

URBAN SYSTEMS (PHD)

Civil and Urban Engineering Department (<https://engineering.nyu.edu/academics/departments/civil-and-urban-engineering/>)

NYSED: 41225 HEGIS: 0206.00 CIP: 30.0601

Program Description

The doctoral program in Urban Systems offers an interdisciplinary learning and research environment designed to meet the needs of students pursuing careers in academia, research organizations, local and national government, and public service agencies. This PhD program expands upon the unique legacy of decades of collaboration in education and research, development and training between NYU faculty, city agencies, and industry. The program is administered by NYU Tandon in partnership with other NYU schools including: the Stern School of Business (<https://www.stern.nyu.edu/>), Langone Health (<https://med.nyu.edu/>), Wagner Graduate School of Public Service (<https://wagner.nyu.edu/>), and NYU research centers including the Center for Urban Science and Progress (<https://engineering.nyu.edu/research-innovation/centers/cusp/>) and the Center for Connected Mobility, C2SMARTER (<https://engineering.nyu.edu/research-innovation/centers-connected-cities-smart-transportation-c2smart/>).

This program is aligned with the vision and commitment of the university to work within the 'city as a lab' to accelerate the field deployment of innovative solutions to emerging urban needs. Areas of study include sustainability and climate action, infrastructure and resilience, public health and equity. This interdisciplinary laboratory of urban research and innovation brings together expertise and the research excellence of NYU faculty in New York as well as our global campuses in Abu Dhabi and Shanghai, and study abroad sites in London, Paris, Berlin, Madrid, Florence, and Prague. Drawing from the expertise of the Urban Faculty (<https://www.nyu.edu/academics/scholarly-strengths/urban-initiative/research/faculty.html>) across the university, we have built a unique and competitive interdisciplinary educational environment based on the following disciplinary pillars:

- Data Science & Informatics
- Communication and Information Science
- Social Studies, Health, and Policy
- Systems Engineering
- Economics, Finance, and Planning

The program is available to students with diverse educational backgrounds pursuing their studies across disciplines, including Engineering, Environmental Science, Architecture, Urban Planning, Computing, Data Science, Systems Science, Economics, Finance, Public Health, Public Policy, and Law. Development of skills in mathematics, statistics, and programming is included in the course of study, depending on the need associated with the student's dissertation topic.

Admissions

To apply for admission to any Tandon graduate program, please contact the Office of Graduate Admissions (<https://engineering.nyu.edu/admissions/graduate/>).

Application Requirements

1. Master's or Bachelor's degree from an accredited program in physical and mathematical sciences, social sciences, or engineering (other fields upon approval of program administrator).
2. Minimum Master's and Bachelor's degree GPA of 3.5/4.0, and 3.0/4.0, respectively.
3. Submission of GRE, and English language proficiency test scores (when applicable).

An applicant who has not yet earned a master's degree may be directly admitted into the PhD program with the written approval of the program director. Applicants with a master's degree in any discipline other than Master of Science may be required to have prerequisites in the subjects listed below:

- Calculus with analytic geometry
- Statistics and Probability
- Introduction to computer programming

In addition to these degree requirements and the NYU Tandon general admission requirements (<https://engineering.nyu.edu/admissions/graduate/apply/requirements/>), acceptance to the program will depend on:

1. academic excellence,
2. research interests congruent with areas of urban scholarship and faculty research at NYU including the global campuses, and
3. positive recommendations (e.g., from former employers or research advisers).

Note: Application and/or admission to the program does not require prior identification of a research adviser. Acceptance to the program is not automatically accompanied with financial support.

Program Requirements

| Course | Title | Credits |
|---|--|---------|
| Core Courses | | |
| CE-GY 6053 | Monitoring Cities | 3 |
| CE-GY 7815 | Urban Systems Studio | 1.5 |
| CE-GY 7843 | Urban Infrastructure Systems Management | 3 |
| CE-GY 7915 | Urban Systems Immersion for Social Good ¹ | 1.5 |
| or CP-GY 9941 | Internship for PhD I | |
| CUSP-GX 7013 | Introduction to Applied Data Science | 3 |
| Electives | | |
| Choose courses from the Electives list below. ² | | |
| Qualifying Exam | | |
| Students must pass the qualifying exam (QE) within 2 years of beginning the PhD program. The QE is the prerequisite to dissertation. | | |
| RE-GY 9990 PHD QUALIFYING EXAM | | |
| Dissertation Courses | | |
| After passing the QE, students will enroll in dissertation. Once the dissertation has begun, students must enroll in at least 3 credits of the dissertation course each fall and spring semester until graduation. A total of 21 dissertation credits are required. | | |
| CE-GY 999X PHD Diss in Civil Engineering Department ³ | | |
| Total Credits | | |
| 75 | | |

¹ Note: CE-GY 7915 is to be taken after passing the qualifying exam.
² Other courses may be selected with the approval of the program director.
³ Up to 6 credits of CE-GY 998X Dissertation Level Research may count towards the dissertation requirement. Students may enroll in CE-GY 998X before passing the qualifying exam.

Electives

| Course | Title | Credits |
|--|--|---------|
| Urban Systems | | |
| CE-GY 7713 | Selected Topics in Environmental and Water Resources Engineering | 3 |
| CE-GY 7993 | Selected Topic in Infrastructure Systems | 3 |
| CE-GY 8383 | Building Information Modeling (BIM) and Its Applications in AEC/FM | 3 |
| TR-GY 6113 | Forecasting Urban Travel Demand | 3 |
| TR-GY 7353 | Data-Driven Mobility Modeling & Simulation | 3 |
| Statistics and Data Science | | |
| CS-GY 6613 | Artificial Intelligence I | 3 |
| CS-GY 6763 | Algorithmic Machine Learning and Data Science | 3 |
| ECE-GY 6233 | System Optimization Method | 3 |
| MG-GY 6193 | Statistics for Data Analysts | 3 |
| ROB-GY 6203 | Robot Perception | 3 |
| <i>Statistics and Data Science Courses from Other Schools of NYU</i> | | |
| DS-GA 1001 | Introduction to Data Science | 3 |
| DS-GA 1002 | Probability and Statistics for Data Science | 3 |
| DS-GA 1007 | Programming for Data Science | 3 |
| STAT-GB 2301 | Regression and Multivariate Data Analysis | 3 |
| Urban Informatics | | |
| CS-GY 6323 | Large-Scale Visual Analytics | 3 |
| CUSP-GX 7023 | Applied Data Science | 3 |
| CUSP-GX 7033 | Machine Learning for Cities | 3 |
| CUSP-GX 8033 | Urban Spatial Analytics | 3 |
| CUSP-GX 8053 | Urban Decision Models | 3 |
| CUSP-GX 8073 | Big Data Analytics for Public Policy | 3 |
| CUSP-GX 8083 | Big Data Management & Analysis | 3 |
| <i>Urban Informatics Courses from Other Schools of NYU</i> | | |
| PADM-GP 2505 | Advanced Data Analytics and Evidence Building. | 3 |
| URPL-GP 2618 | Geographic Information Systems and Analysis | 3 |
| URPL-GP 4650 | Advanced GIS: Interactive Web Mapping and Spatial Data Visualization | 1.5 |
| Finance, Governance, and Society | | |
| <i>Offered from Other Schools of NYU</i> | | |
| FINC-GB 3186 | Project Finance and Infrastructure Investment | 1.5 |
| PHD-GP 5902 | Research Methods | 4 |
| URPL-GP 2612 | Smart, Sustainable Planning in Amsterdam | 3 |
| URPL-GP 2625 | Environmental Infrastructure for Sustainable Cities | 3 |
| URPL-GP 2645 | Planning for Emergencies and Disasters | 3 |
| URPL-GP 2660 | History and Theory of Planning | 3 |

Urban Science Doctoral Track

The optional Urban Science Doctoral Track (<https://engineering.nyu.edu/urban-science-sensing-complexity-informatics-doctoral-track/>) is

specifically designed for students who want to focus on urban science through a cohesive array of in-class and experiential learning activities, while pursuing their PhD at NYU Tandon. Doctoral track students will engage with CUSP's urban science faculty, experts in methodological aspects pertaining to complexity (dynamical systems, multi-agent systems, network science, and risk engineering), informatics (AI, machine learning, and robotics), and sensing (Internet of Things, smart infrastructure, wireless).

Qualifying Exam and Dissertation

Qualifying Exam

The PhD qualifying examination is designed to (1) assess student's fundamental knowledge about their sub-discipline of Urban Systems, and (2) evaluate the student's ability to conduct PhD-level research, including the ability to approach open-ended questions, reason through complex problems, synthesize and analyze information, and articulate it to others. Students must inform their graduate adviser of the semester that they intend to take the exam. Any student who has been accepted into the PhD program is eligible to take the exam.

The exam consists of two parts: written and oral.

Part 1 - In-person Open-book Written Exam

The written exam is to be administered each year in May after the end of the spring semester (the specific date will be determined each year by the Graduate Adviser). Three subjects will be chosen by the student out of a set of four predetermined subjects. The predetermined subjects must correspond to courses offered at NYU Tandon that year. Predetermined subjects, questions, grading rubrics, and solutions will be decided and reviewed by each sub-discipline. Each subject exam will consist of multiple questions that can be completed over the course of an hour, for a total of a three-hour exam. Students will be proctored by a faculty member and will not be allowed to use internet-connected devices.

A passing grade of 70% is required in each subject. For any subject that a 70% or above is not achieved, the student must petition the graduate advisor for a second opportunity to take the subject exam (this does not guarantee permission), which should be administered within 3-months. The student will only be required to retake subjects that they did not receive a grade of 70% or above during an exam.

Part 2 - Structured Oral Exam

The oral exam is to be administered within three months of the student passing the written exam. After passing this exam, the student becomes a PhD Candidate.

The oral exam consists of a presentation of a research proposal to the PhD qualifying exam committee. The student will be provided a research topic one week prior to the oral exam, and will be asked to spend that time developing a research proposal that they will present to the committee. The research topic will be within the student's proposed field, but not directly related to their chosen research topic. The exam topic will be formulated by the PhD qualifying exam committee chair, and must be approved by all other members of the exam committee before it is provided to the student.

The oral qualifying exam committee will consist of no less than three committee members, with at least two members belonging to the CUE department. The exam committee will be determined by the exam committee chair (typically the student's PhD adviser).

The oral exam will consist of a 20-minute presentation of the student's proposal, during which they will approach the following questions:

- What is known about the research topic? Students should be able to identify at least three key publications on the topic and describe key findings – these should be a mix of seminal works and significant recent breakthroughs. Students should be able to explain/replicate methods, experiments, mathematical proofs, and/or assumptions made in those key publications.
- What are research gaps related to the topic?
- What research question and objectives could be implemented to address the identified knowledge gaps? Students are expected to clearly state their research question(s) and hypotheses)
- What experimental methods could be implemented to answer the research question(s)?
- What are the expected outcomes of the research and why?

After the student presentation, each committee member will be allotted up to 20 minutes to ask targeted questions based on the proposed research, or fundamental understanding related to the topics presented. Students will have access to a chalkboard or white board to write out or illustrate concepts.

The following categories provide a structured evaluation of the results to the PhD Qualifying Examination Committee:

- Pass: the student's performance in written and oral parts of the qualifying examination were satisfactory.
- Conditional pass/retake: the student's performance in the oral part of the qualifying examination was not satisfactory. The student will be asked to take the oral exam again, or perform a set of conditions before being granted a passing grade. The committee will define the time frame for completion of the conditions or retake of the examination. A third attempt is rarely permitted only with written approval of the department chair.
- Fail: the student's performance in the written and/or oral parts were not satisfactory. When a student fails the PhD qualifying exam, there is no option to retake the exam.

The qualifying exam may be taken home with the permission of the program director.

Dissertation

Adviser and Committee

Students declare a dissertation/research adviser during the fall semester of year two, shortly after passing the PhD qualifying exam. The student and the adviser will subsequently select a dissertation guidance committee by start of the spring semester of the same academic year. The guidance committee will be composed of the research adviser and three other faculty members including one external adviser (from another institution or from an NYU school other than the primary adviser). The function of the dissertation guidance committee is to monitor and support the student's progress on an ongoing basis, starting from the dissertation proposal planning. Declaration of the primary adviser and the dissertation committee is done by submitting the designated forms according to the timeline described above. Students should complete the *PhD Guidance Committee* form found on the Graduate Academics website (<https://engineering.nyu.edu/academics/graduate/graduate-student-forms/>) to start the process of gathering a dissertation guidance committee.

Research Proposal Examination

The research proposal examination, overseen by the dissertation guidance committee, must be passed by the spring midterm of the second year. The objective of this exam is to ensure the student has chosen an appropriate PhD research topic and that the research plan is rigorous with a high likelihood of success. The results of each student's proposal examination must be submitted by the primary adviser no later than one week following the exam, along with the proposed scope of work, the student and the dissertation committee copied. A memo on passing of this exam and the committee composition will be documented at the NYU Tandon Graduate Academics Office. Failing to pass this exam in a timely fashion may result in the student being placed under probation.

Progress Assessment

At end of each term, the student submits a progress report outlining the term's academic progress. Subsequent to passing the proposal examination, the progress report should be signed off by the dissertation guidance committee prior to submission.

Dissertation Defense

With the dissertation research adviser and the dissertation guidance committee's approval, the student will submit a written dissertation, in compliance with all requirements of NYU Tandon. It is expected that the student has published at least three articles in a reputable peer reviewed journal (two accepted and one under review). The dissertation must be provided to the guidance committee members who also serve as the examination committee, at least two weeks prior to the defense. The defense includes a public presentation by the student and with questions from the audience. Following the public presentation, the student meets privately with the committee members for comments and/or further questions. The committee makes a decision that is then transmitted, in writing, to the program director and from there to the registrar. The defense of the final draft of the student's dissertation must take place in-person at the Brooklyn campus.

Dissertation Submission

Students must submit the PhD dissertation following the *PhD Dissertation Guidelines*, which can be found on the Graduate Academics website (<https://engineering.nyu.edu/academics/graduate/graduate-student-forms/>).

Sample Plan of Study

| Course | Title | Credits |
|--------------------------|--|-------------|
| 1st Semester/Term | | |
| CE-GY 6053 | Monitoring Cities | 3 |
| CE-GY 7815 | Urban Systems Studio | 1.5 |
| CE-GY 7843 | Urban Infrastructure Systems Management | 3 |
| CUSP-GX 7013 | Introduction to Applied Data Science | 3 |
| Credits | | 10.5 |
| 2nd Semester/Term | | |
| RE-GY 9990 | PHD QUALIFYING EXAM | 0 |
| Elective | | 3 |
| Elective | | 3 |
| Elective | | 3 |
| Credits | | 9 |
| 3rd Semester/Term | | |
| CE-GY 7915 | Urban Systems Immersion for Social Good ¹ | 1.5 |
| Elective | | 3 |
| Elective | | 3 |
| Elective | | 3 |
| Credits | | 10.5 |

| 4th Semester/Term | | |
|--------------------|--|----|
| Elective | | 3 |
| Elective | | 3 |
| Elective | | 3 |
| Credits | | 9 |
| 5th Semester/Term | | |
| Elective | | 3 |
| Elective | | 3 |
| Elective | | 3 |
| Credits | | 9 |
| 6th Semester/Term | | |
| CE-GY 999X | PHD Diss in Civil Engineering Department | 3 |
| Elective | | 3 |
| Credits | | 6 |
| 7th Semester/Term | | |
| CE-GY 999X | PHD Diss in Civil Engineering Department | 3 |
| Elective | | 3 |
| Credits | | 6 |
| 8th Semester/Term | | |
| CE-GY 999X | PHD Diss in Civil Engineering Department | 3 |
| Credits | | 3 |
| 9th Semester/Term | | |
| CE-GY 999X | PHD Diss in Civil Engineering Department | 3 |
| Credits | | 3 |
| 10th Semester/Term | | |
| CE-GY 999X | PHD Diss in Civil Engineering Department | 3 |
| Credits | | 3 |
| 11th Semester/Term | | |
| CE-GY 999X | PHD Diss in Civil Engineering Department | 3 |
| Credits | | 3 |
| 12th Semester/Term | | |
| CE-GY 999X | PHD Diss in Civil Engineering Department | 3 |
| Credits | | 3 |
| Total Credits | | 75 |

¹ Should be taken in the 2nd or 3rd year, and after passing RE-GY 9990
PHD QUALIFYING EXAM.

Learning Outcomes

Upon successful completion of the program, graduates will:

1. Have an understanding of urban infrastructure system governance and operations management.
2. Be skilled on how to integrate artificial intelligence and data analytics for infrastructure operations and performance monitoring.
3. Be able to teach design, system planning, and engineering for resilience, including infrastructure finance and economics.
4. Be able to teach how to identify and assess challenges relevant to urban infrastructure systems and apply appropriate engineering and analytics methods to advance the state of the field.

Policies

NYU Policies

University-wide policies can be found on the New York University Policy pages (<https://bulletins.nyu.edu/nyu/policies/>).

Tandon Policies

Additional academic policies can be found on the Tandon academic policy page (<https://bulletins.nyu.edu/graduate/engineering/academic-policies/>).