

# ARCH 544G ENVIRONMENTAL CONTROL SYSTEMS II

Spring 2024, Associate Professor Hyojin Kim, Ph.D.

**Delivery Mode:** Asynchronous online course (<https://canvas.njit.edu/>)  
**Office Hours:** Tuesdays 11:00 AM – 1:00 PM\* or by appointment  
**Prerequisite:** ARCH 543G

\*Sign up for a time slot using the Calendar in Canvas! Dr. Kim can be also reached by email: [hyojin.kim@njit.edu](mailto:hyojin.kim@njit.edu).

---

**Description:** This course is intended to provide students a deeper understanding of the relationship between architectural design and active building systems. The topics include: indoor air quality and ventilation systems, heating and cooling systems, electric lighting design, electrical energy systems, acoustical systems, building water supply, plumbing systems, and fire protection. This course is the second of a two-course sequence in building environmental control systems (543G, 544G) focusing on active (mechanical/electrical) solutions, yet passive (architectural) solutions are covered in the first sequence.

**Required Text:** Mechanical and Electrical Equipment for Buildings (MEEB), 13<sup>th</sup> Edition, by Grondzik and Kwok (ISBN: 978-1-119-46308-5).

**Course Format:** This is an online course, conducted entirely asynchronously via the learning management system Canvas. To access Canvas, you must have a UCID account with NJIT. For information on using Canvas and other supported learning tools, please visit the IST Service Desk [Knowledgebase](#).

All lectures, labs, and homework will be posted on Canvas every Wednesday. Please navigate to the section “Modules” and complete the weekly module corresponding to the course schedule outlined in this syllabus. For each week, there will be a page named Task List where I will list all the items that need to be completed. This list will assist you in staying on track with your tasks. Students are required to submit their weekly lab deliverables, homework, video quizzes, and one-minute papers in response to video lectures/readings via Canvas by the announced due dates. It is your responsibility to keep it up and complete and submit the labs/homework/video quizzes/one-minute papers professionally and in a timely manner. Exams will be given on Canvas with appropriate proctoring using ProctorU.

**Copyright Statement:** All materials in this course, including lecture videos, lecture slides, labs, homework, exams, and related materials, are intended solely for the use of students currently enrolled in this course and solely for purposes related to this course. Students are strictly prohibited from sharing any of the course materials with third parties. These materials may be protected by copyright law, and any additional use beyond the scope of this course may constitute a violation of federal copyright law.

## Recommended Text

Heating and Cooling of Buildings, Design for Efficiency, 2<sup>nd</sup> Edition, by Kreider, Curtiss, and Rabl (ISBN: 978-1439811511).

The Green Studio Handbook: Environmental Strategies for Schematic Design, 3<sup>rd</sup> Edition, by Kwok and Grondzik (ISBN: 978-1138652293).

The Architect's Studio Companion: Rules of Thumb for Preliminary Design, 6<sup>th</sup> Edition, by Allen and Iano (ISBN: 978-1119092414).

## Course Learning Outcomes

This course will guide students to achieve the following competencies:

- Explain the Heating, Ventilation, and Air Conditioning (HVAC) processes on the psychrometric chart and how to calculate the cooling or heating energy required for a given psychrometric process.
- Identify an appropriate, energy-efficient, HVAC system to comply with current industry codes and standards (i.e., ventilation for ASHRAE Standard 62.1, thermal comfort for ASHRAE Standard 55, energy performance for ASHRAE Standard 90.1).
- Schematically describe the general layout of the HVAC system in a building.
- Identify an appropriate, energy-efficient, electrical lighting system to provide adequate illumination while reducing glare.
- Explain the fundamental elements of electrical systems for a building, including electrical wiring and protection.
- Explain the methods for controlling noise, sound reflections, and reverberation in a building.
- Explain a water supply and waste water system for a building.
- Explain a fire protection system for a building.

## NAAB Criteria

The National Architectural Accrediting Board (NAAB) accredits NJIT's architecture program. The NAAB has Program and Student Criteria that must be covered by any architectural curriculum to attain their approval. This course satisfies the following criteria:

**PC.3 Ecological Knowledge and Responsibility:** How the program instills in students a holistic understanding of the dynamic between built and natural environments, enabling future architects to mitigate climate change responsibly by leveraging ecological, advanced building performance, adaptation, and resilience principles in their work and advocacy activities.

**SC.1 Health, Safety, and Welfare in the Built Environment:** How the program ensures that students understand the impact of the built environment on human health, safety, and welfare at multiple scales, from buildings to cities.

**SC.4 Technical Knowledge:** How the program ensures that students understand the established and emerging systems, technologies, and assemblies of building construction, and the methods and criteria architects use to assess those technologies against the design, economics, and performance objectives of projects.

**Academic Integrity:** Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:

<http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf>.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. ***Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university.*** If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at [dos@njit.edu](mailto:dos@njit.edu).

HCAD librarian Maya Gervits has assembled excellent resources for a students use on using images, citing, and plagiarism [link](#).

**Accommodations for Students with Disabilities:** All reasonable efforts will be made to accommodate a student with a temporary disability (e.g., broken arm, protracted illness, etc.) as long as the student is

responsible for communicating with their instructor about the issue and for cooperating in its resolution. Students with more permanent physical or learning disabilities must provide documented requests for accommodation to their instructor at the beginning of the semester (or as soon as the disability is diagnosed and documented). Students should contact the Student Disability Service Office (<https://www.njit.edu/accessibility/>) for further information and instruction for obtaining medical and/or psychological disability documentation.

**Learning and Teaching Culture Policy:** In addition to the overarching values and ethics of the university, the New Jersey School of Architecture (NJSoA) is dedicated to optimism, diversity and solidarity, professional conduct, constructive evaluation and instruction, collaborative community, health and wellbeing, time management and school-life-work balance, respectful stewardship and space management, and well-rounded enrichment. The pedagogy of architecture and design is as complex as it is rewarding, and as dynamically evolving as the people who learn and teach it. This understanding resides at the core of the NJSoA Learning and Teaching Culture Policy: <https://design.njit.edu/learning-and-teaching-culture-policy>

### **Attendance Policy**

**Attendance:** Attendance is mandatory for all classes, and this class will be tracking attendance through video quizzes. Students who anticipate missing classes or exams due to religious observance must provide a written list of the dates they will be absent to their instructors by the end of the second week of classes. It is expected that students will make arrangements to complete any missed work.

The NJIT office of the Dean of Students (DOS) maintains a way for students to explain absences that instructors can use to regulate absenteeism. By providing verifiable documentation through filing an online [Student Absence Excuse Request](#) form related to the absences within 14 days, a student can ask for accommodation and that their absences not affect their grade. This may include medical or psychological documentation to support a student's claim. Students should not bring such information to their instructor, nor should it be requested by a faculty member. Once the absence has been verified, the DOS will communicate with the instructor. Except for cases determined by law, an instructor *is not required* to accommodate student requests even when extenuating circumstances are certified by the DOS; however, all efforts will be made to ensure a student-friendly environment. Accepted reasons for absence include bereavement, medical concerns, military activity, legal obligations, or university-sponsored events.

### **Course Work**

**Video Quizzes:** Video quizzes will be embedded within the video lectures, prompting students to answer questions and click the "finish" button for each question to submit their responses. To receive a quiz grade, students are required to answer all questions within the corresponding video, as the current interface of the Panopto media platform does not provide partial credit. The quiz can be retaken as many times as needed until a perfect score is achieved.

**One-Minute Papers:** This class will use one-minute papers to gather feedback and verify student engagement with asynchronous lectures. Students are expected to post their one-minute papers to the Canvas discussion board by the announced due dates (i.e., 11:59 AM on Tuesday). A one-minute paper is a very short writing activity in response to a question posed by the instructor, which encourages students to reflect on the day's lesson and provides valuable feedback to the instructor.

**Labs:** All labs will be posted on Canvas. These labs are designed to reinforce the lecture concepts. Students are required to complete the labs and submit their lab deliverables as a SINGLE PDF file via Canvas by the announced due dates (i.e., 11:59 PM on Tuesday) to receive a credit. While you are allowed and encouraged to work in groups to gain a better understanding of the lab, each student must submit their individual work to ensure originality (see the definition of plagiarism the NJIT academic

code of integrity policy [link](#)).

Labs will be graded on a weekly basis, and I will provide feedback on each assignment using the comments feature in Canvas.

**Homework:** All homework assignments will be posted on Canvas. Students are required to submit their completed assignments as a SINGLE PDF file via Canvas by the announced due dates (i.e., 11:59 PM on Tuesday). Students should not email the homework directly to the instructor. The instructor must be able to open and read the files. If a file is corrupt or illegible, and the instructor is unable to read the file, the student will receive a failing grade for that homework. While you are allowed and encouraged to work in groups to gain a better understanding of the homework, each student must submit their individual work to ensure originality (see the definition of plagiarism the NJIT academic code of integrity policy [link](#)).

All questions requiring a short response should be answered with a concise, well-crafted paragraph. Answers should be typed, unless otherwise noted. If you are to fill in answers on the homework sheets themselves, please turn in a clean, legible copy. Illegible answers will not receive credit. Successful presentations of assignments include, but is not limited to: spelling, clarity of thought, following instructions, and design. Points are awarded at the instructor's discretion. Show all calculations and include all units (e.g. Kilowatts = kW). Calculations may be handwritten, if presented legibly.

Homework assignments will be graded on a weekly basis, and I will provide feedback on each assignment using the comments feature in Canvas.

**Late Work:** Students are required to submit all lab deliverables and homework on time by the announced due dates via Canvas. Late work will be accepted up to one week after the due date, but it will be marked accordingly with a 20% deduction. In certain cases, students may be allowed to make up missed work due to excused reasons, without receiving deductions. This allowance depends on the nature of extenuating circumstances that shall be certified by the Dean of Students as described above for Attendance.

### **Exam Policy**

**Exams:** There will be two exams covering the indicated materials, and they will be administered on Canvas with appropriate proctoring using ProctorU. The exams will be open-book and open-note. Computers are allowed only for accessing the Canvas Quiz browser and downloaded e-textbook/course materials. You are NOT allowed to access to any other browser windows (e.g., course materials posted on Canvas) during the exam. Cellphones and other small-sized electronic devices that are capable of sending/receiving electronic messages are NOT allowed. Exams may be rescheduled with an excused reason depending on the nature of extenuating circumstances that shall be certified by the Dean of Students as described above for Attendance.

**Final:** There will be a comprehensive final exam that covers all the material presented in this class. This final exam will be administered on Canvas with appropriate proctoring using ProctorU. The same policies described above for Exams will be applied to the final exam.

**ProctorU:** In this course you will be required to use the following proctoring method to ensure academic integrity for exams. Please see NJIT's policy about online course exam proctoring [here](#). See below for more information about how exams will be proctored in this course.

ProctorU Live+ is a live proctoring service that works by connecting you to a proctor who will watch (and listen to) you live, via webcam, while you take your exam online from the comfort of your home. ProctorU is available 24/7, however, you will need to schedule your proctoring sessions at least 72 hours in advance to avoid any on-demand scheduling fees.

Creating a ProctorU account is simple. You can do so by visiting <https://www.proctoru.com/>. In order to use ProctorU Live+ services, you will need the following:

- [Guardian Browser](#)
- High-speed internet connection
- Webcam (internal or external)
- Microphone and Audio (internal or external)
- NJIT ID or Photo-Issued ID
- Reflective surface such as a small mirror
- To perform an environment check
- Windows or Apple Operating System: Students will be required to have an active Windows license on their computer. ProctorU Live supports the following version of Windows:
  - Recommended OS: Windows 10 (10 S mode is not supported) or MacOS 10.15
  - Minimum OS: Windows 10 (Windows 10 S mode not supported; Guardian Browser requires a 64-bit Windows) or MacOS 10.13 (Oldest still maintained version)

For more information on preparing for a proctored exam using ProctorU Live+, please visit <https://ist.njit.edu/proctoru>.

### **Other Policies or Expectations**

**Lecture Videos:** Lecture videos shall only be used as an educational resource and are not to be distributed or used outside of this class. Students are not allowed to capture or reproduce images or voices without permission.

**Accessibility:** This course is offered through an accessible learning management system. For more information, please refer to Canvas's [Accessibility Statement](#). Canvas Orientation for Students can be found [here](#).

**Resources for NJIT Online Students:** NJIT is committed to student excellence. To ensure your success in this course and your program, the university offers a range of academic support centers and services. To learn more, please review these [Resources for NJIT Online Students](#), which include information related to technical support.

**Communication During the Semester:** The instructor will use Canvas to post materials for the course. The Canvas Announcements page is critical, where important messages will be posted. The Canvas Discussion board is also critical, where you can post your questions related to labs/homework.

In addition to Canvas, email communication with students will be made by NJIT email ([hyojin.kim@njit.edu](mailto:hyojin.kim@njit.edu)) only. Do NOT email through Canvas. Please check your NJIT email prior to each class for possible information pertaining to class. It is your responsibility to maintain your NJIT email account in working order and check it regularly. All emails you send should include "YourName\_544G-S23" on the email subject line and be sent to the course instructor. I will respond to all emails within 24 hours, excluding weekends and holidays.

**Kepler Posting:** Students must upload copies of their homework assignments to the new KEPLER 5 system found under the Kepler tab in Canvas "Modules". Canvas assignments folders are automatically ported to Kepler, although students will need to initiate a separate Kepler upload. The new Kepler has an improved interface for easier batch uploading. Any file, regardless of file size, or type can be uploaded, although .pdfs and .jpgs are recommended to ensure viewability. Kepler no longer has individual student folders. Rather, student work is now available for review in either "List View" organized by student or

"Gallery View" with thumbnails of all work in an assignment folder viewable at once. Your final grade will not be posted until Kepler posting is received.

**Changes to the Syllabus:** Any changes that are made to this syllabus after it has been distributed to students on the first day of class will be made as an addendum and will be promptly distributed to the students. Students are expected to read and abide by all of the information contained in this document.

### Assessment

The weighting of various components of the course grade will be as follows:

Video quizzes	5%
One-minute papers	5%
Labs	10%
Homework	20%
Exam 1	15%
Exam 2	15%
Final exam	30%
Extra credits**	5%

\*\*Periodically, there may be extra credit problems assigned. These challenging problems are designed to help those students who feel that there is a need to improve their grade by performing some extra work.

Grades will NOT be rounded up. Your final course grading based on the University grading system for graduate students will be as follows:

A	Excellent	90.0% and above
B+	Good	85.0% to < 90.0%
B	Acceptable	80.0% to < 85.0%
C+	Marginal Performance	75.0% to < 80.0%
C	Minimum Performance	70.0% to < 75.0%
F	Failure	< 70.0%

### Course Schedule (based on Wednesday class schedule)

Wk 1.	W	Lecture 1: Course overview / Introduction (1/17/2024) a. Lab 1: Carbon footprint calculation
Wk 2.	W	Lecture 2: IAQ and ventilation (1/24/2024) + <b>Homework 1 Issued (Due 1/30)</b> a. Readings: MEEB Ch 5 b. Lab 2: Ventilation rate calculation
Wk 3.	W	Lecture 3: HVAC psychrometric processes (1/31/2024) + <b>Homework 2 Issued (Due 2/6)</b> a. Readings: MEEB Ch 14.1-14.4 b. Lab 3: HVAC Psychrometric analysis
Wk 4.	W	Lecture 4: Basic HVAC system operation (2/7/2024) + <b>Homework 3 Issued (Due 2/13)</b> a. Readings: MEEB Ch 14.5-14.14 b. Lab 4: Spatial requirements for HVAC
Wk 5.	W	Lecture 5: HVAC system types (2/14/2024) a. Readings: MEEB Ch 14.15-14.22

Wk 6.	W	Lecture 6: HVAC distribution systems (2/21/2024) + <b>Exam 1</b> a. Readings: MEEB Ch 14.9
Wk 7.	W	Lecture 7: Light sources (2/28/2024) + <b>Homework 4 Issued (Due 3/5)</b> a. Readings: MEEB Ch 15 b. Lab 5: Illuminance calculations
Wk 8.	W	Lecture 8: Lighting design / Lumen method (3/6/2024) + <b>Homework 5 Issued (Due 3/19)</b> a. Readings: MEEB Ch 16 b. Lab 6: Lumen method
Wk 9.	W	Spring Recess (3/13/2024) – <b>No Class</b>
Wk 10.	W	Lecture 9: Electricity basics (3/20/2024) + <b>Homework 6 Issued (Due 3/26)</b> a. Readings: MEEB Ch 25, 28 b. Lab 7: Power calculations
Wk 11.	W	Lecture 10: Electrical systems / Wiring design (3/27/2024) a. Readings: MEEB Ch 26, 27 <b>Last Day to Withdraw (4/1/2024)</b>
Wk 12.	W	Lecture 11: Acoustics fundamentals (4/3/2024) + <b>Exam 2</b> a. Readings: MEEB Ch 7
Wk 13.	W	Lecture 12: Noise control / Room acoustics (4/10/2024) + <b>Homework 7 Issued (Due 4/16)</b> a. Readings: MEEB Ch 22-23 b. Lab 8: Architectural acoustics
Wk 14.	W	Lecture 13: Water supply (4/17/2024) a. Readings: MEEB Ch 18-19 b. Lab 9: DHW Sizing
Wk 15.	W	Lecture 14: Water distribution systems / Fire protection (4/24/2024) a. Readings: MEEB Ch 24
Wk 16.	W	Reading Day (5/1/2024) – <b>No Class</b>
Wk 17.	TBD	<b>Final Exam</b>