engineering", for a total of 135 credits in the civil engineering major.

In 2018 there are additional required classes on Decision and Systems Analysis and on Transportation Systems Engineering. The Contracts and Specifications class became Civil Engineering Management, and a new Senior Design Project is required. The number of elective credits is reduced, and the "Biomedical Engineering" specialization is replaced by "Multidisciplinary Civil Engineering". The required civil engineering classes in 2018 were

- CE 209 *Structural and Site Plans*
- CE 231 *Statics*
- CE 264 *Civil Engineering Data Analysis*
- CE 316 *Civil Engineering Decision and Systems Analysis*
- CE 326 *Transportation Planning*
- CE 327 *Transportation Systems Engineering*
- CE 332 *Mechanics of Deformable Bodies*
- CE 335 *Computational Methods in Civil Engineering*
- CE 340 *Structural Analysis*
- CE 345 *Soil Mechanics*
- CE 350 *Fluid Mechanics*
- CE 365 *Hydraulic Engineering*
- CE 372 *Environmemtal Impact Assessment*
- CE 401 *Review of Civil Engineering Fundamentals*

- CE 405 *Civil Engineering Management*
- CE 441 *Reinforced Concrete*
- CE 474 *Environmental Engineering*
- CE 509 *Senior Design Project*

and 12 credits of civil engineering electives, which must be from one of the specialization areas, which must be one of "Environmental Engineering and Water Resources", "Structural and Construction Engineering", "Transportation Engineering", or "Multi-disciplinary Civil Engineering", for a total of 134 credits in the civil engineering major.

3.5 Computer Science

The Computer Science BS program started in 1968, with more optimism than resources. The school had an IBM 7040 and an IBM 360/50; there had already been programming classes for several years, but when the formal computer science program started, it was apparently overwhelmed by the demand. Students complained that eight of the sixteen announced classes were cancelled because they could not be staffed,[101] and there were not enough textbooks available for the programming language taught in that first year. The department started with the MAD language, the Michigan Algorithms Decoder[102], which was at that time popular at universities, and available on IBM 7040 and IBM 360 systems. The MAD language was derived from ALGOL 58; block structure was introduced only in ALGOL 60 (which is the ancestor of the most imperative languages, like Pascal or C), and so it was not present in MAD. In Fall 1969 the MAD language was replaced by FORTRAN as the introductory programming language. The FORTRAN language, which was developed and supported by IBM since the late 1950s through many versions had then been recently standardized (as FORTRAN 66) by ANSI, and there were much more teaching materials were available for it. From a 2018 perspective, both MAD and FORTRAN 66 look fairly similar, and quite different from any modern programming language. All programming was by punched cards, which were prepared on a key punch, a kind of typewriter that punched the holes in the cards. A program was represented by a sequence (a deck) of cards, which then were put by a card reader in the computer's memory, where, the program could be compiled and executed.

In those first years the curriculum went through rapid changes. in 1969 the required courses were

CS 100 *Introduction to Algorithmic Processes*
CS 110 *Computer Organization and Programming*

101 Vector October 1969, p.17f

102 Tech News, March 7, 1967: New Computer Course; or Thinking MAD-ly

CS 120 *Information Structures*
CS 130 *Algorithmic Languages and Compilers*
CS 132 *Computer and Programming Systems*

In 1970, the required courses were

CS 100 *Introduction to Algorithmic Processes*
CS 105 *Discrete Mathematics*
at least four out of
Combinatorics and Graph Theory
Constructive Logic
Logical Design and Switching Theory
Introduction to Automata Theory
Formal Languages
Systems Simulation
Mathematical Optimization Techniques
Heuristic Programming
Selected Topics in Computer Science
and 4-6 technical electives.

So the program became much more mathematical; but in the next year, there was a move in the opposite direction. In 1971 the required courses were

CS 101 *Programming and Numerical Methods*
CS 105 *Discrete Mathematics*
CS 110 *Assembly Language Programming*
CS 120 *Information Structures*
CS 130 *Algorithmic Languages and Compilers*
CS 132 *Computer and Programming Systems*
CS 160 *Constructive Logic*

By 1985 the curriculum had stabilized in a structure similar to the one we still have today: the programming class has become a two semester programming sequence, teaching FORTRAN and Pascal. Other programming languages mentioned in the 1985 Bulletin are PL/1, APL, LISP, SNOBOL-IV, and Cobol; for many classes, FORTRAN is mentioned as the programming language[103]. The Discrete Mathematics class has split in three classes, two on discrete structures, one on probability theory. The required computer science classes in 1985 were

CS 100 *Introduction to Computing* I (an introduction to FORTRAN)

[103] The department also offers several programming classes as service for other departments: CS 205 *Computing for Health Care and Management Science*, CS 206 *Computing for the Social Sciences*, and CS 101 *Computer Programming and Numerical Methods*, which is for the Sciences. The Computer Science department is the only department in the School that offers service courses for programs outside the School of Engineering.

CS 112 *Introduction to Computing* II (an introduction to Pascal)
CS 104/204 *Discrete Mathematical Structures* I/II
CS 207 *Discrete Probabilistic Models*
CS 210 *Computers and Assembly Language Programming*
CS 220 *Information Structures* (a Data Structures and Algorithms class)
CS 322 *Software Engineering*
CS 332 *Computer and Programming Systems* (an Operating Systems class)
CS 340 *Logic Design and Switching Theory*

In addition, a student needs 12 credits of computer science elective classes, 9 credits of technical electives, and another 13 credits of free electives, for a total of 128 credits.

The list of electives in 1985 also looks similar to today; CS 334 *Advanced Programming* is a programming language class, CS 336 *Information Processing* is a database class, CS 342 *Computer Organization* a computer architecture class. Some other electives are *Combinatorics and Graph Theory*, *Computability*, *Formal Languages and Automata Theory*, *Computational Methods in Numerical Analysis*, *Systems Simulation*, *Mathematical Optimization Techniques*, *Artificial Intelligence*, and *Real Time Computing*. All these are in 2019 still in the course catalogue, but only Artifical Intelligence gets still offered.

The curriculum in 2000 significantly increased the number of required classes. The most fundamental curricular change, however, is the disappearance of FORTRAN and Pascal (and Cobol, and PL/1); programming is now done C++ from the beginning. By its programming language choice, the 1985 curriculum identifies itself as very conservative and IBM mainframe oriented, in a time when many computer science departments had already moved to workstations and minicomputers; in 2000, the program is a mainstream program, the choice of C++ actually being ambitious and not fully put in practice: C++ is a very large and complex language, and only a subset gets typically taught. The two-semester programming sequence is now CS 102 and CS 212; there is another programming class, the *Software Design Lab* intended to give the experience of a larger programming project. There are now additional required classes on numerical computing, programming language theory, and theoretical computer science. The electives list has considerably expanded, containing now, e.g, *Computer Security*, *Image Processing*, *Computer Vision*, *Distributed Computing*, *Computer Graphics*, *Computer Networks*. The required computer science classes in 2000 were

CS 102 *Introduction to Computing*
CS 104/204 *Discrete Mathematical Structures* I/II
CS 210 *Computers and Assembly Language Programming*

CS 212 *Data Structures*
CS 217 *Stochastic Models for Computer Science*
CS 220 *Algorithms*
CS 221 *Software Design Laboratory*
CS 301 *Numerical Issues in Scientific Programming*
CS 304 *Introduction to Theoretical Computer Science*
CS 322 *Software Engineering*
CS 332 *Operating Systems*
CS 335 *Programming Language Paradigms*
CS 340 *Logic Design and Switching Theory*

In addition, a student needed 15 credits of computer science elective classes, 6 credits of technical electives, and 6 credits of free electives, for a total of 126 credits.

In 2018, Discrete Mathematics is reduced to one semester, the Assembly Programming and Logic Design classes have been combined into one Fundamentals of Computer Systems class, and the higher-level hardware class Computer Organization became required. Also the Database class has become a required class. And theprogram has now a two-semester Senior Design sequence. To balance this, the number of comuter science electives has been reduced. The required computer science classes in 2018 were

CS 103 *Introduction to Computing*
CS 104 *Discrete Mathematical Structures*
CS 113 *Programming Language*
CS 211 *Fundamentals of Computer Systems*
CS 212 *Data Structures*
CS 217 *Probability and Statistics for Computer Science*
CS 220 *Algorithms*
CS 221 *Software Design Laboratory*
CS 301 *Numerical Issues in Scientific Programming*
CS 304 *Introduction to Theoretical Computer Science*
CS 322 *Software Engineering*
CS 332 *Operating Systems*
CS 335 *Programming Language Paradigms*
CS 335 *Introduction to Database Systems*
CS 342 *Computer Organization*
CS 343 *Computer Systems Design Laboratory*
CS 59866/59867 *Senior Project* I/II

In addition, a student needed 12 credits of computer science elective classes, 6 credits of technical electives, and 6 credits of free electives, for a total of 126 credits in the computer science major.

3.6 Electrical Engineering

The required electrical engineering classes in 1933 were

- EE 120/21 *Elementary Electrical Engineering* I/II (Direct Current in EE 120, Alternating Current in EE 121)
- EE 125 *Alternating Circuits*
- EE 132 *Electrical Measurements*
- EE 135 *Electrical Communications* I
- EE 230/231 *Direct Current Machinery* I/II
- EE 232 *Industrial Motor Applications*
- EE 233 *Illumination*
- EE 234 *Electrical Machine Design* I
- EE 237 *Power Plants*
- EE 239/240 *Alternating Current Machinery* I/II and one of the electives *Electrical Communications* II, *Alternating Current Machinery* III, *Electrical Power Transmission*, *Electric Railroad*, *Electrical MachineDesign* II, or a sl Thesis.

Clearly the uses of electricity were still quite limited: motors, illumination, telephones and radios; the entire area of electronics did not exist as a separate subject in this curriculum, although vacuum tubes were in general use in radios. Electrical power generation and distribution were important topics, which later entirely disappeared from the curriculum.

The required electrical engineering classes in 1950 were

- EE 100 *Introduction to Electrical Engineering*
- EE 115 *Alternating Current Theory*
- EE 122/123 *Electrical Measurements* I/II
- EE R130 *Engineering Electronics*
- EE L130 *Engineering Electronics Laboratory*
- EE R141 *Direct Current Machinery*
- EE L141 *Direct Current Machinery Laboratory*
- EE R145/R146 *Alternating Current Machinery* I/II
- EE L145/L146 *Alternating Current Machinery Laboratory* I/II
- EE R161/R162 *Electrical Communications* I/II
- EE L161 *Electrical Communications Laboratory*

and 13 credits of electrical engineering electives.

The Engineering Electronics class covers vacuum tubes; although semiconductor diodes[104] were known and in wide-spread use, as point-contact diodes (detectors) for radios and as selenium rectifiers for higher-power applications, they do not show up in the class descriptions. Semiconductor devices had been

[104] not germanium or silicium, however; the first semiconductor materials are now almost forgotten; they were copper oxide, lead sulfide, and selenium

subject to physics research already for several decades, and the first transistor patent was obtained by Lilienfeld in 1926, but the first practical transistor was demonstrated only in 1947 by Bardeen, Brattain, and Shockley (1956 Nobel prize); in 1950 electronics was vacuum-tube electronics. But communications, by radio or telephone, is now the central part of the electrical engineering curriculum, power generation and distribution has disappeared, and the discussion of electromotors, lighting technologies, and direct current applications has been much reduced.

By 1970, the curriculum had undergone a complete change, having moved from concrete applications to mathematical theory and modeling. Classes on direct and alternating current machinery disappeared, the uses of electric power became a tangential topic, instead there is much on the mathematical theory of signal processing, filtering, and control. Courses on specific applications were moved to the electives. vacuum tubes are still mentioned in some course descriptions, but almost all is now based on semiconductor devices. There are elective classes on the foundations of digital computers, but classes on analogue computers as well. The department had an analogue computer EAI 231 R, which was perhaps the most popular analogue computer ever produced[105]. The required electrical engineering classes in 1970 were

- EE 101/102 *Electromagnetics* I/II
- EE 104/105/106 *Electrical Engineering Analysis* I/II/III
- EE 124/126 *Electrical Measurement* I/II
- EE 141/142/143 *Engineering Electronics* I/II/III
- EE 132/134 *Engineering Electronics Laboratory* I/II
- EE 152 *Electric Power Laboratory*
- EE 157 *Electromagnetic Devices*
- EE 170 *Control Systems Laboratory*
- EE 171 *Electrical Systems Engineering*

and 20 credits of technical electives.

The changes from 1970 to 1985 were comparatively minor; the different laboratory classes were reorganized in one four-semester laboratory sequence, the two-semester sequence on electrical measurements disappeared, but additional classes on the foundations of communication were introduced, and the class on switching systems/digital logic became required. The required electrical engineering classes in 1985 were

- ME 435 *Thermodynamics for Electrical Engineers*
- EE 204/205/306 *Linear Systems Analysis* I/II/III

[105] Analogue computer were quite popular, and shaped with their countless controls, lights, and switches the public perception of how the workplace of the engineer or scientist of the future looks. Digitl computers look less complicated.

- EE 241/342 *Electronics* I/II
- EE 331/332 *Electromagnetism* I/II
- EE 221/322/323/424 *Electrical Engineering Laboratory* I/II/III/IV
- EE 210 *Switching Systems*
- EE 307 *Signals and Noise*
- EE 357 *Electric Power Engineering*
- EE 371 *Linear Feedback Systems*
- EE 373 *Communication Systems and Circuits*
- EE 440 *Electronic Devices*

and 25 credits of technical electives.

The required electrical engineering classes in 2001 were

- ENGR 204 *Electrical Circuits*
- ENGR 230 *Thermodynamics*
- EE 205/306 *Linear Systems Analysis* I/II
- EE 241/342 *Electronics* I/II
- EE 221/322/323/424 *Electrical Engineering Laboratory* I/II/III/IV
- EE 210 *Switching Systems*
- EE 259 *Programming for Electrical Engineering*
- EE 311 *Probability and Random Processes*
- EE 311 *Communication Theory*
- EE 330 *Electromagnetics*
- EE 333 *Introduction to Antennas, Microwaves and Fiber Optics*
- EE 339 *Semiconductor Materials and Devices*
- EE 371 *Linear Feedback Systems*
- EE 441 *Electronic Devices and Semiconductor Materials*
- EE 441 *Digital Computer Systems*

and 24 credits of electrical engineering electives, 1 credits of advanced lab electives, 3 credits of design electives, 3 credits of management electives, for a total of 135 credits in the electrical engineering major.

The required electrical engineering classes in 2018 were

- ENGR 204 *Electrical Circuits*
- ENGR 230 *Thermodynamics*
- EE 205/306 *Linear Systems Analysis* I/II
- EE 210 *Switching Systems*
- EE 221/322 *Electrical Engineering Laboratory* I/II
- EE 241 *Electronics* I
- EE 259 *Programming for Electrical Engineering*
- EE 311 *Probability and Statistics*
- EE 312 *Communication Theory*
- EE 330 *Electromagnetics*
- EE 339 *Semiconductor Materials and Devices*

- EE 344 *Digital Computer Systems*
- EE 425 *Computer Engineering Lab*
- EE 59806/59807 *Senior Design for Electrical Engineering* I/II

and 24 credits of engineering electives, of which at least 15 must be from electrical engineering, subject to several restrictions, and 2 credits of advanced lab electives, for a total of 130 credits in the electrical engineering major.

3.7 Mechanical Engineering

The required mechanical engineering classes in 1933 were

- ME 122 *Power*
- ME 124 *Kinematics*
- ME 210 *Fundamental Aerodynamics*
- ME 214 *Internal Combustion Engines*
- ME 224 *Internal Combustion Engine Laboratory*
- ME 220/240 *Shop Processes* I/II
- ME 221/242 *Heat Power Engineering* I/II
- ME 231/243 *Mechanical Engineering Laboratory* I/II
- ME 232 *Water Power*
- ME 233 *Water Power Laboratory*
- ME 234/244 *Machine Design* I/II
- ME 235 *Steam Turbines*
- ME 241 *Power Plants*
- ME 245 *Seminar*
- ME 254 *Administrative Engineering* There were no electives in the 1933 mechanical engineering curriculum. The curriculum seems centered on power generation; but the early course on Aerodynamics is an interesting aspect. Indeed these were the pioneer years of the airplane industry, with many companies located in the New York region.

The required mechanical engineering classes in 1950 were

- ME 126 *Theory of Machines*
- ME 203 *Introduction to Power Generation*
- ME 205 *Metal Processing Laboratory*
- ME 206 *Engineering Economy* I
- ME 210/230/240 *Shop Processes* I/II/III
- ME 215 *Internal Combustion Engines*
- ME 223 *Engineering Thermodynamics for Mechanical Engineers*
- ME 225/236 *Machine Design* I/II
- ME 243/247 *Mechanical Engineering Laboratory* I/II
- ME 245 *Heat Transfer*
- ME 250 *Heating, Ventilating, Air Conditioning, and Refrigeration*

- ME 252 *Power Plant Engineering*

there were no electives in the mechanical engineering curriculum.

The role of power generation. by water power, steam turbines, and internal combustion engines, has been significantly reduced; but heating and refrigerating has become part of the curriculum.

The required mechanical engineering classes in 1970 were

- ME 100 *Engineering Statistical Analysis*
- ME 101/111 *Thermodynamics* I/II
- ME 104 *Kinematics of Machines*
- ME 110 *Theory of Experimentation*
- ME 112 *Fundamentals of Fluid Dynamics*
- ME 114 *Dynamics of Machines*
- ME 118 *Manufacturing Analysis*
- ME 123 *Materials Science*
- ME 131 *Heat Transfer*
- ME 141 *Thermal Science Laboratory*
- ME 144 *Machine Stress Analysis*
- ME 190 *Systems Analysis*

and 20 credits of engineering electives.

The emphasis on manufacture with three semesters of Shop Processes and the Metal Processing Lab have disappeared, as well as all the courses for specific applications, like Power Generation, Internal Combustion Engines, and Heating and Refrigeration. From 1950 to 1970, the curriculum became much more theoretical.

The required mechanical engineering classes in 1985 were

- CE 330 *Mechanics of Materials* I
- EE 231 *Electrical Engineering* I
- ME 221 *Engineering Statistical Analysis*
- ME 231/331 *Thermodynamics* I/II
- ME 241/341/342 *Mechanics of Machines* I/II/III
- ME 321 *Theory of Experimentation*
- ME 351/352 *Fluid Dynamics* I/II
- ME 431/432 *Thermal Engineering Laboratory* I/II
- ME 433 *Heat Transfer*
- ME 441 *Machine Stress Analysis*
- ME 461 *Materials Science*
- ME 462 *Manufacturing Processes and Materials*

and 18 credits of engineering electives.

The required mechanical engineering classes in 2001 were

- ENGR 204 *Electrical Circuits*
- ENGR 230 *Thermodynamics*

- ENGR 276 *Engineering Economics*
- ME 145 *Computer-Aided Drafting*
- ME 246/247 *Engineering Mechanics* I/II
- ME 311 *Fundamentals of Mechatronics*
- ME 322 *Numerical Methods and Fundamental Computer Applications in Mechanical Engineering*
- ME 330 *Mechanics of Materials*
- ME 331 *Thermodynamics* II
- ME 356 *Fluid Mechanics*
- ME 371 *Computer Aided Design*
- ME 401 *Review of Engineering Fundamentals*
- ME 421 *Systems Modeling, Analysis and Control*
- ME 433 *Heat Transfer*
- ME 436 *Aero-Thermal-Fluids Laboratory*
- ME 461 *Engineering Materials*
- ME 462 *Manufacturing Processes and Materials*
- ME 471 *Energy Systems Design*
- ME 472 *Mechanical Systems Design*
- ME 473/474 *Senior Design Project* I/II
- ME 543 *Dynamics and Controls Laboratory*

and 12 credits of mechanical engineering electives, for a total of 134 credits in the Mechanical Engineering major.

From 2001 to 2018 the curriculum shrunk, from 134 to 129 credits in total; classes that disappeared were the second part of Thermodynamics, the Engineering Economics, the Engineering FUndamentals Review class, and the Dynamics and Control Lab. Systems Modeling, Analysis and Control, and Engineering Materials both increased from 3 credit to 4 credit. The required mechanical engineering classes in 2018 were

- ENGR 204 *Electrical Circuits*
- ENGR 230 *Thermodynamics*
- ME 145 *Computer-Aided Drafting*
- ME 246/247 *Engineering Mechanics* I/II
- ME 311 *Fundamentals of Mechatronics*
- ME 322 *Computer Methods in Mechanical Engineering*
- ME 330 *Mechanics of Materials*
- ME 356 *Fluid Mechanics*
- ME 371 *Computer Aided Design*
- ME 421 *Systems Modeling, Analysis and Control*
- ME 430 *Thermal Systems Analysis and Design*
- ME 433 *Heat Transfer*
- ME 436 *Aero-Thermal-Fluids Laboratory*

- ME 461 *Engineering Materials*
- ME 462 *Manufacturing Processes and Materials*
- ME 472 *Mechanical Systems Design*
- ME 473/474 *Senior Design Project* I/II

and 12 credits of mechanical engineering electives, for a total of 129 credits in the Mechanical Engineering major.

3.8 Computer Engineering

The required computer engineering classes in 2001 were

- ENGR 204 *Electrical Circuits*
- CSC 102 *Introduction to Computing*
- CSC 104 *Discrete Mathematical Structures* I
- EE 205/306 *Linear Systems Analysis* I/II
- EE 210 *Switching Systems*
- CSC 210 *Computers and Assembly Language Programming*
- CSC 212 *Data Structures*
- EE 221/322 *Electrical Engineering Laboratory* I/II
- EE 241 *Electronics* I
- CSC 220 *Algorithms*
- CSC 221 *Software Design Laboratory*
- EE 311 *Probability and Random Processes*
- EE 312 *Communication Theory*
- CSC 322 *Software Engineering*
- CSC 332 *Operating Systems*
- EE 330 *Electromagnetics*
- EE 425 *Computer Engineering Laboratory*
- CSC 342/343 *Computer Organization and Laboratory*
- EE 457 *Digital Integrated Circuits*
- EE 460 *Computer Communication Systems*

and 12 credits of computer science of electrical engineering electives, 3 credits of practice/ethics issues, and 3 credits of engineering science, for a total of 134 credits in the Computer Engineering major.

From 2001 to 2018, the curriculum shrunk slightly; the Software Engineering and Computer Communication Systems stopped being required, the electives were reduced and reorganized, but a two-semester Senior Design sequence, either in computer science or in electrical engineering, were added. The required computer engineering classes in 2018 were

- ENGR 204 *Electrical Circuits*
- CSC 102 *Introduction to Computing*
- CSC 104 *Discrete Mathematical Structures*

- EE 205/306 *Linear Systems Analysis* I/II
- EE 210 *Switching Systems*
- CSC 210 *Computers and Assembly Language Programming*
- CSC 212 *Data Structures*
- EE 221/322 *Electrical Engineering Laboratory* I/II
- EE 241 *Electronics* I
- CSC 220 *Algorithms*
- CSC 221 *Software Design Laboratory*
- EE 311 *Probability and Statistics*
- EE 312 *Communication Theory*
- CSC 332 *Operating Systems*
- EE 330 *Electromagnetics*
- EE 425 *Computer Engineering Laboratory*
- CSC 342/343 *Computer Organization and Laboratory*
- EE 457 *Digital Integrated Circuits*

and 6 credits of computer science of electrical engineering electives either in the Systems track or the Computation and Signal Processing track, 6 credits for the Senior Design sequence either in computer science or electrical engineering, 3 credits of practice/ethics issues, and 3 credits of computer engineering electives, for a total of 132 credits in the Computer Engineering major.

3.9 Earth System Science and Environmental Engineering

The Earth System Science and Environmental Engineering major is listed in the Bulletin from 2007 on; it is a major which is not only interdisciplinary, but also across schools, taking classes from engineering, science. It exists in a BS version for science students and a BE version for engineering students. The BE version requires the following engineering classes in 2007:

- ENGR 101 *Engineering Design* I
- ENGR 103 *Computer-Aided Analysis Tools for Engineers*
- ENGR 204 *Electrical Circuits*
- ENGR 301 *Introduction to Remote Sensing*
- CE 264 *Civil Engineering Data Analysis*
- CE 365 *Hydraulics and Hydrology*
- CE 372 *Environmental Impact Assessment*
- EE 330 *Electromagnetics*
- One of CE 350, ME 350, ChE341 *Fluid Mechanics*
- One of ChE341 or Chem 330 *Thermodynamics*
- ENGR 59869/59870 *ESSEE Design* I/II

one restricted elective and 18 credits of technical electives.

As the major developed, it acquired more specialized classes for this major. The required engineering classes of ESSEE for BE in 2018 are

- ENGR 101 *Engineering Design* I
- ENGR 1061 *Introduction to ESSEE*
- ENGR 208 *Computation Methods for ESSEE*
- one of ENGR 204 *Electrical Circuits* or CE 231 *Statics*
- ENGR 301 *Introduction to Satellite Remote Sensing and Imaging*
- ENGR 59910 *Introduction to Geographic Information Systems*
- CE 264 *Civil Engineering Data Analysis*
- CE 365 *Hydraulics and Hydrology*
- CE 372 *Environmental Impact Assessment*
- CE 474 *Environmental Engineering*
- One of CE 350, ME 350, ChE341 *Fluid Mechanics*
- One of ChE229 or ENGR 230 *Thermodynamics*
- One of ChE330 *Thermodynamics* II or ME 430 *Thermal Systems Analysis*
- ENGR 59869/59870 *ESSEE Design* I/II

and 18 credits of technical electives.

3.10 Technology

The Bachelor in Technology was a program started in 1971 as a two-year program to provide the upper two years for students who had already received an Associate in Applied Science degree from a community college; it existed at City College until 1993. This was a way the School of Engineering could satisfy the mandate that those community college students should have a pathway to a Bachelor degree with only two additional years beyond the community college degree. Acceptance among the faculty was low; the program received entirely separate courses from the engineering majors, it did not even share the science service courses. The curriculum in 1971 was

- Tech 1 *Fundamentals of Modern Chemistry*
- Tech 11/12 *Technical Communication* I/II
- Tech 21/22 *Applied Analysis* I/II
- Tech 32 *Materials Science*
- Tech 41 *Technology Seminar*
- Tech 42/43/44 *Engineering Technology Design Laboratory* I/II/III
- Tech 51 *Electronics* or
- Tech 61 *Mechanics of Materials + Processes*
- Tech 62 *Electro-Mechanical Devices*
- Tech 63 *Instrumentation*
- Tech 64 *Principles of Feedback Control Systems*
- Tech 72 *Statistics*

as well as two technical electives (from the Technology department), two humanistic-social sciences electives, and one free elective.

The curriculum stayed the same during the two decades of the program's existence. It was an unloved part of the school of engineering, which was happy when it finally could transfer the program to another college.

Clearly there is a need for a path for community college students to get an engineering degree while transferring a significant number of their credits, but the reality is that many of the technical classes at the community colleges are not equivalent. Currently all engineering majors have a large number of transfer students from community colleges; they usually can transfer their general education and some science and mathematics classes, but not the classes in the engineering major. If they can transfer engineering classes, it is the result of one of the articulation agreements (with Hostos and La Guardia community colleges) that were introduced under Dean Barba.

4. Graduate Engineering Programs

The Masters degree programs were a much less regulated, consisting mostly of electives, with some distribution requirments. Until ?? all Masters programs required a 1 cr class in Public Speaking, and chemical engineering had a foreign language requirement: candidates must be able to translate German and French.

Beyond the core departmental masters programs, there are several other programs, as well as classes that could be taken as specialization across several masters programs. A typical example was the Nuclear Engineering program, which could be added to all other programs. New programs were created when the enrollment in the classical departent-based programs declined, or when special grant-funded opportunities existed. The Nuclear Engineering Program was created in reaction to an initiative of the Atomic Energy Commission. Robert Marshak, President of CCNY, comments in his 1973 report[106] on the de-emphasis of space and other high technology programs[107] and the decline in engineering enrollment, and announces the creation of a Master in Urban Engineering program, combining engineering with quantitative social sciences and management science, as the new direction. Ultimately, however, the classical department-based programs always recovered, whereas the special initiatives wer vulnerable to crises in funding.

Since the Masters programs consisted only of electives, and the electives actually offered changed more frequently than the list of potential electives in the Bulletin, the source for this chapter are the Schedules of Classes.

4.1 Biomedical Engineering

Graduate classes offered in Spring 2019 and Fall 2019 in Biomedical Engineering

BME G4302 *Physiology for Engineers* II
BME I0000 *Biomedical Engineering Seminar*
BME I3000 *Neural Engineering and Applied Bioelectricity*
BME I3110 *Biofluid Mechanics*
BME I4200 *Organ Transport and Pharmacokinetics*
BME I5000 *Medical Imaging and Image Processing*
BME I6000 *Advanced Biomaterials*
BME I6100 *Intellectual Property, Regulation, and Quality Assurance*
BME I6200 *Cost Analysis and the Business of Translation*

106 Robert E. Marshak: Problems and Prospects of an Urban Public University, 1973
107 the Apollo program ended in 1972

BME I6300 *Engineering, Entrepreneurship, and Business Leadership*
BME I6400 *Translational Challenges in Diagnostics, Devices, and Therapeutics*
BME I6500 *Capstone Design* I — Identifying the Problem
BME I6600 *Capstone Design* II — Conceptual Innovation
BME I7000 *Laboratory Cellular and Molecular Engineering*
BME I7100 *Cell and Tissue Mechanics*
BME I7300 *Cell Tissue Biomaterials Introduction*
BME I9000 *Skeletal Soft Tissue Biomechanics and Physiology*
BME I9300 *Scientific Ethics*
BME I9400 *Special Topics in Machine Learning*

4.2 Chemical Engineering

Graduate classes offered in Spring and Fall 1983 in Chemical Engineering

ChE 5530 *Computer Applications in Chemical Engineering* I
ChE 5534 *Fluid Technology*
ChE 5560 *Chemical Hydrodynamics*
ChE 5700 *Chemical Engineering Seminar*
ChE 5723 *Non-Newtonian Fluids*
ChE 5728 *Advanced Chemical Thermodynamics*
ChE 5732 *Statistical Thermodynamics*
ChE 5761 *Polymer Theory*
ChE 5777 *Process Dynamics and Control*
ChE 5786 *Absorption and Extraction*
ChE 5788 *Distillation*

Graduate classes offered in Fall 2001 and Spring 2002 in Chemical Engineering

ChE G5100 *Polymer Processing*
ChE I0000 *Chemical Engineering Seminar*
ChE I0100 *Fluid Mechanics Seminar*
ChE I2800 *Advanced Chemical Thermodynamics*
ChE I3300 *Advanced Kinetics*
ChE I4100 *Chemical Process Economics*
ChE I5700 *Advanced Materials*
ChE I8600 *Separation Operations*
ChE I9100 *Mass Transfer*

Graduate classes offered in Spring 2019 and Fall 2019 in Chemical Engineering

ChE I0000 *Chemical Engineering Seminar*
ChE I0100 *Fluid Mechanics Seminar*
ChE I2800 *Advanced Chemical Thermodynamics*
ChE I3300 *Advanced Chemical Reaction Engineering*
ChE I5700 *Advanced Materials*

ChE I5800 *Molecular Simulation*
ChE I9100 *Mass Transfer*
ChE I9200 *Soft Materials Laboratory*

4.3 Civil Engineering

Graduate classes offered in Fall 1985 and Spring 1986 in Civil Engineering

CE 5510 *Soil Dynamics*
CE 5516 *Rating and Rehabilitation of Bridges*
CE 5526 *Problem Assessment and Structure Rehabilitation*
CE 5551 *Error Analysis and Structure Modeling*
CE 5552 *Earthquake Engineering*
CE 5553 *Public Transportation*
CE 5554 *Data Analysis and Statistical Inference*
CE 5555 *Introduction to Transportation*
CE 5557 *Travel Demand Forecasting*
CE 5558 *Physical Distribution Systems*
CE 5559 *Traffic Engineering Study*
CE 5574 *Environmental Engineering Analysis*
CE 5577 *Problems in Enironmental Engineering*
CE 5580 *Groundwater Pollution and Hydrology*
CE 5607 *Advanced Hydraulics*
CE 5612 *Engineering Hydrology*
CE 5623 *Advanced Structural Design*
CE 5630 *Structural Dynamics*
CE 5650 *Advanced Reinforced Concrete*
CE 5654 *Arches, Shells, and Plates*
CE 5670 *Environmental Engineering*
CE 5676 *Unit Processes*
CE 5687 *Advanced Soil Mechanics* (Fall 1985)
CE 5688 *Advanced Soil Mechanics* (Spring 1986)
CE 5689 *Foundation Engineering*
CE 5717 *Finite Element Methods in Engineering*
CE 5735 *Advanced Mechanics of Materials*
CE 5738 *Plates and Shells*
CE 5754 *Theory of Structures*
CE 5755 *Stability of Structures*

Graduate classes offered in Fall 2001 and Spring 2002 in Civil Engineering

CE G1200 *Mathematical Methods in Civil Engineering*
CE G2100 *Assessment and Rehabilitation of Structures*
CE G7300 *Surface Water Quality Modeling*

CE G9100 *Water Reserves System Analysis*
CE H0200 *Transportation Economics*
CE H0700 *Advanced Hydraulics*
CE H2100 *Flexible and Rigid Pavements*
CE H4500 *Urban Public Transportation*
CE H5300 *Advanced Structural Design*
CE H6300 *Groundwater Hydrology and Contamination*
CE H7500 *Unit Operations*
CE H7600 *Unit Processes*
CE I1700 *Finite Element Methods in Engineering*
CE I2000 *Travel Demand Forecasting*
CE I2200 *Transportation Assets Management*
CE I2400 *Analytic Techniques for Transportation*
CE I2600 *Urban Transportation Planning*
CE I2700 *Transportation Policy*
CE I3000 *Structural Dynamics*
CE I3500 *Elasticity and Plasticity*
CE I4100 *ITS: Fundamentals and Applications*
CE I4700 *Passenger Terminals*
CE I5400 *Elastic-Inelastic Analysis of Structures*
CE I9200 *Advanced Soil Mechanics*

Graduate classes offered in Spring 2019 and Fall 2019 in Civil Engineering

CE G8150 *Advanced Micro-Scale Hydrology*
CE G9100 *Water Resources Systems Analysis*
CE G9500 *Remote Sensing Water-Environment Engineering*
CE G9800 *Sustainability in Civil Engineering*
CE H0200 *Transportation Economics*
CE H0700 *Advanced Hydraulics*
CE H0800 *Applied Hydraulics in Engineering*
CE H1000 *Analytical Methods in Civil Engineering*
CE H2000 *Traffic Engineering*
CE H3000 *Advanced Strength of Materials*
CE H4000 *Highway Engineering*
CE H4100 *Highway and Airport Construction*
CE H4700 *Urban Freight and City Logistics*
CE H5000 *Advanced Reinforced Concrete*
CE H5100 *Prestressed Concrete*
CE H5200 *Bridge Engineering*
CE H5300 *Advanced Structural Design*
CE H6600 *Engineering Hydrology*

CE H7100 *Water Quality Analysis*
CE H8300 *Air Pollution and Control*
CE H9000 *Foundation Engineering*
CE I2400 *Analytic Techniques for Transportation*
CE I2600 *Urban Transportation Planning*
CE I2700 *Transportation Policy*
CE I3000 *Structural Dynamics*
CE I3500 *Applied Elasticity and Plasticity*
CE I5600 *Earthquake Engineering*

4.4 Computer Science

Graduate classes offered in Fall 1985 and Spring 1986 in Computer Science are

CSC 5560 *Computational Combinatorics*
CSC 5604 *Computer Methods in Discrete Mathematics*
CSC 5610 *Software Methods*
CSC 5611 *Database Systems* I
CSC 5625 *File Management/Cobol*
CSC 5630 *Operation Command Languages*
CSC 5643 *Social Issues in Computer Science*
CSC 5660 *Management Science*
CSC 5700 *Statistical Methods in Computer Science*
CSC 5703 *List and String*
CSC 5704 *Operating Systems*
CSC 5707 *Compiler Construction*
CSC 5708 *Topics in Software Systems*
CSC 5711 *Database Systems* II
CSC 5713 *Searching and Sorting*
CSC 5714 *Analysis of Algorithms*
CSC 5715 *Artificial Intelligence*
CSC 5720 *Introduction to Thoretical Computer Science*
CSC 5722 *Computability and Unsolvability*
CSC 5724 *Formal Languages*
CSC 5744 *Microcomputers and Programming*
CSC 5746 *Topics in Computer Systems*
CSC 5747 *Computer Networks*
CSC 5761 *Probabilistic Models in Computer Science*
CSC 5764 *Computer Simulation*
CSC 5824 *Symbolic and Algbraic Manipulation Systems*

Graduate classes offered in Fall 2001 and Spring 2002 in Computer Science

CSC G6700 *Computer Vision and Image Processing Techniques*
CSC I0400 *Operating Systems*
CSC I0600 *Fundamental Algorithms*
CSC I0700 *Compiler Construction*
CSC I0804 *Concurrent and Distributed Processing*
CSC I0807 *Image Processing*
CSC I0818 *Programming: HTML and Java*
CSC I0852 *Information Management*
CSC I0900 *Theory and Algorithms*
CSC I1000 *Database Systems* I
CSC I1100 *Database Systems* II
CSC I1222 *Computational Geometry*
CSC I1245 *Combinatorics*
CSC I1271 *Bioinformatics* I
CSC I1272 *Bioinformatics* II
CSC I1500 *Artificial Intelligence*
CSC I1800 *Topics in Artificial Intelligence*
CSC I2200 *Computability and Unsolvability*
CSC I2400 *Formal Languages*
CSC I2600 *Computational Complexities*
CSC I4300 *Computer Communication*
CSC I4722 *High Performance Networks*
CSC I6000 *Methods for the Analysis of Algorithms*
CSC I6300 *Decision Analysis*
CSC I6723 *Digital Libraries: Visual Computing*
CSC I6724 *Statistical Software and Pattern Understanding*
CSC I9600 *Special Topics in Contemporary Computer Science*

Graduate classes offered in Spring and Fall 2019 in Computer Science

CSC I0600 *Fundamental Algorithms*
CSC I0700 *Compiler Construction*
CSC I1000 *Database Systems* I
CSC I1500 *Artificial Intelligence*
CSC I2400 *Formal Language Theory*
CSC I4722 *High Performance Networks*
CSC I4900 *Computer Security*
CSC I6400 *Topics in System Simulation*
CSC I6716 *Computer Vision*
CSC I9613 *Distributed Algorithms*
CSC I9606 *Concurrent and Shared Memory Systems*

4.5 Electrical Engineering

Graduate classes offered in Spring and Fall 1983 in Electrical Engineering

EE 5520 *Microprocessors*
EE 5522 *Digital System Architecture*
EE 5525 *Power System Design*
EE 5527 *Microprocessor based System Design*
EE 5540 *Spread Spectrum*
EE 5551 *Communication Electronics*
EE 5557 *Design of Feedback Control*
EE 5558 *Variable Methods Control*
EE 5576 *Optical Electronics*
EE 5581 *Computer Communication Networks*
EE 5582 *Image Processing and Recognition* I
EE 5584 *Adaptive Digital Systems*
EE 5586 *Mobile Communication*
EE 5588 *Image Processing and Recognition* II
EE 5681 *Power Systems* I
EE 5687 *Nuclear Power Engineering*
EE 5700 *Electrical Engineering Seminar*
EE 5705 *Linear Systems*
EE 5708 *Electronic Materials*
EE 5721 *Digital Processing of Signals*
EE 5723 *Digital Computers* I
EE 5724 *Digital Computers* II
EE 5725 *Network Synthesis* I
EE 5726 *Network Synthesis* II
EE 5728 *Advanced Graph Theory*
EE 5731 *Electronic Circuits* I
EE 5741 *Advanced Control Systems* I
EE 5742 *Advanced Control Systems* II
EE 5761 *Integrated Circuit Design and Fabrication* I
EE 5762 *Integrated Circuit Design and Fabrication* II
EE 5764 *Microwave Networks*
EE 5771 *Statistical Communication*
EE 5775 *Information Theory and Coding*
EE 5783 *Optical Communication*
EE 5873 *Signal Detection*

as well as the graduate laboratories in the subjects power, microprocessors, microwaves, and laser optics.

Graduate classes offered in Fall 2001 and Spring 2002 in Electrical Engineering

EE F5200 *Fiber Optic Communications*
EE F5300 *Digital Signal Processing*
EE F5800 *Introduction to Lasers*
EE F6000 *Computer Communication Systems*
EE F6300 *Wireless Communication*
EE G9400 *Performance of High Speed Computer Systems*
EE I0100 *Probability and Stochastic Processes*
EE I0500 *Linear Systems*
EE I1200 *Cryptology*
EE I3200 *Electronic Circuits* II
EE I4600 *Analysis and Design of Intelligent Systems*
EE I4700 *Neural Networks*
EE I7000 *Local Area Networks*
EE I7400 *Digital Data Communication*
EE I8300 *Optical Communication*

Graduate classes offered in Spring and Fall 2019 in Electrical Engineering
EE F5200 *Fiber Optic Communications* I
EE F5800 *Introduction to Lasers*
EE F6000 *Computer Communication Systems*
EE F6300 *Wireless Communication*
EE G3300 *Mobile Robotics*
EE G3301 *Power Systems*
EE G4400 *Advanced Computer Architecture*
EE G6400 *5G Technologies and IoT*
EE G6530 *Biologically Inspired Computing*
EE G6800 *Optical Remote Sensing*
EE G6904 *Advanced Statistics and Non Linear Analysis*
EE G6910 *Renewable Energy*
EE G6912 *Secure Internet of Things Design Laboratory*
EE I0100 *Probability and Stochastic Processes*
EE I2200 *Image Processing*
EE I6600 *Communications Protocol Engineering*
EE I6700 *IP Routing*
EE I7000 *Network and Security*
EE I8300 *Fiber Optic Communications* II
EE I9400 *High Speed Networks*

4.6 Mechanical Engineering

Graduate classes offered in Spring and Fall 1983 in Mechanical Engineering
ME 5504 *Product Safety Management Engineering*

ME 5508 *Applications of Turbulence*
ME 5532 *Steam and Gas Turbines*
ME 5708 *Fluid Mechanics* I
ME 5709 *Fluid Mechanics* II
ME 5736 *Conductive Heat Transfer*
ME 5740 *Analysis of Mechanisms*
ME 5754 *Advanced Stress Analysis*
ME 5756 *Advanced Analytical Dynamics*
ME 5762 *Advanced Mechanical Vibrations*

Graduate classes offered in Fall 2001 and Spring 2002 in Mechanical Engineering

ME G0200 *Applied Fluid Mechanics*
ME G0500 *Mechanical Vibrations*
ME G1100 *Methods of Fluid Mechanics and Comb??*
ME G2300 *Heating, Ventilation, and Air Conditioning*
ME G4000 *Applied Stress Analysis*
ME G4200 *Continuum Mechanics*
ME I0000 *Mechanical Engineering Seminar*
ME I2400 *Turbulent Flows*
ME I3100 *Steam and Gas Turbines*
ME I3600 *Conductive Heat Transfer*
ME I3700 *Convective Heat Transfer*
ME I6200 *Advanced Mechanical Vibrations*
ME I6500 *Computer Aided Design*
ME I6700 *Composite Materials*

Graduate classes offered in Spring and Fall 2019 in Mechanical Engineering

ME G2300 *Heating, Ventilation, and Air Conditioning*
ME G4800 *Auto Safety Design*
ME G5400 *Advanced Mechatronics*
ME G5910 *Fundamentals and Applications of Microfluidics*
ME G6100 *Wind Energy Fundamentals and Applications*
ME G7300 *Sustainable Energy Conversion Systems*
ME I0000 *Mechanical Engineering Seminar*
ME I0200 *Applied Fluid Mechanics*
ME I3100 *Steam and Gas Turbines*
ME I3400 *Advanced Heat Transfer*
ME I4200 *Applied Stress Analysis*
ME I4400 *Nano-Micromechanics*
ME I4500 *Mechanics and Physics of Solids*
ME I6700 *Composite Materials*

4.7 Other Programs

Graduate classes offered in Spring and Fall 1983 with unspecific Engineering code

ENGR 5580 *Computer Design Methods*
ENGR 5706 *Applied Algebra*
ENGR 5711 *Introduction to Engineering Analysis*
ENGR 5714 *Differential Equations*
ENGR 5715 *Introduction to Numerical Methods*
ENGR 5745 *Engineering Probability* I
ENGR 5746 *Engineering Probability* II
ENGR 5802 *Theory of Turbulence*

Graduate classes offered in Fall 2001 and Spring 2002 with unspecific Engineering code

ENGR G7600 *Engineering Law*
ENGR G8500 *Project Management*
ENGR I0000 *Seminar in Biomedical Engineering*
ENGR I0800 *Foundations of Fluid Mechanics* I
ENGR I1100 *Introduction to Engineering Analysis*
ENGR I1400 *Differential Equations*
ENGR I1500 *Introduction to Numerical Methods*
ENGR I7100 *Cell and Tissue Mechanics*

Graduate classes offered in Spring and Fall 2019 with unspecific Engineering code

ENGR G5200 *Nuclear Reactor Physics and Engineering*
ENGR G5600 *Nuclear Reactor Design, Operation, and Safety*
ENGR G6601 *Environmental Modeling for Earth Systems Science and Engineering*
ENGR G8500 *Project Management*
ENGR G6901 *Teaching Practicum for Molecular Biophysics and Biomaterials*
ENGR H7600 *Engineering and Business Law*
ENGR I0800 *Foundations of Fluid Mechanics* I
ENGR I1100 *Introduction to Engineering Analysis*
ENGR I1400 *Applied Partial Differential Equations*
ENGR I1500 *Introduction to Numerical Methods*
ENGR I2400 *Turbulent Flows*
ENGR I7500 *Poroelasticity*
ENGR I9500 *Special Topics in Earth Systems and Environmental Engineering*

Graduate classes offered in Spring and Fall 2019 in Data Science and Engineering

DSE I1020 *Introduction to Data Science*

DSE I1030 *Applied Statistics*
DSE I2100 *Applied Machine Learning and Data Mining*
DSE I2400 *Data Engineering: Infrastructure and Applications*
DSE I2450 *Big Data and Scalable Computation*
DSE I2700 *Visual Analytics*

Graduate classes offered in Spring and Fall 2019 in Information Science
MIS G0200 *Database Management*
MIS G5010 *Seminar in Information System Management*
MIS H1010 *Statistics and Decision Making*
MIS H2011 *Trends in Information Technology*
MIS H3010 *Managerial Economics*
MIS H3030 *Organization and Management*[108]
MIS H4010 *System Analysis and Design*

108 the same course is simultaneously offered as ECO C0026 *Managing Business Complexity*. ECO C0026 does not occur in the Bulletin.

5. Faculty

5.1 Faculty and Departments

The School of Technology had in 1933 ten professors: two full professors (including the Dean), four Associate Professors, and four Assistant Professors. There were three professors each in Civil, Electrical, and Mechanical Engineering, and the Dean was professor of Civil and Mechanical Engineering. There was no professor of Chemical Engineering. In addition there were 17 Instructors, 2 Tutors, 2 Fellows, 9 Lab Assistants, 4 Field Assistants, and 2 Clerical Assistants. Together these served a total School of Technology enrollment of 906 students. In 1933, the school graduated 77 students with a BS in Engineering, and 10 as Chemical Engineer, 20 as Civil Engineer, 13 as Electrical Engineer, and 13 as Mechanical Engineer.

By 1940, the School had more than doubled in size, with 24 professors and 36 Instructors and Tutors. The School was now divided into Departments, with faculty distributed as follows.

Engineering Faculty 1940		
Department	Professors	Instructor/Tutors
Chemical Engineering	3	3
Civil Engineering	8	10
Electrical Engineering	2	8
Mechanical Engineering	5	5
Drafting	6	10

The Department of Drafting was apparently a service department. These departments served an enrollment of 1757 students in the Day Session; the enrollment in the Evening Session is not broken down into Schools, since formally the Evening Session was a separate unit; but the college total enrollment was 8572 students in the Day Session, 13541 in the Evening Session. Most of the professors hired between 1933 and 1940 have a PhD, whereas in 1933 none of the faculty had a PhD.

In 1950 the rapid growth continues, with 57 faculty and 81 Instructors, Lecturers, and Tutors. The department structure is the same; the distribution is now

Engineering Faculty 1950		
Department	Professors	Instructor/Tutors
Chemical Engineering	6	3
Civil Engineering	14	18
Electrical Engineering	9	33
Mechanical Engineering	15	17
Drafting	14	10

The ratio of professors to lecturers (and similar titles) is very different in the different departments; Chemical Engineering primarily relies on professors, with half as many lecturers as professors, whereas electrical engineering has more than three times as many lecturers as professors. The enrollment was 2392 students in the Day Session (among which were 25 women); again Evening Session students are formaly not belonging to the School of Technology, so we cannot identify the number of engineering students in the evevning session, but the college total enrollment was 10327 students in the Day Session and 23245 students in the Evening Session.

In 1960 the period of growth is over, with 63 faculty and 122 Lecturers and Instructors. The department of drafting has shrunk, mechanical engineering and chemical engineering are constant, only civil and electrical engineering have significant growth. The number of lecturers has increased a lot, most in electrical engineering. The distribution is now

Engineering Faculty 1960		
Department	Professors	Instructor/Tutors
Chemical Engineering	6	5
Civil Engineering	18	23
Electrical Engineering	15	57
Mechanical Engineering	15	22
Drafting	9	15

The ratio of lecturers to professors went up everywhere; in the department of Electrical Engineering, the lecturer numbers are exploding, they have almost four times as many lecturers as professors. The enrollment is not listed in the Bulletin any more.

In 1970 there is a renewed growth of faculty with 94 faculty and 82 lecturers. This is even though the Department of Drafting has moved in 1968 to the new School of Architecture. There is some reduction in the number of lecturers, and the titles of Tutor and Instructor almost disappeared. The growth happened mostly in Chemical, Civil, and Electrical Engineering, and there is since 1968 a very small Department of Computer Science. In 1970 the distribution of faculty numbers over departments is

Engineering Faculty 1970		
Department	Professors	Lecturers
Chemical Engineering	14	9
Civil Engineering	29	13
Computer Science	5	3
Electrical Engineering	28	45
Mechanical Engineering	18	12

In 1981 the School of Engineering has shrunk drastically; there are only 72 faculty and 78 lecturers[109]. After the introduction of Open Admissions, the need for teaching increased, but the available money shrunk, as the City of New York under Mayor John Lindsay (1966-1973) and Abraham Beame (1974-1977) ran into the financial crisis of 1975. In 1972, the Board of Education (CUNY Board of Trustees) declared a quota on tenured faculty: at most half the full-time faculty in each department should be tenured, to reduce the more expensive senior faculty. This was much fought against, and ultimately abandoned in 1974, but in 1972 and 73 many tenure cases across CUNY were declined even though they came with the college's recommendation. And in 1975 when the City of New York went through many stages of near-bankruptcy, all non-tenured faculty members were fired [*needs reference*]. The department of Civil Engineering was hardest hit, shrinking by almost half (from 29 to 17 professors); the other departments lost between a quarter and a third of their faculty. The only slight growth occured in the department of Computer Science (from 5 to 9 professors), and in the newly formed small Department of Technology, which was formed of faculty from the other departments.

Engineering Faculty 1981		
Department	Professors	Lecturers
Chemical Engineering	9	10
Civil Engineering	17	11
Computer Science	9	0
Electrical Engineering	18	37
Mechanical Engineering	14	12
Technology	5	6

In 1991, the School of Engineering faculty has grown again, to 92 professors: almost the state of 1970. Adjuncts are not listed in the Bulletin, and all lecturer-type titles have disappeared. The department of Technology has disappeared, it was transferred to CityTech, together with the B.Tech. degree

109 actually, there is now again a great diversity of non-professorial titles, with Lecturers, Adjunct Lacturers, Adjunct Assistant professors, Adjunct Associate Professors, Adjunct Professors, Graduate Fellows, Graduate Assistants, and Technicians

program. The growth in Chemical and Civil Engineering was small, but Computer Science grew from 8 to 15, Electrical Engineering from 20 to 29, and Mechanical Engineering from 14 to 18.

Engineering Faculty 1991	
Department	Professors
Chemical Engineering	12
Civil Engineering	18
Computer Science	15
Electrical Engineering	29
Mechanical Engineering	18

In 2001, the departments are almost the same size, with minimal growth in total: the School of Engineering has now 93 faculty. Chemical and Mechanical Engineering stayed constant, Electrical and Civil engineering shrunk a bit, and Computer Science grew significantly, from 15 to 21.

Engineering Faculty 2001	
Department	Professors
Chemical Engineering	12
Civil Engineering	15
Computer Science	21
Electrical Engineering	27
Mechanical Engineering	18

In 2018, the School of Engineering has again grown a lot, to 118 professors in total. The growth comes mostly from the new department of Biomedical Engineering, with 12 faculty, from Chemical Engineering, which grew from 12 to 16 professors, and from Civil Engineering, which grew from 15 to 19. Computer Science is almost stationary now, from 21 to 22, and Electrical and Mechanical Engineering each gained two new professors (27 to 29 and 18 to 20).

Engineering Faculty 2019	
Department	Professors
Biomedical Engineering	12
Chemical Engineering	16
Civil Engineering	19
Computer Science	22
Electrical Engineering	29
Mechanical Engineering	20

5.2 Background of the Faculty

The Bulletins contain some minimal biographical material on each faculty: the degrees and institutions from which the degrees came from. There are some patterns to observe: there are faculty with a doctorate, and faculty with a P.E. degree (Professional Engineer), but without doctorate. In the beginning, no professor had a doctorate, but the fraction of faculty with doctorate continually increased, until now everyone has a doctorate. Computer Science is close to Mathematics, and Chemical Engineering close to the sciences, so in these disciplines, faculty almost always had doctorates. A large fraction of City College had their undergraduate degree from City College; many of the rest come from other New York City institutions (Columbia, NYU, Brooklyn Polytech), but both numbers have decreased much. A large, and increasing, fraction of the faculty have their undergraduate degree from foreign countries.

Background of Engineering Professors				
Category	1981	1991	2001	2018
total faculty	72	91	92	117
CCNY undergrad degree	26	18	9	6
NYC undergrad degree	37	30	17	13
foreign undergrad degree	19	36	47	71
doctorate	53	84	90	116

In 1981, the faculty with an undergraduate degree from a foreign country came from 11 nations, but was mostly European. The largest group were from Britain (five), followed by China (three), with two each from India, Israel, and the Soviet Union (one from Russia, one from the Ukraine), and one each from Argentina, Estonia, Greece, Hungary.

This has changed much in 2018: the largest group are 17 professors from China, followed by eight from India, five from the Iran, four each from Germany, Russia, and Egypt, three each from Canada, Greece, Turkey, and Korea, two each from Roumania, Taiwan, Italy and Ukraine, and one each from South Africa, Puerto Rico, Britain, Lebanon, Lithuania, Japan, France, Hungary, and Mexico. Thus in addition to the large Chinese group (17), and a still dominant european group (21), there is a surprising presence from the middle east (13), an indian group (8), but not much from the Americas outside the USA: one each from Canada, Mexico, and Puerto Rico. The British background has almost disappeared.

If we look at the PhD institutions from which the faculty came, in 1981 the largest group came from Columbia (ten), followed by NYU (seven), Brooklyn Polytech (four), CUNY (four), MIT (three), Princeton (three), University of Minnesota (two), Illinois Institute of Technology (two), ane one each from Yale, Imperial College (London), State Pedagogical Institute (Moscow), Technion (Israel), Harvard, Case Institute of Technology, Lehigh, Cornell, University College (London), Technical University Karlsruhe (Germany), McGill (Canada), University of Michigan, Technical University Munich (Germany), Technical University Delft (Netherlands), Adelphi, University of Southern California, Stanford University, Moscow State University (Russia). Thus in 1981, faculty tended to be local, and preferably from Columbia or NYU.

Again there was a major change by 2018: thirteen of our faculty are our own products, with PhD from CUNY. The second largest group is still Columbia university, with six faculty, followed by four each from UC Berkeley, UT Austin, MIT, and the University of Michigan. The there are three from Georgia Institute of Technology, two each from Case Western, UCLA, UC Santa Barbara, CalTech, UC Irvine, Stevens Institute, NYU, Technion, University of New Hampshire, Penn State University, Rutgers, University of Utah, University of Maryland, Cornell University, and the Univesity of Hong Kong. The remaining faculty comes from 47 universities, each contributing one. Faculty hiring became much less local, which is good; but the large increase in in-house hiring is a bad sign.

5.3 Female Faculty

In 1942, Cecilie Froehlich joined the faculty of the electrical engineering department as the first female faculty in the school of engineering. This was under very uncommon circumstances; and it took more than forty years before a second woman was appointed as professor in the school of engineering.

Cecilie Froehlich (originally Cäcilie Fröhlich) was a german industrial mathematician who, as Jew, was forced to leave Germany in 1937[110]. She obtained her PhD in Mathematics at the University of Bonn in 1926, and after a year as high school teacher of mathematics, joined the company AEG (Allgemeine Elektricitäts-Gesellschaft, i.e., General Electricity Company) in Berlin[111], a large german company active in all areas of electric power engineering, from generation to electric household appliances. She advanced in the company to become advisor to the board of directors, and when forced by the persecution of Jews to leave Germany, she obtained a position with a belgian electrical engineering company. However, in 1940 Belgium was invaded, and she had to flee again, via France and Portugal; in 1941 she entered the USA as

[110] for more detail about her biography, see: Renate Tobies: "From the German Electrical Engineering Industry to the United States: The Case of Cecilie Froehlich", in: Women in Industrial Research (Wissenschaftskultur um 1900, Vol. 8), Renate Tobies and Annette B. Vogt, eds., Fraz Steiner Verlag 2014, 103–114.

[111] in 2015, her memory was honored in Berlin by naming a street: the Cäcilie-Fröhlich-Straße in a new technology park in Berlin-Marzahn

refugee. With the support of Richard Courant[112], the director of the Mathematics Institute of NYU (now known as the Courant Institute for Mathematical Sciences) and the Emergency Committee for the Aid of Displaced Foreign Scholars she obtained an appointment in the Department of Electrical Engineering at CCNY, from 1950 on as full professor. 1955 Cecilie Froehlich became chair[113] of the department of Electrical Engineering; she retired from CCNY in 1965, but then became chair of the Mathematics department at Pacific University, Forest Grove, Oregon, where remained until her death in 1992. She was very actively dedicated to the cause of women in engineering; she was founding member of the Society of Women Engineers SWE[114] at the founding meeting on May 27, 1950, and active in many outreach events. Yet this did not lead to further hiring of female faculty.

Only in 1985 the School of Engineering hired again women as professors; in that year hired were Carol A. Steiner (Chemical Engineering, still at CCNY), Aspasia Zerva (Civil Engineering, now at Drexel University) and Mitra Basu (Electrical Engineering, now at NSF), followed in the next year by Claire McKnight (Civil Engineering, recently retired from CCNY), and Nadine Aubry in 1988 (Mechanical Engineering; now Dean of Engineering at Northeastern University). Clearly those female faculty hires were quite successful, yet the numbers increased only slowly. In 2018, there are 19 women among 118 engineering faculty at CCNY.

5.4 Minority Faculty

CCNY is serves a highly diverse city population, and has a highly diverse student body. As always, faculty diversity is lagging behind, and it is difficult to track from the available documents. We concentrate here on Black and Hispanic minorities; although since 1976 Italian-Americans are by CUNY policy another group that is subject to affirmative action policy, and every now and then this again comes up in the news[115][116], this was not an issue at the School

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112 who himself had left Germany in 1933. Richard Courant had become director of the famous mathematics institute in Göttingen as a comparatively young man; his special genius was in mathematics organisation and leadership. He was removed from his office in 1933, being jewish and politically active against the national socialists. He emigrated, and became NYU faculty in 1936. He soon rose to become chairman of the NYU mathematics department, and led it to become a famous mathematical center.

113 this was so uncommon that even the New York Times reported it: Woman of City College heads Engineering Unit, New York Times, August 28, 1955

114 SWE - Magazine of the Society of Woman Engineers Spring 2015, page 34

115 NY Times, September 14, 2010: “Unlikely Group Charges Bias at University”

116 for more material, see: Liana Kirillova: “When Affirmative Action is White: Italian

of Engineering.

The first Hispanic professor in Engineering was probably Vincent Del Toro, who was professor in Electrical Engineering in the 1960s and 1970s, and wrote several several textbooks, including one about control systems engineering. The second hispanic faculty was Alberto La Cava in Chemical Engineering; he was at CCNY from 1977 to 1985, and left as tenured Associate Professor. After a period in industry, he returned to academia, and is still active as department chair at Saint Peter's University. Octavio Betancourt came from Chile, spent some time at NYU working in computational plasma physics, and joined the Computer Science Department in 198?, as the third hispanic faculty of the school of engineering; he retired in 2017. Jose Holguin-Veras was in the Department of Civil Engineering from 1997 until 2002, then he moved on to the Rensselaer Polytechnic Institute (RPI), where he is now William H. Hart Professor. Current hispanic faculty at the School of Engineering are Joseph Barba (Dean of Engineering 2004–2013, Electrical Engineering), Luis Cardoso (Biomedical Engineering), Julio Davalos (currently Department Chair of Civil Engineering), Jorge Gonzalez (Mechanical Engineering), and Maribel Vazquez (Biomedical Engineering).

The first Black faculty in engineering was Edgar T. Lynk in Mechanical Engineering; he came around 1984? and left 1989?. In 1985, Charles Watkins joined the School of Engineering as Dean of Engineering, and the second black professor in engineering; before that, he had been the department chair of Mechanical Engineering at Howard University. After that, in the 1980s came Neville Parker (as director of the Transportation Institute), Ardie Walser (currently Associate Dean), and Roger Dorsinville (currently Department Chair of Electrical Engineering). In the 1990s came Keith Guinn (Chemical Engineering, stayed only a short time, now in electronics packaging), Richard Birchwood (Civil Engineering, 1995-2000, now in the oil and gas industry), and Shermane Austin (Computer Science, now at Medgar Evers college). In the 2000s came Damian Rouson (Mechanical Engineering, now CEO of Sourcery, a scientific software development company), James Hammonds (Mechanical Engineering, left). In the 2010s came Debra Auguste (Biomedical Engineering, now at Northeastern University), Camille Kamga (currently acting director of the University Transportation Center), Gilda Barabino (Biomedical Engineering, currently Dean of Engineering) and Rosemarie Wesson (Chemical Engineering, currently Associate Dean). This list shows that there is a serious retention problem of black faculty: everyone hired as assistant professor in the 1990s and 2000s has left; we have 0% retention in that group. It should

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Americans in the City University of New York, 1976–now", Spring 2016, Souther Illinois University at Carbondale OpenSIUC be noted that in the 1990s we had both a black president (Bernard Harleston 1982–1991 and Yolanda Moses 1993–1999) and a black Dean of Engineering (Charles Watkins 1986–2000), and still it was apparently a difficult time for black faculty.

5.5 Faculty Salaries

Faculty salaries have clearly become an issue now. In 1980, a full professor's salary was \$36.5k; President Marshak's salary was \$49.5k (plus an official apartment on the upper west side)[117], and a full year of in-state tuition was \$920. In 2018, a full professor's salary is \$128k, the president's salary is \$370k, and a year of in-state tuition is \$6530. Thus as multiple of the annual tuition, the president's salary stayed approximately constant, raising from 54 to 56 years of tuition, but the faculty salary fell from 40 to 19 years of tuition, so relatively less than half.

Maximum Full Professor Salary (Union Contract)					
1973	1980	1990	2000	2007	2017
\$33.4k[118]	\$36.5k	\$72k	\$90k	\$102k	\$128k

Faculty salaries are determined by union contract across CUNY; each class, e.g., full professor, comes as a scale with fifteen salary steps, but it is the same scale for community colleges and senior colleges, as well as for all subjects. And once appointed, faculty moves automatically every two years up a step, until they are at the top. To be competitive, engineering faculty is frequently appointed near the top of the applicable scale, so engineering salaries are generally higher than liberal arts salaries at the beginning of the career, but since everyone ultimately reaches the top, this evens out over time. Faculty salaries, averaged over all subjects, at CUNY are generally above salaries at other public universities (which is balanced by the high cost of living in New York); but salaries for engineering faculty are low compared to salaries for engineering faculty elsewhere. In the last twenty years, the school has increasingly hired at above-scale salaries; recently even associate and assistant professors are hired above the top salary possible on the CUNY scale. Thus some recently hired faculty earn significantly more than their older colleagues. At the end of 2017[119] the School of Engineering had 60 full professors, out of which there were 16 at above-scale salary, 37 at the top of the salary scale (\$128k), and only 7 below the top[120]: at most two steps below the top (\$117k). Clearly the salary steps of the union contract are not matching

117 The Campus Vol 146(2) February 13, 1980

119 material from the HR department distributed April 2018 in the CCNY faculty senate

120 The author of this book is among those seven

the needs of the school of engineering, and the realities of engineering salaries in NYC.

Another reason why the problem is becoming more serious is that by the changing demographics of the faculty, the motivation of the faculty to work at CCNY is changing. In the 1970s and 80s, being at CCNY was also a political statement, faculty that served here also did this out of a social mission. But with a large fraction of the faculty being born outside the USA, the honor of teaching at an institution with a social and historical mission cannot replace competitive salaries any more.

One way to address this problem are Named and Distinguished Professorships. The Distinguished Professor rank was created by CUNY in 1967, it carries both a higher salary and a very much reduced teachng load. The number of Distinguished Professors across CUNY is capped by the union contract (125 in 1997, 175 in 2006, 250 in 2016); they are nominated by the college, and reviewed by a CUNY committee, and are subject to re-evaluation every five years (the re-appointment has been denied only once, for political reasons entirely unrelated to the scholarly performance, which was indeed distinguished). A Distinguished Professor is free to choose the department of his appointment. The School of Engineering currently has five Distinguished Professors. A different way to give recognition beyond the full professor rank are the Named Professorships, which are usually supported by an endowment. The School currently has one Michael Pope Professorship, five Herbert G. Kayser Professorships, two Wallace Coulter Professorships and one Daniel and Frances Berg Professorship. There is also the Albert Einstein Professorship, which was for a long time held by members of the School of Engineering (Levich and his two successors), but which now is held by a professor in Chemistry.

- Herbert G. Kayser received a Bachelor of Science at CCNY in 1919; in 1972 he gave a bequest of about $250k to CCNY, which was to be used for engineering education. According to the CCNY press release of 4/7/1972, he was associated for a number of years with the Freed-Eisemann Radio corporation, which was an early developer of radios. However, the Freed-Eisemann corporation existed only 1921–1929, so we know nothing about most of his life.
- Michael Pope received a Bachelor of Electrical Engineering at CCNY in 1944; he started a successful engineering company. His pioneering developments in clean combustion of coal, especially his 1970 atmospheric fluidized-bed combustion process, were an important part in the DoE's plan to counter oil and gas shortages. He made repeated large donations to the school.
- Wallace Coulter is not connected to CCNY; but he, and his foundation, are major supporters of biomedical engineering research. The foundation

made, starting 2003, repeated large donations, $5.1M in total, to support biomedical engineering at the school of engineering. Wallace Coulter invented the Coulter Principle, which allows to count a measure particles suspended in a fluid, e.g., cells in a blood sample. This is the basis of the automatic blood count now used wherever blood samples are drawn. Coulter started a very successful company, and made many other engineering contributions to medical practice. He sold the company and created a foundation, which is major sponsor of biomedical engineering at several universities.

- Daniel Berg received a Bachelor of Science in Physics and Chemistry at CCNY in 1950. He worked from 1953 to 1977 at Westinghouse Electric, then joied Carnegie-Mellon University as Dean of Science, then Provost, and finally became President of Rensselaer Polytechnic Institute 1984–1987.

6. Departments, Centers, and Resources

6.1 Biomedical Engineering

Faculty names:
Debra Auguste
Gilda Barabino
Marom Bikson
Luis Cardoso
Stephen Cowin
Jacek P. Dmochowski
Susannah P. Fritton
Bingmei Fu
Steven Nicoll
Lucas Parra
Mitchell B. Schaffler
John M. Tarbell
Maribel Vazquez
Sihong Wang
Sheldon Weinbaum

- 2018 Department of Biomedical Engineering
Gilda Barabino (Professor and Dean)
Marom Bikson (Professor)
Luis Cardoso (Professor)
Jacek P. Dmochowski (Assistant Professor)
Susannah P. Fritton (Professor)
Bingmei Fu (Professor)
Steven Nicoll (Associate Professor)
Lucas Parra (Herbert G. Kayser Professor)
Mitchell B. Schaffler (CUNY and Wallace Coulter Distinguished Professor and Chair)
John M. Tarbell (CUNY and Wallace Coulter Distinguished Professor)
Maribel Vazquez (Associate Professor)
Sihong Wang (Associate Professor)

6.2 Chemical Engineering

Faculty names:
Andreas Acrivos
Sanjoy Banerjee
Elizabeth J. Biddinger
Marco Castaldi
Xi Chen

Alexander Couzis
Morton M. Denn
Nathan D. Field
M. Lane Gilchrist Jr.
Robert A. Graff
Leslie L. Isaacs
Stanley Katz
Morris Kolodney
Ilona Kretzschmar
Alberto I. LaCava
Benjamin Levich
Siegfried Lichtblau
Harvey L. List
Charles Maldarelli
Charles A. Marlies
Roberto Mauri
Robert J. Messinger
Jeffrey F. Morris
Henry S. Myers
Albert B. Newman
Minocher K. N. Patell
Vincent O. Pauchard
Robert Pfeffer
Irven Rinard
David S. Rumschitzki
Alois X. Schmidt
W. Fred Schurig
Reuel Shinnar
Arthur M. Squires
Carol A. Steiner
Gabriel Tardos
Christos A. Tsiligiannis
Raymond S. Tu
Herbert Weinstein
Rosemarie Wesson
G. Edwin White
David J. Williams
Joseph Yerushalmi

- 1940 Department of Chemical Engineering
  Charles A. Marlies (Assistant Professor)

Albert B. Newman (Professor, Chairman Chemical Engineering Dept, Acting Dean)

G. Edwin White (Assistant Professor)

- 1950 Department of Chemical Engineering
  Morris Kolodney (Associate Professor)
  Henry S. Myers (Assistant Professor)
  Albert B. Newman (Professor)
  Alois X. Schmidt (Assistant Professor)
  W. Fred Schurig (Assistant Professor (pro tempore))
  G. Edwin White (Associate Professor, Chairman Chemical Engineering Department)
- 1960 Department of Chemical Engineering (with 5 Lecturers)
  Morris Kolodney (Professor)
  Siegfried Lichtblau (Assistant Professor)
  Harvey L. List (Assistant Professor)
  Henry S. Myers (Associate Professor)
  Minocher K. N. Patell (Assistant Professor)
  Alois X. Schmidt (Professor and Chairman)
- 1970 Department of Chemical Engineering (with 9 Lecturers)
  Robert A. Graff (Associate Professor)
  Stanley Katz (Professor)
  Morris Kolodney (Professor)
  Harvey L. List (Professor)
  Henry S. Myers (Professor)
  Minocher K.N. Patell (Professor)
  Robert Pfeffer (Associate Professor)
  Alois X. Schmidt (Professor and Acting Dean)
  Reuel Shinnar (Professor)
  Arthur M. Squires (Professor and Chairman)
  David J. Williams (Associate Professor)
  Joseph Yerushalmi (Assistant Professor)
- 1981 Department of Chemical Engineering
  (with 4 Technicians, 3 Graduate Fellows, 3 Adjunct Lecturers)
  Robert A. Graff (Michael Pope Professor)
  Leslie L. Isaacs (Associate Professor)
  Alberto I. LaCava (Assistant Professor)
  Benjamin Levich (Albert Einstein Professor)
  Minocher K. N. Patell (Professor)
  Robert Pfeffer (Herbert G. Kayser Professor and Chairman)
  Reuel Shinnar (Distinguished Professor)

Gabriel Tardos (Assistant Professor)
Herbert Weinstein (Professor)

- 1991 Department of Chemical Engineering
  Andreas Acrivos (Albert Einstein Professor)
  Robert A. Graff (Michael Pope Professor and Chairman)
  Leslie L. Isaacs (Associate Professor and Assistant Dean)
  Charles Maldarelli (Associate Professor)
  Roberto Mauri (Assistant Professor)
  Robert Pfeffer (Herbert G.Kayser Professor and Provost)
  Irven Rinard (Professor)
  David S. Rumschitzki (Associate Professor)
  Reuel Shinnar (Distinguished Professor)
  Carol A. Steiner (Assistant Professor)
  Gabriel Tardos (Professor)
  Herbert Weinstein (Professor)
- 2001 Department of Chemical Engineering
  Alexander Couzis (Associate Professor)
  Morton M. Denn (Albert Einstein Professor)
  M. Lane Gilchrist Jr. (Assistant Professor)
  Robert A. Graff (Michael Pope Professor and Chairman)
  Leslie L. Isaacs (Professor)
  Charles Maldarelli (Professor)
  Irven Rinard (Professor)
  David S. Rumschitzki (Professor)
  Reuel Shinnar (Distinguished Professor)
  Carol A. Steiner (Professor)
  Gabriel Tardos (Professor)
  Herbert Weinstein (Herbert G. Kayser Professor)
- 2018 Department of Chemical Engineering
  Sanjoy Banerjee (Distinguished Professor)
  Elizabeth J. Biddinger (Assistant Professor)
  Marco Castaldi (Professor)
  Xi Chen (Assistant Professor)
  Alexander Couzis (Herbert G. Kayser Professor)
  M. Lane Gilchrist Jr. (Associate Professor)
  Ilona Kretzschmar (Professor and Chair)
  Charles Maldarelli (Professor)
  Robert J. Messinger (Assistant Professor)
  Jeffrey F. Morris (Professor)
  Vincent O. Pauchard (Associate Professor)

David S. Rumschitzki (Professor)
Carol A. Steiner (Professor)
Gabriel Tardos (Professor)
Raymond S. Tu (Associate Professor)
Rosemarie Wesson (Professor and Associate Dean for Research)

6.3 Civil Engineering

Faculty names:
Anil Agrawal
Mahdieh Allahviranloo
William Allan
Jacques E. Benveniste
C. Donald Brandt
William W. Brotherton
Joseph Cataldo
Anselm Cefola
David H. Cheng
Carl J. Constantino
Alison Conway
Richard G. Coulter
James A. Cowan
Charles W. Cunningham
Julio Davalos
Naresh Devineni
Vasil Diyamandoglu
Robert F. Dressler
Leslie W. Engler
Balazs Fekete
Lin Ferrand
John Fillos
Michel Ghosn
Ralph E. Goodwin
Bruce D. Greenshields
Paul Hartmann
Norman C. Jen [Magnetohydrodynamics, Plasma]
Camille Kamga [Transportation]
Bernard Kaplan
Mumtaz K. Kassir
Edward Keosaian
Reza M. Khanbilvardi
Nir Krakauer
Feng-Bao Lin

Claire E. McKnight
Frederick O.X. McLoughlin
Charles A. Miller
David L. Muss
George Mylonakis
Gerner A. Olsen [Biomedical Engineering]
Norbert Oppenheim
Robert E. Paaswell [Transportation]
Gerald Palevsky
George Papoulas
Neville A. Parker [Transportation]
Raymond Parnes
John Sandford Peck
Ming L. Pei
Milton Pikarsky [Transportation]
Michael Piasecki
Joseph Pistrang
Eli Plaxe
Henry J. Plock
Lathrop C. Pope
Thomas H. Prentice
Thomas Price
Walter Rand
Robert T. Ratay
J. Charles Rathburn
Edward S. Reitz
Anthony V. Rizzi
Kyoung Ro
Mitsuru Saito
Morris D. Silberberg
Frederick Skene
Clifford V. Smith
David B. Steinman [bridges]
James R. Steven
Kolluru Subramanian
Hansong Tang
John J. Theobald
Jose Holguin Veras
Charles Vörösmarty
John R. White
Walter L. Willig

Ann E. (Beth) Wittig
Ardavan Yazdanbakhsh

Civil Engineering Faculty

- 1933 Department of Civil Engineering
  Ralph E. Goodwin (Assistant Professor)
  Frederick O.X. McLoughlin (Professor)
  J. Charles Rathburn (Associate Professor)
  Frederick Skene (Dean, Professor, Civil and Mechanical Engineering)
- 1940 Department of Civil Engineering
  William Allan (Assistant Professor, Chairman Civil Engineering Department)
  Ralph E. Goodwin (Associate Professor)
  Bruce D. Greenshields (Associate Professor)
  John S. Peck (Assistant Professor)
  Thomas H. Prentice (Assistant Professor)
  J. Charles Rathburn (Associate Professor)
  Frederick Skene (Professor Emeritus)
  John J. Theobald (Assistant Professor)
- 1950 Department of Civil Engineering
  William Allan (Professor, Dean)
  William W. Brotherton (Associate Professor)
  Charles W. Cunningham (Associate Professor)
  Leslie W. Engler (Associate Professor, Dean of Administration)
  Paul Hartmann (Assistant Professor)
  Gerner A. Olsen (Assistant Professor)
  John Sandford Peck (Associate Professor)
  Lathrop C. Pope (Associate Professor)
  Thomas H. Prentice (Associate Professor)
  J. Charles Rathburn (Emeritus Professor)
  Anthony V. Rizzi (Assistant Professor)
  James R. Steven (Assistant Professor)
  John R. White (Assistant Professor)
  Walter L. Willig (Professor, Chairman Civil Engineering Department)
- 1960 Department of Civil Engineering (with 23 Lecturers)
  William Allan (Professor and Dean)
  C. Donald Brandt (Assistant Professor)
  David H. Cheng (Associate Professor)
  Richard G. Coulter (Assistant Professor)
  Charles W. Cunningham (Professor)
  Leslie W. Engler (Professor and Dean of Administration)

Paul Hartmann (Professor and Chairman)
Bernard Kaplan (Associate Professor)
Edward Keosaian (Associate Professor)
David L. Muss (Assistant Professor)
Gerner A. Olsen (Professor)
Ming L. Pei (Associate Professor)
Joseph Pistrang (Assistant Professor)
Henry J. Plock (Professor)
Lathrop C. Pope (Associate Professor)
Walter Rand (Assistant Professor)
James R. Steven (Associate Professor)
John R. White (Professor)

- 1970 Department of Civil Engineering (with 13 Lecturers)
  William Allan (Professor and Dean)
  Jacques E. Benveniste (Professor)
  G. Donald Brandt (Professor)
  William W. Brotherton (Professor)
  Joseph Cataldo (Assistant Professor)
  Anselm Cefola (Professor)
  David H. Cheng (Professor)
  Carl J. Constantino (Assistant Professor)
  Richard G. Coulter (Professor and Chairman)
  James A. Cowan (Assistant Professor)
  Robert F. Dressler (Professor)
  Leslie W. Engler (Professor and Dean of Administration)
  Paul Hartmann (Professor)
  Norman C. Jen (Professor)
  Mumtaz K. Kassir (Assistant Professor)
  Edward Keosaian (Associate Professor)
  Charles A. Miller (Assistant Professor)
  David L. Muss (Associate Professor)
  Gerner A. Olsen (Professor)
  Gerald Palevsky (Assistant Professor)
  Raymond Parnes (Associate Professor)
  Ming Lung Pei (Professor) (also Computer Science)
  Joseph Pistrang (Professor and Associate Dean)
  Eli Plaxe (Associate Professor and Associate Dean)
  Walter Rand (Professor)
  Robert T. Ratay (Assistant Professor)
  Morris D. Silberberg (Professor and Associate Dean)
  Clifford V. Smith (Associate Professor)

James R. Steven (Professor and Dean of Summer Session)

- 1981 Department of Civil Engineering (with 4 Technicians, 1 Graduate Fellow, 3 Adjunct Lecturers, 5 Adjunct Assistant Professors, 6 Adjunct Associate Professors, 5 Adjunct Professors)
  Jacques E. Benveniste (Professor)
  G. Donald Brandt (Professor)
  David H. Cheng (Professor and Dean)
  Carl J. Constantino (Professor)
  John Fillos (Associate Professor)
  Norman C. Jen (Professor)
  Mumtaz K. Kassir (Professor)
  Charles A. Miller (Professor)
  Gerald Palevsky (Associate Professor)
  George Papoulas (Professor)
  Ming L. Pei (Professor)
  Joseph Pistrang (Professor)
  Eli Plaxe (Professor)
  Walter Rand (Professor)
  Edward S. Reitz (Associate Professor and Director of Curricular Guidance)
  Morris D. Silberberg (Professor and Acting Provost)
  James R. Steven (Professor)

- 1991 Department of Civil Engineering
  Jacques E. Benveniste (Professor)
  Carl J. Constantino (Professor)
  Vasil Diyamandoglu (Assistant Professor)
  Lin Ferrand (Assistant Professor)
  John Fillos (Professor)
  Michel Ghosn (Associate Professor)
  Mumtaz Kassir (Professor)
  Reza M. Khanbilvardi (Associate Professor)
  Claire E. McKnight (Assistant Professor)
  Charles A. Miller (Professor and Chairman)
  Norbert Oppenheim (Professor)
  Robert E. Paaswell (Professor)
  George Papoulas (Professor)
  Neville A. Parker (Professor)
  Eli Plaxe (Professor)
  Edward S. Reitz (Associate Professor)
  Mitsuru Saito (Assistant Professor)

Morris D. Silberberg (Professor and Dean for Faculty Relations)

- 2001 Department of Civil Engineering
  Anil Agrawal (Assistant Professor)
  Vasil Diyamandoglu (Assistant Professor)
  John Fillos (Professor and Chairman)
  Michel Ghosn (Professor)
  Jose Holguin Veras (Associate Professor)
  Mumtaz Kassir (Professor and Associate Dean)
  Reza M. Khanbilvardi (Professor)
  Claire E. McKnight (Associate Professor)
  George Mylonakis (Assistant Professor)
  Norbert Oppenheim (Professor)
  Robert E. Paaswell (Distinguished Professor)
  Neville A. Parker (Herbert G. Kayser Professor)
  Thomas Price (Assistant Professor)
  Kyoung Ro (Associate Professor)
  Kolluru Subramanian (Assistant Professor)
- 2018 Department of Civil Engineering
  Anil Agrawal (Professor)
  Mahdieh Allahviranloo (Assistant Professor)
  Alison Conway (Associate Professor)
  Julio Davalos (Professor and Chair)
  Naresh Devineni (Assistant Professor)
  Vasil Diyamandoglu (Assistant Professor)
  Balazs Fekete (Assistant Professor)
  John Fillos (Professor)
  Michel Ghosn (Professor)
  Camille Kamga (Associate Professor)
  Reza M. Khanbilvardi (Professor)
  Nir Krakauer (Associate Professor)
  Feng-Bao Lin (Associate Professor)
  Robert E. Paaswell (Distinguished Professor)
  Michael Piasecki (Associate Professor)
  Hansong Tang (Associate Professor)
  Charles Vörösmarty (Professor)
  Ann E. (Beth) Wittig (Associate Professor)
  Ardavan Yazdanbakhsh (Assistant Professor)

6.4 Computer Science

The first, and possibly most famous, contribution to computer science made at City College happened outside the school of engineering, and long before computer science existed. Emil Leon Post was a professor of mathematics at CCNY from 1936 to his death in 1954; he studied the theory of computing, which was a subject in mathematical logic even before computers existed. Post was a contemporary of Turing and Gödel, and studied the same questions: what kind of knowledge might be generated in a systematic manner. That question much predates the existence of computers, already Hilbert's 10th problem, stated in 1900, is about existence of an algorithm to decide whether a diophantine equation has a solution. To argue about such questions, one first needs a formal model of computation, of which now the Turing machine is the the best known; almost at the same time, submitted a few months later, Post published a model which is similar but slightly simpler, now known as Post-Turing machine. Post was especially interested in computation models based on string replacement rules, and his most famous result is that Post's correspondence problem is undecidable. An instance of the correspondence problem is a list of pairs of words over the same alphabet, which are the building blocks; the question is whether we can build a sequence of these blocks (repetition allowed) such that the first words of the pairs, written together in that sequence, give the same long word as the second words of the pairs. Post developed is as an example of an undecidable problem that is simpler than the halting problem. In classes on computability all over the world, Post's Correspondence Problem is taught; unfortunately there has been no class on computability at CCNY for several decades.

Post graduated with a BS in Mathematics in 1917, and a PhD in Mathematics from Columbia 1920, followed by a Postdoc in Princeton 1920-1921. There he developed hat is now known as bipolar disorder; he was advised to do no more than three hours of mathematics research per day, since it triggered manic episodes. Post then served for fifteen years as high school teacher in New York City; in 1936 he was appointed to the Mathematic department of City College. In 1954 he died of a heart attack following electroshock treatment for his depression. His work in computability apparently left no traces at CCNY.

The Computer Science BS program started in 1968, with more optimism than resources. The school had an IBM 7040 and an IBM 360/50; there had already been programming classes for several years, but when the formal computer science program started, it was apparently overwhelmed by the demand. Students complained that eight of the sixteen announced classes were cancelled because they could not be staffed,[121] and there were not enough textbooks available for the programming language taught in that first year. The department started with the MAD language, the Michigan Algorithms De-

[121] Vector October 1969, p.17f

coder, which was at that time popular at universities, and available on IBM 7040 and IBM 360 systems. The MAD language was derived from ALGOL 58; block structure was introduced only in ALGOL 60 (which is the ancestor of the most imperative languages, like Pascal or C), and so it was not present in MAD. In Fall 1969 the MAD language was replaced by FORTRAN as the introductory programming language. The FORTRAN language, which was developed and supported by IBM since the late 1950s through many versions had then been recently standardized (as FORTRAN 66) by ANSI, and there were much more teaching materials were available for it. From a 2018 perspective, both MAD and FORTRAN 66 look fairly similar, and quite different from any modern programming language. All programming was by punched cards, which were prepared on a key punch, a kind of typewriter that punched the holes in the cards. A program was represented by a sequence (a deck) of cards, which then were put by a card reader in the computer's memory, where, the program could be compiled and executed.

In those first years the curriculum went through rapid changes. in 1969 the required courses were

CS 100 Introduction to Algorithmic Processes
CS 110 Computer Organization and Programming
CS 120 Information Structures
CS 130 Algorithmic languages and Compilers
CS 132 Computer and Programming Systems

In 1970, the required courses were

CS 100 Introduction to Algorithmic Processes
CS 105 Discrete Mathematics
at least four out of
- Combinatorics and Graph Theory
- Constructive Logic
- Logical Design and Switching Theory
- Introduction to Automata Theory
- Formal Languages
- Systems Simulation
- Mathematical Optimization Techniques
- Heuristic Programming
- Selected Topics in Computer Science

and 4-6 technical electives.

So the program became much more mathematical; but in the next year, there was a move in the opposite direction. In 1971 the required courses were

CS 101 Programming and Numerical Methods
CS 105 Discrete Mathematics
CS 110 Assembly language Programming

CS 120 Information Structures

CS 130 Algorithmic Languages and Compilers

CS 132 Computer and Programming Systems

CS 160 Constructive Logic

Corresponding to the initial fluidity of the curriculum is a high turnover in the faculty; when the department was started, the department chair, Eugene Isaacson, was a visiting professor. Isaacson graduated in 1939 from CCNY with a Bachelor of Science in Mathematics, then attended NYU, where he received his Master in 1941 and his PhD in 1949; in 1952 NYU received their first computer, and Isaacson became famous as a pioneer of numerical analysis. He spent the rest of his professional on the faculty of NYU, with the exception of the one year he helped CCNY build the computer science program[122]. Albert Madansky joined the department in 1971, as department chair, and left in 1974 to become Professor at the Graduate School of Business of the University of Chicago. Madansky worked in analytical data processing and econometrics. Martin E. Kaliski was in the department 1971 to 1973; he moved on to Northeastern University. Donald Goldfarb joined the department in 1968 and stayed until 1982; he then moved to the Operations Research Department at Columbia University. Goldfarb was an expert in Optimization Algorithms. Ming Lung Pei, of civil engineering, who had been involved in the acquisition and operation of the first CCNY computers, joined the department for some years, but returned to civil engineering. Michael Anshel and George Ross were the founding members of the computer science department that stayed on until the end (Anshel retired in 201?, Ross died in 201?).

By 1985 the curriculum had stabilized in a structure similar to the one we still have today: the programming class has become a two semester programming sequence,

CS 100 Introduction to Computing I: teaches FORTRAN

CS 112 Introduction to Computing II: teaches Pascal

Other programming languages mentioned in the 1985 Bulletin are PL/1 and Cobol. The department also offers several programming classes as service for other departments (CS 205 Computing for Health Care and Management Science, CS 206 Computing for the Social Sciences, and CS 101 Computer Programming and Numerical Methods, which is for Engineering and the Sciences). The Computer Science department is the only department in the School that offers service courses.

The Discrete Mathematics class has split in three classes

CS 104 Discrete Mathematical Structures I

[122] Eugene Isaacson Oral History Interview by Philip J. Davis, 10 September 2003, Courant Institute, New York. Society for Industrial and Applied Mathematics

CS 204 Discrete Mathematical Structures II

CS 207 Discrete Probabilistic Models

Assembly Programming is still required, although by the end of the 1980s, the importance of assembly programming outside specialized applications will have disappeared.

CS 210 Computers and Assembly Language Programming

The class CS 120 Information Structures has been moved to 200 level,

CS 220 Information Structures: teaches Data Structures and Algorithms

The remaining required classes are

CS 322 Software Engineering

CS 332 Computer and Programming Systems: teaches Operating Systems

CS 340 Logic Design and Switching Theory

In addition, a student needs 4 computer science elective classes, 3 technical elective classes, and another 4 free elective classes, for a total of 128 credits.

The list of electives also looks similar, although names have changed: "Advanced Programming" is now "Programming Language Paradigms", "Information Processing" is "Database Systems", both of them in 2019 required classes. "Computer Organization" is another elective that became a required class; it replaced "Logic Design and Switching Theory". Some other electives are "Combinatorics and Graph Theory", "Computability", "Formal Languages and Automata Theory", "Computational Methods in Numerical Analysis", "Systems Simulation", "Mathematical Optimization Techniques", "Artificial Intelligence", and "Real Time Computing". All these are in 2019 still in the course catalogue, but only Artifical Intelligence gets offered.

The faculty in 1985 had increased by the addition of Gary S. Bloom and Stephen A. Burr, both working in Graph Theory (graph labeling and Ramsey theory, respectively); Stanley Habib, who was a CCNY alumnus with a PhD from the Brooklyn Polytechnic Institute, and who worked in Computer Architecture, especially microprogramming; Stephen Lucci, who received his PhD from the CUNY computer science program, with Michael Anshel as advisor, and who was interested in Artificial Intelligence; Gideon Lidor, with a PhD from Stanford in Operations Research, who left in 1982 after a short period at CCNY to join Bell Labs; Daniel D. McCracken, who was a 1978–1980 president of the ACM, author of the first FORTRAN textbook, as well as numerous other programming textbooks; Valentin Turchin, a russian theoretical physicist and dissident, who had emigrated to the USA in 1977, joined the department in 1979, and whose work is described as evolutionary-cybernetic philosophy; and Charles T. Weldon, who was a chess player, and who died 1993 during a chess tournament in Yugoslavia of complications of appendicitis. In this period there was clearly a problem that the majority of computer science faculty, even if they were research active, were not active in computer science.

By 2000, the computer science faculty had more than doubled; Stanley Habib and Valentin Turchin had retired, and Charles Weldon died, but Octavio Betancourt, Abbe Mowshowitz, Douglas Troeger, Michael Vulis, and George Wolberg were hired by 1990, and Shermane Austin, Sam Fenster, Izidor Gertner, Irina Gladkova, Akira Kawaguchi, Devendra Kumar, Linda Xuhong Li, Janos Pach, Anargyros Papageorgiou, Kaliappa Ravindran, and Jie Wei were hired between 1990 and 2000. Of these, Betancourt did numerical simulations of plasma behavior; Mowshowitz studied social aspects of computing, as well as graph algorithms; Troeger used logical methods in the semantic of programs; Vulis studied DFTs and related transforms, then started the company MicroPress, which produced TeX-related typesetting software and fonts; and Wolberg worked in image processing. Of the 1990–2000 hires, Gertner studied efficient computations on various computer architectures; Gladkova worked on image compression and radar waveform design; Kawaguchi on databases, Kumar on distributed computation; Pach on combinatorial and computational geometry and graph drawing; Papageorgiou on Quasi-Monte-Carlo methods and the complexity of continuous problems, Ravindran on Networks and Distributed Systems, and Wei on Pattern Recognition, Segmentation, and Indexing. The problem of a faculty working mainly outside computer science clearly has been overcome. There is some concentration on topics related to image processing, which complements the developments in Electrical Engineering, and in graph theory, and distributed systems; apart from that there is an attempt to cover everything. Of the 1985–2000 hires, Papageorgiou moved to Columbia University; Shermane Austin to Medgar Evers college, Sam Fenster became the administrative director of the computer engineering program, and Linda Xuhong Li left. Janos Pach joined in 2008 the EPFL in Lausanne. The others are still present in 2019.

The curriculum in 2000, in its course numbers and structure, was almost the same as in 1985: CS 220 was renamed "Algorithms", and CS 332 "Operating Systems", and "Computer Organization" and "Programming Language Paradigms" became required classes, reducing the number of electives. The fundamental curricular change, however, is the disappearance of FORTRAN and Pascal (and Cobol, and PL/1); programming is now done C++ from the beginning. By its programming language choice, the 1985 curriculum identifies itself as very conservative and IBM mainframe oriented, in a time when many computer science departments had already moved to workstations and minicomputers; in 2000, the program is a mainstream program, the choice of C++ actually being ambitious and not fully put in practice: C++ is a very large and complex language, and only a subset gets typically taught.

By 2019, there had been some faculty turnover, but not that much growth anymore. In 2002, Peter Brass and Zhigang Zhu were hired, followed by Esther Levin 2003, Michael Grossberg 2004, Benyuan Liu 2004, Noémie Elhadad 2006, Jianting Zhang 2008, Nelly Fazio, William Skeith, Rosario Gennaro, Leonid Gurvits 2013, Huy Vo 2016, Zheng Peng 2016, and Ronak Etemadpour 2017. But Gary Bloom died in 2009, George Ross in ??, and Daniel McCracken in 2011; Michael Anshel, Stephen Burr and Octavio Betancourt retired, and Janos Pach left. Gilbert Baumslag moved from the Mathematics department to computer science, then died in 2014. A significant number of the new hires left again: Benyuan Liu in 2010?, Esther Levin in 2007, and Noémie Elhadad in 2007, The the loss of Bloom, Burr, and Pach, the graph theory concentration disappeared, but with Fazio, Gennaro, and Skeith, an new concentration in Cryptography was built, extending earlier cryptography interests of Anshel and Baumslag.

Faculty names:

Michael Anshel [cryptography]

Shermane Austin

Gilbert Baumslag [group theory]

Octavio Betancourt [computational plasma physics]

Gary S. Bloom [graph theory, graph labeling]

Peter Brass [computational geometry, discrete geometry, data structures]

Stefan A. Burr [graph theory, ramsey theory]

Noemie Elhadad [natural language processing for biomedical applications]

Ronak Etemadpour [visual analytics]

Nelly Fazio [cryptography]

Sam Fenster

Rosario Gennaro [cryptography]

Izidor Gertner [image processing, target recognition]

William Gewirtz

Irina Gladkova [signal processing, remote sensing]

Donald Goldfarb [at CCNY 1968–1982, then moved to OR department at Columbia. Optimization]

Michael D. Grossberg [image processing, statistical data analysis, data science]

Leonid Gurvits

Stanley Habib

Eugene Isaacson [founding chair while visiting professor, mostly professor at NYU; numerical mathematics]

Martin E. Kaliski [prof 1971–1973]

Akira Kawaguchi [databases]

Devendra Kumar [parallel computing]

Esther Levin [computer speech, dialogue systems]
Linda Xuhong Li
Benyuan Liu [sensor networks]
Gideon Lidor [evaluating mathematical software]
Stephen Lucci [artificial intelligence]
Albert Madansky [Prof and Chair 1971–1974, then Prof at Graduate School of Business, University of Chicago]
Daniel McCracken [computer science education]
Abbe Mowshowitz [social issues in computing, network science, graph theory]
Robert M. Nirenberg
Janos Pach [discrete geometry, graph drawing]
Anargyros Papageorgiou [quasi-monte-carlo methods, low discrepancy sequences; now at Columbia University]
Ming Lung Pei
Zheng Peng [underwater sensor networks]
Kaliappa Ravindran [networks]
George G. Ross
William E. Skeith [cryptography]
Douglas R. Troeger [functional languages]
Valentin F. Turchin [supercompilers]
Huy T. Vo [urban data visualization]
Michael Vulis [computer text processing and typesetting]
Jie Wei [image processing, video processing]
Charles T. Weldon [chess master; died 1993 after a tournament in yugoslavia]
George Wolberg [computer graphics]
Jianting Zhang [geographical information systems]
Zhigang Zhu [computer vision]

- 1970 Department of Computer Science (with 3 Lecturers)
  Michael Anshel (Assistant Professor)
  Donald Goldfarb (Assistant Professor)
  Eugene Isaacson (Visiting Professor and Acting Chairman)
  Ming Lung Pei (Professor)
  George G. Ross (Assistant Professor)
- 1981 Department of Computer Science
  Michael Anshel (Professor)
  Gary S. Bloom (Associate Professor)
  Stefan A. Burr (Associate Professor)
  Donald Goldfarb (Professor)

Stanley Habib (Associate Professor)
Gideon Lidor (Assistant Professor)
George G. Ross (Professor and Chairman)
Valentin F. Turchin (Professor)
Charles T. Weldon (Assistant Professor)

- 1991 Department of Computer Science
  Michael Anshel (Professor)
  Octavio Betancourt (Professor)
  Gary S. Bloom (Professor and Chairman)
  Stefan A. Burr (Professor)
  Stanley Habib (Professor)
  Stephen Lucci (Assistant Professor)
  Daniel McCracken (Professor)
  Abbe Mowshowitz (Professor)
  Anargyros Papageorgiou (Assistant Professor)
  George G. Ross (Professor)
  Douglas R. Troeger (Associate Professor)
  Valentin F. Turchin (Professor)
  Michael Vulis (Associate Professor)
  Charles T. Weldon (Associate Professor)
  George Wolberg (Assistant Professor)
- 2001 Department of Computer Science
  Michael Anshel (Professor)
  Shermane Austin (Assistant Professor)
  Octavio Betancourt (Professor)
  Gary S. Bloom (Professor)
  Stefan A. Burr (Professor)
  Sam Fenster (Substitute Assistant Professor)
  Izidor Gertner (Professor)
  Irina Gladkova (Assistant Professor)
  Akira Kawaguchi (Assistant Professor)
  Devendra Kumar (Associate Professor)
  Linda Xuhong Li (Assistant Professor)
  Stephen Lucci (Associate Professor)
  Daniel McCracken (Professor)
  Abbe Mowshowitz (Professor)
  Janos Pach (Professor)
  Kaliappa Ravindran (Associate Professor)
  George G. Ross (Professor)
  Douglas R. Troeger (Associate Professor and Chairman)

Michael Vulis (Associate Professor)
Jie Wei (Assistant Professor)
George Wolberg (Professor)

- 2018 Department of Computer Science
  Peter Brass (Professor)
  Ronak Etemadpour (Assistant Professor)
  Nelly Fazio (Associate Professor)
  Rosario Gennaro (Professor)
  Izidor Gertner (Professor)
  Irina Gladkova (Associate Professor)
  Michael D. Grossberg (Associate Professor)
  Leonid Gurvits (Professor)
  Akira Kawaguchi (Professor and Chair)
  Devendra Kumar (Associate Professor)
  Stephen Lucci (Associate Professor)
  Abbe Mowshowitz (Professor)
  Zheng Peng (Assistant Professor)
  Kaliappa Ravindran (Associate Professor)
  William E. Skeith (Associate Professor)
  Douglas R. Troeger (Professor)
  Huy T. Vo (Assistant Professor)
  Michael Vulis (Associate Professor)
  Jie Wei (Professor)
  George Wolberg (Professor)
  Jianting Zhang (Associate Professor)
  Zhigang Zhu (Herbert G. Kayser Professor)

6.5 Drafting

Faculty names:
Alfred N. Appleby
George C. Authenrieth
Gilbert R. Bischoff
Howard G. Bohlin
Mario Carbone
Anselm Cefola
George Clemens
Frank C. Codola
Clifford Gould de Neergard
Andre Halasz
Frank Majer, Jr
Jesse Markowitz

Engelbert Neus
Leroy S. Olsen
Henry J.Plock
Frank A. Rappolt
Wilfred L. Stork
Peter L. Tea
Harold V. Walsh
Louis Wolchonok

- 1940 Department of Drafting
  George C. Authenrieth (Professor, Chairman Drafting Department)
  Howard G. Bohlin (Associate Professor)
  Mario Carbone (Assistant Professor)
  Engelbert Neus (Professor Emeritus)
  Frank A. Rappolt (Assistant Professor)
  Wilfred L. Stork (Assistant Professor)
  Peter L. Tea (Assistant Professor)
- 1950 Department of Drafting
  Alfred Noel Appleby (Associate Professor)
  George C. Authenrieth (Professor)
  Anselm Cefola (Assistant Professor)
  George Clemens (Assistant Professor)
  Clifford G. deNeergard (Assistant Professor)
  Andre Halasz (Assistant Professor)
  Jesse Markowitz (Assistant Professor)
  Engelbert Neus (Professor Emeritus)
  Henry J. Plock (Associate Professor, Chairman Drafting Department)
  Frank A. Rappolt (Associate Professor)
  Wilfred L. Stork (Associate Professor)
  Peter L. Tea (Associate Professor)
  Harold V. Walsh (Associate Professor)
  Louis Wolchonok (Assistant Professor)
- 1960 Department of Drafting (with 15 Lecturers and Instructors)
  Alfred N. Appleby (Professor)
  Gilbert R. Bischoff (Associate Professor)
  Anselm Cefola (Associate Professor)
  Frank C. Codola (Assistant Professor)
  C. Gould de Neergard (Associate Professor)
  Andre Halasz (Associate Professor)
  Frank Majer, Jr (Assistant Professor)
  Leroy S. Olsen (Assistant Professor)

Frank A. Rappolt (Professor and Chairman)

6.6 Electrical Engineering

Faculty names:

Abraham Abramowitz

Samir Ahmed

Robert Alfano

Tuvia Apelewicz [student of Schilling]

Joseph Barba [student of Schilling]

Mitra Basu

Harry Baum

Leonard Bergstein

Ellis Blade

Egon Brenner

Philip Marshall Brown

Maximilian Chameides

Shee-Ming Chen

Ki H. Chon

George J. Clemens

Patrick L. Combettes

Michael Conner

David Crouse

Vincent Deltoro

Roger Dorsinville

Lionel Echtman

William Edmondson

George Eichmann [PhD electrical engineering 1968 at CCNY, student of Mansour Javid]

Demos Eitzer

Aly F. Elrefaie

Morris Ettenberg

Paul Fenster

Cecilie Froehlich

Alexander Gilerson

Barry M. Gross [student of Manassah]

Ibrahim Habib [student of Saadawi]

Henry B. Hansteen

Maxwell Henry

Ping-Pei Ho [student of Alfano]

William T. Hunt, Jr.

Mansour Javid

Mohammad A. Karim [Dean 2000-2004, now Provost at UMass Dartmouth; electro-optical systems]

Paul R. Karmel

Bruce Kim

George M. Kranc

Myung Jong Lee

Yao Li

Nicholas Madamopoulos

Jamal T. Manassah

David Manela [student of Schilling]

Nenad M. Marinovic [student of Eichmann]

Ralph Mekel

Irving M. Meth

Jacob Millman

Ahmed Mohamed

Fred Moshary [lidar remote sensing, atmospheric science]

Joseph S. Nadan [student of Ettenberg]

Truong Thao Nguyen

Se Jeung Oh

Sydney R. Parker

Mary J. Potasek

Stephen L. Richter

William Rossow [atmospheric science, satellite remote sensing]

Leonid Roytman

Tarek N. Saadawi

Norman Scheinberg [student of Schilling]

Donald Schilling

Carl Schulman

Sang Woo Seo

Aidong Shen

Kai Shum [student of Alfano]

Kenneth Sobel

Robert Stein

Gerald E. Subak-Sharpe

Yi Sun

Herbert Taub

Frederick E. Thau

Yingli Tian [computer vision]

Richard Tolimieri

Umit Uyar [communication protocol testing]

Srinvasa R. Vemuru

Bayram Vural [since 1967, died 1971. microwaves]
Ardie D. Walser [student of Alfano and Dorsinville]
Otto W. Walter
Louis Weinberg
Harold Wolf
Jizhong Xiao [robotics]
Bo Yuan
Chaim Ziegler [student of Schilling]

Although Electrical Engineering was planned from the beginning of the School of Technology, it had problems with lab equipment and the staffing of courses. Professor Charles Parmly, who was intended as the initial leader of the school, had designed and taught courses on "Elementary Electrical Engineering" and "Alternating Currents", but with his sudden death in September 1917, at the beginning of the first semester of the new programs, the electrical engineering program was left shortstaffed. The Trustees immediately hired Steinman to fill in for Parmly in the Civil and Mechanical Engineering classes, but Steinman did not work in Electrical Engineering. They also hired Alfred Goldsmith, who brought expertise in radio electronics and radio transmission. The 1920s were the great age of radio development. In the short period of City College's war effort 1917–1918, Goldsmith arranged the training of soldiers in radio communication, so he was not fully available. He developed the curriculum further, introducing more electronics; so the Electrical Engineering curriculum became "Elementary Electrical Engineering", "Alternating Currents", "Electrical Motors", "Illumination", "Electrical Measurement", "Electrical Communication", "Radio"[123]. However, until 1924 not all classes of the curriculum were offered on a regular basis. In 1924, Goldsmith left City College to become the Chief Broadcast Engineer of the Radio Corporation of America (RCA), and two new professors were hired. Also the electrical engineering program received money from the evening school programs to equip its laboratories. As a result, in June 1926 finally the first five students graduated from the electrical engineering program.

- 1933 Department of Electrical Engineering
  Harry Baum (Associate Professor)
  Maxwell Henry (Assistant Professor)
  Otto W. Walter (Assistant Professor)
- 1940 Department of Electrical Engineering
  Harry Baum (Professor, Chairman Electrical Engineering Department)

123 City College Alumnus 22(5) May 1926 p.199ff. "The curriculum, as arranged by Professor Parmly, would be wholly inadequate now; but at that time it compared favorably with that of many technical schools throughout the country."

Maxwell Henry (Assistant Professor)
Otto W. Walter (Assistant Professor)

- 1950 Department of Electrical Engineering
  Abraham Abramowitz (Assistant Professor)
  Harry Baum (Emeritus Professor)
  Ellis Blade (Assistant Professor)
  Cecilie Froehlich (Associate Professor, first women faculty member of the School of Technology, appointed 1942)
  Henry Hansteen (Professor)
  Jacob Millman (Associate Professor)
  Robert Stein (Assistant Professor)
  Herbert Taub (Assistant Professor)
  Harold Wolf (Professor, Chairman Electrical Engineering Department)
- 1960 Department of Electrical Engineering (with 57 lecturers and instructors)
  Abraham Abramowitz (Associate Professor)
  Leonard Bergstein (Assistant Professor)
  Egon Brenner (Associate Professor)
  Maximilian Chameides (Associate Professor)
  George J Clemens (Associate Professor)
  Vincent Deltoro (Associate Professor)
  Lionel Echtman (Assistant Professor)
  Henry B. Hansteen (Professor)
  William T. Hunt (Associate Professor)
  Mansour Javid (Assistant Professor)
  Sydney R. Parker (Assistant Professor)
  Carl Shulman (Assistat Professor)
  Robert Stein (Associate Professor)
  Herbert Taub (Professor and Chairman)
  Harold Wolf (Professor and Assistant Dean)
- 1970 Department of Electrical Engineering (with 45 Lecturers)
  Abraham Abramowitz (Professor)
  Egon Brenner (Professor and Dean)
  Philip Marshall Brown (Assistant Professor)
  Shee-Ming Chen (Associate Professor)
  Vincent Deltoro (Professor)
  Lionel Echtman (Associate Professor)
  George Eichmann (Assistant Professor)
  Demos Eitzer (Professor, in Charge of Computation Center and University Television Network)

Morris Ettenberg (Professor and Chairman)
Paul Fenster (Assistant Professor)
William T. Hunt, Jr. (Professor)
Mansour Javid (Professor)
Paul R. Karmel (Associate Professor and Associate Dean)
George M. Kranc (Associate Professor)
Ralph Mekel (Associate Professor)
Irving M. Meth (Associate Professor)
Joseph S. Nadan (Assistant Professor)
Se Jeung Oh (Assistant Professor)
Stephen L. Richter (Assistant Professor)
Donald Schilling (Associate Professor)
Gerald E. Subak-Sharpe (Associate Professor)
Carl Shulman (Professor)
Robert Stein (Professor)
Herbert Taub (Professor)
Frederick E. Thau (Assistant Professor)
Bayram Vural (Professor)
Louis Weinberg (Professor)
Richard Wiener (Assistant Professor)

- 1981 Department of Electrical Engineering (with 9 Adjunct Lecturers, 18 Graduate Assistants, 5 Technicians, 4 Adjunct Assistant Professors, 1 Adjunct Associate Professor)
  Samir Ahmed (Professor)
  Tuvia Apelewicz (Assistant Professor)
  Shee-Ming Chen (Professor)
  Vincent Deltoro (Professor)
  George Eichmann (Associate Professor)
  Demos Eitzer (Professor)
  Morris Ettenberg (Professor)
  Mansour Javid (Professor and Chairman)
  Paul R. Karmel (Professor and Associate Dean of Graduate Studies)
  George M. Kranc (Professor)
  Irving M. Meth (Professor)
  Se Jeung Oh (Professor)
  Donald Schilling (Professor)
  Carl Schulman (Resident Professor)
  Gerald E. Subak-Sharpe (Professor)
  Herbert Taub (Professor)
  Frederick E. Thau (Professor)
  Louis Weinberg (Professor)

Chaim Ziegler (Assistant Professor)

- 1991 Department of Electrical Engineering
  Samir Ahmed (Professor and Chairman)
  Robert Alfano (Distinguished Professor of Science and Engineering)
  Joseph Barba (Associate Professor)
  Sanghamitra Basu (Assistant Professor)
  Shee-Ming Chen (Professor and Associate Dean)
  Patrick L. Combettes (Assistant Professor)
  Michael Conner (Associate Professor)
  Roger Dorsinville (Associate Professor)
  William Edmondson (Assistant Professor)
  Aly F. Elrefaie (Associate Professor)
  Ping-Pei Ho (Professor)
  Paul R. Karmel (Professor)
  George M. Kranc (Professor)
  Myung Jong Lee (Assistant Professor)
  Yao Li (Associate Professor)
  Jamal T. Manassah (Professor)
  David Manela (Assistant Professor)
  Nenad M. Marinovic (Associate Professor)
  Leonid Roytman (Professor)
  Tarek N. Saadawi (Professor)
  Norman Scheinberg (Associate Professor)
  Donald Schilling (Herbert G. Kayser Professor)
  Kai Shum (Associate Professor)
  Kenneth Sobel (Associate Professor)
  Gerald E. Subak-Sharpe (Professor)
  Frederick E. Thau (Professor)
  Richard Tolimieri (Professor)
  Ardie D. Walser (Assistant Professor)

- 2001 Department of Electrical Engineering
  Samir Ahmed (Herbert G. Kayser Professor)
  Mohamed A. Ali (Professor)
  Joseph Barba (Professor and Deputy Provost)
  Mitra Basu (Associate Professor)
  Ki H. Chon (Assistant Professor)
  Patrick L. Combettes (Professor)
  Michael Conner (Professor)
  Roger Dorsinville (Professor)
  Barry M. Gross (Assistant Professor)

Ibrahim Habib (Associate Professor)
Ping-Pei Ho (Professor)
Mohammad A. Karim (Professor and Dean)
George M. Kranc (Professor)
Myung Jong Lee (Associate Professor)
Jamal T. Manassah (Professor)
Fred Moshary (Associate Professor)
Truong Thao Nguyen (Associate Professor)
Leonid Roytman (Professor)
Tarek N. Saadawi (Professor)
Norman Scheinberg (Professor)
Kai Shum (Professor)
Kenneth Sobel (Professor)
Gerald E. Subak-Sharpe (Professor)
Yi Sun (Assistant Professor)
Frederick E. Thau (Professor and Chairman)
Umit Uyar (Associate Professor)
Srinvasa R. Vemuru (Assistant Professor)
Ardie D. Walser (Associate Professor)

- 2018 Department of Electrical Engineering
  Samir Ahmed (Herbert G. Kayser Professor)
  Mohamed A. Ali (Professor)
  Joseph Barba (Professor)
  Michael Conner (Professor)
  Roger Dorsinville (Professor and Chair)
  Alexander Gilerson (Associate Professor)
  Barry M. Gross (Professor)
  Ibrahim W. Habib (Professor)
  Ping-Pei Ho (Professor)
  Bruce Kim (Associate Professor)
  Myung Jong Lee (Professor)
  Nicholas Madamopoulos (Associate Professor)
  Jamal T. Manassah (Professor)
  Ahmed Mohamed (Assistant Professor)
  Fred Moshary (Professor)
  Truong Thao Nguyen (Associate Professor)
  William Rossow (Distinguished Professor)
  Leonid Roytman (Professor)
  Tarek N. Saadawi (Professor)
  Norman Scheinberg (Professor)
  Sang Woo Seo (Associate Professor)

Aidong Shen (Professor)
Kenneth Sobel (Professor)
Yi Sun (Associate Professor)
Yingli Tian (Professor)
Umit Uyar (Professor)
Ardie D. Walser (Professor and Associate Dean)
Jizhong Xiao (Professor)
Bo Yuan (Assistant Professor)

6.7 Mechanical Engineering

Faculty names:

Clarence B. Anderson

Yiannis Andreopoulos

Nadine Aubry [now Dean of Engineering at Northeastern University. fluid mechanics: turbulence, complex flows]

Eugene A. Avallone

Antonio F. Baldo

Charusheel N. Bapat

Gary F. Benenson

Gustave J. Bischof

Arthur Bruckner

Stanley W. Burgess

Hugh Burns

Frank C. Codola

Stephen C. Cowin

Zeev Dagan

Feridun Delale

Niell Elvin

Jing Fan

Jimmy Feng [James J. Feng CCNY 1998-2003; now professor at UBC; fluid mechanics, rheology, mechanics of cells and tissues]

Susannah P. Fritton [now BME]

Peter Ganatos

Jorge Gonzalez-Cruz

George A. Guerdan

Herman R. Heideklang

Lawrence W. Hem

Thomas Hewett

Douglas Jahnke

Latif M. Jiji

Masahiro Kawaji

Clarence H. Kent

Frederick Kuhlen
Taehun Lee
Myron Levitsky
Jacqueline Jie Li
Been-Ming Benjamin Liaw
Gerard G. Lowen
Sherwood B. Menkes
Victor L. Nichols
Rishi Raj
Prathap Ramamurthy
Arthur V. Repetto
Harold A. Rothbart
Damian Rouson
Ali M. Sadegh
Earl B. Smith
Anton L. Steinhauser
Chan Mou Tchen
Stephen J. Tracy
George Triantafyllou [1990–1998, now National Technical University of Athens]
Henry T. Updegrove, Jr
Maribel Vazquez [now BME]
Arthur Vigdor
Ioana R. Voiculescu
Charles B. Watkins
Sheldon Weinbaum [now BME]
Joseph R. Weiss
Honghui Yu

- 1933 Department of Mechanical Engineering
  Arthur Bruckner (Associate Professor)
  Frederick Kuhlen (Assistant Professor)
  Earl B. Smith (Associate Professor)
- 1040 Department of Mechanical Engineering
  Gustave J. Bischof (Assistant Professor)
  Clarence Kent (Associate Professor)
  Frederick Kuhlen (Associate Professor, Chairman Mechanical Engineering Dept)
  Earl B. Smith (Associate Professor)
  Stephen J. Tracy (Assistant Professor)
- 1950 Department of Mechanical Engineering

Gustave J. Bischof (Professor, Chairman Mechanical Engineering Department)
Stanley W. Burgess (Assistant Professor)
George A. Guerdan (Associate Professor)
Laurence W. Hem (Assistant Professor)
Clarence Kent (Professor)
Frederick Kuhlen (Professor)
Victor L. Nichols (Assistant Professor)
Arthur V. Repetto (Assistant Professor)
Harold A. Rothbart (Assistant Professor)
Earl B. Smith (Emeritus Professor)
Anton L. Steinhauser (Assistant Professor)
Stephen J. Tracy (Assistant Professor)
Henry T. Updegrove (Assistant Professor)
Joseph R. Weiss (Assistant Professor)

- 1960 Department of Mechanical Engineering (with 22 Lecturers)
  Eugene A. Avallone (Assistant Professor)
  Antonio F. Baldo (Assistant Professor)
  Gustave J. Bischoff (Professor)
  Stanley W. Burgess (Associate Professor)
  George A. Guerdan (Professor and Chairman)
  Lawrence W. Hem (Professor and Assistant Dean)
  Clarence H. Kent (Professor)
  Gerald G. Lowen (Assistant Professor)
  Sherwood B. Menkes (Associate Professor)
  Arthur V. Repetto (Associate Professor)
  Harold A. Rothbart (Associate Professor)
  Anton L. Steinhauser (Associate Professor)
  Stephen J. Tracy (Associate Professor)
  Henry T. Updegrove, Jr. (Professor)
  Arthur Vigdor (Assistant Professor)
- 1970 Department of Mechanical Engineering (with 12 Lecturers and Instructors)
  Clarence B. Anderson (Professor)
  Eugene A. Avallone (Professor and Dean for Campus Planning and Development)
  Antonio F. Baldo (Professor)
  Stanley W. Burgess (Professor)
  Hugh Burns (Associate Professor)
  Frank C. Codola (Associate Professor)

George A. Guerdan (Professor)
Herman R. Heideklang (Assistant Professor)
Thomas Hewett (Assistant Professor)
Latif M. Jiji (Professor)
Myron Levitsky (Assistant Professor)
Gerard G. Lowen (Professor)
Sherwood B. Menkes (Professor)
Arthur V. Repetto (Associate Professor)
Anton L. Steinhauser (Professor and Chairman)
Chan Mou Tchen (Professor)
Henry T. Updegrove, Jr (Professor)
Arthur Vigdor (Associate Professor)
Sheldon Weinbaum (Associate Professor)

- 1981 Department of Mechanical Engineering (with 4 Graduate Fellows, 4 Technicians, 1 Lecturers, 1 Adjunct Assistant Professors and 2 Adjunct Associate Professors)
  Clarence B. Anderson (Professor)
  Eugene A. Avallone (Professor)
  Antonio F. Baldo (Professor)
  Hugh Burns (Associate Professor)
  Frank C. Codola (Associate Professor)
  Peter Ganatos (Assistant Professor)
  Herman R. Heideklang (Associate Professor)
  Latif M. Jiji (Professor)
  Myron Levitsky (Associate Professor)
  Gerald G. Lowen (Professor)
  Sherwood B. Menkes (Professor and Chairman)
  Rishi Raj (Associate Professor)
  Chan Mou Tchen (Professor)
  Sheldon Weinbaum (Professor)
- 1991 Department of Mechanical Engineering
  Yiannis Andreopoulos (Professor)
  Nadine Aubry (Assistant Professor)
  Charusheel N. Bapat (Assistant Professor)
  Frank C. Codola (Professor)
  Stephen C. Cowin (Distinguished Professor)
  Zeev Dagan (Associte Professor and Chairman)
  Feridun Delale (Professor)
  Peter Ganatos (Professor)
  Herman R. Heideklang (Associate Professor)

Latif M. Jiji (Herbert G. Kayser Professor)
Been-Ming Benjamin Liaw (Associate Professor)
Gerald G. Lowen (Herbert G. Kayser Professor and Associate Dean of Graduate Studies)
Sherwood B. Menkes (Professor)
Rishi Raj (Professor)
Ali M. Sadegh (Associate Professor)
George Triantafyllou (Assistant Professor)
Charles B. Watkins (Professor and Dean)
Sheldon Weinbaum (Distinguished Professor)

- 2001 Department of Mechanical Engineering
  Yiannis Andreopoulos (Professor)
  Charusheel N. Bapat (Associate Professor)
  Gary F. Benenson (Associate Professor)
  Stephen C. Cowin (Distinguished Professor)
  Zeev Dagan (Professor and Provost)
  Feridun Delale (Professor and Chairman)
  Jimmy Feng (Associate Professor)
  Susannah P. Fritton (Associate Professor)
  Peter Ganatos (Professor)
  Herman R. Heideklang (Associate Professor)
  Latif M. Jiji (Herbert G. Kayser Professor)
  Been-Ming Benjamin Liaw (Professor and Associate Dean)
  Rishi Raj (Professor)
  Damian Rouson (Assistant Professor)
  Ali M. Sadegh (Professor)
  Maribel Vazquez (Assistant Professor)
  Charles B. Watkins (Herbert G. Kayser Professor and Deputy Executive Officer)
  Sheldon Weinbaum (Distinguished Professor)
- 2018 Department of Mechanical Engineering
  Yiannis Andreopoulos (Michael Pope Professor)
  Charusheel N. Bapat (Associate Professor)
  Gary F. Benenson (Professor)
  Zeev Dagan (Professor)
  Feridun Delale (Herbert G. Kayser Professor and Chair)
  Niell Elvin (Professor)
  Jing Fan (Assistant Professor)
  Peter Ganatos (Professor)
  Jorge Gozalez-Cruz (Professor)

Douglas Jahnke (Substitute Assistant Professor)
Masahiro Kawaji (Professor)
Taehun Lee (Associate Professor)
Jacqueline Jie Li (Professor)
Been-Ming Benjamin Liaw (Professor)
Rishi Raj (Professor)
Prathap Ramamurthy (Assistant Professor)
Ali M. Sadegh (Professor)
Ioana R. Voiculescu (Associate Professor)
Charles B. Watkins (Professor)
Honghui Yu (Associate Professor)

6.8 Technology

- 1981 Department of Technology (with 6 Adjunct Lecturers, 1 Adjunct Assitant Professors, and 1 Adjunct Associate Professors)
  Eugene Boronow (Assistant Professor)
  Samuel Derman (Assistant Professor)
  John Goodlet (Assistant Professor)
  Sandor T. Halasz (Associate Professor and Chairman)
  Arthur Sloan (Associate Professor)

6.9 Teaching Labs and Equipment

The Bulletins contain a list of the teaching labs of the engineering departments, some of them with a list of the equipment used. These lists stayed the same for long periods, so they might be outdated; but changes in the list clearly show changes in the curriculum, and the interests of faculty. Thus in Chemical Engineering, Unit Operations is always a core subject, whereas the importance of Electrochemistry, Furnaces and Fuels decreased, and Material Science disappeared in the 2000s. In Civil Engineering, Materials, Soil Mechanics, and Fluid Mechanics are always core subjects; Transportation subjects start in the 1960s, and stay important until the present, and sanitary engineering becomes environmental engineering and stays important. Electrical Engineering expanded and changed multiple times, initially just dealing with electrical machines, then acquiring electronics, telecommunications, computers, computer networks, remote sensing, photonics, and for some time in the 1990s microwaves, and computer vision and image processing. Mechanical Engineering also started with mechanical machines, engines, turbines etc, and acquired material science (which disappeared from chemical engineering), computer control, mechatronics, and computer aided design and manufacturing.

In 1906

- Even before the beginning, there were teaching Laboratories for the "Mechanical Arts"; indeed in the new campus one of the five buildings was the Mechanical Arts Building. What was taught here were mostly very practical skills in making things and using tools.
  - Mechanical Laboratory (in Physics Department): testing of steam, gas, and hot-air engines.
  - Electrical Laboratory (in Physics Department): operation and testing of alternating and direct current motors and generators.
  - Joinery Laboratory (in Mechanical Arts): use of woodworking bench tools.
  - Forge and Foundry Laboratory (in Mechanical Arts): Forge work, chipping, filing, soldering, and casting.
  - Turning and Pattern-Making Laboratory (in Mechanical Arts): Lathe turning of wood and soft materials.
  - Machine Tools Laboratory (in Mechanical Arts): use of metal-working machine tools.

In 1919

- In the beginning, there was no subdivision into departments.
  - Hydraulics Laboratory
  - Materials Laboratory
  - Electrical Measurements Laboratory
  - Forge and Foundry Laboratory
  - Mechanical Instruments Laboratory
  - Pattern Making Laboratory
  - Machine Tool Laboratory
  - Steam Power Laboratory
  - Water Power Laboratory
  - Gas Power Laboratory

In 1940

- Chemical Engineering
  - Unit Operations Laboratory
  - Electrochemistry Laboratory
  - Electric Furnace Processes Laboratory
  - Fuel Technology Laboratory
  - Technical Analysis Laboratory
  - Product Control Laboratory
  - Metallography Laboratory
- Civil Engineering
  - Materials Testing Laboratory
  - Soil Mechanics Laboratory

Fluid Mechanics Laboratory

- Electrical Engineering
  - Electrical Machinery Laboratories (2)
  - Electrical Measurements, Electronics, Communication Laboratories (2)
  - Photogrammetry Laboratory
- Mechanical Engineering
  - Heat-Power Laboratory

In 1950

- Chemical Engineering
  - Unit Operations Laboratory
  - Industrial Electrochemistry Laboratory
  - Fluids and Lubricants Laboratory
  - Metallurgy Laboratory
  - Metallography Laboratory
- Civil Engineering
  - Materials Testing Laboratory
  - Soil Mechanics Laboratory
  - Fluid Mechanics Laboratory
  - Surveying Laboratory
- Electrical Engineering
  - Dynamo Laboratories (3)
  - Electronics and Communications Laboratory
  - Electrical Measurements Laboratory
- Mechanical Engineering
  - Mechanical Machines Laboratory
  - Metal Processing Laboratory

In 1969

- Chemical Engineering
  - Unit Operations Laboratory
  - Process Control Laboratory
  - Metallic Materials Laboratory
  - Nonmetallic Materials Laboratory
- Civil Engineering
  - Experimental Stress and Structures Laboratory
  - Soil Mechanics Laboratory
  - Materials Laboratory
  - Fluid Mechanics Laboratory
  - Highway Laboratory
  - Sanitary Engineering Laboratory

Photogrammetry Laboratory

- Electrical Engineering
  - Electrical Machinery Laboratories
  - Electro-mechanical Laboratory
  - Electronics and Communications Laboratories
  - Electrical Measurements Laboratory
  - Electromagnetics Laboratory
  - Control System Laboratory
  - Analog Computer Laboratory
- Mechanical Engineering
  - Metallurgy Laboratory
  - Materials Science Laboratory
  - Nuclear Laboratory

In 1981

- Chemical Engineering
  - Unit Operations Laboratory
  - Measurement and Process Control Laboratory
  - Metallic Materials Laboratory
  - Nonmetallic Materials Laboratory
- Civil Engineering
  - Experimental Stress and Structures Laboratory
  - Soil Mechanics Laboratory
  - Engineering Materials Laboratory
  - Fluid Mechanics Laboratory
  - Surveying Laboratory
  - Highway Laboratory
  - Sanitary Engineering Laboratory
  - Photogrammetry Laboratory
  - Magnetohydrodynamics Laboratory
- Electrical Engineering
  - Communications and Electronics Laboratories
  - Control Systems Laboratory
  - Digital Computer Laboratory
  - Analog Computer Laboratory
  - Electromagnetics Laboratory
  - Electrical Machinery Laboratory
  - Electrical Measurements Laboratory
  - Semiconductor Devices Laboratory
- Mechanical Engineering
  - Energy Conversion Laboratory

Internal Combustion Engines Laboratory
Fluid Flow Laboratory
Heat Transfer Laboratory
Motion and Time Study Laboratory
Solid Mechanics Laboratory
Materials, Foundry, Metallurgy Laboratory
Turbo Machinery Laboratory
Machine Tool Laboratory

In 1991

- Chemical Engineering
  - Unit Operations Laboratory
  - Process Control Laboratory
  - Materials Science Laboratory
- Civil Engineering
  - Materials of Engineering Laboratory
  - Soil Mechanics Laboratory
  - Fluid Mechanics Laboratory
  - Highway and Airfield Laboratory
  - Traffic and Transportation Laboratory
  - Sanitary Engineering Laboratory
  - Surveying Laboratory
- Computer Science
  - PC Laboratory
  - Unix laboratory
  - Macintosh Laboratory
- Electrical Engineering
  - Communication and Electronics Laboratory
  - Photonics Engineering Laboratory
  - NASA Remote Sensing Computer Laboratory
  - PC Microcomputer Laboratory
  - Large Scale Computing Laboratory
  - Loral Microwave Laboratory
  - Image Processing Laboratory
  - Optical Computations Laboratory
- Mechanical Engineering
  - Aero-Thermal-Fluid Laboratory
  - Engineering Materials Laboratory
  - Dynamics and Control Laboratory
  - Computer Aided Design Laboratory
  - Computer Aided Manufacturing Laboratory

Engineering Experimentation and Instrumentation Laboratory
Machine Shop
Personal Computer Center

In 2001

- Chemical Engineering
  - Unit Operations Laboratory
  - Process Control Laboratory
  - Materials Science Laboratory
- Civil Engineering
  - Materials of Engineering Laboratory
  - Soil Mechanics Laboratory
  - Fluid Mechanics Laboratory
  - Highway and Airfield Laboratory
  - Traffic and Transportation Laboratory
  - Environmental Engineering Laboratory
- Computer Science
  - PC Laboratory
  - Unix laboratory
- Electrical Engineering
  - Core Teaching Laboratory
  - Communication and Control Laboratory
  - Photonics Engineering Laboratory
  - NASA Remote Sensing Computer Laboratory
  - PC Microcomputer Laboratory
  - Computer Engineering Laboratory
  - Local Area Networks Laboratory
  - Advanced Electronics Laboratory
  - Semiconductor Laboratory
- Mechanical Engineering
  - Aero-Thermal-Fluid Laboratory
  - Engineering Materials Laboratory
  - Mechatronics Laboratory
  - Dynamics and Control Laboratory
  - Computer Aided Design Laboratory
  - Computer Aided Manufacturing Laboratory
  - Senior Projects Design and Test Laboratory
  - Machine Shop
  - Personal Computer Center

In 2018

- Biomedical Engineering

  - Wet Laboratory
  - Electronics and Senior Design Laboratory
  - Biocharacterization Laboratory
  - Computer Laboratory
  - Machine Shop
- Chemical Engineering
  - Chemical Engineering Science Laboratory
  - Unit Operations and Control Laboratory
  - Powder Science and Technology Laboratory
  - Interfacial Chemistry Laboratory
  - Bioprocessing Laboratory
  - Computer Laboratory
- Civil Engineering
  - Materials of Engineering Laboratory
  - Soil Mechanics Laboratory
  - Fluid Mechanics Laboratory
  - Highway and Airfield Laboratory
  - Traffic and Transportation Laboratory
  - Environmental Engineering Laboratory
- Computer Science
  - Linux Laboratory
  - Computer Architecture Laboratory
  - Image Processing Laboratory
  - Network Protocols Laboratory
  - Operating Systems Laboratory
  - Parallel Programming Laboratory
- Electrical Engineering
  - Core Teaching Laboratory
  - Analog Communications Laboratory
  - Control Engineering Laboratory
  - Photonics Engineering Laboratory
  - NASA Remote Sensing Computer Laboratory
  - PC Microcomputer Laboratory
  - Computer Engineering Laboratory
  - Local Area Networks Laboratory
  - Advanced Electronics Laboratory
- Mechanical Engineering
  - Aero-Thermal-Fluid Laboratory
  - Engineering Materials Laboratory
  - Mechatronics Laboratory
  - Dynamics and Control Laboratory

Computer Aided Design Laboratory
Computer Aided Manufacturing Laboratory
Senior Projects Design and Test Laboratory
Machine Shop
Personal Computer Center

6.10 Research Labs and Centers

In the beginning, City College, and the School of Engineering, were viewed purely as teaching institutions; any research done was the private ambition of the professor. The College was proud if some professor was successful, but did not have resources to support research. The teaching load was always high at CCNY. Also engineering research was less important compared to work as practising engineer. This changed in the 1960s, which also led to the creation of the PhD program in engineering in 1963. At that time, reserch groups were still small.

One of the first Research Centers was the *Clean Fuels Institute*, started in 1980 ?[*listed in 1981 Bulletin*], and supported by NSF, Department of Energy, and industry grants. The Clean Fuels Institute was founded to study the gasification and liquefaction of coal. The background of the renewed interest in coal was the second oil crisis in 1979-1980 (that was started by the Iran revolution in 1979 and start of the Iran-Iraq war 1980), as well as the near-disaster in the Three Mile Island nuclear reactor (March 28, 1979). The Institute continued to exist, although the interest in coal liquefaction soon waned as the oil prices continually dropped during the 1980s and 1990s; the focus shifted to other energy problems. The Clean Fuels Institute transformed into the *CUNY Energy Institute* in 2008, which now studies a variety of topics, but mostly batteries and other energy storage technologies. It is currently led by Sanjoy Bannerjee.

The *Benjamin Levich Institute for Physico-Chemical Hydrodynamics* was originaly founded as the City College Institute for Applied Chemical Physics in 1979[124], with Benjamin Levich as its first director. The institute was chartered to use "basic methods of physics in their application to chemical physics and engineering, such as the theory of the kinetics of chemical reactions." Benjamin Levich had recently emigrated from the Soviet Union, first to Israel in 1978, and then joined CCNY as Albert Einstein Professor in spring 1979. After Levich's death in 1987, the Institute was renamed as Benjamin Levich Institute of Physico-Chemical Hydrodynamics. This title, which seems much more special than "Applied Chemical Physics", was inspired by an influential book "Physicochemical Hydrodynamics", written by Levich in the Soviet

[124] Charter by Board of Higher Education, August 6, 1979

Union in 1952, and translated in the USA in 1962. The second director of the Institute was Andreas Acrivos, from 1988 to 2000, again as Albert Einstein Professor of Science and Engineering. Acrivos was an expert in Fluid Mechanics, which determined the further research orientation of the Levich Institute. Acrivos was succeeded as Director, and as Albert Einstein Professor of Science and Engineering, by Morton Denn, whose special expertise was in Rheology and the Fluid Dynamics of Non-Newtonian Fluids. Morton Denn was Director from 2000 to 2015, and succeeded as Director by Jeffrey Morris, who continues the interest in Rheology and the flow of complex fluids. The Levich Institute has currently seven facuty members, four from chemical engineering and three from physics. The Albert Einstein professor title, however, is not given to the Director of the Levich Institute anymore; instead CUNY decided to give that title to the directors of the CUNY ASRC.

The *NOAA-CREST Center for Earth Systems Sciences and Remote Sensing Technologies* was established in 2001 with an initial $7.5M three-year grant of NOAA; it continues since then mainly funded by NOAA, but also including funding from other sources. It was founded and continues to be led by Reza Khanbilvardi, with faculty from several departments being members of this center. *needs more detail*

The *CAISS Center for Algorithms and Interactive Scientific Software* was founded by Gilbert Baumslag in ??; at that time it was in the Division of Science, although several computer science faculty were participating in it. Baumslag was a Distinguished Professor, and Distinguished Professors can choose the department in which they serve. In 2007, Baumslag moved from the matematics department to the computer science department, which clearly was a better fit for the CAISS. Baumslag was an expert in group theory, but he was also interested in scientific software to allow experiments in group theory; thus he founded CAISS to perform software development of computer algebra systems, while also giving some support to the New York Group Theory Cooperative. The initial project was the MAGNUS system, a computer algebra system with special extensibility to provide for experimentation with algebra in infinite groups; this work was supported by an NSF grant, but ultimately the project was abandoned around 2005, after funding ran out, and a different project came along. The AXIOM computer algebra system was originally developed by IBM, initially named SCRATCHPAD II. IBM sold it to NAG, and after finding sales disappointing, NAG decided to place the AXIOM system in the public domain. Timothy Daly, who was already lead developer of MAGNUS at CAISS, became lead developer of AXIOM, which he still is, and managed the transition of AXIOM to an open source project, and its further development. The MAGNUS system is dead, but AXIOM is still widely used. Under Baumslag's direction, the CAISS also attempted develoment of other scientific software, but with no lasting success. Baumslag retired in 2013, and died in 2014; after that it was decided to change the direction of CAISS into a center for cryptography, stressing especially mathematical techniques and cryptographic methods involving algebraic structures, by that following some of Baumslag's legacy. CAISS is currently led by Gennaro Rosario.

The *NYCBE New York Center for Biomedical Engineering* was established in 1994, supported by a Whittaker Foundation award, as a collaborative research consortium beween City College and several private medical institutions, the Albert Einstein College of Medicine, the Cardiovascular Research Foundation, the Columbia College of Physicians and Surgeons, the Hospital for Special Surgery, the Mount Sinai School of Medicine, the Memorial Sloan-Kettering Cancer Center, and the Weill Medical College of Cornell University. At that time, faculty working in biomedical engineering were distributed across different departments, and NYCBE provided a focal point for them, from where they could work to introduce the the BME PhD-program, then graduate and undergraduate major, and finally start the department of Biomedical Engineering. In 1996, it was designated a CUNY Research Institute. The NYCBE still functions a center by providing the connection between engineering faculty and medical institutions, which is the basis of translational research.

The *CUNY Institute for Transportation Systems* was created when Milton Pikarsky[125] was hired in 1985 as Distinguished Professor of Civil Engineering. Milton Pikarsky was the Head of Public Transportation in Chicago, and active nationwide in transportation policy. In 1964, he became the youngest Commissioner of Public Works in the history of Chicago. However, when the political environment in Chicago changed, Pikarsky left the public service and took an academic appointment, first at the Illinois Institute of Technology (1978), then at CCNY (1985). Pikarsky was a graduate of CCNY (Civil Engineering, 1944), and at CCNY he founded both the Transportation Institute, and the Transportation Research Consortium, which was a consortium of twelve universities to cooperate in transportation research and in influencing transportation policy. Pikarsky died suddenly in 1989. Neville A. Parker, who had been appointed the year before as Associate Director of the Transportation Institute, and Professor of Civil Engineering, succeeded Pikarsky as Director of the Institute, which he stayed until his retirement in 2017. The Transportation Institute received support by CUNY, the City, and the State of New York, but over the years funding and activity has declined; currently it is unfunded, and after the retirement of Neville Parker, no new director has been appointed. Besides his activities in Transportation Research, Neville

125 Milton Pikarsky, in: National Academies Press: Memorial Tributes Vol. 4 (1991) 285–292

Parker was important in CCNY's and CUNY's attempts to increase minority participation in careers in engineering, science, and mathematics. Over many renewal cycles, Parker was the PI of the Louis Stokes Alliance for Minority Participation at CUNY a major education grant of the NSF to CUNY.

The *UTRC2 University Transportation Research Center Region 2* grew out of the Transportation Research Consortium that Milton Pikarsky had created. Pikarsky had been active in federal politics, he had served on the National Research Council's Transportation Research Board in a variety of roles from 1974 to his death in 1989. In 1987, an Act of Congress[126] established ten University Transportation Research Centers, and City College became the lead institution for DOT Region 2 (New York, New Jersey, Puerto Rico, and the US Virgin Islands), leading the same consortium of twelve universities that Pikarsky had brought together before. After Pikarsky's death, Robert Paaswell was appointed in 1990 as Distinguished Professor of Civil Engineering, and director of the UTRC2; Paaswell was, like Pikarsky, previously director of Chicago's public transportation. Paaswell stayed director of UTRC2 until 2009, when he became Interim President of CCNY for one year. Current acting director is Camille Kamga. The UTRC2 continues as a major organisation; however, even if City College is the lead institution, it is only a small part in a large consortium.

The *CUNY Institute for Urban Systems* was created in 2001, to unite all groups at CUNY that are interested in urban infrastructure. The founding director was Robert Paaswell, who continues until today. In the beginning, it had significant funding from city and private sources, but funding dried up, the last annual report was 2005, the last newsletter 2006, and of the initial partners, only the Building Performance Lab seems still active. And the Building Performance Lab has an office at CCNY, but not in engineering.

Other Institutes:

Earthquake Engineering Center (does not exist anymore). *needs detail*

Institute for Municipial Waste Research. Director (2018) John Fillos. *needs detail*

Center for Advanced Engineering Design and Development. established 1999. Director (2018) Ali Sadegh. *needs detail*

Center for Water Resources and Environmental Research. established 1993.

The following are Institutes which mainly belong to the division of science, but have engineering faculty participating

126 Surface Transportation and Uniform Relocation Assistance Act. Reauthorized and changed many times, the DOT's University Transportation Center program has grown to at least 60 centers in a large variety of sub-programs, but UTRC2 is, after more than thirty years, still in it.

Institute for Ultrafast Spectroscopy and Lasers (founded 1983?) *needs detail*

Center for Exploitation of Nanostructures for Energy and Sensing Applications CENSES. established 2008 with a $5M over five years grant from the CREST program of NSF, Daniel Akins, Director. *needs detail*

The following are institutes and centers of institutions outside CCNY, which have engineering faculty participating.

International Center for Environmental Resources and Development *needs detail*

6.11 Computers at the School of Engineering

After Ming Pei and Deimos Eitzer, faculty members of the Civil Engineering department, had attended a special course at the University of Michigan on computer use in engineering, the school acquired in 1961 its first computer. This was a used Librascope/Royal McBee LGP-30. The LGP-30 was and early off-the-shelf vacuum tube computer with magnetic drum memory of 4096 words of 31 bit each. it used 113 vacuum tubes, which frequently failed; the professor in charge had to replace failed vacuum tubes several times a day [*find reference*]. This limited the length of useful computation jobs. This computer was a single-user batch situation [*get photo*], so this was available only to a very limited number of users. The LGP-30 was introduced 1956, and cost $47,000 new; the college obtained a used one for $30,000.

In 1964 the school bought an IBM 7040 for $350,000 and established the computation center[127], with a full-time research assistant, a part-time assistant, and a fellow as support staff and Prof Ming Pei as director of the computation center, and Prof Demos Eitzer as assistant director[128]. The IBM 7040 was a transistor-based computer introduced in 1963, which was popular at universities (Columbia University bought one in 1965) for its comparatively low price. To help to introduce the Computer in engineering research use, Chancellor Bowker of the City University managed to hire Richard Hamming of Bell Research Labs as university visiting professor, attached to the civil engineering department[129]. Hamming is now recognized as one of the great applied mathematicians of the 20th century.

In 1968 the school bought an IBM 360/50; this was a midrange model of IBMs new System/360 series. IBM had introduced the System/360 architecture in 1964 to provide a common architecture for all its computers, to

127 Tech News Vol 18(3) April 24, 1963

128 Tech News Vol 19(1) October 2, 1963

129 Tech News Vol 19(3) October 30, 1963

reduce software and development costs and replace the large number of mutually incompatible computers it had before. The IBM 7040 was a computer with 6-bit characters, with 32k of 36-bit words main memory; the 360/50 used 8-bit bytes and 32-bit words, with 64-512kbyte of magnetic core memory.

The IBM 360/50 starts the period in which many people had access to the computer, with remote entry stations (with a card reader and a line printer) at several locations on campus (in the social sciences statistics lab, the physical sciences computer room, and the architecture design lab). Thus the computer provided service for research and teaching, as well as for the administration.

In 1971 the IBM 7040 was replaced by an IBM 360/20, the smallest model of the System/360 family; it had only 4-32kbyte of core memory, and was intended mainly for data processing and tabulating, as opposed to computation; so it was mainly providing service for administration.

In this period all computer use was in batch mode: the user prepared his program and data with a card punch as a deck of cards; they were put into a card reader, from which the data went either directly into the computer, or on a tape, which the operator then runs; the results are printed and handed back to the user. The user had no direct access to the computer, frequently not even to the card reader; everything had to go via computation center staff.

In 1973 CUNY established their own University Computing Center (UCC), which in 1980 had a IBM 370/168, an upper range model of IBM's mainframes, providing remote computer access to all CUNY campuses. The CUNY UCC continued with top-of-the-line computers from IBM; in 1990 it had a IBM 3090/400 with vector facility and a IBM 3081

In 1980 the Computation Center was still located in the School of Engineering; with the IBM 360/50 and 360/20; it had 27 person staff, and many cardreaders and printers providing service for students and faculty. The availability of cardreaders was an issue for students [*find reference*]. There were also some interactive terminals for students to view their enrollment data, but the access for programming continued in batch mode. There must also be minicomputers, beyond the mainframes listed, for the school claims to be the only engineering school in NYC connected to ARPAnet (the predecessor of the internet) [*reference*]. However, NYU had already ARPAnet connection in 1977, when CCNY did not.

In 1981 Ira Fuchs, then CUNY Vice Chancellor of University Systems, cofounded BITNET, initially connecting CUNY's UCC to Yale. ARPAnet and BITNET were not entirely compatible; but BITNET also provided e-mail and LISTSERV services, and interactive file transmission, and there were gateways to ARPAnet and UUCPnet/Usenet (a dial-up mail, news and discussion service). All network services grew at an enormous rate through the 1980s, but in the 1990s the internet, based on ARPAnet, became dominant because its more general transport mechanisms supported more new services, and the BITNET members transitioned to internet. By 1996 BITNET had essentially disappeared, but at its peak, it was *the* major competitor of the internet, and it originated at CUNY. BITNET was strongly associated with IBM, and IBM was at that time opposed to open standards, trying to lock in the customer base to IBM-related technologies like mainframes, token ring networks, and BITNET, as opposed to workstations and PCs, ethernet, and internet; so when the IBM mainframes lost importance, BITNET declined with it.

In 1982, the CCNY Computation Center replaced the IBM 360/50 by an IBM 4341, an entry-level model of IBMs new midrange 43xx series, which was a considerable step up in capacity for the college. It now supported timesharing access (under VM/CMS) from 50 IBM 3278 terminals, and, of course, it was connected to the new BITNET. The 43xx computers were popular since they were air-cooled (as opposed to the water-cooled machines at the high end), and had much smaller infrastructure requirements than previous mainframes.

By 1991, the Computation Center had left the School of Engineering, and had become the college computing center, located in NAC, operating two IBM 4381, which were the top of IBM's midrange series. The mainframes have interactive/timesharing service, with 60 terminals for the college students. There were also computer labs in NAC with 60 Apple Macs and 30 IBM PS/2, as well as various department-operated labs. The Computer Science Department had 70 Mac SE and 24 PS/2, as well as 20 terminals to AT&T 3B2s under UNIX; Chemical, Civil, and Mechanical Engineering each had their own comuter labs with networks of VAX workstations, and the Department of Technology had its separate labs with IBM PCs and Apple Macs. Clearly the process of decentralization of IT was well underway; but since an IBM PC clone at that time cost about $1000, which is about one semester's full-time undergraduate tuition, most students will still not have access to their own computer at home.

6.12 The Nuclear Reactor

In the 1950, the Atomic Energy Commission expected a shortage of nuclear engineers[130]. Initially, the AEC operated its own educational institution, the Oak Ridge School of Reactor Technology (discontinued 1957), but it intended to help the introduction of nuclear engineering programs at colleges and universities across the nation by offering from 1955 on nuclear materials on loan without cost. The City College of New York was in a good position to apply for this, since several of its faculty, Harry Soodak in the Physics department, and Morris Kolodney in Chemical Engineering, had been active in the Project Manhattan. The City College application was led by Harry Soodak and Mor-

130 Twenty-Third Semiannual Report of the Atomic Energy Commission, January 1958

ris Kolodney. CCNY became one of the 17 colleges and universities[131] which obtained nuclear materials under this program.

The program was located in the School of Engineering, with Morris Kolodney and Sherwood Menkes as main faculty. City College obtained in 1956 a water-moderated sub-critical reactor with over $2\frac{1}{2}$ tons of uranium, and equipped with a 5 curie plutonium-beryllium neutron source[132]. This was initially located below the stands in the Lewisohn stadium. When the Steinman Hall was finished, in 1963, the reactor was moved to the sub-basement of Steinman (Room 04B). The reactor initially came with a polonium-based neutron source, which was exhausted by 1957[133], the AEC provided a new, plutonium-based neutron source with a longer lifetime. The reactor was used in teaching from spring 1958 on[134], in the graduate nuclear engineering program.

In 1962, the college received from the AEC another grant, $30,000 for the expansion of the nucleonics program[135]. The college used part of this to acquire in 1963 a Co^{60} gamma ray source of 1,936 curie[136].

The nuclear reactor and the nuclear engineering specialization existed until 1972, when the materials were presumably returned to the AEC. The AEC itself was dissolved in 1975, when it had come under strong attack, and public debate over the dangers of nuclear energy grew. The specialization in nuclear engineering disappeared from the Bulletin 1972.

6.13 The Engineering Library

The Engineering Library had many locations of its history[137]. When City College moved to its present location, the plan did not contain a library building, and the early Bulletins do not mention a library. Alumni started discussing the need for a library in 192?, and donated money for it. After several delays in building, the college finally got a library building in 1929[138], known as the Alumni Library, or Bowker Hall. The donations were sufficient only for the central part of the planned building, it was intended to later add two wings.

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131 Alabama Polytechnic Institute, Cornell University, University of Florida, Georgia Institute of Technology, Iowa State College, University of marylan, Massachussetts Institute of Technology, New York University, City College of New York, North Carolina State College, Ohio State University, Reed College Rensselaer Polytechnic Institute, Stanford University, Virginia Polytechnic Instutute, and Yale University

132 Chemical Engineering News 1958 36(8) 100–101

133 The Campus, December 2, 1958

134 The Campus, November 27, 1957

135 Tech News Vol 17(2) October 17, 1962

136 Tech News Vol 19(4) November 13, 1963

137 Tech News Vol 18(2) March 27, 1963

138 The Campus, Vol 45(1) September 19, 1929

Thus the space was immediately too small; there was no space for the stacks, and no circulation library, only a reference library. It was an ill-fated building, the second world war changed alumni priorities and slowed donations, and for two decades the Bulletin stated that the next phase of construction would begin soon. However, with the acquisition of the South Campus, the center of the college moved south, and President Gallagher felt that a college library at the extreme north end of the campus was inconvenient. Bowker Hall was destroyed 1957 to make room for Steinman Hall, having existed only 28 years[139]

The Engineering Library was for a short period located in the basement of Bowker Hall, then it moved to the room across from the Great Hall, then in 1936 to the basement of Townsend Harris Hall (the Technology Reading Room), then in 1950 into the Great Hall in Shephard Hall, and in the summer of 1963, when Steinman Hall was finished, into Steinman. The entire second floor of the Steinman building was dedicated to the Engineering Library (at Steinman 203), which in 1975 had more than 15000 books an 10700 bound periodicals. However, in 1980 or 1981, the Engineering library merged with the Science library, and moved to the Marshak building. By this, the School of Engineering gained a lot of space for offices and labs, but lost not only direct access and control over the library, but also a lot of work space for the students; the engineering library in Steinman had, at least initially, 400 seats for students. Working space for students was always an issue[140].

6.14 Grant Support

The largest grant-giving agency for the School of Engineering is the NSF. The NSF awards database contains more that 400 grants from the Directorate of Engineering awarded to CCNY, in addition there are grants from the Directorate of Computer and Information Science and Engineering, as well as from a number of other subdivisions within the NSF. We cannot analyze them all here, but below are the grants of more than $1,000,000 that were awarded to CCNY and have a member of the engineering faculty as PI or co-PI. In principle any project supported by the NSF has a research component and

139 The second attempt at a Library Building did not fare better. The building for the Morris Raphael Cohen Library was started in 1957, but in 198? the library moved to the NAC building; the building became afterwards known as the Y building, after its identifier on the Campus Map. It was then the temporary space nobody wanted to stay in, for a short time also housing the computer science department, until in 2009 the building was gutted, and became, with totally new inside, the home of the School of Architecture. Since then 198?, CCNY again has no library building.

140 space for faculty, too. In the author's first semester at CCNY, he had no office, just a desk in another professor's TA room, which he could not lock. This was not uncommon for new faculty at CCNY.

an educational component; the mission of the NSF contains both the direct support of research, as well as the preparation of the next generation of researchers. The list below is divided into projects that are more education, and projects that are more research. Clearly the largest grants are education grants, the record being "LSAMP Phase III' with a grant volume of $7.2M; and Neville Parker is the faculty that has brough in the largest grant volume in this measure[141]. However, these education grants are mostly money just going through and distributed to students; the college cannot tax this with indirect cost. Also managing a large education grant is much work, and there is not much money for the PI or his lab allowed in there. Thus the college tends to be more interested in research grants.

Grants of more than $1,000,000 with Engineering PI or Co-PI that are predominantly education grants:

- "Center for Minorities in Information Processing Systems", PI:Joseph Barba; Co-PI:Daniel McCracken, Norman Scheinberg, Douglas Troeger, Mitra Basu. Amount $1.3M, Start 1991, Award Number:9114481;
- "Bridges to Engineering Success for Transfers", PI:Joseph Barba; Co-PI:Carlos Molina, Daniel Lemons, Feridun Delale, Amanda Bernal-Carlo, Mahmoud Ardebili, Maria Tamargo. Amount $1.5M, Start 2005, Award Number:0525413;
- "Building Capacity: City College of New York STEM Communities" PI:Joseph Barba; Co-PI:Doris Cintron, Feridun Delale, Jorge Gonzalez, Millicent Roth. Amount $1.5M, Start 2018, Award Number:1832567;
- "AMP: New York City Alliance for Minority Participation", PI: ?, Co-PI: ?; Amount $5.1M, Start 1992, Award Number:9252789;
- "AMP: New York City Alliance for Minority Participation", PI:Neville Parker; Amount $5.2M, Start 1997, Award Number:9703600;
- "City University of New York LSAMP Phase III", PI:Neville Parker; Co-PI:Louise Squitieri, Leon Johnson. Amount $7.2M, Start 2002, Award Number:0217542;
- "New York City Louis Stokes Alliance Phase IV", PI:Neville Parker; Co-PI:Louise Squitieri, Leon Johnson. Amount $6.2M, Start 6.2M, Award Number:0703449;
- "NYC Louis Stokes Alliance", PI:Charles Watkins; Co-PI:Pamela Brown, Leon Johnson. Amount $3.1M, Start 2012, Award Number:1202520.
- "Collaborative Research: The Hispanic AGEP Alliance for the Environmental Science and Engineering Professoriate in Community Colleges and Associate Degree Programs", PI:Jorge Gonzalez; Co-PI:Kyle McDonald,

141 The LSAMP series of grants were CUNY-wide, with CCNY the lead institution; so only a fraction of those grants were distributed to CCNY students

Ellen Smiley, Joseph Barba, Fred Moshary. Amount $1.4M, Start 2017, Award Number:1723209.

- "City Technology Curriculum Guides", PI:Gary Benenson; Co-PI:James Neujahr. Amount $1.3M, Start 1997, Award Number:9618767.
- "Teaching Technology from Everyday Stuff: Sustaining Professional Development Online", PI:Gary Benenson; Co-PI:James Neujahr, Dorothy Bennett, Wilvena Gordon. Amount $1.7M, Start 2001, Award Number:0096627.
- "Redefining Mechanical Engineering : Systemic Reform of the Mechanical Engineering Program at City College", PI:Feridun Delale; Co-PI:James Hammonds, Thomas Perry, Latif Jiji, Benjamin Liaw, Gary Benenson. Amount $1.5M, Start 2003, Award Number:0343154.
- "Physical Science Comes Alive: Exploring Things that Go", PI:Gary Benenson; Co-PI:James Neujahr, Richard Lehrer. Amount $2.5M, Start 2007, Award Number:0733209.

Grants of more than $1,000,000 with Engineering PI or Co-PI that are predominantly research grants:

- "PREM: City College-Chicago MRSEC Partnership on the Dynamics of Heterogeneous and Particulate Materials", PI:Jeffrey Morris; Co-PI:Sidney Nagel, Mark Shattuck. Amount $3.0M, Start 2009, Award Number:0934206.
- "CREST Center for Mesoscopic Modeling and Simulation", PI:Charles Watkins; Co-PI:James Hammonds, Joel Koplik, Godfrey Gumbs. Amount $2.2M, Start 2002, Award Number:0206162.
- "PIRE Investigation of Multi-Scale, Multi-Phase Phenomena in Complex Fluids for the Energy Industries", PI:Masahiro Kawaji; Co-PI:Jeffrey Morris, Taehun Lee, Robert Messinger, Vincent Pauchard, Sanjoy Banerjee. Amount $3.1M, Start 2017, Award Number:1743794.
- "CREST: Center for Exploitation of Nanostructures in Sensors and Energy Systems", PI:Daniel Akins; Co-PI:Swapan Gayen, Alexander Couzis, Maria Tamargo. Amount $5.1M, Start 2008, Award Number:0833180.
- "CREST Center for Interface Design and Engineered Assembly of Low-Dimensional Systems (IDEALS)", PI:Maria Tamargo; Co-PI:Swapan Gayen, Lia Krusin-Elbaum, Gustavo Lopez, Ilona Kretzschmar. Amount $4.1M, Start 2016, Award Number:1547830.
- "EFRI-M3C: Mobility Skill Acquisition and Learning through Alternative and Multimodal Perception for Visually Impaired People", PI:Zhigang Zhu; Co-PI:Kok-Meng Lee, Boris Prilutsky, Tony Ro, YingLi Tian. Amount $2.4M, Start 2011, Award Number:1137172.
- "Conformational dynamics and regulatory interactions in a bacteriophage RNA polymerase complex", PI:Ranajeet Ghose. Amount $1.1M, Start 2014, Award Number:1412007;

- "IGERT: Multiscale Phenomena in Soft Materials", PI:Morton Denn; Co-PI:Jeffrey Koberstein. Amount \$3.5M, Start 2002, Award Number:0221589.
- "Type 2 - LOI02170327 - A Regional Earth System Model of the Northeast Corridor: Analyzing 21st Century Climate and Environment", PI:Charles Vorosmarty; Co-PI:Jerry Melillo, Wilfred Wollheim, Faye Duchin, Jorge Gonzalez. Amount \$2.7M, Start 2011, Award Number:1049181.
- "CRISP 2.0 Type 2: Collaborative Research: Integrated Socio-Technical Modeling Framework to Evaluate and Enhance Resiliency in Islanded Communities (ERIC)", PI:Jorge Gonzalez; Co-PI:T. Agami Reddy, Eric Klinenberg, Reza Khanbilvardi, Masoud Ghandehari. Amount \$1.6M, Start 2018, Award Number:1832678.
- "CNH: Impacts of Global Change Scenarios on Ecosystem Services from the World's Rivers", PI:Charles Vorosmarty; Co-PI:Faye Duchin, Peter McIntyre, Balazs Fekete. Amount \$1.3M, Start 2011, Award Number:1115025.

6.15 Donations and the Grove Gift

7. Student Activities

7.1 Student Groups

In 1933 there were student chapters of the American Institute of Chemical Engineers (AIChE), American Society of Civil Engineers (ASCE), American Institute of Electrical Engineers (AIEE), and American Society of Mechanical Engineers (ASME).

In 1940, when the Evening Session was declared formally equivalent, and also offering Engineering Degrees, there is also an Evening Engineering Society. A first engineering fraternity is Chi Alpha Pi, founded 1936; but it disappears again and is not listed in 1950 anymore. There is also The Dam Club, a civil engineering graduates club dedicated to "perpetuate ideals and teachings of Prof F.O.X. McLoughlin". Frederick O. X. McLoughlin was one of the founding faculty of the School of Technology.

In 1950, in addition to the student chapters of AIChE, ASCE, AIEE, ASME there are student chapters of the Society of Automotive Engineers and the Institute of Radio Engineers. And there are four new honorary engineering fraternities, each a chapter of a national organization, and each still exists in 2018: Tau Beta Pi (general engineering, CCNY chapter started 1940), Chi Epsilon (civil engineering, CCNY chapter started 1949), Eta Kappa Nu (electrical engineering, CCNY chapter started 1946) and Pi Tau Sigma (mechanical engineering, CCNY chapter started 1942). The Evening Engineering Society and the Dam Club still exist.

In 1960, all the students chapters of engineering societies still exist, and additional chapters of the American Society of Tool Engineers, the Society of Women Engineers, and the American Society of Military Engineers were formed.

In 1970, there is additionally a chemical engineering honorary fraternity, Omega Chi Epsilon. Additonal student chapters of the American Institute of Aeronautics and Astronautics and the Association for Computing Machinery. Evening Session students are now eligible for the engineering societies of the day session. The Evening Engineering Society is not mentioned any more in 1970, neither are the Society of Tool Engineers and the Society of Women Engineers. The Society of Tool Engineers became the Society of Manufacturing Engineers (SME), but does not have a student chapter at CCNY now. The Society of Women Engineers still has a student chapter at CCNY.

Below is the list of Engineering Student Clubs that were registered with the college in 2017–2018. Student Clubs apply for funding, and for that it is necessary that they are registered. The funding comes from two streams: the student activity fee ($40 for part-time, $63.5 for full-time students in 2017–

2018), and the Auxiliary Enterprise Corporation of CCNY, which distributes the money received from business operations on the campus (food services, campus store, vending machines etc.). From an administrative perspective, student clubs are existing only for one year, and need to be re-formed in the next, since the persons involved change every year. Most student clubs continue to exist for a long time, especially if they are student chapters of a larger organisation. But since student activities fluctuate, they sometimes do not get registered. Thus, e.g., the American Nuclear Society has a student chapter at CCNY, but it was not registered in 2017–2018. Similarly, the Pi Tau Sigma chapter and the Omega Chi Epsilon chapter (mechanical and chemical engineering honors societies) are currently dormant.

1. American Institute of Aeronautics and Astronautics AIAA (student chapter of national professional society)
2. American Institute of Chemical Engineers AIChE (student chapter of national professional society)
3. American Society for Engineering Education ASEE (student chapter of national professional society)
4. American Society of Civil Engineers ASCE (student chapter of national professional society)
5. American Society of Heating, Refrigerating, and Air-Conditioning Engineers ASHRAE (student chapter of national professional society)
6. American Society of Mechanical Engineers ASME (student chapter of national professional society)
7. Arab American Engineering Club
8. Biomedical Engineering Society
9. CCNY Aerospace Club
10. CCNY Amateur Radio Society
11. CCNY Association for Computing Machinery ACM (student chapter of national professional society)
12. CCNY Code Dojo (programming bootcamp)
13. CCNY FIRST Robotics Club (outreach to schools helping with national FIRST Robotics Challenge)
14. CCNY Robotics Club
15. Chartered Institute of Building (construction management, student chapter of national professional society)
16. Chi Epsilon (civil engineering national honors society)
17. Concrete Canoe Club (branch of ASCE student chapter; competes every year)
18. Deep Foundations Institute (foundation engineering; student chapter of national professional society)
19. Engineers Without Borders

20. Entrepreneurship Student Club
21. Habitat for Humanity at CCNY
22. IEEE - Eta Kappa Nu (HKN) (electrical and computer engineering national honor society)
23. Institute of Electrical and Electronics Engineers IEEE (student chapter of national professional society)
24. LAESA-SHPE (Latin American Engineering Student Association-Society of Hispanic Professional Engineers)
25. National Society of Black Engineers CCNY Chapter NSBE (student chapter of national professional society)
26. New York Water Environment Association (NYWEA) (water quality management)
27. Planetary and Rocket Science Group
28. Practical Engineering Club
29. Society of Asian Scientists and Engineers SASE (student chapter of national professional society)
30. Society of Automotive Engineers SAE (student chapter of national professional society)
31. Society of Women Engineers SWE (student chapter of national professional society)
32. Tau Beta Pi (national engineering honor society)
33. The Chemists' Club (student chapter of a New York club)
34. United Steel Bridge Club
35. Women's Robotics Club

In addition to these student clubs specifically related to engineering activities, there is a large number of student clubs dedicated to entertainment, social and societal purposes, religion, national and regional origin, and many other interests; but among all CCNY majors, engineering students are especially active in creating student groups connected to their profession.

4.2 Student Newspapers

Information relevant for the engineering students was published almost from the beginning of the School of Technology, at first in the *Campus*, the oldest general student newspaper at CCNY. A Tech reporter of the beginning years, who was tech editor of the *Campus*, graduated in 1921, and went on to become Prof Bischof in the Mechanical Engineering department. The probably first engineering student paper were the *Tech News*, which appeared first in October 1931. The *Tech News* were a weekly mimeographed paper published by the student chapter of the ASCE, thus written mainly for civil engineers, and paid by the civil engineers. Almost immediately, the other engineering societies

AIChE, AIEE and ASME proposed to join; a Tech Council was created to coordinate the activities of all four engineering societies, and they shared financing and producing the *Tech News*. The *Tech News* stayed a mimeographed publication, only one issue was printed (instead of mimeographed), in Fall 1933, when it replaced the *Campus*, which at that time was suspended for it's April's Fool edition (for which several students were expelled[142]). Prof McLoughlin was the faculty advisor of the *Tech News* team until his death 1936, succeeded by Prof Allen (later Dean). Unfortunately, the joint publication with a bit higher weight by the civil engineers ran into conflicts: the civil engineers maintained a veto right on topics, since formally they were responsible for the publication, both to the Board of Higher Education and to their national organisation ASCE. The other engineering societies wanted also to include articles on political and other controversial topics. This led to a split in 1936; the AIChE, AIEE and ASME withdrew from the *Tech News*, and started the *Tech Bulletin*; they invited the ASCE to join the *Bulletin*, but no agreement could be reached. The *Tech Bulletin* effort, however, could not be maintained, it stopped publication in 1940. In 1942, the *Tech News* finally became a paper published by all Tech Societies and related fraternities at CCNY, under the Tech Intersociety and Interfraternity Council. The Council wanted to move from a mimeographed paper to a printed one, but could not finance the move; as a result, in September 1943 the *Tech News* merged with the (printed) *Campus*: the *Campus* acquired a subtitle "merged with Tech News, Student Newspaper of the School of Technology". The subtitle lasted from *Campus* Vol 73(1) in Fall 1943 to Vol 76 in Spring 1945; the engineering content was small, mostly on sports events with engineering teams. Thus the Tech Intersociety and Interfraternity Council again produced an issue of the Tech News in May 1945. This caused a very angry editorial in the *Campus*[143]. The center of the disagreement was money: the *Campus* was financed by subscription, and it felt its position endangered by another magazine for sale at CCNY. The *Tech News* was revived as mimeographed paper for one season, 1946-47, but disappeared again. Instead the individual engineering societies each started their own paper, in the period 1944-47, continued until summer 1954 (the ASME *Prony Express*, the AIEE *Analyzer*, and the ASCE *Influence Lines*, as well as the SWE *Power Puff*). In the Fall of 1954, finally the efforts were bundled again to resume a new *Tech News*, now representing all engineering specializations. All of the preceding information is from the

142 This and other controversial April's Fool editions are missing in the copies of the *Campus* in the CCNY Archive; apparently the Arhie was practising some censorship.

143 The Campus Vol 76(13) May 17, 1945

Inaugural Issue of the new *Tech News*, Vol 1(1) October 14, 1954[144] The *Tech News* then continually existed from October 1954 until November 1970, each semester one volume, each volume 5-7 issues, so appearing about bi-weekly in the semester time. In the 1930s and 40s, it appears the student papers were funded by the engineering societies, but it the new *Tech News* was funded by the college, specifically by student funds distributed by the College's Student Council. Thus the *Tech News* was discontinued end of 1970 because it stopped being funded; the student council decided to support instead a new publication, *The Paper*. *The Paper* was a publication of the political black student's community, so it contains no further information on the school of engineering. Even before that, however, in 1968-1970 the *Tech News* had increasingly political content; the Tech Council complained that the *Tech News* editors stopped serving the interests of the engineering students. The loss of support from its own constituency combined with an apparent anti-engineering feeling in the student council to end the *Tech News*.

In parallel to the *Tech News* exists for almost the same period a kind of journal produced by engineering students, the *Vector* (sometimes *The City College Vector*). The *Vector* contained papers written by students on technical topics of engineering interest unrelated to the school or college; e.g., lasers, holography, nuclear propulsion for interplanetary rockets, nuclear fusion, etc. Usually only the editorial and possibly some letters to the editor, and profiles of newly hired faculty were connected to CCNY. The articles were written by students, and ranged from non-technical introduction to articles unreadable by the non-specialist; clearly the *Vector* had difficulties recruiting student contributors, and there are many editorials dedicated to that topic. The *Vector* appeared quarterly, it ended in 1971; at least that is the last issue present in the archive. A year earlier an editorial complained about funding reductions by the student council, so perhaps it was also de-funded. In 1960, the *Vector* won a first price for best editorial in a national competition of the Engineering College Association.

Below are the student council's allocations of the student fees in 1962[145]; I could not find data for other years.

Campus $3000 (15 issues a $200)

Observation Post $3000 (15 issues a $200)

Tech News $1320 (8 issues a $165)

Vector $1000

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144 this contradicts, however, the information from the CCNY Bulletin, which lists in 1950 the *Tech News* as weekly publication of the Tech Intersociety and Interfraternity Council. I suspect Bulletin information is frequently outdated.

145 Tech News Vol 16(7) May 23, 1962

Journal of Social Studies $315
Baskerville Chemistry Journal $220
AIEE-IRE $305
Debating Society $650
IFC $205
Hillel $151
House Plan Association $1,379
Student Government $3,326
Architectural Society $91
Alpha Phi Omega $18
American Rocket Society $60
Beaver Broadcasters $114
Baskerville Chemical Society %50
Blood Bank Council $50
Class of '64 $125
Caduceus Society $80
City College Conservative Club $15
Chess Club $20
Democratic Student Union $17
Economic Society $42
Gamma Sigma Sigma $25
Government and Law Society $49
Italian Club $9
History Society $21
Modern Dance Society $40
Musical Comedy Society $200 (underwrite)
Newman Club $98
Omicron Chi Epsilon $18
Psychology Society $41
Pershing Ries Co. A-8 $55
Railroad Club $18
Sociology Anthropology Society $28
Society for Criticism and Discussion $5
Society of Women Engineers $20
Young Conservatives $13
Young Democrats $50
Young Republicans $24

In addition to these, the City College Bulletin mentions in 1940 a paper *Techometer*, a weekly, published by the Evening Engineering Society; I could not locate any issues.

I could not locate any engineering student paper for the next forty years.

From 2008 to 2013 the School of Engineering produced the *Journal of Student Research* (`http://www.gsoejsr.org`), which had some similarity in its structure to the *Vector*: it contained articles written by students on research activities in which they had participated in the research labs of the school, as well as more survey-style papers on research activities in different departments, and feature articles on the research in specific labs. The students were writers of the articles, but their writing was supervised and edited by Dr. Yuying Gosser as Executive Editor, who managed the entire production of the journal. This avoided many problems the Vector had, with the very uneven quality of student writing, recruting of student authors, and production deadlines; the *JSR* was generally well-designed and written. However, it managed only one issue per year, and its distribution was never satisfactorily resolved, with much of one print issue being destroyed when a storage room in Steinman was flooded. In 2013 it was decided to discontinue the *JSR* for cost reasons.

7.3 The Zahn Center and Student Entrepreneurship

7.4 Placement and Employment

From 1953 until [*when?*] City College had a placement office, which arranged on-campus interviews with employers, gathered statistics on the employment of graduates and their starting salaries, managed internship placements and later the COOP/Eng program, etc. The functions later mostly got lost. Unfortunately the only available materials on this office are reports in the student newspapers, e.g., the Tech News.

As example, in Fall 1955 the companies conducting interviews for January graduates were

Allis-Chalmers,
Bendix Eclipse Pioneer,
Boeing,
Burndy Engineering,
Columbia Gas System Corporation,
Columbia Southern Chemical Corporation,
Curtiss-Wright Aeronautical,
Diamond Ordinance Fuse Labs,
Emerson Research Laboratories,
General Aniline Works,
General Electric,
General Foods,
Interchemical Corporation,

Lockheed Aircraft,
McDonnell Aircraft Corporation,
Mergenthaler Linotype Corporation,
MIT Dynamic Analysis and Control Lab,
MIT Instrumentation Laboratory,
National Cash Register,
Naval Air Development Center,
NACA,
Naval Air Rocket Testing Station,
NJ Highway Department,
North American Aviation,
NY Central Railroad,
NY Naval Shipyard,
Ordinance Corporation,
Otis Elevators,
Philadelphia Naval Shipyard,
Piasecki Helicopter Corporation,
Public Service Commission,
Raytheon,
RCA Victor,
Rome Air Development Center,
Shawinigan Resins,
Sylvania,
United Aircraft,
Western Union Telegraph,
Willow Run Research Center.

Of these 39 employers there are 11 in aviation and another 5 in military supplies and development. On Campus interviews in spring 1965 were abandoned after disruptive picketing against CIA recruiting. They were resumed in Fall 1965; he companies conducting interviews for January graduates were[146]

Air Reduction;
Airborne Instruments Laboratory;
American Cyanamid Company;
American Oil Company;
Applied Data Research;
Army Corps of Engineers;
AVCO Corporation (Lycoming Division);
Bell Telephone Labs;
California State Personnel Board;

146 Tech News Vol 22(3) October 1965

Chronetics;
CIA;
Combustion Engineering;
Corning Glass;
Eastman Kodak;
Esso Research and Engineering;
General Dynamics (Electric Boat Division);
General Dynamics (Electronics Division);
General Telephone and Electronics Lab,
Giannini Controls Corporation;
Hooker Chemical;
Humble Oil and Refining;
Jaros, Baum and Bolles;
Johnson & Johnson;
Lummus Company;
Monsanto;
MIT Lincoln Labs;
Naval Underwater Ordance Station;
New York Central System;
New York State Electric & Gas Corporation;
New York Telephone;
Perkin-Elmer;
Polak's Frutal Works;
Portsmouth Naval Shipyard;
Proctor & Gamble;
Raytheon;
Service Bureau Corporation, New York City;
Sikorsky Aircraft;
Sperry Gyroscope Company;
Standard Oil;
United Aircraft (Hamilton Standard Division);
United States Steel Corporation;
Western Electric;
Wigton-Abbott Corporation;
Xerox Corporation;

Among these 44 employers, there are only 5 aviation companies, and 7 further military-related employers. Instead now we have telecommunications, document processing, and the oil industry.

In 1970 there is no list of job interviews in the Tech News; either the Placement office stopped organizing the event, or the Tech News did not print the lsit anymore. However, there are still companies that paid for job advertisements in the Tech News; in 1970 there are job ads by the following companies:

Atlantic Richfield Company;
Bethlehem Steel;
Ebasco;
First National City Bank;
Grumman Aerospace;
Hughes Aircraft Company;
Miller Brewery;
The Mitre Corporation;
NJ Department of Transportation;
NY Department of Transportation;
Norden–United Aircraft;
RCA;
Riverside Research Institute;
Sikorsky Aircraft;
United Nuclear Corporation;
US Air Force.

There are also ads for films, clothing, textbooks and study supplies, social events of fraternities; a venture capital fund (Globus Inc) searches students with business ideas; and there are now also ads for woman specific issues, including the Abortion Information Agency offering its advice, "Maybelline" offering designer eye lashes, and "My Own" runs many ads for a vaginal deodorant. Although this is a progress over the male-centered advertising ten years earlier, it still strange, it does not appear to be aimed at female engineering students.

In the Fall 2018 STEM Career Fair the following employers were recruiting at CCNY:

US Patent and Trademark Office
MTA-New York City Transit Authority
US Environmental Protection Agency
NYC Department of Buildings
Natilik
NAVAIR
NOAA-CREST-CCNY
New Visions for Public Schools
US Army
LiveOn NY
US Marine Corps
The Port Authority of NY and NJ

Tekintellect Inc.
Evensource Energy
Solar Landscape
TurboFil Packaging Machines
Ramapo for Children
Naval Surface Warfare Center
EnterSolar
Career Poit Staffing
J-Track LLC
NYPD Cadet Corps
US Census Bureau
Jaros, Baum & Bolles
Lutron Electronics Company
DASNY
Sollers Solutions
National Grid
NYC Parks Department
AppNexus
US Department of State-Bureau of Diplomatic Security
NYC Department of Transportation
Rockefeller University
Railroad Construction Company
RBC Capital Markets
Syska Hennessy Group
Etsy
Epic
ACV ENVIRO
US Nuclear Regulatory Commission
New York Power Authority
STV
NV5
Albert Einstein College of Medicine
Site Safety, LLC
LifeSci NYC Internship Program
Gannett Fleming
Lee Spring Company
H2M Architects
United Technologies Corporation/Pratt and Whitney
Echem Consultants LLC
New York State Department of Environmental Conservation
Plaza Construction

Pire Project

Bloomberg LP

CUNY Internship Programs

CUNY Tutor Corp

Infosys

Epic Management

PSEG

Management Solutions

Something Digital

HCZ Promise Academy Charter School

New York State Department of Transportation

Peace Corps

East Side House Settlement

Revature

New York Department of Environmental Protection

Corning

Viagogo

Skanska

Exelon

United Parcel Service

Bank of America

Cond Edicon

FDNY

US Navy

Statistics released by placement office in 1965 average monthly salary of recent graduates[147].

June 1964: Monthly Salary of Recent Graduates				
major	number	average	low	high
Chemical Engineering	54	$600	$520	$665
Civil Engineering	30	$598	$540	$640
Electrical Engineering	151	$612	$542	$700
Mechanical Engineering	75	$604	$540	$672

147 Tech News March 1965 Vol 21(10)

January 1965: Monthly Salary of Recent Graduates				
major	number	average	low	high
Chemical Engineering	10	\$641	\$610	\$700
Civil Engineering	13	\$580	\$435	\$650
Electrical Engineering	44	\$632	\$576	\$745
Mechanical Engineering	20	\$621	\$583	\$700

Tech News September 1965 Vol 22(1) Starting salary of recent graduates in dependence of class standing

Starting Monthly Salary of Recent Graduates and Class Standing			
major	top third	middle third	bottom third
Chemical Engineering	\$645	\$638	\$631
Civil Engineering	\$597	\$577	\$561
Electrical Engineering	\$654	\$626	\$622
Mechanical Engineering	\$628	\$612	\$624

8. Alumni of CCNY Engineering

8.1 Famous Engineers from CCNY before the School of Engineering

Before the engineering programs existed at CCNY, students typically took a science degree at CCNY, and the went for graduate engineering studies to other universities. Some returned as professors of engineering to CCNY.

Gano Sillick Dunn (1870–1953) Bachelor of Science 1889 at CCNY, Electrical Engineering degree 1891 from Columbia University, Master of Science 1897 from CCNY. Chief Engineer of Crocker-Wheeler Company 1898-1911, President of J.B. White & Company from 1913. President of AIEE 1911–1912, Edison Medal of AIEE 1937, Hoover Medal of National Engineering Societies 1939, Honorary Doctorates from Rutgers 1938, Columbia 1939, New York University 1941, Lehigh 1942, and Bowdoin College and CCNY 1947. member of the National Academy of Sciences since 1919, chairman of the National Research Council 1923–1928, President of Cooper Union 1935–1953[148]

Alfred Norton Goldsmith (1888–1974) Bachelor of Science 1907 at CCNY, PhD 1911 from Columbia University 1912 co-founder of the Institute of Radio Engineers IRE[149], and first editor of the proceedings of the IRE, which he remained for 42 years, president of the IRE in 1928, and member of its Board of Directors from the founding in 1912 until its merger into the IEEE in 1963. Goldsmith simultaneously was professor at CCNY (assistant associate *need dates*), teaching electrical engieering classes and forming the electrical engineering curriculum, and did consulting first for GEC, the from 1917 as director of research for Marconi Wireless and from 1919 for the newly-formed Radio Corporation of America (RCA), until he officially left CCNY to become Chief Broadcast Engineer of RCA in 1924. He advanced in RCA to become Vice-President and General Manager, then left in 1931 to become independent consultant. At CCNY in 1917–1918 he was also as part of the war effort Technical Director of the US Signal Corps School of Coomunication and US Naval Radio School. He received the Townsend Harris Medal 1942, and the IEEE named 1975 their Award for Distinguished Contributions to Engineering

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148 Gano Sillick Dunn, 1870-1953, A Biographical Memoir by Vannevar Bush, National Academy of Sciences 1954

149 The Institute of of Radio Engineers (IRE) and American Institute of Electrical Engineers (AIEE) were separate professional organisation with overlapping interests; the IRE was formed because the AIEE seemed primarily interested in electrical power. The societies merged in 1963 to form the IEEE, the Institute of Electrical and Electronics Engineers, which is now the largest professional society in Engineering.

Communication in his honor.[150]

Saul Horowitz (1897–1984) CCNY class of 1917. Horowitz started in 1925 with two partners Saul Ravitch and Murray Hyman the H.R.H. Construction Company, which became a major developer of high-rise apartments in NYC. Horowitz was for 40 years chairman of HRH, then in 1965 turned it over to his son; but the son died 1975 in a plane crash. The company was the sold in 1977; after that HRH slowly faded away, and went bankrupt in 2007[151]. 125th Anniversary Medal of CCNY, 1973.

John White Howell (1857–1937) CCNY class of 1879, Engineering degree from Stevens Institute 1881, became employee of Edison in Menlo Park in 1881, where he spent the rest of his life in engineering, especially in the development of the incandescent lamp and its manufacturing. Edison Medal of the AIEE 1924, honorary Doctorates from Rutgers 1925 and Stevens Institute of Technology in 1932.

Emil Leon Post (1897–1954) Bachelor of Science in Mathematics 1917 at CCNY, PhD in Mathematics from Columbia University. Worked as a high school mathematics teacher in New York City, then in 1936 joined the mathematics department at CCNY. He initially studied problems in Logic, then in 1936 he developed a model of computability, independent and at the same time as Turing (who then was visiting in Princeton), which is equivalent to the Turing machine model, but simpler. He then studied computation problems based on string replacement, and in 1946 created the problem known as Post's Correspondence Problem[152], as a simple example of an undecidable problem. He is a pioneer of computability from the time before there were computers. Post died in 1954 as result of electroshock treatment for depression.

David Barnard Steinman (1886–1960) Bachelor of Science 1906 at CCNY, teaches surveying class at CCNY 1908-1910, PhD in Civil Engineering from Columbia University in 1911. 1910–1914 Assistant Professor at University of Idaho in Moscow, Idaho; returns to New York to work as Assistant Engineer on Hell Gate Bridge and other bridge projects; 1917–1920 Associate Professor of Civil and Mechanical Engineering at CCNY, and the most senior professor in the new Engineering Department. 1920 he starts his own engineering consulting company Robinson & Steinman, which became a leading bridge design company, and in which he was active until his death 1960, designing more than 400 bridges. Steinman was especially concerned about professional

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150 Oral History: Alfred N. Goldsmith, an interview conducted by E. Kenneth van Tassell, IEEE Center for the History of Electrical Engineering, March 1974

151 New York Times, July 15, 1984: Saul Horowitz, retired chief of H.R.H. Construction

152 The author of this book knew Post's Correspondence Problem as undergraduate student, long before he had ever heard of CCNY

education, qualification and conduct for engineers; he founded and was first president of the National Society of Professional Engineers, which is the organisation of licensed Professional Engineers, and concerned with the state licensing processes.

8.2 Famous Alumni of the School of Engineering

Engineers are generally not celebrities, so it is difficult to identify what our famous alumni are. As a starting point, I took all those Alumni which received the Townsend Harris Medal of the Alumni organisation, all members of the National Academy of Engineering that I could identify, as well as some other names. The current list contains 30 alumni from electrical engineering, 21 from civil engineering; 16 from mechanical engineering, and 9 from chemical engineering. This roughly mirrors the size of the programs: electrical engineering was always the largest, and chemical engineering always the smallest. Also the 20th century had an especially strong development in electrical engineering. The computer science program was started only in 1968, which gives some explanation why it is not represented.

Among our Alumni, we have 28 members of the National Academy of Engineering, 2 members of the National Academy of Sciences, Industry Leaders, College Presidents, a MacArthur Fellow, an Olympic Medalist and a professional Basketball player. Engineers an make career also outside engineering, we have successful journalists, lawyers, real-estate developers etc.

Stan Altman Bachelor in Electrical Engineering at CCNY 1963. Master from Purdue 1964, PhD from Brooklyn Polytech 1967. Altman started his career as Assistant Professor in Electrical Engineering at CCNY 1966–68, over several steps at Princeton and Stony Brook, changing his field via computer engineering to management to public affairs, he became Dean of the School of Public Affairs at Baruch College 1999–2005, and Interim President 2009–2010. Townsend Harris Medal 2016.

Maurice Apstein (1910–1987) Bachelor in Electrical Engineering at CCNY 1932, Master in Engineering Administration from George Washington University 1959, PhD in Research Administration from the American University 1963. After graduating from CCNY, Apstein entered Simplex Electric Company as design engineer, the joined Morlen Electric Company in 1935, and became its chief engineer in 1938. In 1940 he entered public service for the City of New York in a variety of roles, including chairman of the Radio department. He became chief engineer of Cardwell Manufacturing Corporation in 1945, then in 1948 joined the ordnance division of the National Bureau of Standards, and continued to work in variety of roles in government research labs leading the development of military technology until his retirement in

1974. From 1974 to 1977 he was research professor of engineering administration at George Washington University. Member of the National Academy of Engineering since 1977, for the development of proximity fuzes and leadership in the development of large electronic systems.[153]

Amos A. Avidan PhD in Chemical Engineering from CCNY 1979. 1996–2000 Mobil Oil. Avidan joined Bechtel Corporation in 2000, from 2007 until his retirement in 2016 he served as senior vice president. Member of the National Academy of Engineering since 2009, for contributions to the understanding, scale-up, and commercialization of fluidized-bed reactors, liquefied natural gas facilities, and gasification plants.

Albert Axelrod (1921–2004) Bachelor in Electrical Engineering at CCNY 1949. Axelrod started fencing at Stuyvesant High School[154]. After serving in the Navy during World War II, he studied at CCNY because they had a strong fencing program; he led his college team to a national team foil championship. Axelrod joined Grumman Corporation after graduating, but gained fame as fencer. He won 15 US National Gold Medals, including team medals, and in 1960 an Olympic Bronze Medal in men's foil.

Joseph Barba Bachelor in Electrical Engineering at CCNY 1975. Master 1977. PhD 1981 (all CCNY) since 1982 Professor of Electrical Engineering at CCNY, Associate Dean for Academic Affairs 1997–2000, Deputy Provost 2000–2004, Dean of Engineering 2004–2013, Townsend Harris Medal 2009

Melvin L. Baron (1927–1997) Bachelor in Civil Engineering at CCNY 1948. Graduate studies at Columbia University, Partner, later Board Chairman, in Weidlinger Associates; specialized in design and analysis of blast-resistant structures, andin the numerical simulation of the effects of explosions. Lifetime Achievement Award of Defense Nuclear Agency, Department of Defense Exceptional Public Service Medal, Member of the National Academy of Engineering since 1978, for contributions in structural mechanics, particularly in the fields of numerical analysis, ground shock, and the response of buried structures. Townsend Harris Medal 1988. [155]

Eleanor K. Baum (born 1940) Bachelor in Electrical Engineering at CCNY 1959. 1964 PhD from Brooklyn Polytechnic Institute; after that professor at Pratt Institute; 1984 Dean of Pratt Institute's School of Engineering, 1987 Dean of School of Engineering of Cooper Union. President of ABET *when*, 1995 President of American Society of Engineering Education (ASEE), hon-

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[153] Maurice Apstein 1910–1987, by Jacob Rabinow. Memorial Tributes of the National Academy of Engineering, Vol 4 (1991)

[154] New York Times, March 5, 2004. Obituary. Albert Axelrod, 83, a Champion in Fencing

[155] Melvin L. Baron, by Jeremy Eisenberg. Memorial Tributes Vol 10 (2002), The National Academies Press

orary doctorates from Cooper Union and Union College, Townsend Harris Medal 1997

Benjamin Berkey (1911–1984) Bachelor of ??? Engineering 1932. After graduating from CCNY, he bought with a loan from his mother a partnership in a photographic studio on the Lower East Side, which became Berkey Photo, Inc., and grew to become the second largest company (after Eastman Kodak) in the Photo Finishing business: developing films, making prints, etc. Beyond this, Berkey provided for all aspects of the amateur photography business. After acquiring the Keystone Camera Company, they had also their own line of cameras. The complex relationship to the giant Eastman Kodak, for which Berkey Photo was both customer of films and other materials, and competitor with cameras, led to a famous antitrust suit, Berkey Photo vs. Eastman Kodak, which at that time was described as one of the largest private antitrust suits. The main object was Kodak's 1972 introduction of the 110 format cartridge film (with 13mm $\times$ 17mm negatives) together with the Pocket Instamatic cameras. The innovation in the film format, where Kodak was near monopolist, gave it a decisive advantage in the introduction of the camera, where Berkey was one of many competitors. After a long legal battle, in which a Federal Court Jury awarded Berkey more than $100 million in damages, but was overturned in the Appellate Court, Kodak and Berkey settled for $6.8 million[156]. Benjamin Berkey sold his business in 1982[157]. 125th Anniversary Medal of CCNY, 1973.

Julius Blank (1925–2011) Bachelor of Mechanical Engineering 1946. Blank initially worked in a number of mechanical engineering jobs at Babcock & Wilcox, Goodyear Aircraft, and Western Electric, then in 1956 he joined the Shockley Semiconductor Laboratory. William Shockley was co-inventor of the transistor, and had left Bell Labs and started his own company to work on silicon-based semiconductor devices, as opposed to the germanium-based ones, which was the beginning of silicon valley. Blank developed the technologies for growing silicon crystals and mass-producing the silicon chips. In 1957 he was among the group that left Shockley over management difficulties and started Fairchild Semiconductors. In 1969 Blank left Fairchild, and became consultant for start-up companies. In 1978 he co-founded Xicor, a maker of non-volatile RAM, which was bought in 2004 by Intersil.[158]

Maurice Bluestein (1941–2017) Bachelor in Mechanical Engineering at CCNY

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156 New York Times, September 24, 1981: Kodak, Berkey settle for $6.8 million

157 New York Times, December 19, 1984: Benjamin Berkey dies at 73; founder of photo company

158 Oral History of Julius Blank, interviewed by Craid Addison, January 25, 2008. Computer History Museum Reference X4436.2008

1962. Masters in Mechanical Engineering from New York University 1964, PhD in biomechanical engineering from Northwestern University 1967. After an industry career in biomedical engineering, he re-entered academia as full professor of Mechanical Engineering at Indiana University-Purdue University at Indianapolis, where he served for 19 years. His best known contribution is a new formula for the wind chill factor. Townsend Harris Medal 2013. Book: Irving Granet, Maurice Bluestein: Thermodynamics and Heat Power, 2014 (8th ed.)

Bruno Adrian Boley (1924–2017) Bachelor in Civil Engineering at CCNY 1943. Doctor in Aeronautical Engineering from Brooklyn Polytechnic Institute 1946, where he remained as Assistant Professor until 1948. After a short period at Goodyear Aircraft, he rejoined academia at Ohio State University in 1950, then Columbia University in 1952, where he stayed until 1968, then chairman of the Department of Theoretical and Applied Mechanics at Cornell University until 1972, Dean of the Technological Institute at Northwestern University until 1986, finally returning to Columbia University. His best known work is the "Theory of Thermal Stresses" co-authored with J. Weiner, which had many reprints. Member of the National Academy of Engineering since 1975, for contributions in research and teaching of applied mechanics, particularly on thermal stress analysis and on dynamical problems. Warner Medal of ASME in 1975, Townsend Harris Medal 1981, Honorary Doctorate from CCNY in 1982, von Kármán Medal of ASCE 1991. Books: Bruno A. Boley, J.H. Weiner: Theory of Thermal Stresses, 1960; Bruno A. Boley: Crossfire in Professional Education: Student, the Professors, and Society, 1977; Bruno A. Boley: Wondering through Europe: The Story of European Geographical Names, 2009.

Seymour W. Brown (–2001) Bachelor in Mechanical Engineering at CCNY 1937. After graduating, he worked 1937–1955 for the Carrier Corporation, a major company in air conditioning, heating and ventilation. He advanced there to become Chief Engineer and Acting Manager in the Marine Department, where he worked, among other things, on the air system of submarines including the Nautilus, the first nuclear submarine. In 1955 he started his own company, S.W. Brown & Associates, Consulting Engineers. In 1969 he joined Michael Baker, Jr., from 1971 on as President and Director; this is a consulting engineering firm and subsidiary of the Michael Baker Corporation. In the later part of hs career, he mainly worked on energy conservation and energy systems planning [159]. Brown served on many boards, including the National Institute for Building Sciences, and the CCNY Alumni Association.

[159] Jimmy Carter Presidential Papers, Memorandum to the President, June 29, 1978; Subject: Board of Directors of the National Institute for Building Sciences; CVs of the proposed directors

125th Anniversary Medal of CCNY, 1973.

Bernard Budiansky (1925–1999) Bachelor in Civil Engineering at CCNY 1944. Joined NACA (the predecessor of NASA), where he began the study of the dynamics of thin-walled structures, elastic plates, shells, and other structures necessary for aviation. Interrupted his NACA years in 1947 for graduate studies in applied mathematics at Brown University, receiving a PhD in 1950. Rejoined NACA, 1952 head of Structural Mechanics Branch. Joined Harvard University in 1955, where he built the mechanics program. Elected to National Academy of Sciences in 1973 and National Academy of Engineering in 1976, for contributions to the understanding of buckling phenomena, materials behavior, and new mathematical analyses of structural response. Townsend Harris Medal 1974, von Kármán medal of ASCE 1982, Timoshenko Medal of ASME 1989.[160]

Leroy N. Callender Bachelor in Civil Engineering at CCNY 1958. Callender started his own engineering consulting company in 1969. Townsend Harris Medal 1992 *needs more information*

Irwin G. Cantor (1927–2017) Bachelor in Civil Engineering at CCNY 1951. Cantor was a structural engineer, who had from 1971 his own engineering company, which in 1992 became The Cantor Seinuk Group, an international structural engineering firm which was responsible for numerous high-rise buildings in Manhattan and around the world. After he retired in 1997 from the firm, he continued to lend his expertise to the public service, e.g., 1994–2012 on the New York City Planning Commission, as well various professional standards, e.g., New York City's first seismic building code. Townsend Harris Medal 1995.

Robert B. Catell (born 1937) Bachelor in Mechanical Engineering at CCNY 1958, Master 1964. Catell joined Brooklyn Union Gas in 1958, and advanced in the company to become its CEO and President 1991–1998, and led its transformation to KeySpan Energy 1998, of which he was the CEO and chairman until 2005. KeySpan was formed by the merger of Brooklyn Union Gas and Long Island Lighting; after acquiring several more regional suppliers, KeySpan was bought in 2006 by National Grid USA. After KeySpan, Catell has served as chairman, director or trustee of a large number of mostly energy-related companies, nonprofits, and advisory boards, including the CCNY School of Engineering Advisory Board, the CCNY Colin Powell School Advisory Board, and the Board of the CCNY 21st Century Foundation. Townsend Harris Medal 1999.

Zeev Dagan Bachelor in Mechanical Engineering at CCNY 1977, Master

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[160] Bernard Budiansky, A Biographical Memoir by James R. Rice. National Academy of Sciences 2008

1978, PhD 1981, all CCNY. since 1983 Professor of Mechanical Engineering at CCNY, Associate Dean of School of Engineering 1993, Deputy Provost 1997, Provost of CCNY 1999–2010, since 2011 Executive Director of Entrpreneurial Research Initiatives at CUNY. Townsend Harris Medal 2007

Peter Delfyett Bachelor of Electrical Engineering at CCNY 1981, Master in Electrical Engineering from the University of Rochester 1983, PhD in Engineering from CCNY 1988. From 1988 to 1993, Delfyett worked at Bell Communications Research (Bellcore) on semiconductor lasers, ultrafast lasers and their applications. In 1993 he joined the University of Central Florida, where he currently serves as Trustee Chair Professor of Optics. Black Engineer of the Year award 1993 and 2000, President of the National Society of Black Physicists 2008–2012. In 2003, Delfyett co-founded Raydiance, Inc., the maker of the first software-controlled ultrashort pulse laser; the company was acquired in 2015 by Coherent. Townsend Harris Medal 2018

Daniel Dicker (died 2015) Bachelor in Civil Engineering at CCNY 1951. Master in Engineering from New York University 1955, PhD from Columbia University 1961. Worked for C.L Bogert and Praeger-Cavanagh Engineers, then became in 1962 assistant professor in the engineering science program of Stony Brook University, which then was still under development and had just moved from its initial Oyster Bay campus to Stony Brook. He was professor in the department of applied mathematics and statistics, and retired in 1994. Townsend Harris Medal 2004.

Anthony J. Dinardo Bachelor in Electrical Engineering at CCNY 1964. worked on sensor design 1968–1975 for Airborne Instruments Laboratory (AIL) Division of Cutler-Hammer, then joins Northrop Grumman and became chief scientist of the Space Based Infrared Systems (SBIRS) program. Townsend Harris Medal 2016

John M. Dionisio (born 1948) Bachelor in Civil Engineering at CCNY 1971. Master in Civil Engineering 1976 from Brooklyn Polytechnic Institute. Joined Frederic R. Harris Inc., an engineering consulting company, and advanced to become its president in 1996 and its CEO in 1999. Frederick R Harris and several other engineering, architecture, and management companies, including DMJM, came in 1990 together to form AECOM (Architecture, Engineering, Consulting, Operations, and Management). Dionisio became in 2005 president and CEO of AECOM; in 2011–2014 he was its chairman. Townsend Harris Medal 2012

Harry Dornbrandt (born 1922) Bachelor of Mechanical Engineering at CCNY 1944, then joined NACA (the predecessor of NASA). Master in Mechanical Engineering from Columbia University 1953. Worked in satellite development for Fairchild Industries Space and Electronics, becoming its President in 1975, then president of the American Satellite Corporation in 1976. NASA Distinguished Public Service Medal 1974

Bernard Morris Dwork (1923–1998) Bachelor in Electrical Engineering at CCNY 1943. Master in Electrical Engineering from Brooklyn Polytechnic Institute 1948. Dwork worked for the Atomic Energy Commission (AEC) 1948–1950 and for the Radiological Research Lab at Columbia University 1950–1952, but at the same time took evening classes at Columbia and New York University on topics in Pure Mathematics, and became graduate Mathematics student at Columbia University in 1952, and received his PhD in Mathematics there in 1954. 1954–1957 Peirce Instructor at Harvard University, 1957–1964 professor at Johns Hopkins University, from 1968 on professor at Princeton University. From 1992 until his death he had a special chaired professorship at the University of Padua in Italy. Townsend Harris Medal 1969. [161]

Joel Stanley Engel (born 1936) Bachelor in Electrical Engineering at CCNY 1957, Master in Electrical Engineering 1959 from MIT, PhD from Brooklyn Polytechnic Institute 1964. Worked at Bell Labs on mobile phone systems, where his enngineering team developed the "Advanced Mobile Phone System", the first-generation cellphone standard. He later became Vice President of Engineering at Satellite Business Systems 1983–1986, Vice President of Research and Development at MCI Communications 1986–1987, and Chief Technology Officer at Ameritech 1987–1997. Member of National Academy of Engineering since 1996, for contributions to the theory and design of cellular communication systems. Alexander Graham Bell Medal of IEEE in 1987, National Medal of Technology 1994, Townsend Harris Medal 2014

Frederick W. Eversley, Jr. (1919–1983) Bachelor in Civil Engineering at CCNY 1942, then in 1942 joined Republic Aviation, where he ultimately became Director of Corporate Planning. In 1963 he left Republic, and started F.W. Eversley & Company, which became at its height, in 1971–1973, one of the largest minority-owned construction businesses in the New York area. The recession of 1974 and the default of several nonprofit housing companies for which he had built low-income housing damaged the company, and Eversley liquidated it in 1977. After that, served as official of the National Minority Contractors Assistance Project in Washington[162]. 125th Anniversary Medal of CCNY, 1973.

Mitchell Feigenbaum (born 1944) Bachelor in Electrical Engineering at CCNY 1964, PhD in theoretical Physics from MIT 1970. Staff Member Los Alamos 1974–1982, Professor at Cornell University 1982–1988, the professor at Rockefeller University, since 1996 Director of Center for Studes in Physics

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[161] Bernard Dwork (1923–1999) by Nicholas M. Katz and John Tate, Notices of the AMS Vol 46 (3) 338–343

[162] New York Times, January 4, 1983: F.W. Eversley, Jr., contractor, dead

and Biology at Rockefeller University. MacArthur Fellow 1984. Member of National Academy of Sciences since 1988. Pioneered the field of chaotic dynamics.

Jacob Feinstein Bachelor in Electrical Engineering at CCNY 1965. After graduation he joined Consolidated Edison, where he spent most of his professional life, from 1965 to 1998. He was Vice President of Systems and Transmission Operations at ConEdison from 1991–1998, and Vice President of Cogen Technologies 1998–1999. Feinstein is Board Member of the City College Fund since 2011. Townsend Harris Medal 2017

Saul K. Fenster (born 1933) Bachelor in Mechanical Engineering at CCNY 1953. Master from Columbia University 1955, and PhD in Mechanical Engineering from the University of Michigan 1959 Research engineer at Sperry-Rand Corp. 1959–1962, professor of Fairleigh Dickinson University from 1962, various administrative appointments at Fairleigh Dickinson up to provost of its Rutherford campus 1972–1978, President of the New Jersey Institute of Technology (NJIT) 1978–2002 Honorary doctorates from Rutgers University 2002, William Paterson University 2002, NJIT 2002, Townsend Harris Medal 1995

Harold B. Finger (born 1924) Bachelor in Mechanical Engineering at CCNY 1944, Master in Aeronautical Engineering from Case Western University 1950. Finger joined NACA, the NASA, and became Director of Space Nuclear Systems, leading the study of nuclear propulsion. In 1969 he left NASA and joined the federal Department of Housing and Urban Development as Assistant Secretary for Research and Technology. In 1972 he joined the General Electric Company in various management roles, then in 1983 he left GEC to become President and CEO of the U.S. Council for Energy Awareness, a non-profit energy analysis and public information organization. Townsend Harris Medal 1970

Jerald G. Fishman (1945–2013) Bachelor of Electrical Engineering at CCNY 1967. Master of Electrical Engineering from Northeastern University 1970, MBA from Boston University 1972, JD from Suffolk University 1976. Fishman joined Analog Devices in 1971, and became its president and COO in 1991, president and CEO in 1996, in which role he remained until his death in 2013.

Philip Garfinkel (1926–1992) Bachelor in Electrical Engineering at CCNY 1949. Joined Stone & Webster Engineering as electrical designer in 1959, and stayed with the company throughout his professional life, becoming its president and CEO in 1988, and chairman in 1991 until his death 1992. Stone & Webster was a major engineering company, perhaps the largest engineering contractor of the second world war effort, the lead contractor of the Manhattan project, later the leading contractor for nuclear powerplant design, then moving to powerplant and petrochemical plant design. From the mid 1990s the company experienced financial difficulties, and collapsed in 2000 after a major indonesian bribery scandal. Townsend Harris Medal 1992

Arthur Gelb (born 1937) Bachelor in Electrical Engineering at CCNY 1958. Master in Applied Mathematics from Harvard Univesity in 1959, PhD in Systems Engineering from MIT in 1961. Department manager, Dynamics Research Corporation 1961–1966, then co-founded in 1966 The Analytic Sciences Corporation (TASC) which he led as president and CEO 1966–1993, chairman 1993–1994. Member of the National Academy of Engineering since 2010, for leadership in applying Kálmán filtering techniques to the solution of critical national aerospace problems. TASC was an engineering and software company, especially providing information management and decision support systems, modeling and analysis for the government. Townsend Harris Medal 1998

Lester A. Gerhardt (1940–2018) Bachelor in Electrical Engineering at CCNY 1961. Master 1964, PhD 1969, both from University of Buffalo, while working at Bell Aerospace. In 1970 Gerhardt became professor at Rensselaer Polytechnic Institute, and served in a sequence of administrative leadership positions, as department chair 1975–1986, Associate Dean of Engineering, Dean of Engineering, Vice Provost and Dean for Graduate Education. Lamme Award and Medal of ASEE 2012, Honorary doctorate from Technical University of Denmark, Townsend Harris Medal 2015

Richard D. Gitlin (born 1943) Bachelor in Electrical Engineering at CCNY 1964, Master in Electrical Engineering 1965 and Doctor of Engineering Science 1969, both from Columbia. After receiving his doctorate, Gitlin joined Bell Research Labs, where he remained until 2001; at retirement he was senior vice president of communications and networking research. He contributed to the development of the Digital Subscriber Line (DSL) technology and smart MIMO antennas. After retiring from Bell Labs, he joined the University of South Florida as Distinguished University Professor and Agere Endowed Chair of Electrical Engineering. Member of the National Academy of Engineering since 2005 for contributions to communication systems and networking.

Robert M. Gitlin Bachelor in Mechanical Engineering at CCNY 1944. Started American Aerospace Controls (AAC) in 1965.posthumous Townsend Harris Medal 2016 *needs more information*

Daniel Saul Goldin (born 1940) Bachelor in Mechanical Engineering at CCNY 1962. After graduating, worked at NASA Research Center in Cleveland on propulsion technologies, then in 1966 joined TRW Space and Technology Group and in 1987 became its Vice President and General Manager. Appointed NASA Administrator 1992–2002, serving under Presidents G.H.W. Bush, W. Clinton, and G.W. Bush, as the longest-serving NASA administrator. In 2003 selected as President of Boston University, then cancelled shortly before the inauguration, in a process that exposed the troubled state of Boston University's Board of Trustees, and has led to reforms since. Founder, President and CEO of Intellisis Corp., renamed KnuEdge. Member of National Academy of Engineering since 1998, for pioneering development of advanced space communications and electronics, and for leadership in managing the U.S. space program. Townsend Harris Medal 1994

Andrew S. Grove (1936–2016) Bachelor in Chemical Engineering at CCNY 1960, PhD in Chemical Engineering from University of California at Berkeley 1963. After graduating from Berkeley, Grove joined Fairchild Semiconductors, then a pioneer and leading company in the semiconductor market. Management diffculties in Fairchild Semiconductors led in 1968 a group of key employees, including Grove, to leave the company and start Intel. Grove initially worked as Intel's director of engineering. He led a re-orientation from the initial focus on manufacturing memory chips to developing microprocessors. Grove became Intel's president in 1979, CEO in 1987 and chairman in 1997 until his retirement in 2004. Member of the National Academy of Engineering since 1979, for leadership in semiconductor technology, particularly in contributions to the understanding of the structure and instabilities of the silicon-oxide interface. In 2005 Grove donated $26 Million to CCNY, the largest grant in CCNY history; the School of Engineering was renamed Grove School of Engineering in his honor. He received honorary doctorates from CCNY 1985, Worcester Polytechnic Institute 1989, and Harvard University 2000. Townsend Harris Medal 1980

Bernard Haber (born 1929) Bachelor in Civil Engineering at CCNY 1951. He joined Hardesty & Hanover, and engineering company specializing in bridges and transportation infrastructure, in 1953, and spent all his professional life with this company. Haber became managing partner, and retired as partner emeritus in 2001. He is also the longest-serving community board member in New York City, serving continuously since 1969, and as chairman of community board 11 from 1972 to 2002. Townsend Harris Medal 2004

Barry Martin Horowitz Bachelor of ? Engineering ar CCNY 1965, Masters 1967 and PhD 1969 in ? from New York University. After graduating from NYU, Horowitz joined the Mitre Corporation, where he stayed from 1969 until 1996, serving 1988–1991 as COO and executive vice president, and 1991–1996 as CEO and president. Joined in 2001 the University of Virginia as Professor in the Systems and Information Engineering Department, where he is now Munster Professor. Member of the National Academy of Engineering 1996 for contributions in the field of military and civilian aeronautical and information systems engineering.

Robert Elliot Kahn (born 1938) Bachelor in Electrical Engineering at CCNY 1960. Masters 1962 and PhD 1964; in Electrical Engineering from Princeton

University. Kahn is known as one of the "fathers of the internet". After graduating, he worked for a short time at the Bell Laboratories, then became Assistant Professor of Electrical Engineering at MIT. At that time, the Defense Advanced Research Projects Agency (DARPA) had already started discussions with various parties on the need for a computer network connecting diverse computer systems. It was decided that the network should use the new technology of packet-switching. In 1968, the planning phase was completed, and in 1969 Bolt Beranek and Newman (BB&N) was selected as contractor to build the network. Robert Kahn left MIT and joined BB&N to work on this project. In 1972, Kahn joined DARPA, and became director of its Information Processing Techniques Office. There he developed together with Vinton Cerf a more general model of network communication, and protocols for it, which became the current TCP/IP, and which replaced the original protocols (1822 protocol and NCP) on the ARPAnet. This new model allowed to communicate transparently across a wide variety of individual networks joined together, and became the internet. Kahn received honorary doctorate by CCNY, the University of Pavia, Princeton University, ETH Zurich, the University of Maryland, George Mason University, the University of Central Florida, and the University of Pisa. Member of National Academy of Science since 2015. Member of the National Academy of Engineering since 1987, for research contributions to computer networks and packet switching, and for creative management contributions to research efforts in computers and communications. A.M. Turing Award 2004. Presidential Medal of Freedom 2005, Townsend Harris Medal 2005

Theodore Karagheuzoff (1935–1985) Bachelor in Civil Engineering 1955, Master from Northwestern University 1965, Bachelor of Laws from Brooklyn Law School 1961. After graduating, Karagheuzoff joined the NYC Traffic Department and spent the rest of his life as career civil servant managing traffic and public transportation in New York. He became Chief Engineer, New York City Traffic Department, in 1963, then in 1968 he was appointed Traffic Commissioner, the in 1978 he moved to the Transit Authority (now MTA), where he became in 1982 general superintendent, and finally chief facilities officer of the surface division[163]. 125th Anniversary Medal of CCNY, 1973. Sloan Public Service Award 1976.

Thomas Christian Kavanagh (1912–1978) Bachelor in Civil Engineering and Master in Civil Engineering at CCNY, MBA and PhD from New York University. Assistant Professor of Civil Engineering at New York University, then Professor at Pennsylvania State University, and 1948 head of the Struc-

163 New York Times, April 23, 1985: Theodore Karagheuzoff, 50, dies; served as commissioner of traffic

tures department. In 1952 Kavanagh returned to New York University and became chairman of the Civil Engineering department. He joined an engineering firm which became Praeger-Kavanagh-Waterbury, then joined Louis Berger International Inc. as vice president in 1975, then founded Iffland-Kavanagh-Waterbury in 1976. Kavanagh received a honorary doctorate from Lehigh University, and a David Steinman medal from CCNY. He was a founding member of the National Academy of Engineering (since 1964) and its Treasurer 1964–1974.[164] Book: Thomas C. Kavanagh: Construction Management: A Professional Approach, 1978.

Harvey L. Kaylie (1937–2018) Bachelor in Electrical Engineering at CCNY 1960. Master in Electrical Engineering from New York University in 1964. After his CCNY graduation, he worked for ITT 1960–1961, Amperex Electronics Corporation 1961–1964, Dumont Laboratories in 1964, Airborne Instruments Laboratories (AIL) 1964–1968. In 1968, Kaylie founded Mini-Circuits in 1968, which grew to become a leading manufacturer of RF and microwave components. Kaylie remained President of Mini-Circuits from its founding until 2015, and CEO until his death. In 1999, Kaylie and his wife established the Harvey and Gloria Kaylie Foundation. In 2007, he established the Mini-Circuits scholarship at CCNY, and in 2010, he endowed the Kaylie Price for Entrepreneurship at CCNY. Kaylie received honorary doctorates from CCNY in 2012, the University of South Florida in 2012, and Yeshiva University in 2013. Townsend Harris Medal 2011.

Leonard Kleinrock (born 1934) Bachelor in Electrical Engineering at CCNY 1957. Master in Electrical Engineering 1959 and PhD in Computer Science 1963, both from MIT. He then joined the faculty of the University of California at Los Angeles, where he still serves as Distinguished Professor of Computer Science. Kleinrock is known as one of the "fathers of the internet". His best known work is on the theory of queueing systems. In his dissertation he studied the mathematical theory of packet switching networks, which are a technology underlying the internet and its predecessor, the ARPAnet, from the beginning. The first message over the ARPAnet was transmitted from Kleinrock's lab at UCLA to a lab at the Stanford Research Institute. He is Member of the National Academy of Engineering since 1980, for pioneering contributions to the field and leadership as an educator in computer communications networks. Townsend Harris Medal 1982

Frederick J. Krambeck Bachelor in Chemical Engineering 1963 (*from CCNY?*) PhD 1968. Joined ExxonMobil 1967–2001, then became research professor at Johns Hopkins University 2002, which he still is; also founded ReacTech in

164 Thomas C. Kavanagh 1912–1978, by Anton Tedesco. Memorial Tributes of the National Academy of Sciences Vol 1 (1979)

2002, of which he is still president. Member of the National Academy of Engineering since 1999, for advancing the theory of complex reacting mixtures, and applying chemical reaction engineering principles to the design of commercial processes.

Morris Kolodney (1911–2009) Bachelor in Mechanical Engineering 1932, Chemical Engineering 1933, both at CCNY. PhD from Columbia University 1940. Worked 1943–1946 on the isolation and refining of plutonium in the Manhattan Project; in 1946 returned to CCNY as Professor of Chemical Engineering until his retirement in 1973. Townsend Harris Medal 1965

Martin Lang (1915–2000) Bachelor in Chemical Engineering at CCNY 1935. After graduation, Lang joined the New York City administration, in which he served in a variety of roles in engineering and environmental management until his retirement in 1977. Master in Civil Engineering from New York University 1954. Director of Division of Sewage Disposal 1964, director of Bureau of Water Pollution Control 1965–1970, commissioner of Department of Water Ressources, commissioner of Department of Sanitation, administrator of Department of Parks, Recreation, and Cultural Affairs 1976–1977. Member of National Academy of Engineering since 1980, for leadership in developing and applying basic technology and research for solving the multitudinous environmental problems of New York City. Townsend Harris Medal 1973

David Laub Bachelor in Civil Engineering at CCNY 1942. Laub gained fame as basketball player. At CCNY, he played under coach Holman. After graduating, he served in the Army Corps of Engineers 1943–1946, the he played for one year professional basketball for the Troy Celtics of the American Basketball League, the predecessor institution of the NBA league. After that, he followed a more normal career path in the constrution field. His brother Jack Laub, also a CCNY alumnus, but not engineer, had a longer career in professional basketball. Townsend Harris Medal 2018.

Matthys P. Levy Bachelor in Civil Engineering at CCNY 1951. Master in Civil Engineering from Columbia University 1956, joined Weidlinger Associates in 1956, became Principal in 1964, chairman 2002, and chairman emeritus 2006. National Academy of Engineering since 1996, for design in major structures. Townsend Harris Medal 2007

Stuart S. Levy Bachelor in Electrical Engineering at CCNY 1972. JD from George Mason University. Patent Examiner, then supervisor in charge of computer technology, from 2000 administrative law judge at USPTO, then retired from USPTO and entered private law firms. Townsend Harris Medal 2017

John Lowe III (1916–2012) Bachelor in Civil Engineering at CCNY 1936. Master in Engineering from MIT 1937. After graduating, he took a sequence of teaching positions, at the University of Maryland, then as instructor at

MIT. In 1945 Lowe joined the Knappen Engineering, which in 1946 became Knappen-Tibbets-Abbett Engineering, and later Tippetts-Abbett-McCarthy-Stratton (TAMS), and retired as senior partner in 1983. During that time, he continued occasional teaching at New York University 1949-1951 and CCNY 1953–1960. As the head ot TAMS geotechnical group, he became an expert in soil mechanics, and in the design of dams. His most challenging project was design and construction supervision of the Tarbela dam in Pakistan, which in 1968 was the largest civil engineering contract ever awarded. Lowe was member of the National Academy of Engineering since 1974, for leadership in the development and application of the principles of soil mechanics. Townsend Harris Medal 1982[165]

Albert Macovski (born 1929) Bachelor in Electrical Engineering at CCNY 1950. Master of Engineering from Brooklyn Polytechnic Institute 1953, PhD from Stanford University 1968. After graduating from CCNY, Macovski joined the RCA Laboratories, working on television technology. In 1957 he became assistant professor at the Brooklyn Polytechnic Institute, later associate professor. In 1960 he moved to the Stanford Research Institute (SRI) while working on his PhD in Electrical Engineering at Stanford. In 1972 he became professor at Stanford, with a joint appointment in Electrical Engineering and in Radiology, where he worked on medical imaging technologies. Member of the National Academy of Engineering since 1988, for contributions to color television and to medical imaging, using computer processing and alternative illuminating sources. Townsend Harris Medal 2013 Book: Albert Macovski: Medical Imaging Systems, 1983

Seymour L. Moskovitz (born 1932) Bachelor in Mechanical Engineering at CCNY 1954, Civil Engineering Master 1956. Director of Research and Development at Curtiss-Wright Corporation, then 1985–1994 Senior Vice President at Vitro Corporation. Executive Vice President for Technology at Anteon International Corporation, Co-Founder of CoVant Management. Townsend Harris Medal 2010

Norman A. Nadel Bachelor in Civil Engineering at CCNY 1949. former President of McLean Grove & Company. Chairman of Nadel Associates Inc.. Member of the National Academy of Engineering since 1983, for engineering improvements in underground construction, including tunneling equipment, excavation supports, and economy of performance. Townsend Harris Medal 1987 *needs more information*

George M. Nemhauser (born 1937) Bachelor in Chemical Engineering at CCNY 1958. Master 1959 and PhD 1961 from Northwestern University. Af-

[165] John Lowe III 1916–2012, by Ingo Fox. Memorial Tributes of the National Academy of Engineering Vol 18 (2014) 178–185.

ter obtaining his PhD, Nemhauser joined the faculty at Johns Hopkins University 1961–1969, then Cornell University 1969–1985, then Georgia Institute of Technology since then. Nemhauser works in Mathematical Optimization and Operations Research; he is the founding editor of the Operations Research Letters, 1981 president of the Operations Research Society of America (ORSA). He is also partner in the Sports Scheduling Group, which schedules various sports leagues. Member of the National Academy of Engineering since 1986, for fundamental operations-research contributions in scheduling methodology, and for contributions to large-scale combinatorial optimization problems. Books: George M. Nemhauser: Introdution to Dynamic Programming, 1966; Robert Garfinkel, George M. Nemhauser: Integer Programming, 1972; Laurence A. Wolsey, George M. Nemhauser: Integer and Combinatorial Optimization, 1988.

Milton Pikarsky (1924–1989) Bachelor in Civil Engineering at CCNY 1944. After graduation, Pikarsky joined the New York Central Railroad, where he worked, with the 1944–1946 interruption of his service in the Navy, until 1956. From 1956 to 1959, he was partner in the firm Plumb, Tucket & Pikarsky; 1959–1960 he worked on a railroad project in Blue Island, a suburb of chicago, and in 1960 he joined the Chicago public works as engineer. In 1964 he became commissioner of public works in Chicago, then 1973–75 chairman and CEO of the Chicago Transit Authority, and 1975–1978 of the Regional Transportation Authority. Then Pikarsky left public service, and became director of the Transportation Research Institute of the Illinois Institute of Technology 1979–1984, and Distinguished Professor of Civil Engineering and director of the Institute for Transportations Systems at CCNY. Member of several federal advisory groups related to transportation. Member of the National Academy of Engineering since 1973, for accomplishments in developing urban transportation systems and other urban public works. Townsend Harris Medal 1969[166] Book: Milton Pikarsky, Daphne Christensen: Urban Transportation Policy and Management, 1977

Neville A. Parker Bachelor in Civil Engineering at CCNY 1965. Master and PhD in Civil Engineering from Cornell University 1966 and 1971, respectively. 1971–1976 professor of civil engineering at Howard University. Parker was active in the 6-th Pan-African Congress 1974 in Tanzania, leading the committee on Science and Technology and delivering its report[167]. The proposed Pan-

[166] Milton Pikarsky 1924–1989, by Anton Tedesko. Memorial Tributes of the National Academy of Engineering Vol 4 (1991)

[167] The Pan African Imperative for Increased Emphasis on Science and Tehnology, prepared by the Committee on Science and Technology of the 6th Pan African Congress, June 19–27, 1974, read by Neville A. Parker

African Center of Science and Technology did not happen, but Parker played an important role in the development of the next generation of engineers at the University of Dar es Salaam in Tanzania. He came to the University of Dar es Salaam 1976–1979 as Senior Fulbright Scholar. After the end of the Fulbright Scholarship, Parker stayed on, and became department chair of civil engineering at the University of Dar es Salaam. After twelve years there, he returned to USA in 1988, when he was appointed at CCNY as professor of civil engineering and director of the institute for Transportation Studies. Here he continued to be especially active in projects to increase the participation of black students in engineering. 1994 Black Engineer of the Year. Townsend Harris Medal 2015[168]

Henry D. Perahia Bachelor of Mechanical Engineering at CCNY 1971, Master in Mechanical Engineering 1973, also CCNY. 1998–2014 Deputy Commissioner of New York City Department of Transportation. After his retirement from public service, he joined in 2015 K S Engineers, where he currently serves as Vice President. Honorary doctorate by CCNY 2014.

Stewart D. Personick (born 1947) Bachelor of Electrical Engineering at CCNY 1967, Master 1968 and doctoral degree 1970 from MIT. After graduating from CCNY, Personick joined Bell Labs, where he stayed until 1978, performing research on fiber optics technology. From 1978 to 1983 he was amanager at TRW, Inc., then in 1983 he joined Bell Communications Research (Bellcore). In 1998 he left industrial research and joined Drexel University as chair professor of telecommunications, then in 2008 he moved to the New Jersey Institute of Technology (NJIT). Member of the National Academy of Engineering since 1992 for contributions toward fostering the theoretical understanding and practical applications of optics and electro-optics in telecommunication systems.

Edward S. Plotkin (born 1932) Bachelor in Civil Engineering at CCNY 1953. Master in Civil Engineering 1956 at CCNY, MBA in Engineering Management from Baruch College 1966. Deputy Design Director of Svendrup Engineering 1970–1974, construction manager vice president for MacLean Grove 1974–1991. Some projects Plotkin worked on are the Second Ave Subway, 63 Ave subway lines, and the NYC third water tunnel. Commissioner of Public Works in Westchester county 1992–1996, chair of the Dobbs Ferry planning board 1965–2015, President of the CCNY Alumni Association. Townsend Harris Medal 2011. Honorary Doctorate from CCNY 2019.

Michael Pope (born 1924) Bachelor in Civil Engineering at CCNY 1944. In 1946 he joined a predecessor of the company that became Pope Evans

[168] Tribute to Neville A. Parker, PhD, by the Honorable José A. Serrano, of New York. January 25, 2009. Congressional Record: Senate. Vol 155 part 5.

and Robbins Inc, and stayed with it 1946–1983, from 1969–1983 as CEO and chairman. 1983–1984 senior partner of Pope Engineers, 1984–1987 president of Parsons Brinckerhoff Development Corporation, 1988–1989 president of Aegis Industries; 1989–1991 president of Robbins, Pope and Griffis, CEO of Pepe, Evans and Robbins since 1991 until his retirement 2004. In his retirement he decided that he should never stop learning, and received a Bachelor in English 2016 from St Joseph's College. President of the City College Fund 1976–1979. David Steinman Medal 1981, Townsend Harris Medal 1983.

Wilbur Louis Pritchard (1923–1999) Bachelor in Electrical Engineering at CCNY 1943. In 1947 Pritchard joined Raytheon and worked on problems of microwave technologies, then 1960–1962 for a Raytheon subsidiary on radar teachnologies. In 1962 he joined the Aerospace Corporation, and directed the team that created the nation's first operational military satellite system. In 1967 he moved to the Communication Satellites Corporation (COMSAT), establishing their research labs, and creating numerous technologies for use in satellites. He served 1973–1974 as president of Fairchild Space and Electronics Company. He founded two companies working on satellite communications. Honorary doctorate from CCNY in 1993. Member of the National Academy of Engineering since 1995, for contributions to microwave and satellite technology as applied to communication and direct broadcast. Townsend Harris Medal 1976[169] Book: Wilbur L. Pritchard, Joseph A. Sciulli: Satellite communication systems engineering, 1993 (2nd ed.)

Jacob Rabinow (1910–1999) Bachelor in Electrical Engineering at CCNY 1933. Master in Electrical Engineering 1934. Joined the National Institute of Standards in 1938, and advanced there to become the Chief of the Electro-Mechanical Ordnance Division, the left in 1954 to form his own company, Rabinow Engineering. Rabinow was a prolific inventor, during this period he invented among other things the first magnetic disc data storage media for computers, the first magnetic particle clutch, and the first machine for automatically reading the addresses on letters and sorting mail. In 1964, his company was bought by the Control Data Corporation (CDC), one of the big manufacturers of that time, and Rabinow became a Vice President of CDC, which he stayed until 1972. In 1968 he again started a company, RABCO, to produce a linear tracking phonograph he had invented. Phonographs (turntables) usually have the pickup cartridge at the end of a pivoted tone arm, but this way the stylus of the cartridge cannot always be tangential to the groove on the disc; an alternative is to move the cartridge on a radial arm, keeping the stylus always tangential to the groove. RABCO's phonographs were

169 Wilbur L. Pritchard 1923–1999, by Yvonne Brill and John F. Kelly. Memorial Tributes of the National Academy of Engineering Vol 9 (2001)

an early successful implementation of this principle. RABCO was bought by Harman-Kardon, and Rabinow returned in 1972 to the National Institute of Standards, where he was Chief Research Engineer until his retirement in 1989. He earned a total of 229 US patents. He received the CCNY School of Engineering's 50th anniversary medal in 1969. Member of the National Academy of Engineering since 1976 for inventions and development of devices in computers, power transmission, and post office automation. Book: Jacob Rabinow: Inventing for Fun and Profit, San Francisco Press 1989.

Alvin E. Radkowsky (1915–2002) Bachelor in Electrical Engineering at CCNY 1935. Master in Physics from George Washington University, PhD in Physics 1947 from the Catholic University of America. After graduating from CCNY, Radkowsky worked for the Singer Sewing Machine Corporation, then in 1938 joined the U.S. Navy Bureau of Ships as electrical engineer. While working at the Bureau of Ships he completed his Master, with Edward Teller as advisor, then his PhD; and in 1947 he joined the Navy's study of nuclear propulsion. From 1948 to 1950 he studied nuclear reactor technology at the Argonne national lab, then he led the Navy's reactor development effort as chief scientist, earning the Navy's Distinguished Civilian Award in 1954. In 1972 he retired from government service, and moved to Israel, where he became associated with Tel Aviv and Ben Gurion universities. In 1992 he started the Radkowsky Thorium Power Corporation. Member of the National Academy of Engineering since 1991, for seminal contributions and innovations in the engineering development of nuclear power. Townsend Harris Medal 1968[170]

John Ralph Ragazzini (1912–1988) Bachelor in Electrical Engineering at CCNY 1933. Master 1939 and PhD 1941, both in Electrical Engineering from Columbia University. After graduation, Ragazzini joined the Columbia faculty, 1941 as instructor, from 1944 as assistant professor, 1947 associate professor, 1952 professor, 1954 executive officer of electrical engineering. In 1958 he moved to New York University, as Dean of the College of Engineering; there he stayed as Professor of Applied Science until his retirement 1977. Townsend Harris Medal 1958 Book: Gene F. Franklin, John Ralph Ragazzini: Sampled-Data Control Systems, 1958.

Barbara A. Res Bachelor in Electrical Engineering at CCNY 1972. After graduation, Res initially worked with an electrical contractor, then with a general contractor, and got into construction management. She joined HRH Construction 1978–1980, then executive vice president of The Trump Organisation 1980–1992, interrupted by a time at the Hartz Mountain Corporation 1985–1987, always managing large building projects. Her largest project was

[170] Alvin E. Radkowsky 1915–2002, by Milton Levenson. Memorial Tributes of the National Academy of Engineering Vol 11 (2007)

the Trump Tower in New York. Further work as vice president Vornado Realty Trust 1993–1995, vice president for facilities of Club Quarters 1999–2003, then a change of direction to law. Res received a JD from Rutgers University 2007. Since 2016, she has her own law office. Townsend Harris Medal 1991. Book: Barbara A. Res: All Alone on the 68th Floor: How One Woman Changed the Face of Construction, 2013

Juan A. Rodriguez (born 1941) Bachelor in Electrical Engineering at CCNY 1962. Master in Electrical Engineering 1963 from New York University; after that he joined IBM working on storage technologies. In 1969 started his first company, Storage technology Corp.; then in 1985 co-founder of Exabyte, a manufacturer of magnetic tape data storage products and storage automation solutions (tape autoloaders). Founded multiple other companies[171]. Since 1992 Professor at the University of Colorado at Boulder. Townsend Harris Medal 2003. Honorary Doctorate from University of Colorado at Boulder 2011.[172]

Julius Rosenberg (1918–1953) Bachelor in Electrical Engineering at CCNY 1939. Rosenberg was the head of the famous "nuclear spy ring", which communicated secrets on the making of the atomic bomb, as well as other military technology, to the Soviet Union. Other ring members Joel Barr, William Perl, Morton Sobell, as well as the prosecution witness Max Elitcher were all graduates of the School of Engineering. Julius Rosenberg and his wife Ethel were executed by the electric chair in 1953.

Gerald Rosenfeld Bachelor in Civil Engineering at CCNY 1968, Master 1970 also CCNY, PhD in Applied Mathematics 1973 from New York University. 1973–1976 Rosenfeld was assistant professor at the University of Maryland Baltimore County, then he joined McKinsey 1976–1979, then Salomon Brothers 1979–1988, as chief financial officer 1987–1988, then managing director of Bankers Trust Company 1988–1992. Rosenfeld was head of investment banking at Lazard Freres & Co 1992–1998 CEO of Rothschild North America 1999–2007, 2007–2011 deputy chairman, then he re-joined Lazard as vice chairman of US investment banking. Townsend Harris Medal 2001.

Stanley I. Sandler Bachelor in Chemical Engineering at CCNY 1962, PhD in Chemical Engineering from University of Minnesaota 1966. Sandler joined the University of Delaware as assistant professor of chemical engineering in

171 Rodriguez in 1996 co-founded another magnetic tape data storage company, Ecrix, that introduced the VXA tape format, which was a significant technological advance in tape storage. Exabyte and Ecrix merged in 2001; then Rodriguez returned as chairman. The combined companies were bought in 2006 by Tandberg Data.

172 Oral History of Juan A. Rodriguez, Interviewed by Gardner Hendrie, Computer History Museum 2009, CHM Ref X5431.2009

1967, and stayed there for his entire professional life, since 2000 as the duPont Chair. Member of the National Academy of Engineering since 1996, for new applications of thermodynamics for chemical process design and for chemical engineering education. Townsend Harris Medal 2017 Book: Stanley I. Sandler: Chemical, Biochemical, and Engineering Thermodynamics, 2006 (4th ed.); Stanley I. Sandler: An Introduction to Applied Statistical Thermodynamics, 2010

Gino P. Santi (1916–1997) Bachelor and Master in Civil Engineering at CCNY *needs year*; Santi worked four years for NACA, the predecessor of NASA, then joined the airforce in 1947, where he gained fame for developing the pilot ejection system[173].

Dorothy Louise Schnabel Bachelor in Electrical Engineering at CCNY 1954. worked for IBM, did logic design for mainframes. Townsend Harris Medal 2015 *needs more information*

George Schoepfer (–1987) Bachelor in Civil Engineering at CCNY 1951. Schoepfer joined the Triborough Bridge and Tunnel Authority (the predecessor of MTA Bridges and Tunnels) in 1955, and became its Executive Officer and Chief Engineer in 1974. In 1982 became president of the New York State Urban Development Corporation, when it was building the Jacob Javits Convention Center. Townsend Harris Medal 1986

Robert M. Schwartz (1920–2008) Bachelor in Mechanical Engineering at CCNY 1941. Master from Newark College of Engineering, PhD from Stevens Institute of Technology. Schwartz worked 1945–1975 at the Picatinny Arsenal, as chief engineer of the U.S. Munitions Command. After his retirement from government service, he became vice president of research of the engineering company Day & Zimmermann, where he remained until 1995. Schwartz received the Army's Exceptional Civilian Service medal for the development of an atomic bomb as artillery shell, which was originally intended for use in the Korean war. He received 1961 a Presidential Medal for significant contributions to the defense of the USA. Townsend Harris Medal 1954

Harold Shames Bachelor in Mechanical Engineering at CCNY 1944. Vice President of Melard Manufacturing Corporation. In 2004 Shames endowed a professorship in biomedical engineering. Townsend Harris Medal 2009 *needs more information*

Stephen B. Shepard (born 1939) Bachelor in Mechanical Engineering at CCNY 1961. Master Mechanical Engineering Columbia 1964. Townsend Harris Medal 1990. Already as student interested in journalism; editor-in-chief of the City College Vector 1959–1961; started 1963 working for McGraw-Hill, working as technology/engineering journalist, then advancing to higher-profile

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173 New York Times, April 9, 1997: Gino P. Santi, Developer of Pilot Ejection System, Dies

journalism work, foreign correspondent of BusinessWeek in London, senior editor of Newsweek 1976–1981, editor of Saturday Review 1981–82, then executive editor, from 1984 on editor-in-chief, of BusinessWeek, until 2005, when Shepard became the founding Dean of the Graduate School of Journalism of CUNY. He served in that position until 2013. Books: Stephen B. Shepard: Deadlines and Disruption, 2012; Stephen B. Shepard: A Literary Journey to Jewish Identity, 2018.

Martin B. Sherwin Bachelor of Chemical Engineering at CCNY 1960, Master Chemical Engineering Brooklyn Polytechnic Institute 1963, PhD Chemical Engineering CCNY 1967. First graduate of the PhD program in engineering. joined Chem Systems Inc 1966, where he became vice-president of research & development 1971–1978, then managinf director of Chem Systems International, London, 1978–1980. Founder and managing director, W.R. Grace & Co. 1980–1997. Member of National Academy of Engineering since 1998, for technical leadership in the development of artificial organs, environmetally friendly insecticides, gas separation membranes, and important petrochemical processes

Morton Solomon Bachelor in Civil Engineering 1926. Solomon worked for Metcalf & Eddy Engineering, an environmental engineering company specializing in wastewate treatment, and became Senior Vice President of the company. Also served in the Army Corps of Engineers at the rank of Colonel until 1958. Townsend Harris Medal 1961. *needs more information*

Bernard Spitzer (1924–2014) Bachelor in Civil Engineering at CCNY 1943. Master in Civil Engineering and Engineering Mechanics from Columbia University 1947, started his own engineering company Spitzer Engineering, which then became an important real estate developer in New York City. Bernard Spitzer and his wife Anne started their family foundation, which, among other projects, endowed the Spitzer School of Architecture at CCNY.

Arnold F. Stancell Bachelor in Chemical Engineering at CCNY 1958. PhD Chemical Engineering at MIT 1962; first black student to achieve that in that department. Townsend Harris Medal 2009. From 1962 worked at Mobil Oil, becoming Vice President of Plastics in 1976, VP of Marketing and Refining in Europe 1982, and VP of Oil and Gas Exploration and Production in 1989. Retired from Mobil Oil in 1993, and joined Georgia Tech as Professor of Chemical Engineering. Emeritus Professor since 2004, he served 2011-2014 on the National Science Board. Member of the National Academy of Engineering since 1997, for petrochemical research and development and management of oil and gas resources.

Seymour Sternberg (born 1943) Bachelor in Electrical Engineering at CCNY 1965. Master in Computer science at Northeastern University 1968. Townsend Harris Medal 2002. Initially interested in computer systems, joined Raytheon, the Data Architects, worked on information systems for Massachussetts Mutual Life Insurance, then became head of its health insurance business, and continued his career in the management, changing 1989 to New York Life Insurance company, and becoming its CEO in 1997. He retired as CEO of New York Life in 2008, but continues as its chairman.

Sidney M. Stoller Bachelor in Chemical Engineering at CCNY 1943. Townsend Harris Medal 2009. Founder and former CEO of the nuclear engineering firm S.M. Stoller Corp. Former President and former Chairman of The City College Fund. *needs more information*

Jerome Swartz (born 1940) Bachelor in Electrical Engineering at CCNY 1961, Master 1963, PhD at the Brooklyn Polytechnic Institute. Swartz co-founded Symbol Technologies, Inc., in 1976, and served as its Chairman and Director from 1976 until his retirement in 2004. He was the pioneer of barcode technologies, making possible their ubiquitous use. He led the development of the first hand-held barcode scanner, the self-checkout systems, and the two-dimensional barcode technology. Member of the National Academy of Engineering since 2000, for bar code technologies, including laser scanners and wireless data capture.

Ghebre E. Tzeghai PhD in Chemical Engineering at CCNY 1984. Member of the National Academy of Engineering since 2014, for contributions to the world health through the development and commercialization of dental care and personal hygiene products. *needs more information*

Charles B. Yates (1939–2000) Bachelor in Chemical Engineering at CCNY 1960. After graduating, he went to Luxembourg and established a copper-foil plant as part of his family's business. In 1967 he returned to the USA and became president of the family company, then he became involved in New Jersey politics, and served 1971 to 1977 as state assemblyman, then 1977 to 1981 as state senator, where he became chairman of the Joint Legislative Committee on Ethical Standards and the Joint Appropriations Committee. In this role he pressed for independent investigations of several political scandals. After his term as senator ended, he left politics. The family company was sold to Square D in 1980, and Yates became vicepresident of that company, but left it after two years. In 1992 he became chairman of a bank in New Jersey, and in 1993 he obtained a law degree from Vermont Law School. In 1997 he became again president of the copper foil company, when it was reacquired by the family. Yates died in 2000 in crash of his private plane approaching the airport on Martha's Vineyard under somewhat mysterious circumstances[174].

Norman J. Zabusky (1929–2018) Bachelor in Electrical Engineering at

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174 New York Times, October 10, 2000: Charles B. Yates, 61, Banker and Ex-New Jersey Legislator

CCNY 1951. Master in Electrical Engineering from MIT 1953, PhD in Physics from California Institute of Technology 1959. After graduating from CalTech, he spent a year each at the Max Planck Institute for Physics in Munich and at the Plasma Physics Laboratory in Princeton. Then in 1961 Zabusky joined Bell Laboratories, where he worked until 1976. After that he became Professor of Mathematics at the University of Pittsburgh, then in 1988 the State of New Jersey Professor of Computational Fluid Dynamics at Rutgers University. He retired from Rutgers in 2006. Zabusky pioneered the use of computer simulations to gain analytical insight in nonlinear equations, and discovered in 1965, together with Martin Kruskal, the soliton solutions to the Korteweg-de Vries equation, a nonlinear partial differential equation which models waves on shallow water surfaces[175].

Irwin Zahn Bachelor in Mechanical Engineering at CCNY 1948. Started in 1954 the General Staple Company, developing a new method to produce zippers, and gradually growing the scope; the company was renamed Autosplice in 1990, and has become a market leader in electronic interconnection technologies, as well as offering many related technological services. Zahn sold Autosplice in 2011, and started the Moxie Foundation, which is dedicated to advancing educational achievement and entrepreneurial success. The Zahn Center for Entrepreneurship at CCNY was started with his support. Townsend Harris Medal 2010. Book: Natasha Josefowitz, Irwin Zahn: He Writes, She Writes: A Dialogue of Contrasting Views Written in Verse, 2017

8.3 Engineers in other ways associated with CCNY

These engineers spent some of their studies at CCNY, but did not graduate from CCNY.

David Atlas (1924–2015) started electrical engineering studies at CCNY in 1941, but then entered pre-meteorology training of a special Army Air Corps program. Doctor in Meteorology from MIT 1955. Atlas was a pioneer of radar meteorology. He served in the Air Force Cambridge Research Lab, the National Center for Atmospheric Research, and the Goddard Space Flight Center in a number of leadership roles. Member of National Academy of Engineering since 1986, for contributions, inventions, leadership, and public service in the application of radar and electromagnetic engineering to meteorology. [176]

George Washington Goethals (1858–1928) entered City College in 1876, but was admitted to the U.S. Military Academy West Point in 1879, and graduated from there 1880. He then worked for the Army Corps of Engineers.

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175 Physics Today Vol 71 Issue 8 p.61 (2018) Norman Julius Zabusky

176 David Atlas 1924–2015, by Robert J. Seraphin and Richard E. Carbone, Memorial Tributes of the National Academy of Engineering Vol 21 (2017)

Goethals is famous for the construction of the Panama Canal, a project attempted since 1881, initially by a French group under Ferdinand de Lesseps, who before that had built the Suez canal. The Panama canal turned out to be more difficult, especially because of the climate and epidemics among the workers. President Theodore Roosevelt believed the canal to be a vital U.S. strategic interest. After buying out the failed French project as well as supporting a revolution which split off the country of Panama from Colombia, and some management issues which wore out two previous chief engineers, President Roosevelt appointed Goethals in 1907 as chairman and chief engineer of the Panama Canal commission. Goethals completed the canal by 1914, and was appointed 1914–1917 as first governor of the Canal Zone. During the first world war period, Goethals worked on the transportation of soldiers and war material, first as general manager of the Emergency Fleet Corporation, then as Acting Quartermaster General, then as Assistant Chief of Staff of the Army. After the war, he was from 1919 to his death 1928 president his own engineering firm George W. Goethals and Company.

Herman Hollerith (1860–1929) entered City College in 1875, but then transferred to Columbia University, and graduated from Columbia in 1879. In 1890 he was awarded a PhD from Columbia. Hollerith invented the first machines for automatic tabulating and sorting of information, based on a punched card system. Card with holes to encode information were previously used in the Jacquard loom to encode weaving patterns; Hollerith's initial application was to encode census data of the U.S. Census of 1890; he built machines which then could count, tabulate and sort different information from these cards. His company underwent a series of mergers, which in 1924 became the International Business Machines Corporation (IBM).

George Koval (1913–2006) was born in the USA, but his family emigrated in his childhood in the Soviet Union. There he was recruited as spy, and returned in 1940 to the USA. He came through the US Army's Specialized Training Program to study Electrical Engineering at CCNY, then in 1944 transferred to the Special Engineer Detachment, which worked on the Manhattan Project. Koval left the USA in 1948; he was never identified in his lifetime. In 2007 he was awarded posthumously the title "Hero of the Russian Federation" by the Russian President Putin for his contributions to the development of the Soviet atomic bomb.

Ascher H. Shapiro (1916–2004) started his studies 1932 at CCNY, but in the College of Arts & Sciences, and moved in 1935 to MIT, where he studied Mechanical Engineering, receiving a bachelor at MIT in 1938 and a doctorate in 1946, joining the faculty of MIT, and becoming full professor in 1952, Ford chair professor 1962, department chair of Mechanical Engineering 1965–1974, institute professor at MIT 1975. After initial work on fluid dynamics, jet engines, rockets, and nuclear power, he became a pioneer in biomedical engineering. Member of the National Academy of Sciences since 1967, received honorary doctorate of the Technion 1985. Townsend Harris Medal in 1976[177].

8.4 Engineering Students winning Awards

Students can receive a number of honors and awards during their time as student; the most visible is to be seleted as the Valedictorian during the graduation ceremony. That honor usually goes to one of the highest-GPA graduating students, but other factors also enter the selection of the valedictorian, e.g., the willingness of a department chair or dean to defend a candidate in the competition. Recent Valedictorians from the School of Engineering were

2016: Antonios Mourdoukoutas (Biomedical Engineering)
2010: Atin Saha (Biomedical Engineering)
2006: Ilana Hellman (Mechanical Engineering)
2003: Silvia A. Arredondo (Chemical Engineering)
2001: Olumuyiwa Ogunnika (Electrical Engineering)
1996: Mica A. Carcamo (Civil Engineering)

Since *??* the college also recognizes the Salutatorian; recent Salutatorians from the School of Engineering are

2018: Zhiying Zhu (Biomedical Engineering)
2015: Da Wih Shin (Biomedical Engineering)

The Alumni Association also gives each year an award to the best student in each engineering major. *insert list*

[177] Ascher Shapiro. A Biographical Memoir by Ronald F. Probstein. Natonal Academy of Sciences 2014

9. Faculty Books

Books are among the most visible and lasting contributions to the intellectual life and professional culture. Below is a [*still incomplete*] list of books whose authors were CCNY engineering faculty[178] The types of books written by engineering faculty are very diverse; David Steinman wrote on Bridges, but also poetry; Harold Rothbart on Cams and poetry; Arthur Squires on government management of technology, but also on anthropology. The most prolific authors in the faculty were writing programming textbooks: Daniel McCracken and ???. McCracken wrote the first Fortran textbook.

Iris Anshel; **Michael Anshel**; Dorian Goldfeld: Contributions to contemporary cryptography; World Scientific 2002

George C. Authenriet, **Peter L. Tea**, **H. Vandervoort Walsh**: Elements of Descriptive Geometry for Students of Engineering, 1948, 363 pages.

James J. O'Connor, John Boyd, **Eugene A. Avallone**: Standard Handbook of Lubrication Engineering, McGraw-Hill 1968

Theodore Baumeister, **Eugene A. Avallone**: Marks' Standard Handbook for Mechanical Engineers, McGraw-Hill 1978[179]

Mitra Basu, Tin Kam Ho: Data complexity in pattern recognition, Springer 2006

Gilbert Baumslag: Lecture Notes on Nilpotent Groups, AMS 1971

Gilbert Baumslag: Topics in Combinatorial Group Theory, Birkhäuser 1993

Gilbert Baumslag, C. F. Miller: Algorithms and classification in combinatorial group theory, Springer 1992

Gilbert Baumslag, Benjamin Baumslag: Calculus, Quantum 1976, 427 pages

Gilbert Baumslag: A course in mathematical cryptography, de Gruyter 2015

Gary F. Benenson, James L. Neujahr: Designed Environments: Places, Practices, and Plans, Heinemann 1972

Gary F. Benenson, James L. Neujahr: Mapping, Heinemann 1972

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178 The books were not necessarily written during the time the authors were at CCNY. Not included in this list are reports, dissertations, and edited works. The CCNY authors are set in boldface; the list is sorted after the name of the first CCNY author. The list was obtained by WorldCat queries for each faculty name.

179 started by Lionel Simeon Marks in 1916; revised by Eugene A. Avallone, Theodore Baumeister III. Apparently Baumeister and Avallone took over from the 8th edition 1978; the 11th edition appeared in 2006, with Ali M. Sadegh, another CCNY professor, joining the team.

Gary F. Benenson, James L. Neujahr: Mechanisms and Other Systems, Heinemann 1972

Gary F. Benenson, James L. Neujahr: Packaging and Other Structures, Heinemann 1972

Gary F. Benenson, James L. Neujahr: Signs, Symbols, and Codes, Heinemann 1972

Gary F. Benenson, **Peter Ganatos**, **Michel Ghosn**, S. Jayasena: ECSEL Freshman Design Manual, McGraw-Hill 1998

Eugene L. Boronow: Fundamentals of Engineering (F.E.) examination: a study guide for the licensed professional engineer examination, Arco Publishers 1986, 262 pages.

Peter Brass: Advanced Data Structures, Cambridge University Press 2008

Peter Brass, W.O.J. Moser, **János Pach**: Research Problems in Discrete Geometry, Springer 2005

C. W. Tan; Yusuf Efe; Alan Wolfe; **Joseph Cataldo**: GRE in Engineering, Prentice-Hall 1988

Julio F. Davalos: FRP deck and steel girder bridge systems: analysis and design, CRC Press 2013

Morton M. Denn: Optimization by Variational Methods, McGraw-Hill 1969

Morton M. Denn: Process Fluid Dynamics, Prentice-Hall 1980

T.W.F. Russell, **Morton M. Denn**: Introduction to Chemical Engineering Analysis, Wiley 1972

Morton M. Denn: Process Modeling, Longman 1986

Morton M. Denn: Polymer Melt Processing: Foundations in Fluid Mechanics and Heat Transfer, Cambridge University Press 2008

Morton M. Denn: Stability of Reaction and Transport Processes, Prentice-Hall 1974

Morton M. Denn: Chemical Engineering: A New Introduction, Cambridge University Press 2011

Bruce D. Greenshields: Statistics, with applications to highway traffic analyses, 1952 Eno Foundation for Transportation, 238 pages.

Bruce D. Greenshields: The photographic method of studying traffic behavior, 1933

Bruce D. Greenshields: Traffic performance at urban street intersections, 1947

Chuen Meei Gan, **Barry Gross**, **Fred Moshary**, YongHua Wu: Application of Remote Sensing Instrument in Air Quality Monitoring, INTECH Open Access Publisher 2011

Henry B. Hansteen: Electrician's Vest Pocket Reference Book, Prentice-Hall 1958, 154 pages

Herman R. Heideklang: Safe Product Design in Law, Management, and Engineering, Marcel Dekker 1991

Eugene Isaacson, Herbert Bishop Keller: Analysis of Numerical Methods, Wiley 1966.

Mansour Javid, **Egon Brenner**: Analysis, Transmission, and Filtering of Signals, McGraw-Hill 1963

Mansour Javid, **Egon Brenner**: Analysis of Electric Circuits, McGraw-Hill 1967

Mansour Javid, Philip Marshall Brown: Field Analysis and Electromagnetics; McGraw-Hill 1963

Latif M. Jiji: Heat Transfer Essentials: A Textbook, Bengell House 1998

Latif M. Jiji: Heat Convection, Springer 2006

Latif M. Jiji: Heat Conduction, Springer 2000

Mohammad A. Karim, Abdul A.S. Awwal: Optical Computing: An Introduction, Wiley 1992

Mohammad A. Karim: Electro-Optical Devices and Systems, PWS-Kent Publishiners, 1990

Everett L. Johnson, **Mohammad A. Karim**: Digital Design: a Pragmatic Approach, PWS Engineering 1987

Taan S. ElAli, **Mohammed A. Karim**: Continuous Signals and Systems with MATLAB, CRC Press 2001

Mohammad A. Karim, Xinghao Chen: Digital Design: Basic Concepts and Principles, CRC Press/Taylor & Francis 2008

Mumtaz Kassir: Applied Elasicity and Plasticity, CRC Press/Taylor& Francis 2018

Vladimir Fedorowic Demjanov, **George M Kranc**, Aleksandr Moiseevic Rubinov: Approximate Methods in Optimization Problems, Elsevier 1970

Viktor M. Glushkov, **George M. Kranc**: Introduction to Cybernetics,Academic Press 1966

Mark Aronowitsch Aiserman, **George M. Kranc**: Logic, Automata, and Algorithms, Academic Press 1971

Toshie Takahashi, **George M. Kranc**: Mathematics of Automatic Control, Holt, Rinehart and Winston 1966

Benjamin G. Levich: Physicochemical Hydrodynamics, Prentice-Hall 1962, 700 pages

Benjamin G. Levich: Theoretical Physics: An Advanced Text.

- Vol 1 Electromagnetic Field, Theory of relativity
- Vol 2 Statistical Physics, Electromagnetic Processes in Matter
- Vol 3 Quantum Mechanics

- Vol 4 Quantum Statistics and Physical Kinetics

Harvey L. List: Petrochemical Technology: an overview for decision makers in the international petrochemical industry, Prentice-Hall 1986

Stephen Lucci, Danny Kopec: Artificial Intelligence in the 21st Century, Mercury Learning & Information 2015

Jamal T. Manassah: Elementary Mathematical and Computational Tools for Electrical and Computer Engineers using MATLAB, CRC Press 2001.

Daniel D. McCracken: Digital Computer Programming, Wiley 1957

Daniel D. McCracken: Programming Business Computers, Wiley 1959

Daniel D. McCracken: A guide to Fortran Programming, Wiley 1961

Daniel D. McCracken: A guide to IBM 1401 programming, Wiley 1961

Daniel D. McCracken: A guide to Algol Programming, Wiley 1962

Fred Gruenberger, **Daniel D. McCracken**: Introduction to electronic computers; problem solving with the IBM 1620, Wiley 1963

Daniel D. McCracken, Umberto Garbassi: A guide to Cobol Programming, Wiley 1970

Daniel D. McCracken, William S Dorn: Numerical methods and FORTRAN programming, with applications in engineering and science, Wiley 1964

Daniel D. McCracken: Public policy & the expert; ethical problems of the witness, New York Council on Religion and International Affairs 1971

William S. Dorn, **Daniel D. McCracken**: Numerical methods with Fortran IV case studies, Wiley 1972

Daniel D. McCracken: A guide to Fortran IV programming, Wiley 1972

William S. Dorn, **Daniel D. McCracken**: Introductory finite mathematics with computing, Wiley 1976

Daniel D. McCracken: A guide to PL/M Programming for Microcomputer Applications, Addison-Wesley 1978

Daniel D. McCracken: A guide to NOMAD for applications development, Addison-Wesley 1980

Daniel D. McCracken: A second course in computer science with PASCAL, Wiley 1987

Daniel D. McCracken, W. Salmon: A second course in computer science with Modula-2, Wiley 1987

Daniel D. McCracken, R.J. Wolfe: User-centered website development : a human-computer interaction approach, Prentice-Hall 2004

Jacob Millman, Samuel Seely: Electronics, McGraw-Hill 1941

Jacob Millman: Vacuum-tube and semiconductor electronics, McGraw-Hill 1958

Jacob Millman, Christos C. Halkias: Electronic Devices and Circuits, McGraw-Hill 1967

Jacob Millman, Christos C. Halkias: Electronic fundamentals and applications: for scientists and engineers, McGraw-Hill 1976

Jacob Millman: Microelectronics: Digital and Analog Circuits and Systems, McGraw-Hill 1979

Jacob Millman, **Herbert Taub**: Pulse and Digital Circuits, McGraw-Hill 1956

Jacob Millman, **Herbert Taub**: Pulse, Digital and Switching Waveforms: Devices and Circuits for their Generation and Processing, McGraw-Hill 1965

Elizabeth Guazzelli, **Jeffrey F. Morris**, Sylvie Pic: A physical introduction to suspension dynamics, Cambridge University Press 2012

Engelbert Neus: Descriptive Geometry, 1933, 210 pages

Gerner A. Olsen: Elements of the Mechanics of Materials, Prentice-Hall 1958, 536 pages

Gerner A. Olsen: Strength of Materials, Prentice-Hall 1949, 442 pages

János Pach, Pankaj K. Agarwal: Combinatorial Geometry, Wiley 1995

János Pach, Micha Sharir: Combinatorial geometry and its algorithmic applications : the Alcalá lectures, AMS 2009

Francis J. Gichaga, **Neville A. Parker**: Essentials of Highway Engineering, Macmillan 1988

Frank A. Rappolt: Simplified mathematics and how to use the slide rule, Doubleday, Doran and Company, 1943

Harold A. Rothbart: Mechanical Design and Systems Handbook, McGraw-Hill, 1964

Harold A. Rothbart: Cams: Design, Dynamics, and Accuracy, Wiley 1956

Harold A. Rothbart: Cam Design Handbook, McGraw-Hill 2004

Harold A. Rothbart: Cybernetic Creativity, Speller 1972

Harold A. Rothbart: Bent Mirrors: Poems, Hartmus Press 1974

Damian Rouson, Jim Xia, Xiaofeng Xu: Scientific Software Design: The Object-Oriented Way. Cambridge University Press 2011

Donald L Schilling, Charles Belove: Electronic Circuits, Discrete and Integrated, McGraw-Hill 1968

Charles Belove, Harry Schachter, **Donald L. Schilling**: Digital and analog systems, circuits, and devices: an introduction, McGraw-Hill 1973

Donald L Schilling: Meteor Burst Communications: Theory and Practice, Wiley 1993

John B O'Farrell, **Alois X Schmidt**: The Use of the Literature by Chemical Engineers: A Condensed Guide. 1940. 72 pages

Alois X. Schmidt, **Charles A. Marlies**: Principles of High-Polymer Theory and Practice: Fiers, plastics, Rubber, Coatings, Adhesives. McGraw-Hill 1948, 743 pages

Alois X. Schmidt, **Harvey List**: Material and Energy Balances 1962, Prentice-Hall, 423 pages

Howard Kaufman; Izhak Bar-Kana; **Kenneth Sobel**: Direct adaptive control algorithms: theory and applications, Springer 1994

Arthur M. Squires: The Tender Ship: Government Management of Technological Change, Birkhäuser 1985

Arthur M. Squires: From Toumai to G. Stein and O. Wilde, CreateSpace Independent Publishing Platform 2011

David B. Steinman: Suspension bridges and cantilevers, their economic proportions and limiting spans, van Nostrand 1911

J. Melan, **David B. Steinman**: Theory or Arches and Suspension Bridges, Clark Publishers 1913

J. Melan, **David B. Steinman**: Plain and Reinforced Concrete Arches, Wiley 1915

David B. Steinman: A practical treatise on suspension bridges; their design, construction and erection, J. Wiley & Sons 1929

David B. Steinman: The Wichert Truss, van Nostrand 1932

David B. Steinman, Sara Ruth Watson: Bridges and their Builders, Putnam 1941

David B. Steinman: The builders of the bridge; the story of John Roebling and his son, Harcourt, Brace and Co. 1945

David B. Steinman, Kurt Wiese: Famous Bridges of the World, Random House 1953

David B. Steinman: I built a bridge, and other poems. Davidson Press 1955

David B. Steinman: Miracle Bridge at Mackinac, Eerdmans 1957

William Ratigan, **David B. Steinman**: The Long Crossing, Eerdmans 1959

David B. Steinman: Songs of a Bridgebuilder. Eerdmans 1959

Arthur B. Glaser, **Gerald E. Subak-Sharpe**: Integrated Circuit Engineering: Design, Fabrication, and Applications, Addison-Wesley 1977

Gabriel I. Tardos: Granulation and Coating by Fine Powders, Elsevier 2001

Gabriel I. Tardos: Fundamentals of Powder Science and Technology, Cambridge University Press 2004

Herbert Taub: Digital Circuits and Microprocessors, McGraw-Hill 1982

Herbert Taub, **Donald L. Schilling**: Digital Integrated Electronics, McGraw-Hill 1977

Herbert Taub, **Donald L. Schilling**: Principles of Communication Systems, McGraw-Hill 1986

Chan Mou Tchen: Mean Value and Correlation Problems Connected with the Motion of Small Particles Suspended in a Turbulent Fluid, Martinus Nijhoff Publishers/Springer 1947, 125 pages.

Galen Brandt Schubauer, **Chan-Mou Tchen**: Turbulent Flow, Princeton University Press 1945 (re-published 2015)

John Gever, David Skole, Robert K Kaufman, **Charles Vörösmarty**: Beyond Oil: The Threat to Food and Fuel in the Coming Decades, University Press of Colorado 1991

Michael Vulis: Modern TEX and its Applications; CRC Press 1993

H. Vandervoort Walsh, **Frank A. Rappolt**, Francis J. Burns: Blueprint Reading Made Easy, A. Neil Sawyer Company 1941.

Louis Weinberg: Network Analysis and Synthesis; McGraw-Hill 1962

Paras N. Prasad, **David J. Williams**: Introduction to Nonlinear Optical Effects in Molecules and Polymers, Wiley 1991

George Wolberg: Digital Image Warping, Wiley—IEEE Computer Society Press 1990

Louis Wolchonok: Design for artists and craftsmen, Dover 1953

Louis Wolchonok: The art of three-dimensional design : how to create space figures. Harper 1959

Louis Wolchonok: The art of pictorial composition. Harper 1961

10. The PhD Programs

The early history of the PhD programs is somewhat unclear; CUNY started offering PhD programs through the CUNY Division of Graduate Studies in 1961 with the first PhD students graduating in 1965, and first PhD students in engineering graduating 1967. CUNY created the Graduate Center as location of all PhD programs in 1969. However, since Engineering existed only at CCNY[180], the CCNY engineering program essentially stood on its own, with no need for the CUNY Graduate Center. However, the Graduate Center continued as the formal location also of the engineering program until 2008. The situation is further complicated by Computer Science, which belonged to the Engineering PhD program until 1986[181], and which did exist at other CUNY colleges. In 1986, computer science separated, and got its own executive officer. Since then, the computer science PhD program is a joint program for all CUNY computer science departments, and is located at the CUNY Graduate Center[182][183], whereas the engineering program continue to be located at the School of Engineering at CCNY.

In 2008, the Engineering PhD program[184] was formally transferred from the CUNY Graduate Center to the CCNY School of Engineering. After three decades, this finally adapted the administrative structure to the reality; the main reason why the change received administrative support was to elevate CCNY to a PhD-granting institution, which put CCNY in a different comparison category, especially for rankings. The administrative separation also contained a financial separation: since the Graduate Center managed all CUNY funds for the support of PhD students in all programs, the engineering share

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180 recently the College of Staten Island started an Electrical Engineering undergraduate program

181 each PhD thesis states that it is accepted by "the engineering faculty"; for computer science theses, this changed to "the computer science faculty in engineering", then in 1986 to "the computer science faculty"

182 at great inconvenience: PhD classes are given only at the GC, and all students are located at the GC, separate from the faculty, which are at the colleges. Physically separating students from their advisors is a most unwise decision, and contributes to long times to graduation for the students, and disengagement with the program for the faculty

183 The external evaluation of the Computer Science PhD program in 201? commented on this, and suggested that it should be considered to move the program from the Graduate Center to CCNY.

184 according to CUNY administration, there is only one engineering PhD program, which then has different specializations. According to the NY State approval, there are separate programs in the engineering disciplines; this is important, since they have separate curricular requirements.

of this was transferred to CCNY. Since then, there are complaints that the School of Engineering did not receive its just share of these CUNY funds. However, CUNY funding in total is declining, and the CUNY Graduate Center is shrinking, so the Engineering PhD programs are increasingly dependent on grants and the endowment.

Each PhD program is led by an Executive Officer, which, unlike department chairs, is not elected, but appointed. The Executive Officers of the Engineering PhD program were

- Egon Benner 1967–1971
- Jacques E. Benveniste 1972–1977
- David H. Cheng 1977–1978
- Frederick E. Thau 1979–1980
- Paul R. Karmel 1981–1987
- Jacques E. Benveniste 1988–1989
- Gerard G. Lowen 1990–1997
- Mumtaz Kassir 1998–2012
- Ardie Walser 2013–now

The Executive Officers of the Computer Science PhD program were

- Frank Beckman 1986–1988
- Thomas Wesselkamper 1989–1991
- Stanley Habib 1992–1999
- Theodore Brown 2000–2013
- Robert Haralick 2013–now

The first PhD students graduating from the Engineering PhD program were Martin B. Sherwin and Alan Peltzman in 1967, both in Chemical Engineering. In the first years, Chemical Engineering dominated the program; of the 23 students who graduated in 1967–1969, 12 belonged to chemical, 5 to mechanical, 5 to electrical, and one to civil engineering. A fairly large fraction of the PhD theses all through the 1970s and 80s were on topics related to coal gasification and the clean burning of coal.

The first woman to gain a PhD in Engineering at CCNY was Susan Dee Brandes in 1986; the second was Lisa Wang in 1991.

A posthumous PhD was awarded to Aharon Kestenbaum in 1974; he was killed in 1973 in the Yom-Kippur war in Israel.

The most prolific advisors were Donald Schilling with 40 PhD-students, Sheldon Weinbaum with 39, Michael Anshel with 37, Tarek Saadawi with 33, and Charles Maldarelli with 30; I counted co-advised students for both advisors.

Below are the PhD theses mentored by faculty from the School of Engineering, divided by the department, and within the department sorted according to the advisor[185]. The faculty that joined the Biomedical Engineering department is listed only in that department.

10.1 Biomedical Engineering

The PhD program in Biomedical Engineering was introduced only in 1999; but this list also includes earlier PhDs whose advisors moved to the Biomedical Engineering department.

- **Debra Auguste**
  1. Mansfield, Elizabeth: Synthesis and Characterization of Patterned 3D Constructs for an Engineered Fetal Trachea, 2016
- **Marom Bikson**
  1. Radman, Thomas: Neural targets of electric field stimulation, 2009
  2. Datta, Abhishek: Development of rational non-invasive brain electrotherapy: Optimization, Design and Analysis of Transcranial Current Stimulation, 2011
  3. Ng, Johnny: An MR Compatible Olfactometer For Clinical Research Use, 2012
  4. Elwassif, Maged M.: Bioheat Transfer Model and Temperature Control at DBS Electrodes: Experimentally Validated FEM of DBS lead Architecture, 2013
  4. Reato, Davide: Effects of weak electrical stimulation on brain oscillations, 2013
  5. Rahman, Asif: Synaptic Effects of Electric Fields, 2016
- **Luis Cardoso**
  1. Gu, Xiang Ian: Experimental and numerical investigation of temporal and spatial effects induced by motion and load in joint biomechanics: A study of joint loading in vivo, functional imaging, and finite element modeling with focus on articular cartilage, 2010
  2. Benalla, Mohammed: Experimental determination of the lacunar-canalicular permeability using cyclic loading, 2012
  3. Souzanchi, Mohammad F.: The effect of microarchitecture and fabric anisotropy of trabecular bone on its mechanical behavior, 2013
  4. Maldonado Martinez, Natalia: The role of microcalcifications in vulnerable plaque rupture, 2013
  5. Arnold, Adreanne Alice: A revised microcalcification hypothesis for fibrous cap rupture in human coronary arteries, 2014

[185] The information comes from the ProQuest Dissertations and Theses database (formerly Dissertation Abstracts International). I included only degrees awarded by CCNY or CUNY; some faculty had also students at other institutions, which are not included.

6. Leong, Daniel J.: CITED2-Mediated Mechanotransduction and its use for Chondroprotection, 2014
7. Palacio-Mancheno, Paolo E.: Structure-Dependent Ultrasound Accurately Predicts Anisotropic Elastic and Yield Behavior of Calcaneal Trabecular Bone, 2015 (co-advised by Cardoso and Fritton)
8. Stasiak, Mark E.: Effect of temporal onset of mechanical loading on tendon to bone healing, determined with a novel in-vivo device, 2016
9. Sunderic, Kristifor: Effects of Thermal Dosing and Ultrasound on Osteogenic Differentiation of Human Mesenchymal Stem Cells in 2D and 3D Culture, 2018

- **Stephen Cowin**
  1. Luo, Gangming: A computational study of the long term stability of total hip implants, 1994 (co-advised by Cowin and Sadegh)
  2. Zhang, Dajun: Electromechanical mechanisms of bone remodeling, 1997
  3. Arramon, Yves Pierre: A multidimensional anisotropic strength criterion based on Kelvin modes, 1997
  4. Yang, Guoyu: Averaging and bounding of anisotropic elastic constants, 1999
  5. You, Lidan: A new view of mechanotransduction in bone cells, 2002
  6. Thi, Mia Mia: Cellular communication and mechanotransduction in response to fluid shear stress, 2004
  7. Mi, Li Yuan: Analysis of avian bone response to mechanical loading using a computational connected network, 2004
  8. Yoon, Young June: Estimates of bone elastic constants at sequential hierarchical levels, 2005
  9. Han, Yuefeng: On the transmission of fluid forces to the actin cytoskeleton of bone and endothelial cells, 2006
  10. Gailani, Gaffar: Russian doll poroelasticity, 2009
  11. Benalla, Mohammed: Experimental determination of the lacunar-canalicular permeability using cyclic loading, 2012
  12. Souzanchi, Mohammad F.: The effect of microarchitecture and fabric anisotropy of trabecular bone on its mechanical behavior, 2013

- **Susannah P. Fritton**
  1. Wang, Liyun: Investigating the role of interstitial fluid flow in bone adaptation and metabolism, 2002
  2. Beno, Thoma: Investigating the role of microstructure in bone permeability, 2005
  3. Ciani, Cesare: Characterization of microporosities and load-induced interstitial fluid movement in normal and osteopenic bone, 2008

4. Sharma, Divya: Effects of estrogen deficiency on the osteocyte lacunar-canalicular network, 2012
5. Palacio-Mancheno, Paolo E.: Structure-Dependent Ultrasound Accurately Predicts Anisotropic Elastic and Yield Behavior of Calcaneal Trabecular Bone, 2015 (co-advised by Cardoso and Fritton)
6. Gatti, Vittorio: The Effects of Skeletal Unloading on Bone Microstructure and Fluid-mediated Osteocyte Mechanotransduction, 2018

- **Bingmei Fu**
  1. Yuan, Wei: Quantification of the blood-brain barrier permeability to neutral and charged solutes, 2009
  2. Li, Guanglei: Transport models and in vitro study for the permeability of the blood-brain barrier to water and solutes, 2010
  3. Liu, Qin: Microthrombosis induced by mechanical factors and light/dye treatment in intact microvessels, 2010
  4. Shi, Lingyan: The blood-brain barrier solute permeability and its regulation by chemical and physical stimuli, 2014
  5. Zhang-Chen, Lin: Inhibition of Tumor Cell Adhesion to Microvessel Walls by Suppressing Endothelial Nitric Oxide Production and Protecting Endothelial Surface Glycocalyx, 2016

- **Steven Nicoll**
  1. Walter, Benjamin A.: The role of inflammation in intervertebral disc degeneration, 2015
  2. Gupta, Michelle S.: Development of a Carboxymethylcellulose Hydrogel System for Stem Cell-Based Nucleus Pulposus Tissue Engineering, 2015
  3. Mansfield, Elizabeth: Synthesis and Characterization of Patterned 3D Constructs for an Engineered Fetal Trachea, 2016
  4. Varma, Devika: Development of a Redox-Crosslinked Cellulose-Based Hydrogel for Nucleus Pulposus Replacement and Repair, 2016
  5. Gold, Gittel T.: Development of an Injectable, Cellulose-Based Hydrogel System for Soft Tissue Reconstruction, 2017
  6. Lin, Huizi Anna: Development and Functional Evaluation of Injectable Cellulose-based Hydrogels as Nucleus Pulposus Replacements for Intervertebral Disc Repair, 2018

- **Lucas Parra**
  1. Maul, Kristen K.: Early auditory experience shapes auditory fMRI and ERP responses in the adult zebra finch, 2009
  2. Su, Yuzhuo: Spectrum separation for brain tumor magnetic resonance spectroscopy imaging, 2009

3. Christoforou, Christoforos: The bilinear brain: Bilinear methods for EEG analysis and brain computer interfaces, 2009
4. Zhou, Xiang: Tinnitus as the result of gain adaptation, 2010
5. Reato, Davide: Effects of weak electrical stimulation on brain oscillations, 2013
6. Lafon, Belen: Modulation of neuronal input-output function and entrainment of endogenous brain rhythms using electrical stimulation, 2016
7. Huang, Yu (Andy): Computational Models of Current Flow in Transcranial Electrical Stimulation, 2016
8. Cohen, Samantha Syd: The inter-subject correlation of EEG in response to naturalistic stimuli, 2018 (this thesis was not in engineering, but in the neuroscience program)

- **Mitchell B. Schaffler**

1. You, Lidan: A new view of mechanotransduction in bone cells, 2002
2. Han, Yuefeng: On the transmission of fluid forces to the actin cytoskeleton of bone and endothelial cells, 2006
3. Wang, Yilin: Roles of integrins in flow induced mechanotransduction in osteocytes, 2009
4. Emerton, Kelly Brook: Osteocyte apoptosis initiation of targeted bone remodeling after estrogen withdrawal, 2009
5. Seref-Ferlengez, Zeynep: Diffused microdamage in bone vivo: Structural and mechanical bases of repair, 2014
6. Frikha-Benayed, Dorra: In vivo assessment of osteocyte oxidative metabolism, 2016
7. Cabahug-Zuckerman, Pamela: A $\beta 3$ integrin based mechanosome in bone tissue osteocytes: Plasticity to changes in mechanical loading, 2016
8. Lewis, Karl: Osteocyte Calcium Signaling Responses to Mechanical Load in vivo: A Novel Experimental Approach, 2017
9. Akbas, Ayse Serra: Local Bone Tissue Mechanical Property Changes Without Bone Remodeling: Regulation at the Osteocyte Level, 2018

- **John M. Tarbell**

1. Lopez, Sandra V.: Permeability and glycocalyx mediated shear stress response of endothelium in hyperglycemia, 2010
2. Cancel, Limary M.: The role of apoptosis and mitosis in LDL transport across endothelial cell monolayers, 2010
3. Shi, Zhongdong: Mechanotransduction of interstitial flow modulates vascular smooth muscle cell and fibroblast motility and phenotype in 2-D and 3-D, 2010

4. Qazi, Henry: Effects of interstitial flow and fluid shear stress on tumor cell invasion and metastasis, 2012
5. Mathura, Rishi A.: Hydraulic conductivity of arterial endothelial cell and smooth muscle cell cocultures, 2012
6. Lee, Jia-Jye: Spatiotemporal heterogeneity of aortic and pulmonary micromechanics in Marfan syndrome, 2015
7. Amaya Gomez, Ronny Alejandro: Effects of the interaction between fluid wall shear stress and solid circumferential strain on gene expression in endothelial cells, 2015
8. Russell-Puleri, Sparkle: Mechanisms of flow-dependent endothelial cyclooxygenase-2 and prostaglandin I2 regulation, 2016
9. Nikmanesh, Maria: Mechanotransduction modulates the effect of mechanical forces (fluid shear stress and cyclic strain) on embryonic stem cell differentiation toward vascular endothelial cells, 2016
10. Bartosch, Anne Marie W.: Investigating Endothelial Mechanotransduction Using AFM Pulling: Cell Surface Molecules Glypican-1 and PECAM-1 Mediate the Production of Nitric Oxide and Prostacyclin, 2018

- **Maribel Vazquez**
  1. Kong, Qingjun: Growth factor-induced cell migration using microfabricated devices, 2009
  2. Able, Richard A., Jr.: Real-time Measurement of Glial Progenitor Chemotactic Migration, 2012
  3. McCutcheon, Sean: A Multi-Scale Fluidic Platform for the Study of Dendrite-Mediated Cell Communication, 2017
- **Sihong Wang**
  1. Chen, Jing: Thermal Regulation of Human Mesenchymal Stem Cell Differentiation toward Bone and Cartilage Lineages, 2013
  2. Dereli-Korkut, Zeynep: Development of 3D Microfluidic Living Cell Arrays For Anti-Cancer Drug Screening in Mimicked Tumor Microenvironment, 2013
  3. Sunderic, Kristifor: Effects of Thermal Dosing and Ultrasound on Osteogenic Differentiation of Human Mesenchymal Stem Cells in 2D and 3D Culture, 2018
- **Sheldon Weinbaum**
  1. Saukin, Walter P.: The nature of thermal and flow fields in the vicinity of thermal discontinuities, 1971 (co-advised by Weinbaum and Jiji)
  2. Goldgraben, J. Richard: Hydrodynamic models of water and solute transport in channels and exit mixing regions of epithelial cell layers,

1972 (co-advised by Weinbaum and Graff)

3. Tu, King-Mon: Viscid-inviscid flow interaction, 1975
4. Leichtberg, Sam: Multiparticle low Reynolds number flow with biorheological applications, 1975 (co-advised by Weinbaum and Pfeffer)
5. Kolansky, Michael Steven: Studies in fluid mechanics, 1976 (co-advised by Pfeffer and Weinbaum)
6. Ganatos, Peter: A numerical solution technique for three-dimensional multiparticle Stokes flows, 1979 (co-advised by Weinbaum and Pfeffer)
7. Palaszewski, Stephen John: An air-vapor-droplet local interaction model for spray units, 1980 (co-advised by Jiji and Weinbaum)
8. Dagan, Zeev: Entrance effects in Stokes flow through a pore, 1981 (co-advised by Weinbaum and Pfeffer)
9. Wu, Randall: Theoretical and experimental studies in transient membrane-fluid film interactions for single cells and assemblages, 1981
10. Zhang, Guo-Ping: Steady and transient multi-dimensional solutions for melting and freezing around a buried tube in a semi-infinite medium, 1985 (co-advised by Jiji and Weinbaum)
11. Lawrence, Christopher John: Inertial interactions of particles and boundaries in viscous flows, 1986
12. Song, Wei Jie: Theoretical modeling of peripheral tissue and whole-limb heat transfer, 1987 (co-advised by Weinbaum and Jiji)
13. Zhu, Min: Generalization of the Weinbaum-Jiji bioheat equation and studies of whole limb heat transfer, 1990 (co-advised by Weinbaum and Jiji)
14. Yuan, Fan: Models for receptor-mediated LDL metabolism and arterial macromolecular transport, 1990
15. Tsay, Ruey-Yug: The mechanics of transcapillary exchange, 1991
16. Fu, Bing-Mei: Transport models for the interendothelial cleft, 1995
17. Wu, Yulong: Theoretical and experimental heat transfer studies of the rat tail with application to the human digit, 1995 (co-advised by Weinbaum, Jiji, and Lemons)
18. Zhu, Liang: Temperature modulation and local heat transfer in the microcirculation, 1995
19. Huang, Yaqi: Water filtration and macromolecular transport in the artery wall, 1996
20. Zhang, Dajun: Electromechanical mechanisms of bone remodeling, 1997
21. Song, Ji: Experimental and theoretical studies on vasculature and heat transfer in the rat spinotrapezius muscle, 1998
22. Feng, Jianjun: Particle motion in a Brinkman medium with applications to biological transport, 1999 (co-advised by Weinbaum and

Ganatos)

23. Yin, Yongyi: The initiation and growth of extracellular lipid liposomes in arteries and valves, 1999
24. Butler, Peter Jonathan: Endothelial-dependent, shear-induced vasodilation is rate-sensitive, 1999
25. Hu, Xiaping: A new view of Starling's hypothesis at the microstructural level, 2000
26. You, Lidan: A new view of mechanotransduction in bone cells, 2002
27. Guo, Peng: Mechanotransduction and water transport in rat proximal tubule, 2003
28. Thi, Mia Mia: Cellular communication and mechanotransduction in response to fluid shear stress, 2004
29. Wu, Qianhong: Lift generation in soft porous media: From red cells to skiing to a new concept for a train track, 2005 (co-advised by Weinbaum and Andreopoulos)
30. Zhang, Xiaobing: Mechanotransduction and flow across the endothelial glycocalyx, 2005
31. Han, Yuefeng: On the transmission of fluid forces to the actin cytoskeleton of bone and endothelial cells, 2006
32. Vengrenyuk, Yuliya: New hypothesis for vulnerable plaque rupture due to microcalcifications in thin fibrous caps, 2009
33. Duan, Yi: Flow-mediated mechanotransduction in mouse proximal tubule, 2009
34. Wang, Yilin: Roles of integrins in flow induced mechanotransduction in osteocytes, 2009
35. Mirbod, Parisa: On the generation of lift force in random, soft porous media; its application to an airborne jet train, 2010 (co-advised by Weinbaum and Andreopoulos)
36. Wu, Danielle Nicole: Focal activation and intercellular signaling in osteocyte networks initiated by a novel Stokesian Fluid Stimulus Probe (SFSP), 2012
37. Causey, Laura: Quantitative model for predicting intramuscular fluid pressure and skeletal muscle compressibility during contraction and stretch with oxygen transport correlations, 2013
38. Maldonado Martinez, Natalia: The role of microcalcifications in vulnerable plaque rupture, 2013
39. Arnold, Adreanne Alice: A revised microcalcification hypothesis for fibrous cap rupture in human coronary arteries, 2014

10.2 Chemical Engineering

- **Andreas Acrivos**
  1. Polifke, Wolfgang Herbert: Aspects of helicity in turbulent flows, 1990
  2. Kapoor, Bir: Flow of a sediment layer on an inclined plate, 1994
  3. Wang, Yongguang: Studies on the effective properties of suspensions, 1997
  4. Tripathi, Anubhav: Experimental investigations of shear-induced particle migrations in concentrated suspensions undergoing shear, 1998
  5. Tirumkudulu, Mahesh Subramaniyam: Viscous resuspension and particle segregation in concentrated suspensions undergoing shear, 2001
  6. Jin, Bo: Particle segregation in a sheared suspension with a free surface, 2004
  7. Kumar, Anil: An experimental and theoretical study of electric-field induced particle segregation in concentrated suspensions, 2005
- **Sanjoy Banerjee**
  1. Rane, Jayant Pratapsing: Asphaltene stabilised oil-water interfaces, 2013
  2. Ingale, Nilesh D.: Rechargeability of alkaline Zn-MnO2 batteries: Experimental and mathematical studies, 2015
  3. Zarkar, Sharli: Adsorption of asphaltenes at oil-water interfaces and mechanisms for demulsification of water-in-oil emulsions, 2015
  4. Desai, Divyaraj: Nucleation and growth in alkaline zinc electrodeposition An Experimental and Theoretical study, 2015
  5. Wei, Xia: Study of electrodeposited zinc morphology in rechargeable alkaline batteries, 2016
  6. Majji, Madhu Venkata Rama Krishna: Inertial Instabilities of Suspension Flow in Taylor-Couette Geometry, 2017
- **Elizabeth J. Biddinger**
  1. Karaiskakis, Alexandros N.: Investigation of the Catalytic and Associated Factors that Impact Activity and Selectivity in Carbon Dioxide Electroreduction, 2018
  2. Jung, Sungyup: Sustainable processes for electrochemical conversion of biomass and energy storage, 2018
- **Marco Castaldi**
  1. Crowley, Stephen: Morphology dynamics of precious metal catalysts for the steam reforming of oxygenated fuels, 2016
  2. LeBlanc, Jeffrey: Slow Pyrolysis Experiments for High Yields of Solid Carbon, 2016
  3. Tupsakhare, Swanand: Simulation of In-situ Combustion in Gas Hydrate Systems for Methane Production & Carbon Sequestration, 2017
- **Alexander Couzis**

1. Krishnan, Srinivasan: Kinetics of octadecyltrichlorosilane self-assembly on silicon oxide surfaces: An experimental and numerical study, 1999
2. Kumar, Nitin: Study of adsorption of trisiloxane surfactants on air-water and hydrophobic solid -water interface: An attempt to explain the super-spreading behavior, 2001
3. Lorenzo, Jose Miguel: Measuring the surface dilatational viscosities of surfactant monolayers at the air -water interface by the shape analysis of deforming pendant drops, 2001
4. Palla, Chandra Sekhar V.: Investigating the structural and chemical properties of self -assembled monolayers as a function of hydrocarbon chain length and terminal functional group, 2003
5. Chi, Changzai: Polymorph selective crystallization using organized organic assemblies as templates, 2003
6. Song, Qing: A theoretical and experimental study of surfactant transport from a micellar solution to a clean air /water interface, 2004
7. Liu, Hongjie: Fabrication of nanoisland surfaces by self-assembling monolayers and intact liposome arraying, 2005
8. Kalyankar, Nikhil D.: Novel biosensors using intact liposome microarrays, 2007
9. Halverson, Jonathan D.: Molecular dynamics simulations of the wetting behavior of nanodroplets of water and aqueous surfactant solutions on solid substrates of varying surface energy, 2008
10. Vaidya, Shyam V.: Spectral barcoding of polystyrene microspheres using luminescent semiconductor nanocrystals (quantum dots), 2008
11. Payne, Makonnen Mateos: Synergistic surfactant interactions and the consequences on phase behavior, interfacial tension reduction and hydrophobic surface wetting, 2008
12. Monastiriotis, Spyridon: Facile highly scalable method for templating hollow silica spheres using a two step synthesis, 2010
13. Salako, Oluwaseun Ibrahim: Adsorption behaviors of surfactant at hydrate-water interface, 2013
14. Savaji, Kunal: Kinetics and surface behavior of electrostatically adsorbed particles at a solid-liquid interface, 2015
15. Li, Xue: Electrostatic adsorption of nanoparticles at solid-liquid interfaces, 2015
16. Zarkar, Sharli: Adsorption of asphaltenes at oil-water interfaces and mechanisms for demulsification of water-in-oil emulsions, 2015

- **Morton M. Denn**
  1. Rai, Pradeep K.: Interfacial effects in blends with a liquid crystalline dispersed phase, 2004

2. Xu, Fang: Study of wall slip in entangled polymer melts using stochastic simulation, 2006
3. Singh, John P.: Two dimensional bubbles and drops in a yield stress fluid, 2007
4. Goyal, Rajesh Kumar: Orientation distribution and transitions in polymer-dispersed liquid crystalline droplets, 2008

- **M. Lane Gilchrist Jr.**
  1. Sampathkumar, Parthasarthy: Biologically-based self-assembled monolayers, 2004
  2. Sharma, Manoj K.: Supramolecular complexes for stabilizing membrane protein biocatalysts in native lipid bilayers, 2005
  3. Zhong, Lina: Tether-supported biomembranes with alpha-helical peptide-based anchoring constructs, 2011 (co-advised by Gilchrist and Tu)
  4. He, Bin: Synthesis, characterization, and applications of microsphere-supported biomembranes, 2011
  5. Fried, Eric: Applications of proteolipidbeads in biomimetic cellular interactions and lipid phase separation, 2016
  6. Kyeyune-Nyombi, Eru: Studies of jammed particle systems, 2016 (co-advised by Gilchrist and Makse (Physics))
- **Robert A. Graff**
  1. Goldstein, Arnold Milton: Feasibility study of the oscillatory method for thermal diffusivity measurement in gases, 1968
  2. Schwettmann, Frederick Nickels: Mechanism of the oxidation of titanium-disilicide: 300–1300 degress C, 1970
  3. Ruth, Lawrence A.: Reaction of hydrogen-sulfide with half-calcined dolomite, 1973 (co-advised by Graff and Squires)
  4. Dobner, Samuel: A high pressure thermobalance for process studies, 1976 (co-advised by Squires and Graff)
  5. Siegell, Jeffrey Howard: Defluidization phenomena in fluidized beds of sticky particles at high temperatures, 1976
  6. Chen, Wei-Yin: Flash hydrogenation of coal, 1982
  7. Brandes, Susan Dee: Modification of coal by subcritical steam (pyrolysis, extraction, swelling), 1986 (the first woman to get a PhD in Engineering)
  8. Ivanenko, Olga: Steam pretreatment for coal liquefaction, 1997
  9. Zheng, Jianhong: Rapid thermal conditioning of sewage sludge, 1997
- **Leslie L. Isaacs**
  1. Wang, Wei-Yeong: The heat capacity of coal chars, 1982
  2. Ledesma, Ramona. Applications of thermal analytic techniques in materials engineering, 1991

3. Yao, Di: Development of tetravalent chromium doped tunable solid state laser materials, 1999
4. Popov, Ivan: Synthesis and characterization of glass -ceramic materials for optical applications, 2009

- **Stanley Katz**
  1. Sherwin, Martin B.: Dynamic behavior of the well stirred isothermal crystallizer, 1967 (co-advised by Shinnar and Katz)
  2. Millman, Martin C.: Optimal temperature control in batch reactors, 1968
  3. Krambeck, Frederick J.: Stochastic mixing models for chemical reactions, 1968 (co-advised by Katz and Shinnar)
  4. Cegla, Uriel G.: The design of feedback control for systems with stationary stochastic disturbances, 1969 (co-advised by Shinnar and Katz)
  5. Goldin, Michael Martin: Breakup of a laminar capillary jet of a non-Newtonian fluid, 1970 (co-advised by Shinnar and Katz)
  6. Lei, Shang-Jen: Dynamics and control of the continuous crystallizer with fines trap, 1970 (co-advised by Katz and Shinnar)
  7. Evangelista, John Joseph: Small-scale mixing effects in stirred reactors, 1970

     Stanley Katz died in 1972; the following students started with Katz as advisor, and switched to Reuel Shinnar after Katz' death:
  8. Liss, Barry: The dynamic behavior of particulate systems involving simultaneous nucleation and growth, 1975
  9. Stern, Sidney Simon: The effects of experimental error and filters on the measurement of relative volumes and permeability, 1975
  10. Bayewitz, Marvin Herbert: Gorth of particles in coalescing systems, 1975

- **Morris Kolodney**
  1. Levine, Stanley R.: The thermodynamics of refractory metal silicides by an electromotive force method, 1968
  2. Halbfinger, George Philip: Activated sintering of thoria-yttria solid electrolytes, 1972

- **Ilona Kretzschmar**
  1. Pawar, Amar Babanrao: Fabrication and application of surface-anisotropic particles, 2009
  2. Cui, Jingqin: On the preparation, characterization, and application of Janus spheres, 2009
  3. Song, Jung Hun (Kevin): Template-assisted materials engineering, 2009

4. Mathew, Sonia Susan: The Effect of Network Geometry on Electron Transport in a Titanium Dioxide Photoanode of a Dye-sensitized Solar Cell, 2013
5. Chen, Hsinyu: Effect of Janus Particles on Performance of Electroactive Polymer Films, 2013
6. Chen, Weikang: Dynamics of nanoparticles in fluids and at interfaces, 2014
7. He, Zhenping: Fabrication and Assembly of Patchy Particles with Uniform Patches, 2014
8. Ren, Bin: Magnetic Janus Particles and Their Applications, 2014
9. Van Tassell, Barry James: Scalable fabrication of energy storage materials using spray deposition, 2015
10. Razavi, Sepideh: Janus colloidal particles and fluid interfaces: Approach, breach, and flow behavior, 2015
11. Chang, Roger Nanostructured Zinc Oxide Materials for Use as Dye Sensitized Solar Cell Working Electrodes and Photocatalysts, 2016

- **Alberto La Cava**
  1. Shen, Shi-Jin: Characterization of liquid fuels by flash pyrolysis of coal in various atmospheres, 1984
  2. Fernandez-Raone, Elvio Daniel: Iron catalyst deactivationby carbon deposition from synthesis gas, 1985

- **Harvey L. List**

  Argyriou, Dimitris T.: Bubble growth by coalescence in gas fluidized bed, 1968

- **Charles Maldarelli**
  1. Stebe, Kathleen Joan: The remobilization of the interfaces of moving bubbles and droplets retarded by surfactant adsorption, 1989
  2. He, Zunqing: The influence of surfactants on the motion of spherical fluid particles in an infinite medium and in a tube, 1989
  3. Lin, Shi-Yow: A study of the effects of cohesive forces on the sorption kinetics of surfactants by pendant drop digitization, 1991
  4. Georgiou, Evangelos: Linear interfacial stability of a core-annular flow with application to liquid-liquid displacements in small pores, 1991
  5. Chen, Jinnan: Thermocapillary migration of fluid particles in tubes, 1994
  6. Pan, Rennan: A study of surfactant equations of state and transport dynamics at the air-water interface, 1996
  7. Huang, Wei: The measurement of wetting layers in two-phase flows in capillaries and the effect of surfactant on the wetting layer thickness, 1997

8. Chauhan, Anuj: Capillary instability of jets, 1998
9. Subramanyam, Rajeev: Phase transitions among aqueous soluble surfactants at the air-water interface and its effect on dynamic surface tension and spreading and retention of drops impacting on a hydrophobic surface, 1999
10. Palaparthi, Ravichandra V.: Effect of surfactant transport on the mobility of bubbles in liquids: An experimental and computational study, 2001
11 Lorenzo, Jose Miguel: Measuring the surface dilatational viscosities of surfactant monolayers at the air-water interface by the shape analysis of deforming pendant drops, 2001
12. Kumar, Nitin: Study of adsorption of trisiloxane surfactants on air-water and hydrophobic solid-water interface: An attempt to explain the super-spreading behavior, 2001
13. Chi, Changzai: Polymorph selective crystallization using organized organic assemblies as templates, 2003
14. Song, Qing: A theoretical and experimental study of surfactant transport from a micellar solution to a clean air/water interface, 2004
15. Naouli, Nabil: Non-ionic microemulsion mechanism and theory of formation, 2005
16. Liu, Hongjie: Fabrication of nanoisland surfaces by self-assembling monolayers and intact liposome arraying, 2005
17. Kalyankar, Nikhil D.: Novel biosensors using intact liposome microarrays, 2007
18. Taneja, Ashish: Using surfactants to remobilize the interface of a rising bubble a theoretical and experimental study, 2007
19. Payne, Makonnen Mateos: Synergistic surfactant interactions and the consequences on phase behavior, interfacial tension reduction and hydrophobic surface wetting, 2008
20. Halverson, Jonathan D.: Molecular dynamics simulations of the wetting behavior of nanodroplets of water and aqueous surfactant solutions on solid substrates of varying surface energy, 2008
21. Vaidya, Shyam V.: Spectral barcoding of polystyrene microspheres using luminescent semiconductor nanocrystals (quantum dots), 2008
22. Huang, Fenfen: Theory and experiment on the transport of surfactant from micellar solutions to a clean air/water interface: Experimental evidence of direct micelle adsorption route, 2009
23. Aguirre, Gerson: Fabrication of quantum dot encoded silica beads for high-throughput screening applications, 2011
24. Bhole, Nikhil S.: Interfacial transport processes involved in the surfactant facilitated wetting of liquids on solid surfaces and non-wetting

on superhydrophobic surfaces, 2011

25. Sharifi Mood, Nima: The Diffusiophoretic Motion of Colloids, 2013
26. Leary, Thomas F.: Hydrodynamic and Mass Transport Properties of Microfluidic Geometries, 2014
27. Chen, Xiaoxiao: A microfluidic microbead-based array for screening the binding interactions of biomolecules, 2014
28. Knapp, Elizabeth: Active colloidal systems and wettability of solid substrates in oil water systems, 2015
29. Dani, Archit: Particles And Drops At Interfaces: A Hydrodynamic Study, 2017
30. Mozaffari, Ali: Boundary Guidance in Self-propelled Colloidal Motors, 2017

- **Roberto Mauri**
  1. Wang, Yongguang: Studies on the effective properties of suspensions, 1997
  2. Vladimirova, Natalia Valerievna: Numerical simulations of phase separation of deeply quenched mixtures, 1998
  3. Gupta, Rajan: Phase separation of solvent mixtures with a critical point of miscibility, 1999
- **Jeffrey F. Morris**
  1. Kulkarni, Pandurang Manohar: Suspension mechanics at finite inertia, 2009
  2. Kulkarni, Sandeep Dileep: Dense suspension rheology and flow phenomena, 2010
  3. Cao, Xiujuan: Aggregation and Gelation of Silica Nanoparticles, 2011
  4. Karanjkar, Prasad Uday: Evolving morphology and rheological properties of an emulsion undergoing clathrate hydrate formation, 2012
  5. Nazockdast, Ehssan: Smoluchowski theory for concentrated colloidal dispersions far from equilibrium, 2013
  6. Zylyftari, Genti: Hydrate forming emulsion: A rheological, thermodynamic and morphological study, 2014
  7. Gharaghieh, Hamed Haddadi: Fluid Mechanics of Inertial Particle-Laden Flow, 2014
  8. Ahuja, Amit: Hydrate forming emulsion: Rheology and morphology analysis for flow assurance, 2015
  9. Manoorkar, Sojwal: Inertial suspension flow in bifurcating channels, 2016
  10. Marenne, Stephanie: Unsteady Shear Flows of Monodisperse Colloidal Suspensions Using Discrete Particle Simulations, 2017
  11. Majji, Madhu Venkata Rama Krishna: Inertial Instabilities of Suspension Flow in Taylor-Couette Geometry, 2017

12. Pednekar, Sidhant: Polydispersity and interparticle forces on suspension rheology, 2019

- **Robert Pfeffer**
  1. Peltzman, Alan: The effect of a small number of inert particles on the local and overall mass transfer rates from a single sphere at low Reynolds number, 1967
  2. Rossetti, Salvatore J.: Experimental determination of pressure drop and flow characteristics of dilute gas-solid suspensions, 1969
  3. Chen, Wu-Chi: Mass transfer with homogeneous chemical reaction around spherical particles, 1969
  4. Gluckman, Michael John: Low and intermediate Reynolds number flows in multiparticle systems, 1971
  5. Paretsky, Leon Carl: Filtration of aerosols by granular beds, 1972 (co-advised by Pfeffer and Squires)
  6. Kane, Ronald Steven: Drag reduction in dilute flowing gas-solid suspensions, 1973
  7. Leichtberg, Sam: Multiparticle low Reynolds number flow with biorheological applications, 1975 (co-advised by Weinbaum and Pfeffer)
  8. Lee, Kun-Chieh: Filtration of redispersed power-station fly ash by a panel bed filter with puffback, 1975 (co-advised by Squires and Pfeffer)
  9. Kolansky, Michael Steven: Studies in Fluid Mechanics, 1976 (co-advised by Pfeffer and Weinbaum)
  10. Ganatos, Peter: A numerical solution technique for three-dimensional multiparticle Stokes flows, 1979 (co-advised by Weinbaum and Pfeffer)
  11. Dagan, Zeev: Entrance effects in Stokes flow through a pore, 1981 (co-advised by Weinbaum and Pfeffer)
  12. Hassonjee, Qaizar Nisar: An "exact" solution for the hydrodynamic interaction of a three-dimensional finite cluster of arbitrary sized spherical particles at low Reynolds number, 1987 (co-advised by Ganators and Pfeffer)
  13. Kao, Ju-Nan: A study of aerosol separation in granular and fibrous filters, 1987 (co-advised by Tardos and Pfeffer)
  14. Compo, Peter C.: Thermally induced agglomeration in fluidized beds, 1989 (co-advised by Tardos and Pfeffer)
  15. Yuan, Fan: Models for receptor-mediated LDL metabolism and arterial macromolecular transport, 1990
- **Irven Rinard**
  1. Fan, Zhen: IGCC power plant simulation: Steady state, dynamic and control, 1993
  2. Huang, Zupeng: Modeling, simulation, stability analysis and control of a modern fluidized catalytic cracker, 1995

3. Arbel, Arnon: Partial control of complex chemical plants, 1996
4. Huang, Shaoqun: Model fidelity considerations in the dynamic simulation of equilibrium staged separation operations, 1996
5. Citro, Francesco: A rational framework for evaluating potential advantages and possible obstacles to process simplification, 2005
6. Chin, James: Development of a general design method for intensifying distillation and multiple reactions, 2007

- **David S. Rumschitzki**
  1. Georgiou, Evangelos: Linear interfacial stability of a core-annular flow with application to liquid-liquid displacements in small pores, 1991
  2. Lim, Kwang-Hee: Mathematical/kinetic models for low density lipoprotein pathway in non-hepatic human cells (using historic experimental data on human fibroblasts), 1992
  3. Liu, Ke: Reaction and coking kinetics of n-heptane catalytic reforming, 1995
  4. Huang, Lin: Heat transfer to a vapor bubble suspended near or attached to a solid plate, 1996
  5. Huang, Yaqi: Water filtration and macromolecular transport in the artery wall, 1996
  6. Chauhan, Anuj: Capillary instability of jets, 1998
  7. Yin, Yongyi: The initiation and growth of extracellular lipid liposomes in arteries and valves, 1999
  8. Wei, Hsien-Hung: The effect of tube corrugation on the stability of a core -annular flow, 2000
  9. Shou, Yixin: Water and macromolecular transport into the walls of vessels with differing atherogenic susceptibilities, 2005
  10. Zeng, Zhongqing: Macromolecular transport in heart valves and blood vessel walls, 2006
  11. Nguyen, Tieuvi H.: Aquaporin-1 contribution to rat aortic endothelial hydraulic conductivity and how chronic transmural pressure affects it, 2008
  12. Russell, Stewart: Energy depletion causes endothelial hyperpermeability in hyperglycemia, 2008
  13. Sun, Yu: The focal spread of macromolecular tracers in vessel walls: Frequency and effect of intima compaction and blood pressure, 2008
  14. Toussaint, Jimmy Deon: Aquaporin-1 and pressure-driven water transport across aortic endothelia. Aquaporin-1 expression, distribution and regulation, 2009
  15. Bao, Jinyong: Continuum and Molecular Dynamics Simulations of the Growth of a Vapor Bubble on a Heating Surface: Exploring the Mechanism of Nucleate Boiling Heat Transfer, 2011

16. Raval, Chirag B.: Increasing aortic endothelial cell aquaporin-1 expression upregulates endothelial hydraulic conductivity in monolayers and in whole vessels ex vivo, 2012
17. Joshi, Shripad D.: A theory for how Aquaporin-1 and transmural pressure influence the mechanics of and the transport through the artery wall, 2012

- **Reuel Shinnar**

1. Sherwin, Martin B.: Dynamic behavior of the well stirred isothermal crystallizer, 1967 (co-advised by Shinnar and Katz)
2. Krambeck, Frederick J.: Stochastic mixing models for chemical reactions, 1968 (co-advised by Katz and Shinnar)
3. Yerushalmi, Joseph: The stability of a filament of a viscoelastic fluid, 1969
4. Cegla, Uriel G.: The design of feedback control for systems with stationary stochastic disturbances, 1969 (co-advised by Shinnar and Katz)
5. Goldin, Michael Martin: Breakup of a laminar capillary jet of a non-Newtonian fluid, 1970 (co-advised by Shinnar and Katz)
6. Lei, Shang-Jen: Dynamics and control of the continuous crystallizer with fines trap, 1970 (co-advised by Katz and Shinnar)
7. Gordon, Marvin: Non-Newtonian capillary jet instability, 1973
8. Kestenbaum, Aaron: Applications of modern control theory to the control of incompletely specified chemical processes, 1974 (co-advised by Shinnar and Thau. This was awarded posthumously; Kestenbaum was killed in October 1973 in the Yom-Kippur war)
9. Liss, Barry: The dynamic behavior of particulate systems involving simultaneous nucleation and growth, 1975 (originally advised by Stanley Katz, who died 1972)
10. Stern, Sidney Simon: The effects of experimental error and filters on the measurement of relative volumes and permeability, 1975 (originally advised by Stanley Katz, who died 1972)
11. Bayewitz, Marvin Herbert: Gorth of particles in coalescing systems, 1975 (originally advised by Stanley Katz, who died 1972)
12. Palmor, Zalman Joseph: The design of process controllers, 1977
13. Kutten, Moshe: Modelling and control of a fluidized bed gasifier, 1978
14. Silverstein, Jeffrey Lester: Aspects of the design and control of fixed bed catalytic reactors, 1978
15. Shapira, Dan: SNG from coal: thermodynamic and kinetic constraints; use of nuclear energy, 1983
16. Avidan, Alan I.: Performance and modeling of fluidized-bed coal gasifiers, 1987

17. Fan, Zhen: IGCC power plant simulation: Steady state, dynamic and control, 1993
18. Ullmann, Amos: Liquid-liquid extraction using solvent mixtures with a critical point of miscibility, 1993
19. Huang, Zupeng: Modeling, simulation, stability analysis and control of a modern fluidized catalytic cracker, 1995
20. Arbel, Arnon: Partial control of complex chemical plants, 1996
21. Gupta, Rajan: Phase separation of solvent mixtures with a critical point of miscibility, 1999
22. Citro, Francesco: A rational framework for evaluating potential advantages and possible obstacles to process simplification, 2005
23. Califano, Filomena: The coalescence phenomena and droplets motion in spinodal decomposition of low-viscosity liquid mixtures, 2005

- **Arthur M. Squires**
  1. Pell, Melvyn: Reaction of hydrogen-sulfide with fully calcined dolomite, 1971
  2. Paretsky, Leon Carl: Filtration of aerosols by granular beds, 1972 (co-advised by Pfeffer and Squires)
  3. Ruth, Lawrence A.: Reaction of hydrogen-sulfide with half-calcined dolomite, 1973 (co-advised by Graff and Squires)
  4. Lee, Kun-Chieh: Filtration of redispersed power-station fly ash by a panel bed filter with puffback, 1975 (co-advised by Squires and Pfeffer)
  5. Dobner, Samuel: A high pressure thermobalance for process studies, 1976 (co-advised by Squires and Graff)
  6. Kan, George Lan-Yuh: Cyclic use of half-calcined dolomite and magnesium oxide for the removal of sulfur compounds from gases at elevated pressures, 1977
  7. Rodon, Ignacio: Filtration of dusts at 150 degrees Celsius by a panel bed filter with puffback, 1978
- **Carol A. Steiner**
  1. Dualeh, Abdulkadir Jibril: Surfactant-induced phase separation and network formation of surface-active graft copolymers, 1990
  2. Varelas, Charalambos G.: Structural analysis and applications of polymer networks formed from surface-active copolymers in aqueous solvents, 1991
  3. Yang, Yi: Synthesis and characterization of hydrophobically modified polyacrylamide-based polymers and their hydrogels, 1996
  4. Kumar, Vikram: Two studies on self-assembly of amphiphilic molecules: (1) 3-dimensional assembly of hydrophobically modified water soluble polymer (HMWSP); (2) 2-dimensional assembly of surfactants at the solid/water and air/water interfaces, 1997

- **Gabriel Tardos**
  1. Gal, Eli: Dust filtration in granular beds (fluidization, fluid, electrostatic, mechanics), 1984
  2. Mazzone, Dominick Nicholas: Agglomeration of particles in fluidized beds (liquid bridges), 1986
  3. Kao, Ju-Nan: A study of aerosol separation in granular and fibrous filters, 1987 (co-advised by Tardos and Pfeffer)
  4. Compo, Peter C.: Thermally induced agglomeration in fluidized beds, 1989 (co-advised by Tardos and Pfeffer)
  5. Ennis, Bryan Jerard: On the mechanics of granulation, 1990
  6. Khan, Mohammed Irfan: An investigation of powder granulation by experiments and numerical simulation, 1998
  7. Kheiripour Langroudi, Mehrdad: Rheological Behavior of Dense Granular Matter, 2011
- **Raymond S. Tu**
  1. Leon Gibbons, Lorraine: Interfacial Templating of Inorganic Nanostructures Using Rationally Designed Peptide Molecules, 2011
  2. Jain, Vikas Parasmal: Dynamics in Peptide Folding, Surface Activity and Self-assembly, 2011
  3. Badami, Joseph V.: Rationally designed, periodically sequenced peptides for therapeutic, diagnostic, and sensing applications, 2015
  4. Kubilius, Matthew B.: Enhanced Liquid-Phase Synthesis and Interfacial Self-Assembly of Amphipathic Polypeptides, 2017
  5. Veneti, Eleftheria: Using pH-Dependent Elastin-Functionalized Targeted Liposomes for Treating Breast Cancer, 2018
- **Herbert Weinstein**
  1. Meller, Menachem M.: The structure and operating characteristics of high-velocity fluidized beds, 1985
  2. Shao, Manjun: Radial and axial variation in voidage in high velocity fluidized beds, 1986
  3. Schnitzlein, Michael Georg: The hydrodynamics of a fast fluidized bed characterized by its pressure signals (transducer, high velocity, riser), 1987
  4. Chen, Libin: Measurement of normal stress and the shape and extent of the void formed by a horizontal jet in a fluidized bed, 1994
  5. Cao, Chunshe: Characterization of downflowing high velocity fluidized beds, 1998
  6. Shang, Yuming: An experimental investigation of vertical coaxial flows of densely loaded gas -solid streams, 2006
- **David J. Williams**

1. Grancio, Michael Rocco: A kinetic study of monomer-polymer ratio and molecular weight development in ideal styrene emulsion polymerization, 1969
2. Blum, David: Axial pressure profiles in non-Newtonian flow, 1972
3. Goldwasser, David J.: Homopolymer and copolymer solubility: methyl group effects in styrene based systems, 1972
4. Keusch, Preston: Interfacial phenomena and morphological phenomena in polystyrene latex systems, 1973

- **Joseph Yerushalmi**
  1. Turner, David Hartman Larson: Turbulent and fast fluidization (high velocity fluidization), 1979
  2. Avidan, Amos A.: Bed expansion and solid mixing in high velocity fluidized beds, 1980

10.3 Civil Engineering

- **Anil Agrawal**
  1. He, Wanlong: Smart energy dissipation systems for protection of civil infrastructures from near-field earthquakes, 2003
  2. Pan, Ying: Seismic fragility and risk management of highway bridges in New York State, 2007
  3. Xu, Zhou: Design and assessment of seismic protective systems for near-field ground motions, 2007
  4. Yi, Zhihua: Blast load effects on highway bridges, 2009
  5. Zhang, Jianqiu: A novel MR damper based semi-active control system for seismic hazard mitigation of structures, 2012
  6. Liu, Guangyong: Behavior of bridge piers during vehicular impacts, 2012
  7. Zong, Xin: Seismic fragility analysis for highway bridges with consideration of soil-structure interaction and deterioration, 2015
  8. Gong, Xu: Behavior of bridges during fire, 2015
  9. Whitney, Reeves: Seismic performance and design of flexible diaphragms in buildings, 2016
  10. Cai, Yalong: Numerical Study of the Coastal Bridge under Surge Waves during Extreme Hurricanes, 2017
  11. Xu, Xiaochen: Performance Based Approach for Loading and Design of Bridge Piers Impacted by Medium Weight Trucks, 2017
- **Jacques E. Benveniste**
  1. Garrelick, Joel Marc: Analytical investigation of wave propagation and reflection in Timoshenko beams, 1969
- **Cynthia Chen**

1. Chen, Xiaoqiang: Residential relocation choice and consequent behavioral change, 2009

- **David H. Cheng**
  1. Knapp, Lawrence Jeffrey: Nonlinear transient response of plates subjected to inplane and lateral disturbances, 1970
- **Carl J. Constantino**
  1. Lung, Richard Hai: Seismic analysis of structures embedded in saturated soils, 1981
- **Alison Conway**
  1. Cheng, Jialei: Performance measures for sustainable urban freight delivery, 2015
  2. Chen, Quanquan: Commercial Vehicle Parking Management Strategies for Residential Delivery in New York, 2017
- **Naresh Devineni**
  1. Etienne, Elius: Development of a Demand Sensitive Drought Index and its Forecasting for Climate Adaptation and Water Management over the continental United States, 2017
- **Vasil Diyamandoglu**
  1. Phillip, Neal Hudson: The kinetics of bromate decomposition during UV irradiation of aqueous solutions, 1998
  2. Talu, Gonca F.: Chemical transformation of short chain saturated carboxylic acids under UV irradiation in aqueous solutions, 2003
  3. Beckles, Yvette: Interactions occurring between halide ions and aqueous ammonia under ultra violet light with low pressure mercury lamps, 2007
  4. Fortuna, Lorena M.: Optimization of an integrated solid waste management system based on greenhouse gas emissions taking into consideration materials flow due to product reuse, 2016
- **John Fillos**
  1. Hussein, Hassan Emam: Design, laboratory verification, and mathematical modeling of an anaerobic system for the treatment of low-strength wastewater, 1990
  2. Pierides, Kyriacos Michael: Rapid thermal conditioning of sewage sludges to improve digestibility, methane production, and metals solubilization, 1994
  3. Katehis, Dimitrios: Measurement of maximum nitrifier specific growth rate for use in activated sludge modeling, 2005
  4. Rosenthal, Alex: Nitrite sensitivity in granular anammox biomass, 2014

5. Mehrdad, Mahsa: Biofilm Population Diversity and Distribution in an Anammox MBBR Pilot: Molecular Analysis and Mathematical Modeling, 2016

- **Michel Ghosn**
  1. Deng, Linzhong: Artificial intelligence techniques for reliability assessment of nonlinear bridge systems, 2000
  2. Wang, Jian: Hybrid genetic algorithms for reliability assessment of structural system, 2004
  3. Pan, Ying: Seismic fragility and risk management of highway bridges in New York State, 2007
  4. Mechakhchekh, Abdallah: Seismic risk analysis of bridge structural systems, 2008
  5. Miao, Feng: Reliability-based progressive collapse and redundancy analysis of bridge systems, 2013
  6. Fiorillo, Graziano: Reliability and Risk Analysis of Bridge Networks Under the Effect of Highway Traffic Load, 2015
  7. Yang, Jian: Structural redundancy and system reliability of highway bridges, 2016
- **Norman C. Jen**
  1. Warren, Andrew Henry: Thermal Turbulent Jets, 1976
- **Camille Kamga**
  1. Singhal, Abhishek: A novel laser ranging over-height vehicle detector to mitigate over-height vehicle collisions, 2016
  2. Wan, Dan: The Spatial Analysis of Crash Frequency and Injury Severities in New York City: Applications of Geographically Weighted Regression Method, 2018
- **Mumtaz K. Kassir**
  1. Chuaprasert, Manoon: Boussinesq problems of a non-homogeneous elastic half-space, 1973
  2. Bandyopadhyay, Kamal Kanti: Torsional vibration of dissimilar materials containing a cylindrical crack, 1982
  3. Xu, Jimin: Influence functions of structures bonded to a saturated elastic half-space, 1988
  4. Phurkhao, Pichaya: Coupled thermoelastic crack problems, 1988
  5. Mahmoud, Khaled Mohamed: Continuum damage model for plastic fracture of work-hardening materials, 1997
- **Reza M. Khanbilvardi**
  1. Ahmed, Shabbir: Modeling unsteady state leachate flow in a landfill using finite difference and boundary element methods, 1992

2. Afshari-Tork, Shahriar: Sludge ash utilization and hydroplaning on concrete and asphalt pavements, 1994
3. Blake, Reginald Alexander: Assessing climate change impacts on runoff from karstic watersheds: NASA/GISS land-surface model improvement, 1998
4. Adib, Foad: Application of unmodified activated carbon for removal of odor from wastewater treatment facilities, 2000
5. Stern, David Alan: Modeling flow through natural wetlands with a modified dynamic wave equation, 2001
6. Esfandiary, Siamak: Sediment-controlled radionuclide transport: Mathematical modeling and field application, 2001
7. Zaman, M. Selim Uz: A computational investigation of the effects of heterogeneity on the behavior of soil moisture in the unsaturated zone, 2002
8. Zoghi Moghadam, Bahar: Settling characteristics of Cryptosporidium and Giardia under different environmental conditions, 2006
9. Ozkurt, Ozlen: A physically based conceptual model of flow and sediment dynamics in river mouth jet flow, 2006
10. Eshraghi Azar, Amir: Application of satellite-borne microwaves in estimation of snowpack properties, 2007
11. Mejia, Yajaira: A robust neural network system ensemble approach for detecting and estimating snowfall from the advanced microwave sounding unit, 2008
12. Nazari, Rouzbeh: Development of an advanced technique for mapping and monitoring sea and lake ice for the future GOES-R Advanced Baseline Imager (ABI), 2010
13. Norouzi, Hamidreza: Improved retrieval of global land emissivity from AMSR-E observations, 2011
14. Azarderakhsh, Marzieh: Dynamics of terrestrial water budget over Amazon and Mississippi basins using satellite data, 2012
15. Shields, Gerarda M.: Decision support tools for prioritizing the hydraulic vulnerability of existing New York State coastal bridges due to the impact of climate change projections, 2012
16. Seo Dugwon: Assimilation of satellite based soil moisture data to the NOAA's operational hydrologic model (HL-RDHM) for gridded flash flood guidance, 2014
17. Gonzalez-Alvarez, Alvaro Development of a dynamic Natural Resources Conservation Service Curve Number (NRCS-CN) to account for the vegetation and soil moisture effect on hydrological processes, 2014

18. Munoz-Barreto, Jonathan: Microwave snow emission model using a long-term field experiment, 2014
19. Infante Corona, Jose Alberto: Assimilating Merged Remote Sensing and Ground-Based Snowpack Information for Streamflow Simulation, 2015
20. Glickman-Eliezer, Heather: Aerosol and Urban Heat Island effects on warm cloud-top shortwave infrared reflectance and visible albedo, 2015
21. Sy Savane, Ousmane: Effects of Aerosol on Cloud Water Path: Statistical Method a Potential Source for Divergence in Observation-based Correlative Studies, 2015
22. Perez Hoyos, Isabel Cristina: Identification of phreatophytic groundwater dependent ecosystems using geospatial technologies, 2016
23. Cullen, Cheila Avalon: Guidance index for shallow landslide hazard analysis, 2016
24. Etienne, Elius: Development of a Demand Sensitive Drought Index and its Forecasting for Climate Adaptation and Water Management over the continental United States, 2017
25. Kraatz, Simon G.: An Algorithm for Automated Satellite-Based River Ice Identification Using a Local Cloud Mask: Application over the Lower Susquehanna River Using VIIRS and MODIS, 2017
26. Karimi, Maryam Elisa: Impact of urbanization on temperature variation in big cities measuring health risk while targeting vulnerable population, 2017
27. Hamidi, Ali: Investigating the Spatiotemporal Variability of Extreme Rainfall and Its Impacts on the Urban Infrastructure Systems, 2017
28. Diaz, Carlos Luis Perez: Development of a Microwave - Remote Sensing Based Snow Depth Product, 2018

- **Nir Krakauer**
  1. Perez Hoyos, Isabel Cristina: Identification of phreatophytic groundwater dependent ecosystems using geospatial technologies, 2016
  2. Asadieh, Behzad: Implications of Climate Change for Extreme Precipitation and Stream-flow, and Impacts on Water Resources Management, 2017
- **Feng-Bao Lin**
  1. Zeng,Fei: Numerical modeling and experimental investigation of masonry structures, 2010
- **Claire E. McKnight**
  1. Isaacs, Beatrice Stein: A method to evaluate and improve the operational safety of trucks on highway ramps, 1995

2. Lin, Haiyun: Understanding Residential Location Choices and Housing Search, 2012

- **Charles A. Miller**
  1. Jaffarpour, Khalil: Combined shear-torsion behavior of one-way slabs, 1989
  2. Gu, Yongtai: Soil-structure interaction influence of liftoff, 1990
- **George Mylonakis**
  1. Syngros, Konstantinos (Costis): Seismic response of piles and pile-supported bridge piers evaluated through case histories, 2004
- **Robert E. Paaswell**
  1. Kamga Ngassa, Camille: Estimation of network based incident delay in a transportation network using dynamic traffic assignment, 2006
  2. Chen, Li: The effectiveness of safety countermeasures in New York City, 2012
- **Neville A. Parker**
  1. Humphrey, Mewburn Hilary: A mechanistic approach to determine the impacts of small utility cuts in urban street pavements, 1997
  2. Ali, Hesham A.: Accounting for the seasonal variations in the design of flexible pavements, 1997
  3. Prancl, Patrick Joseph: An LCCA procedure for selecting and evaluating durable pavement structures using SHRP-LTPP mechanistic-empirical relationships, 2000
  4. Hussain, Sajjad: Pavement damage and road pricing, 2005
- **Ming L. Pei**
  1. Hsu, Michael Bing-Sun: Framed dome dynamics and lower bound to the fundamental frequency of structural systems, 1970
- **Michael Piasecki**
  1. Celicourt, Paul: Development of an End-To-End Automated Environmental Data Collection System Using Open Source Software and Off-the-Shelf Cost-Effective Hardware, 2016
- **Mitsuru Saito**
  1. Fan, Jianzhong: Optimal traffic signal control system using an artificial neural network, 1998
- **Hansong Tang**
  1. Cai, Yalong: Numerical Study of the Coastal Bridge under Surge Waves during Extreme Hurricanes, 2017
  2. Qu, Ke: Computational Study of Hydrodynamic Impact by Extreme Surge and Wave on Coastal Structure 2017
- **Charles Vörösmarty**

1. Ehsani, Nima: Integrated water balance model (IWBM) case study in the northeastern United States, 2016
2. Miara, Ariel: Connections across Climate, Water Resources and Electricity Generation in the United States: Challenges and Opportunities in the 21st Century, 2018

- **Ann E. (Beth) Wittig**

1. Arriaran La Torre, Vilma Maria: Optimization of use of Fourier transform infrared to measure the composition of fine particulate matter, 2011

10.4 Computer Science

- **Michael Anshel**

1. Geller, Jacob Ben-Zion: The use of Petri-nets in detecting and modeling concurrencies, 1980
2. Domanski, Bernard: The complexity of decision problems in group theory, 1980
3. Crowder, Harlan Pinkney: Contributions to a theory for linear program problem modeling, 1983
4. Najarian, John Panos: Investigations of braid group algorithms, 1985
5. Basu, Dipak: Mechanization of data model design: a Petri-net based approach for learning, 1986
6 Lucci, Stephen: String matching: a comparative study of algorithms, and its relation to problems of parallel and distributed computing, 1987
7. Fulda, Joseph Simcha: Cross-examination as a model of knowledge elicitation in the design of expert systems, 1990
8. Baumslag, Marc: Cayley networks: A group-theoretic approach to the design and analysis of parallel networks, 1991
9. Chung, Ilyong: Dynamic security, 1991
10. Tien, Jonathan Yeh: Neural Petri nets and their applications to combinatorial games, 1991
11. Finz, Harold Richard: Studies in computational group theory, 1992
12. Tse, Stephen Kam Hong: Design and development of a document imaging system: IMAGE TRAC(TM), 1992
13. Galatianos, Anthony Athanassios: Foundations of a versatile personal digital cellular communication decision support system (VPDCCDSS-Pythia) applied to different digital cellular environments, 1992
14. Austin, Shermane Annette: Discrete models for robot path planning, 1993

15. Yoon, Kisong: Fault-tolerant node disjoint routing inn-dimensional hypercube interconnection network, 1993
16. Vulis, Marina: A computational study of the factor groups of the lower central series of a certain free product, 1994
17. Vulis, Dimitri: Collective encryption: Cryptosystems based on the commutator collection process for certain free products, 1995
18. Leff, Arthur Allan: The representation of combinatorial games and the algorithms used to play them, 1995
19. Chen, Chang-Lin Charles: A constructive approach for Chinese character recognition, 1995
20. Finch, Patricia J. M.: A study of the blowfish encryption algorithm, 1995
21. Brenner, Mike: Computational experiments in braids, 1997
22. Deutsch, Marjorie J.: Automated structural representation and algorithmic authentication of musical style and authorship, 1997
23. Fadairo, Sikiru Adesina: Mutual authentication protocols using Smart card: A new approach for authentication protocols. Tackling the masquerader's problem, 1998
24. Zhao, Kaiyan. The combinatorics of chessboards, 1998
25. Azimi-Gass, Susan: The Towers of Hanoi Puzzle and the Padluc cryptosystem, 1998
26. Arroyo, Edward: Dawson's chess, snort on graphs and graph involutions, 1998
27. Belianina, Maria: Studies in algorithmic graph theory, 1999
28. Bak, Daniella: Properties of shuffle groups and their relationship to cryptography, 2000
29. Salwen, Michael F.: Quantum computational attack on two diophantine cryptosystems, 2001
30. Wei, Xinzhou: An investigation of the lattice-based digital signature scheme and its application in e -commerce, 2002
31. Feder, Elie: Algorithmic problems in the braid group, 2003
32. Zucker, Marc: Studies in cryptological combinatorics, 2005
33. Nguyen, Anh Quoc. Building an effective general-purpose quantum simulator for the design and analysis of quantum circuits, 2006
34. Zheng, Jianliang: Wireless mesh personal area networks: System design and analysis, (co-Advisors: Myung Lee, Michael Anshel) 2006
35. Ulrich, James L.: Ore revisited: An algorithmic investigation of the simple commutator promise problem, 2006
36. Zhang, Xiaowen: Applications of the multi-map orbit hopping mechanism in stream cipher designs, 2007
37. Gao, Qinghai: Secure biometrics, 2008

- **Octavio Betancourt**
    1. Gregory Kozlovsky: An interactive programming environment for solving partial differential equation using adaptive grids (with application to flame-flow interation problems), (co-Advisor: Octavio Betancourt, Gregory Sivashinsky) 1992
- **Gary S. Bloom**
    1. Olga Salizkiy: Reliable Network topologies in a model with node failures, 1989
- **Peter Brass**
    1. Ivo Vigan: Geometric Packing and Separation Problems, 2015
- **Stefan A. Burr**
    1. Saoping Loo: Multicolor Ramsey numbers for disjoint unions of graphs, 1990
- **Nelly Fazio**
    1. Irippuge DeShan Melinda Perera: Theory and applications of outsider anonymity in broadcast encryption, 2015
- **Rosario Gennaro**
    1. Matteo Campanelli: Rationality and efficient verifiable computation, 2018
- **Izidor Gertner**
    1. Igor V. Mazlov: Improving the performance of evolutionary algorithms in imaging optimization, 2008
- **Irina Gladkova**
    1. Dmitry Chebanov: New approaches in radar waveform design, 2008
    2. George Bonev: Machine Learning algorithms for automated stellite snow and sea ice detection, 2017
    3. Fazlul Shahriar: Machine learning approach for retrieving physical variables from remotely sensed data, 2017
- **Donald Goldfarb**
    1. Idnani, Ashok U.: Numerically stable dual projection methods for solving positive definite quadratic programs, 1980
    2. Oko, Selina Omagha: Surrogate Methods for linear inequalities and linear programming problems, 1983
- **Stanley Habib**
    1. Ti Jin: An operational approach to computer system specification using applicative high-order logic, 1992
    2. Quan Xu: Technology mapping algorithms for sequenctial circuits using LUT-based FPGAs, 1996
- **Abbe Mowshowitz**

1. David Bellin: Information commodities and the production process:How the introduction of CASE tools affects the software development life cycle, 1991
2. William Joseph Ferns, Jr: The impact of expert system technology on the delivery of social services 1992
3. Andi Toce: Efficient communication through structured nodelabeling in peer-to-peer networks 2013

- **Janos Pach**
  1. Ariel Halpert: Thresholds in random graphs, 2003
  2. Deniz Sarioz: Geometric graph theory and wireless sensor networks, 2012
- **Kaliappa Ravindran**
  1 Christopher Amo-Quarm: MPEG-2 video traffic models and their impact on network performance, 2002
  2. Xiliang Liu: A stochastic analysis of end-to-end available bandwidth estimation, 2005
  3. Ali Shihab Sabbir: Context-aware coordination control indistributed collaborations, 2005
  4. Jun Wu: Optimization algorithms for proxy placement in content distribution networks, 2011
  5. Arun Adiththan: Service Quality Assessment for cloud-based distributed data services, 2018
- **Douglas R. Troeger**
  1. Marco T. Morazan Sohnle: Toward fast functional languages throught distributed virtual memory, 1999
- **Valentin F. Turchin**
  1. Nirenberg, Robert Michael: The mapping of the REFAL machine onto a on Neumann machine, 1983
- **Michael Vulis**
  1. Dwen-Ren Tsai: Computing Discrete Fourier Transforms on a rectangular arra consisting of ordinary and crystallographic-invaiant data, 1990
- **George Wolberg**
  1. Yitzhak Alfy: New results on monotone cubic splines and hierarchical scattered data interpolation, 2000
  2. Siavash Zokai:Robust image registration using log-polar transforms, 2004
  3. Gene Yu: Piecewise surface reconstruction from range data, 2010
  4. Weihong Li: Lightweight 3d modeling of urban buildings from range data, 2011

5. Hadi Fadaifard: Multiscale feature extraction and matching with applications to 3d face recognition and 2d shape warping,

- **Jianting Zhang**
  1. Simin You: Large-scale spatial data management on modern parallel and distributed platforms, 2016
- **Zhigang Zhu**
  1. Tao Wang: An adaptive and integrated multimodal sensing and processing framework for long range moving object detection and classification, 2013
  2. Hao Tang: 3D scene modeling and understanding from image sequences, 2013
  3. Edgardo Molina: Panorama Generation for Stereoscopic Visualization of Large-Scale Scenes, 2015
  4. Wai Lun Khoo: GIVE-ME: Gamification In Virtual Environments for Multimodal Evaluation - A Framework, 2016
  5. Wei Li: Deep Learning Based Facial Computing - Data, Algorithms and Applications, 2017
  6. Feng Hu: Vision-Based Assistive Indoor Localization, 2018
  7. Farnaz Abtahi: Multimodal Sensing and Data Processing for Speaker and Emotion Recognition Using Deep Learning Models with Audio, Video and Biomedical Sensors, 2018

10.5 Electrical Engineering

- **Samir Ahmed**
  1. Gergely, John Steven: Dye laser system for monitoring atmospheric molecular pollutants, 1978
  2. Barone, Frank Ralph: Dye laser system for monitorinng atmospheric ozone, sulfur dioxide, and nitrogen dioxide, 1979
  3. Kokkinos, Dimitrios S.: Lidar system using polarization discrimination techniques for molecular air polution monitoring, 1984
  4. Ali, Mohamed: Steady-state energy transfer processes in laser dye mixtures, 1989
  5. Mitwally, Khalil A.: Optical refractive and reflective properties of resonantly absorbing medium, 1989
  6. El-Massry, Mohamed H.: Remote monitoring of gaseous pollutants by image topography techniques, 1989
  7. Panoutsopoulos, Basilios: Continuous-wave energy transfer dye lasers in the near-infrared spectral region, theory, modeling, simulation, performance, 1991

8. Hussain, Tarik Mustafa: Infrared vehicle sensor for traffic control, 1994
9. Li, Ping: Detection of buried objects using thermal infrared imaging 1995
10. Zhang, Zhiwei: Fluorescence image and spectrum in random media and cancer cells, 1995
11. Issa, Hanaa Ibrahim: Long-haul very high bit rate transmission systems and all optical synchronous multiple access fiber networks using OTDM and optical amplifiers, 1995
12. Khrais, Nidal Nuri: Performance degradation of multiwavelength optical networks due to laser and optical (de)multiplexer misalignements, 1996
13. Musa, Sarhan Mahmoud: Induced optical fluorescence spectroscopy of laser excited microorganisms in water, 2001
14. Jean-Pierre, Azed: A review and stochastic simulations of nonlinear properties of ocean waves: applications for remote sensing, 2003
15. Hassebo, Yasser Y.: Lidar signal-to-noise ratio improvements: considerations and techniques, 2007
16. Sana, Ajaz: Design and implementation of next-generation ethernet-based hybrid wired/wireless broadband access networks for delivering differentiated services, 2008
17. Amin, Ruhul: Optical algorithms for assessment of fluorescence sources in seawaters, 2009
18. Tonizzo, Alberto: Multiangular hyperspectral polarimetric observations in coastal waters, 2010
19. Ioannou, Ioannis: Retrieval of inherent optical properties from reflectance spectra in oceanic and coastal waters with neural network modeling, 2011
20. Ibrahim, Amir: Polarimetric light fields in the open ocean and coastal waters and retrieval of water parameters from polarimetric observations, 2015
21. El-Habashi, Ahmed: Remote sensing over coastal and open oceans: retrieval of water constituents from scalar and polarimetric observations, 2018

- **Robert Alfano**

1. Li, Yao: Parallel ultrafast digital optical computations, 1987 (co-advised by Eichmann and Alfano)
2. Shum, Kai: Photogenerated carrier dynamics in semiconductor quantum wells, 1987
3. Delfyett, Peter John, Jr.: Picosecond time-resolved Raman induced phase conjugation in crystals, 1988

4. Baldeck, Patrice L: self- and cross-phase modulation effects on the nonlinear propagation of ultrashort pulses in optical fibers, 1989
5. Petrˇcević, Vladimir: Laser and spectroscopic properties of chromium-doped forsterite, 1990
6. Walser, Ardie Darnel: Transport properties of photoexcitations in stretched trans-polyacetylene, 1991 (co-advised by Alfano and Dorsinville)
7. Yang, Lina: Third-order optical properties of polymers, 1991 (co-advised by Alfano and Dorsinville)
8. Seas, Antonios: Generation of ultrashort pulses froma chromium-doped forsterite laser, 1993
9. Yang, Ming: Ultrafast spectroscopy in conjugated organic and biological materials, 1993
10. Mihailidi, Margarita: Ultrafast optical pulse studies of metallic layers and particles, 1994
11. Mohaidat, Jihad Mansour: Electron tunneling dynamics in engineered semiconductor nanostructures and applications to efficient solar cells, 1994
12. Takiguchi, Yoshihiro: Carrier and exciton dynamics in strained semiconductor bulk and quantum wells, 1995 (co-advised by Shum and Alfano)
13. Wang, Leming: Picosecond Kerr gated imaging of phantoms in turbid media, 1995 (co-advised by Alfano and Ho)
14. Guo, Yici: Nonlinear optical spectroscopy and microscopy of model random and biological media, 1998 (co-advised by Alfano and Ping-Pei Ho)
15. Zhang, Gang: Far-red to near-infrared emssion and scattering spectroscopy for biomedical applications, 2001
16. Siddique, Masood: Ultrafast optical pulse interactions in active disordered condensed matter, 2005
17. Zevallos, Manuel Eduardo: Near infrared optical imaging and light propagation in highly scattering random media, 1999
18. Xin, Xuying: Inter/intra molecular dynamics in gases and liquids studied by terahertz time -domain spectroscopy, 2007
19. Pu, Yang: Time-resolved spectrosopy and near-infrared imaging for prostrate cancer detection: receptor-targeted and native biomarker, 2011
20. Islam, S.M. Zakirul: Optical Properties of Solar Cells Based on Zinc(hydr)oxide and its Composite with Graphite oxide Sensitized by Quantum Dots, 2014

- **Mohamed A. Ali**

1. Hussain, Arshad: Performance analysis of a multiserver discrete-time queueing system with correlated batch arrivals for ATM-based B-ISDN, 1997
2. Metivier, Garrick P.: Novel hybrid CATV network architectures for subcarrier multiplexed entertainment video and digital B-ISDN services in the local loop, 1997
3. Luo, Gengxian: Theoretical and experimental investigations of dynamic automatic gain control in multi-channel EDFA cascades and its implication on WDM multi-access lightwave networks performance, 1997
4. Mendez, Maria Fernanda: Performance analysis and testbed demonstration of long-haul point-to-point transmission systems based on DWDM technology, 1998
5. Richards, Dwight Hugh: Detailed dynamic performance analysis and feasibility assessment of emerging optical switching and its impact on the performance of a fully reconfigurable WDM transport network, 1999
6. Ye, Yinghua: Multiwavelength optical networks capabilities for next generation Internet, 2000
7. Shami, Abdallah A.: Traffic engineering in hybrid, IP -centric DWDM-based optical networks, 2003
8. Khalil, Ahmad: Dynamic provisioning of heterogeneous unicast/multicast traffic in IP -centric WDM-based optical networks, 2005
9. Hadjiantonis, Antonis: A framework for traffic engineering of diverse traffic granularity entirely on the optical layer terms, 2006
10. Chamas, Haidar: A truly end-to-end global multiservice optical ethernet networking architecture, 2006
11. Hossain, A.S.M. Delowar: Next-generation self healing broadband access PON architectures for supporting triple play services & private networking capability, 2007
12. Marty, Christopher: An integrated framework for management and traffic engineering of best effort service in next generation data centric networks, 2007
13. Sherif, Sherif R.: Unified multiservice all-packet-based broadband access architecture: An evolutionary path towards a fixed mobile convergence solution, 2008
14. Erkan, Hasan: Next-generation ring based self healing WDM-PON architecture with private networking capability and wavelength sharing, 2008
15. Rahman, Tanvir: On the vision of provisioning multicast and groupcast traffic in next-generation WDM-based optical networks, 2009

16. Obaidat, Muath: An Integrated Framework for QoS Support in Mobile Ad Hoc Networks, 2012
17. Shahwan, Ihsan: A Framework for Cross-Layer QoS-Aware Radio Resource Management in Mobile WiMAX Systems, 2012
18. Zaidi, Syed Rashid Nafees: On the Merits of Deploying TDM-based Next-Generation PON Solutions in the Access Arena As Multiservice, All Packet-Based 4G Mobile Backhaul RAN Architecture, 2014
19. Hussain, Shabab: An Innovative RAN Architecture for Emerging Heterogeneous Networks: "The Road to the 5G Era", 2014

- **Joseph Barba**
  1. Colef, Michael: Motion compensation in the Hadamard domain for video conferencing, 1987
  2. Jeanty, Henry Henrick: Detection of edge points using entropy, 1990
  3. Li, Yuan: Cytological image contour extraction and segmentation, 1990
  4. Suardiaz, Manuel: Three-dimensional reconstruction of the arterial lumen, 1990
  5. Wali, Rahman: Contour shape analysis, with applications to cytology, 1993
  6. Zhu, Jianxin: Wavelet multiresolution and applications, 1996
  7. Lewis, Michael A.: New pitch based techniques for speech enhancement and speaker count determination, 1998
  8. Ting, Rulei: A multiscale analysis and adaptive technique for management of resources in ATM networks, 1998
  9. Jeremiah, Rolston Montgomery: A DCT multiresolution analysis for image decomposition and texture segmentation, 1998
  10. Turner, Claude Fitz-Gerald: Multiresolution analysis for effective dynamic bandwidth management, 2003
  11. Carranza, Aparicio: Enterprise virtual private network with dense wavelength division multiplexing design, 2004
- **Mitra Basu**
  1. Kennedy, Lesa Marie: Experiments in image enhancement using biological and artificial neural networks, 1998
  2. Su, Min: Modular neural networks in image processing, 2002
  3. Mi, Li Yuan: Analysis of avian bone response to mechanical loading using a computational connected network, 2004
- **Ki H. Chon**
  1. Lu, Sheng: Nonlinear systems identification and parameter estimation, 2002
- **Patrick L. Combettes**

1. Puh, Hong: Operator Theoretic Image Coding, 1996
2. Luo, Jian: Non-differentiable constrained signal restoration by subgradient level methods, 2000

- **Michael Conner**
  1. Granata, John A.: The design of discrete Fourier Transform and convolution algorithms for RISC architectures, 1990
  2. Sharif, Hooshang F.: A machine learning approach to security improvement in mobile communication, 2005
  3. Hassan, Kafi I.: Adaptive algorithm for obtaining in-phase and quadrature-phase pseudo-noise sequences in CDMA systems, 2005

- **David Crouse**
  1. Ikram, Ataul Aziz: Optimization of a multilayer alumina template for electrochemical deposition of quantum wires and quantum dots, 2007
  2. Lansey, Eli: Aperture array photonic metamaterials: theoretical approaches, numerical techniques, and a novel application, 2012
  3. Pishbin, Nafiseh: Designing a broadband antireflective coating, 2013
  4. Rezaei Homami, Hassan: On chip micropower self generator for Smart Pavement material application, 2013
  5. Jung, Jonathan Y.: Metamaterials for selective spatial sorting, 2016
  6. Rexhepi, Taulant: Metamaterials for mobile and satellite communication systems, 2016 (co-advised my Madamopoulos and Crouse)
  7. Popescu, Ada-Simona: Metamaterials for wavefront manipulation, 2017 (co-advised by Crouse and Madamopoulos)

- **Roger Dorsinville**
  1. Walser, Ardie Darnel: Transport properties of photoexcitations in stretched trans-polyacetylene, 1991 (co-advised by Alfano and Dorsinville)
  2. Yang, Lina: Third-order optical properties of polymers, 1991 (co-advised by Alfano and Dorsinville)
  3. Edwards, Andrew Gordon: Photoluminescence and electroluminescence in lanthanide-organic complexes and organic polymers, 1997
  4. Harris, David Lindel: Characterization and relaxation dynamics of the nolinear optical properties of thiophene-based polymers, 1998
  5. Yaglioglu, Gul H.: Characterization and time-resolved dynamics of nanostructures for nonlinear optical applications, 2001
  6. Etienne, Michael: Nonlinear optical spectroscopy and imaging of photonic materials and nanostructures, 2007
  7. Ummy, Muhammad Ali: gain characterization of a hybrid Raman/parametric amplifier and phase characterization of a semiconductor optical amplifier, 2008

8. Prescod, Andru: Classical and quantum non-linear optical applications using the Mach-Zehnder interferometer, 2010 (co-advised by Dorsinville and Madamopoulos)
9. Lama, Pemba: Fabrication of monodispersed silver nanoparticles and their optical characterizations, 2014
10. Bikorimana, Simeon: Development of dual-wavelength semiconductor optical amplifier-based fiber compound-ring laser for continuous-wave terahertz photomixing, 2017

- **George Eichmann**

1. Cha, Seung Kack: The static and dynamic mean scattering cross-sections of rough surfaces, 1977
2. Tesler, Martin Howard: Non-spectral representations in open waveguides, 1977
3. Lee, Kang Soo: Elementary patterns for large conformal arrays, 1980
4. Mammone, Richard James: Robust superresolving restoration with applications, 1981
5. Stirbl, Robert Clark: Hybrid optical-digital encoding for video bandwidth reduction, 1982
6. Keybl, Jaroslav Edvard: Low time-bandwidth product signal phase estimation (linear programming, resolution, Hilbert transform), 1984
7. Sidhu, Jagjeet Singh: Electromagnetic backscattering from a layer of disc scatterers using discrete approach and radiative transfer theory (radar cross-section), 1986
8. Marinovic, Nenad M.: The Wigner distributio znd the ambiguity function: generalizations, enhancement, compression, and some applications (signal processing, pattern recognition, computer vision, medical ultrasonics), 1986
9. Li, Yao: Parallel ultrafast digital optical computations, 1987 (co-advised by Eichmann and Alfano)
10. Stojanovic, Mihajlo M.: New robust methods for superresolving signal recovery and bandlimited signal extrapolation, 1988
11. Kasparis, Takis C.: Non-linear processing of signals and images, 1988
12. Jankowski, Mariusz: Shape description and boundary restoration, 1989

    The following students started under Eichmann, and became after his death in 1990 students of Y. Li:

13. Kostrzewski, Andrew Adam: Optical arithmetic-logic processors based on location, content addressable and associative memories 1990
14. Kim, Dai Hyu: Switching-, logic-, memory-, and symbolic substitution-oriented optical signal processing, 1991

15. Ha, Berlin: Free-space optical interconnects for multiprocessing computers, 1993

- **Morris Ettenberg**
  1. Nadan, Joseph Stanley: Semiconductor traveling wave interaction, 1969
  2. Abella, Lorenzo Jose: Electromagnetic wave interactions in ferromagnetic semiconductors, 1972
  3. Haspel, Mitchell Stuart: A slow waveguide with circular-electric mode propagation and centrifugal electrostatically focused electron-beam, 1972
  4. Camisa, Raymond Louis: Microwave metal-insulator-semiconductor varactors, 1975
  5. Colef, Gabriel-Dumitru: Modelling and performance of an integrated six-port reflectometer operated with pulsed signals, 1988
- **Alexander Gilerson**
  1. Hlaing, Soe Min: Bidirectional reflectance correction model for coastal water and its application to minimization of uncertainties in satellite and in-situ water leaving radiances at Long Island Sound Coastal Observatory site, 2012
  2. Foster, Robert: The polarization of light in coastal and open oceans: Reflection and transmission by the air-sea interface and application for the retrieval of water optical properties, 2017
- **Barry M. Gross**
  1. Vladutescu, Daniela Viviana: Optical remote sensing of properties and concentrations of atmospheric trace constituents, 2008 (co-advised by Moshary and Gross)
  2. Cordero, Lina: Appication of ground observations together with neural network technique to PM2.5 estimation from satellite aerosol optical depth product, 2014 (co-advised by Gross and Moshary)
- **Ibrahim Habib**
  1. Tarraf, Ahmed Abd El Hameed: A neural network model for traffic management in broadband networks, 1994
  2. Meng, Weiping P.: On the grouping of a dual bus configuration and its application, 1997 (co-advised by Saadawi and Habib)
  3. Zhang, Zhiguang: Multiple access and bandwidth reservation in wireless ATM local networks, 1998
  4. Youssef, Sameh Ahmed: Bandwidth allocation in ATM networks using neural networks, 1999 (co-advised by Saadawi and Habib)
  5. Sherif, Mahmoud R.: Adaptive quality of service management in wireless/mobile networks, 2000

6. Moustafa, Mohamed Nabil: QoS-aware allocation of resources in wireless networks, 2001
7. De Angelis, Flavio: An adaptive filtering architecture for QoS-based heterogeneous networks, 2005
8. Song, Qiang: IP optical network control plane performance analysis and deployment, 2007
9. Li, Zhaoming: Design and deployment of a GMPLS control plane in IP optical networks, 2007

- **Ping-Pei Ho**
  1. Wang, Leming: Picosecond Kerr gated imaging of phantoms in turbid media, 1995 (co-advised by Alfano and Ho)
  2. Guo, Yici: Nonlinear optical spectroscopy and microscopy of model random and biological media, 1998 (co-advised by Alfano and Ping-Pei Ho)
- **Mansour Javid**
  1. Eichmann, George: Diffraction of electromagnetic waves in a uniaxially anisotropic media, 1968
- **George Kranc**
  1. van Gelder, Arthur, Jr.: Time sub-optimal control of a class of linear systems subject to several simultaneous input constraints, 1968
  2. Klafter, Richard David: Time-optimal control of linear systems with controller of partially specified structure, 1969
  3. Vachtsevanos, George John: Conditional optimization of nonlinear adaptive control systems, 1970
  4. Shilman, Michael Bernard: Applications of functional analysis to time-optimal control of linear systems with output constraints, 1970
- **Myung Jong Lee**
  1. Liu, Changdong: Adaptive multimedia synchronization and scalable multipoint routing with mobility support, 1998
  2. Ahn, David S.: Optimal buffer allocation in ATM switches by effective cell loss,1998
  3. Liu, Jong: Design and analysis of wireless ad hoc routing algorithms, 2005
  4. Zheng, Jianliang: Wireless mesh personal area networks: System design and analysis, 2006
  5. Zhu, Chunhui: Multipoint communications for wireless ad hoc networks, 2008
  6. Hu, Xuhui: Progressive route discovery protocols for wireless mesh networks 2008

7. Zhang, Rui: Design and Analysis of WPAN Mesh with a Case Study of 802.15.5, 2011
8. Yoon, June Seung: Design of real-time medium access control and the optimization of end-to-end delay using genetic algorithm, 2012
9. Liu, Yanchen: Resource allocation in mobile cloud computing, 2015
10. Ahmed, Kazi j.: IoT Device Security for 5G Network, 2018
11. Hussain, Muhammad A: V2G Optimization in Smart Grid Network, 2018

- **Yao Li**
  1. Ha, Berlin: Free-space optical interconnects for multiprocessing computers, 1990 (original advisor was George Eichmann, who died 1990)
  2. Kostrzewski, Andrew Adam: Optical arithmetic-logic processors based on location, content addressable and associative memories, 1990 (original advisor was George Eichmann, who died 1990)
  3. Kim, Dai Hyun: Switching-, logic-, memory-, and symbolic substitution-oriented optical signal processing, 1991 (original advisor was George Eichmann, who died 1990)
  4. Zhang, Yan: New optical methods for signal processing, 1992
  5. Phuvan, Sonlinh: Optical texture characterization, 1995

- **Nicholas Madamopoulos**
  1. Prescod, Andru: Classical and quantum non-linear optical applications using the Mach-Zehnder interferometer, 2010 (co-advised by Dorsinville and Madamopoulos)
  2. Peiris, Sasanthi Chamarika: Amplified CWDM-based next generation broadband access networks, 2014 (co-advised by Madamopoulos and Neophytos Antoniades)
  3. Rexhepi, Taulant: Metamaterials for mobile and satellite communication systems, 2016 (co-advised my Madamopoulos and Crouse)
  4. Vlachokostas, Efthimios Alexandros: Impact of complex fenestration on building energy savings: Quantification and applications, 2016
  5. Popescu, Ada-Simona: Metamaterials for wavefront manipulation, 2017 (co-advised by Crouse and Madamopoulos)

- **Jamal T. Manassah**
  1. Mustafa, Mustafa Aref: Self-phase modulation and self-steepening in cubic and fifth-order dispersionless media with nonzero relaxation time 1990
  2. Gross, Barry: Novel results in the propagation of intense pulses and beams in nonlinear media, 1993

- **Nenad M. Marinovic**

1. Puria, Sunil: A theory of cochlear input impedance and middle ear parameter estimation, 1991

- **Ralph Mekel**
  1. Peruo, Patrick, Jr: Design of nonlinear control systems via a time domain ratio criterion, 1970
  2. Sobotkin, Fred Miles: Controller design for modeling problems with applications to a class of physiological systems, 1973
  3. Feldman, Walter Kenneth: Considerations of the design of nonlinear controllers for identification and observation of partially unknown plants, 1973
  4. Nachmias, Solomon: A learning control system with applications to flight systems, 1978
- **Fred Moshary**
  1. Zhou Jing: Spectral sensing technique for water constituents, 2006
  2. Vladutescu, Daniela Viviana: Optical remote sensing of properties and concentrations of atmospheric trace constituents, 2008 (co-advised by Moshary and Gross)
  3. Charles, Leona Ann Marie: Intra and inter-continental aerosol transport and local and regional impacts, 2008
  4. Bustamante Benitez, Miguel A.: Improved processing and development of the Multi-Filter Rotating Shadow-band Radiometer (MFRSR) network, 2010
  5. Lwin, Maung Thet: Performance modeling and validation of a chirped pulse quantum cascade laser for open-path ambient gas monitoring, 2010
  6. Gan. Chuen-Meei: Utilizing Operational and Improved Remote Sensing Measurements to Assess Air Quality Monitoring Model Forecasts, 2011
  7. Santoro, David: Development of an Eye Safe Coherent Doppler Wind Lidar System, 2012
  8. Abdelazim, Sameh: Analysis and implementation of signal processing strategies for a three-dimensional Doppler lidar wind profiler, 2012
  9. Tsereki, Alexandra: Development and Assessment of a Neural Network Approach for Retrieving Aerosol Properties from Multispectral, Multiangle Polarization Measurements, 2012
  10. Castillo Campodonico, Paulo Cesar: Remote Sensing of Long Path-Averaged Ambient Methane and Nitrous Oxide Greenhouse Gas Concentrations with a Mono-Static Quantum Cascade Laser Based System, 2014
  11. Cordero, Lina: Application of ground observations together with neural network technique to PM2.5 estimation from satellite aerosol op-

tical depth product, 2014 (co-advised by Gross and Moshary)
12. Diba, Abdou Salam: Widely tunable Sampled Grating Distributed Bragg Reflector Quantum Cascade laser for gas spectroscopy applications, 2015
13. Dagan, Morann: Infrared Lidar for Aerosol and Cloud Observations, 2018

- **Joseph S. Nadan**
  1. Gerson, Thomas James: Electromagnetic surface wave propagation on a ferromagnetic insulator with active and passive boundaries, 1974
  2. Mandelman, Jack Allan: Microstrip-oxide distributed pνn devices, 1975
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- **Thomas Hewett**
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- **Latif M. Jiji**
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3. Milentijevic, Dejan: Articular cartilage response to an impact load: In vitro and in vivo models for traumatic joint injury, 2003 (co-advised by Torzilli and Sadegh)
4. Tchako, Abraham: Sport injury biomechanics and stress changes in adjacent intervertebral discs after partial discectomies and fusion of the cervical spine, 2005
5. Zoghi Moghadam Kodehi, Mohamad: The role of CSF and SAS trabeculae in head/brain injuries: A new local/global and solid/fluid modeling, 2006
6 Saboori, Parisa: Mechanotransduction of Head Impacts to the Brain Leading to TBI: Histology and Architecture of Subarachnoid Space, 2011

- **Chou Mou Tchen**
  1. Hankel, Ralph D.: Dynamics of a plasma inhomogeneity in the upper atmosphere, its diffucion, oscillation, and turbulent motions, 1973
  2. Mendelsohn, Alfred: The effect of turbulence on wave propagation in the atmosphere: generation, attenuation, and scattering, 1980
  3. Jian, Qian: Closure problem and numerical studies of turbulence, 1984
- **Ioana R. Voiculescu**
  1. Liu. Fei: Multiparametric cell-based biosensor platform for rapid detection of water toxicity in field use, 2013
  2. Zhang, Xudong: Stretchable impedance spectroscopy sensor for mammalian cell studies, 2016
- **Charles B. Watkins**
  1. Gu, Kai: Multiscale molecular simulations of heat and mass transfer at multiphase flow interfaces, 2010 (co-advised by Watkins and Koplik (Physics))
- **Honghui Yu**
  1. Liu, Zhen: Simulating stress driven structural evolution in solid, 2009
  2. Diab, Mazen: Contact induced micro-plasticity near surface: A novel boundary element technique, 2010

11. Numbers about CCNY Engineering

11.1 Degrees Awarded: Graduation Numbers

The following data is from the CUNY Student Data Books, from the CUNY Institutional Research webpage. The data given in the Student Data Books changed several times, and the books 1989-1991 are missing. A star in the 'total' column means that this is the number of engineering degrees awarded across CUNY; this includes a small number of degrees awarded by Richmond College (later the College of Staten Island). A plus in the 'total' column means this does not include the computer science degrees. A dash in the column of a degree means that the degree did not exist or was not awarded in that year, an empty box means that I have no data. The year is always the year in which the academic year ends (so 1970 means the academic year 1969-1970).

All data below is from CUNY Institutional research; for 2007–2016 we have also the data from the Cityfacts, which unfortunately differs significantly from this.

Bachelor Degrees

Bachelor Degrees Awarded by School of Engineering									
Year	total	BME	Chem	Civil	CpE	CSc	El	Mech	BTech
1964	465*	—			—				
1965	490*	—			—				
1966	451*	—			—				
1967	413*	—			—				
1969	401*	—			—				
1969	490*	—			—				
1970	463	—	51	82	—	27	203	100	
1971	417	—	48	67	—	42	178	82	
1972	504	—	51	57	—	68	239	81	
1973	540	—	35	58	—	91	185	82	89
1974	480	—	28	65	—	71	157	70	89
1975	430	—	22	62	—	50	141	64	81
1976	423	—	13	64	—	62	124	70	90
1977	390	—	18	62	—	56	114	69	71
1978	381	—	32	67	—	46	111	65	60
1979	392	—	34	52	—	54	107	72	73
1980	352	—	27	47	—	42	117	65	54

Bachelor Degrees Awarded by School of Engineering (continued)									
Year	total	BME	Chem	Civil	CpE	CSc	El	Mech	BTech
1981	390	—	31	57	—	48	159	63	32
1982	326	—	29	39	—	52	107	49	50
1983	342	—	29	55	—	52	108	65	33
1984	397	—	27	58	—	66	134	70	42
1985	349	—	40	31	—	68	123	56	31
1986	409	—	26	49	—	66	162	59	47
1987	425	—	25	53	—	69	197	54	27
1988	388	—	23	41	—	85	161	44	34
1989		—			—				
1990		—			—				
1991		—			—				
1992		—			—				
1993		—			—				
1994	296 $^+$	—			—				39
1995	225 $^+$	—			—				30
1996	228 $^+$	—			—				7
1997	203 $^+$	—			—				2
1998	194 $^+$	—			—				—
1999	150 $^+$	—			—				—
2000	139 $^+$	—			—				—
2001	115 $^+$	—			—				—
2002	114 $^+$	—			—				—
2003	143 $^+$	—			—				—
2004	136 $^+$	—			—				—
2005	162 $^+$	—			—				—
2006	125 $^+$	—			—				—
2007	202 $^+$	—			—				—
2008	249 $^+$	—			—				—
2009	228 $^+$	—			—				—
2010	259 $^+$	—			—				—
2011	244 $^+$	—			—				—
2012	217 $^+$	—			—				—
2013	268 $^+$	—			—				—
2014	279 $^+$	—			—				—
2015	290 $^+$	—			—				—
2016	347 $^+$	—			—				—
2017	369 $^+$	—			—				—

Master Degrees

In addition to the Masters degrees listed here, there was also a very small program in Urban Engineering, whch produced a total of seven graduates (two in 1976, two in 1977, one in 1983 and two in 1988)

Master Degrees Awarded by School of Engineering								
Year	total	Gen	Chem	Civ	CSc	El	IS	Mech
1963	87*				—		—	
1964	94*				—		—	
1965	84*				—		—	
1966	100*				—		—	
1967	87*				—		—	
1968	84*				—		—	
1969	107*				—		—	
1970	107	6	8	19	—	45	—	29
1971	112	4	9	16	8	44	—	35
1972	97	5	5	18	4	34	—	31
1973	115	4	6	24	11	30	—	40
1974	107	4	9	10	23	30	—	31
1975	96	7	7	23	18	22	—	19
1976	89	2	15	18	13	29	—	10
1977	74	—	6	15	20	17	—	14
1978	52	1	7	8	17	10	—	9
1979	34	—	6	11	2	10	—	5
1980	58	—	7	9	21	14	—	7
1981	92	—	6	12	32	25	—	17
1982	103	—	3	24	30	23	—	23
1983	153	—	9	14	74	33	4	18
1984	239	—	14	28	101	48	21	27
1985	240	—	11	31	112	51	14	21
1986	223	—	10	23	80	67	13	30
1987	242	—	14	36	59	81	19	33
1988	231	—	16	28	66	70	32	17

Doctoral Degrees 1968 10 1969 14 1970 12 1971 6 1972 15 1973 6 1974 7 1975 11 1976 8 1977 9 1978 5 1979 10 1980 10 1981 7 1982 9 1983 6 1984 9 1985 8 1986 8 1987 11 (plus one CS doctoral degree at the GC; but was this CCNY advisor?) 1988 19 (plus one CS doctoral degree at the GC; but was this CCNY advisor?) (The CUNY graduate center lists the first PhD degrees in CS graduating 1980, whereas the CUNY summary of awarded degrees gives the first CS PhDs in 1987.)

11.2 Enrollment

For long periods of CCNY history, meaningful enrollment figures for individual degree programs just do not exist, because students were allowed to enroll with an undeclared major. This makes planning impossible; it also obscures the problems with large dropout rates and long time to graduation. As example, the undergraduate enrollment of Fall 1986, according to Cityfacts was

Fall 1986 CCNY Enrollment			
	lower division ug	upper division ug	graduate
CCNY total	5112	5220	2452
undeclared major	4007	1941	450
engineering major	155	1141	617

11.3 Budget

There is no source for financial data that covers the entire history, or even half, of the school of engineering. Below is some data I found, so far without further interpretation.

The numbers below come from CITYFacts. In the budget, the College total excludes Biomed/Medical School, CWE, and SEEK; SEEK is a CUNY-wide program that exists at each college, and has a separate allocation from the state. The Medical School is treated like a separate college. I do not know why CWE is separate, but its budget is very small. This data from the 1980s and 1990s shows the runup to the fiscal crisis of 1995, in which the school of nursing and several departments were closed.

CCNY Operational Budget					
Category	82-83	86-87	89-90	94-95	96-97
CCNY total	\$48.2M	\$65.5M	\$72.7M	\$71.8M	\$64.5M
Instruction PS-Regular	\$20.0M	\$26.4M	\$32.8M	\$30.7M	\$26.0M
Instruction PS-Adjunct	\$0.7M	\$1.7M	\$2.1M	\$4.0M	\$3.1M
Instr. Support PS-Reg	\$5.3M	\$5.8M	\$8.2M	\$8.1M	\$6.9M
Organized Research	\$0.2M	\$0.6M	\$0.6M	\$0.8M	\$0.9M
Library	\$2.1M	\$3.0M	\$3.3M	\$2.1M	\$2.7M
Student Services	\$1.8M	\$2.6M	\$3.0M	\$2.7M	\$3.1M
Maintenance & Operations	\$11.0M	\$13.7M	\$8.7M	\$9.0M	\$8.0M
General Administration	\$2.2M	\$3.5M	\$4.1M	\$4.0M	\$3.3M
Gen Instruction Services	\$3.7M	\$5.2M	\$5.4M	\$6.2M	\$6.3M

The budget of the Medical School was \$4.4M in 1982-83, \$7.0M in 1986-87.

The numbers below come from CITYFacts; grants labelled as NIH came before 1989 from the US Department of Health and Human Services; grants labelled DoD were before 1989 accounted for the separate services (Army, Navy, Air Force etc). The numbers do not completely agree with the numbers given in the 1989-90 Operating Budget

Annual CCNY Funding from Sponsored Programs				
	1980-81	87-88	89-90	94-95
total	\$10.4M	\$13.8M	\$18.6M	\$27M
NSF	\$4.6M	\$3.0M	\$5.0M	\$6.6M
NIH	\$2.1M	\$3.1M	\$5.2M	\$4.8M
DoEnergy	\$0.7M	\$1.4M	\$1.1M	\$1.1M
DoD	\$?	\$?	\$0.9M	\$1.9M
DoT	–	–	\$0.5M	–
NASA	–	–	–	\$1.0M
NYS DoEdu	\$0.2M	\$1.0M	\$0.5M	\$1.1M

Below is the funding received by the School of Engineering for Sponsored Research for the period 1989 to 2016; the 2000–2013 data is from the School of Engineering Annual Reports. There were Annual Reports from 2002 until 2013; for 2016 the data is from the GSoE Research report of that year. The data 1989–1996 is from annual reports on Sponsored Programs of the Research Office. I included also two historic data points, 1981 and 1985, from the CityFacts. The data 1989–1996 includes the Levich Institute, which each year was about \$1M; I assume the other data also includes the Levich Institute.

Sponsored Research Awards Received by GSoE	
Year	Amount
1980–1981	\$1.8M
1984–1985	\$2.3M
1989–1990	\$3.3M
1990–1991	\$4.9M
1991–1992	\$5.5M
1992–1993	\$6.9M
1993–1994	\$8.2M
1994–1995	\$6.7M
1995–1996	\$7.3M
2000–2001	≈\$8M
2001–2002	≈\$12M
2002–2003	≈\$15M
2003–2004	≈\$15M
2004–2005	\$16.1M
2005–2006	\$16.1M
2006–2007	\$18.6M
2007–2008	\$23.8M
2008–2009	\$21.7M
2009–2010	\$31.4M
2010–2011	\$34.4M
2011–2012	\$27.7M
2012–2013	\$24.8M
2015–2016	≈\$20M

Below is the grant funding received by City College. Grant funding does not go directly to the college, instead there are two institutions, RFCUNY and CCRF, which serve as fiscal agents, receive the grant, and disburse it according to the instructions of the professor responsible for the grant. The CUNY Research Foundation (RFCUNY) and the City College Research Foundation (CCRF) were both established in 1963; but CCRF has shrunk to insignificance, although it still exists (is mentoned in the 2017 KPMG audit of CUNY). At least in the period 1989–1996, all forms of government grants went via RFCUNY, only some grants from company sponsors went via CCRF. CityFacts claims that the data below is the amount that came via CCRF, but the Annual Reports on Sponsored Programs show this is not true, it is the sum of RFCUNY and CCRF, where the CCRF share is much smaller (\$108k in 1989–1990). Unfortunately the Report on Sponsored Programs is not consistent among different years either.

Grants awarded to City College		
Year	Number	Amount
1974–1975	94	$4.3M
1975–1976	114	$4.6M
1976–1977	119	$4.2M
1977–1978	123	$5.9M
1978–1979	125	$6.9M
1979–1980	141	$7.0M
1980–1981	140	$10.4M
1981–1982	131	$7.7M
1982–1983	108	$7.3M
1983–1984	133	$8.4M
1984–1985	148	$10.8M
1985–1986	147	$11.9M
1986–1987	182	$13.6M
1987–1988	183	$13.8M
1988–1989	213	$17.3M
1989–1990	219	$18.7M
1990–1991	212	$20.4M
1991–1992	243	$21.8M
1992–1993	216	$21.2M
1993–1994	230	$26.1M
1994–1995	214	$27.0M
1995–1996	236	$27.3M

Below are the Private Sponsorship (gifts, bequests, etc.) received by CCNY for the period 1982-1994; the data is from the CityFacts. However, historic data is not always consistent among different years of CityFacts.

Private Sponsorship received by CCNY	
Year	Amount
1982–1983	$2.7M
1983–1984	$3.9M
1984–1985	$3.4M
1985–1986	$3.6M
1986–1987	$5.9M
1987–1988	$5.3M
1988–1989	$6.4M
1989–1990	$5.0M
1990–1991	$6.4M
1991–1992	$3.6M
1992–1993	$2.5M
1993–1994	$4.8M