Engineering Summer Academy at Penn (ESAP) Nanotechnology

1. Semester: Summer 2025
2. Lecture: Glandt Forum (3rd floor), Singh Center for Nanotechnology, 3205 Walnut St., Philadelphia, PA 19104
3. Lab: Quattrone Nanofabrication Facility and Singh 003 at the Singh Center for Nanotechnology
4. Instructor: Gyuseok L. Kim, Ph.D. (kimgyu@seas.upenn.edu)
5. Office: Room 227, Singh Center for Nanotechnology.
6. TA: Yeonjoon Suh, Lisa Jiang, Jimin Jung, Likey Fung, Nancy Pham and Sarah Liao

Course Overview

This course is designed to give students an overview of nanotechnology. The course consists of lectures, invited lectures, lab sessions, a challenge project, and group presentations. Students will learn the fundamentals and applications of nanotechnologies from lectures. Invited speakers from various areas will share their leading-edge research, real-world engineering, and industrial startup experiences with students. Students will use cleanroom facilities at the Singh Center for Nanotechnology for hands-on experiments. Students will fabricate and characterize micropatterns, microfluidic devices, and quantum dots based on top-down or bottom-up fabrication techniques explained by classical or quantum physics. Students will also characterize the LED, solar cell, accelerometer and gyroscope sensor. Each student will have at least one solo presentation opportunity to present their experiments.

Reference text (optional)

- William Callister, "Fundamentals of Materials Science and Engineering: An Integrated Approach," John Wiley and Sons. (2001).
- Andrew Sarangan, "Nanofabrication, Principles to Laboratory Practice". CRC Press (2017).

Safety Rules and Regulations

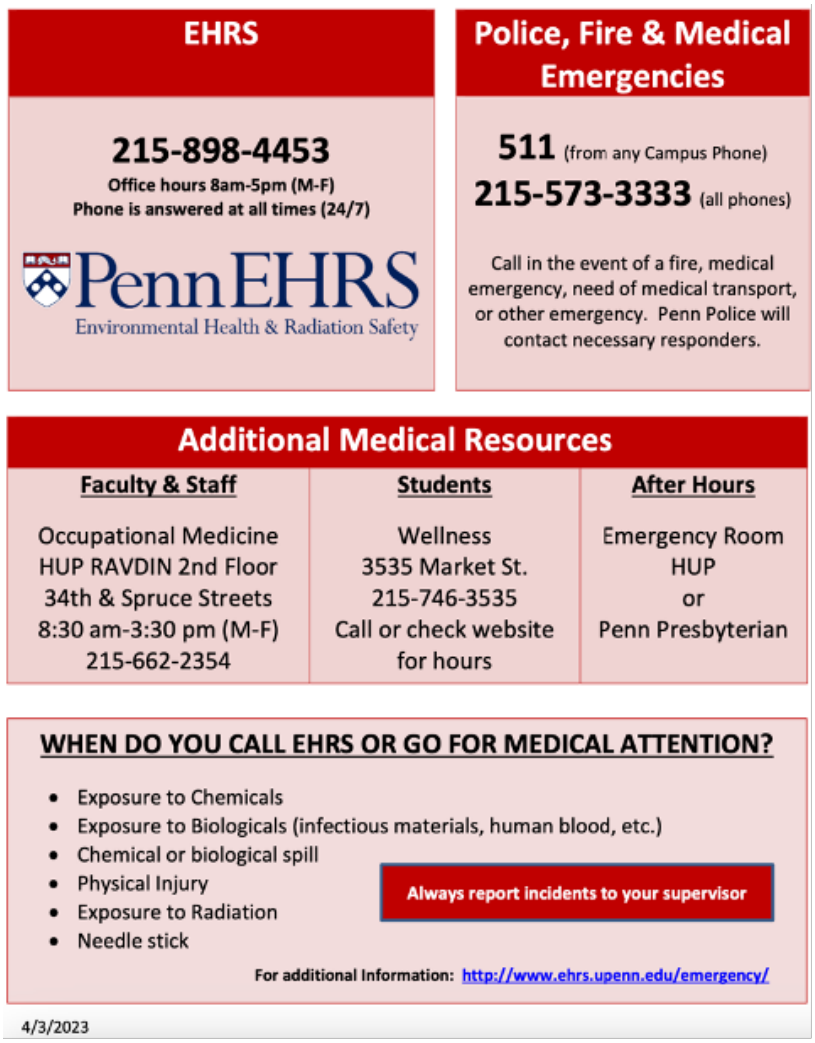
Safety is paramount in this course. You will be interacting with very expensive and delicate equipment, and the misuse of equipment and/or chemicals could cause you and others serious harm. **INTENTIONAL DISREGARD FOR SAFETY OR OPERATION PROCEDURES**

WILL BE GROUNDS FOR IMMEDIATE EXPULSION FROM THE COURSE WITH A GRADE OF 'F', REGARDLESS OF PAST PERFORMANCE.

Students **MUST** follow these regulations.

- Required clothing when you arrive at lab sessions
    - Long pants (no shorts are permitted in any labs)
    - Fully enclosed shoes up to ankle (no ballet flats)
    - Flat bottom shoes (no high heels or heavy work boots)
    - Full shirt (no tank top or tube top)
    - Students who don't wear appropriate attires at the beginning of lab won't be allowed to attend the lap sessions
- Gowning
    - Students will put on blue shoe covers, hairnet, mask and gloves in pre-gowning area
    - Students will wear hood, coverall, boot covers, safety glasses in gowning area
    - Wipe down the devices with 10% alcohol solution
    - Reverse the order when removing gowning
- Personal protective equipment (PPE)
    - Students will put on face shields over the safety glasses to use wet benches in bay 2, 4, and 5. Extra nitrile gloves will be provided when students work on chemical process
    - Students will put on apron, face shields and gloves additionally to use wet benches in bay 3.
    - TAs will instruct students during the experiment about specialized PPE
    - Students violating PPE policy will be ejected from the lab sessions.
- Behavior and supplies
    - No food or drink in the lab.
- Waste disposal
    - TAs will instruct students during the experiment about pipette disposal
    - All chemicals, wipes and wafer debris will be disposed by TAs
- Emergencies

- Inform TA or instructor immediately of any injury or exposure. In the case of chemical contact, cut, or puncture, flush the affected area for 15 minutes with soap and water. If splashed in eye, use emergency eyewash. Hold both eyes open and flush for 15 minutes
- Students must follow the emergency response procedure stated on the Emergency Response instructions poster below.



- Incident reporting
  - Students must immediately inform TAs or the instructor of any emergency

Exams

Two quizzes will be held in the first and second weeks, and the final exam will be held in the third week. The format of the quizzes will be closed book. You may have one sheet of notes, where 'sheet' is defined as a piece of paper no larger than 8.5 by 11 inches in area, no thicker

than 1 millimeter, with information written on any two sides. Any means of recording the information on the sheet may be used, but no artificial means (other than ordinary eyeglasses or contact lenses) may be used to read the information. Partial credit will be given on all exams. The *tentative* quizzes and exam dates are:

- Quiz 1, Friday, July 11
- Quiz 2, Thursday, July 17
- Final Exam, Thursday, July 24

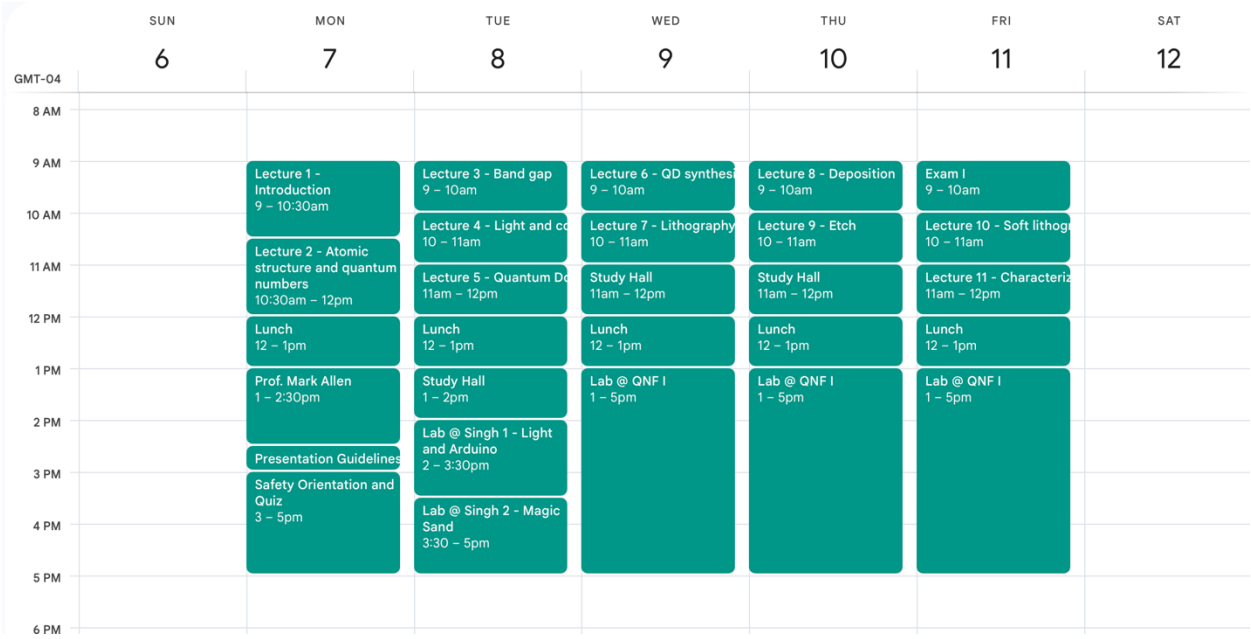
Please understand that these dates are tentative and subject to change. In all cases, it is your responsibility to show up at the appropriate times for exams. There are no make-up exams for this course. If you have a problem or conflict and cannot attend an exam, let me know beforehand, and we will try to work something out. Zero credit will be given for a missed exam that we haven't made arrangements about beforehand unless you have a satisfactory medical excuse.

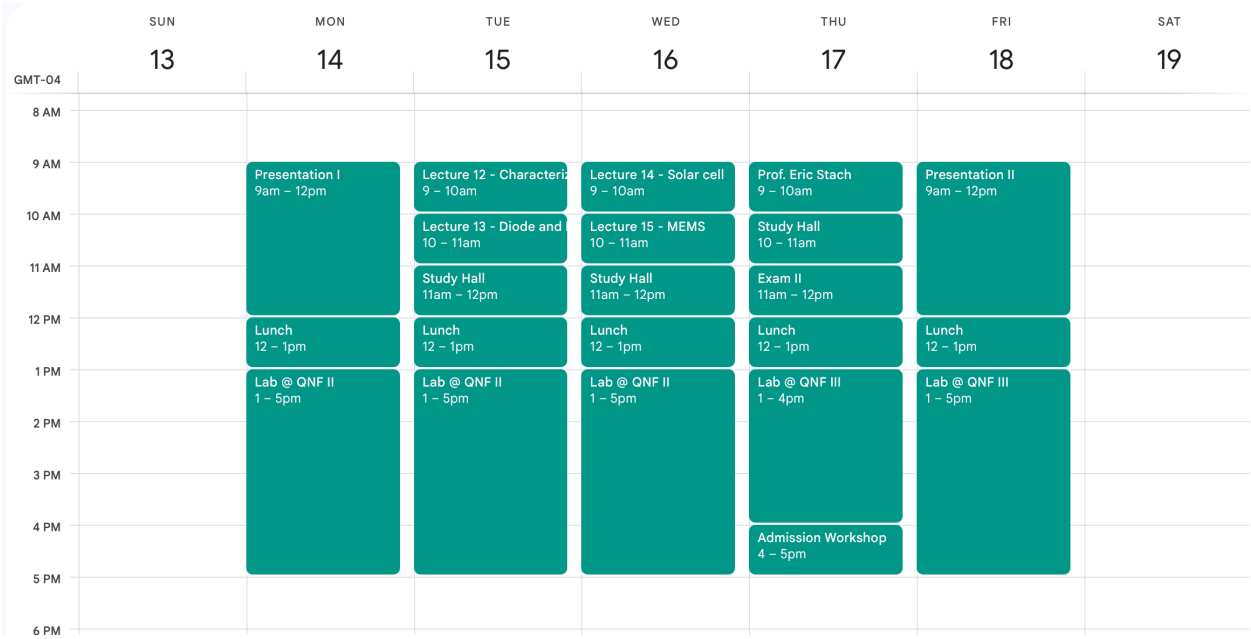
Please note that academic honesty is of paramount importance to ensure that the class and grading are fair to all students. Academic dishonesty will not be tolerated. **You are expected to abide by the Penn Code of Academic Integrity for all conduct in this course, including exams.**

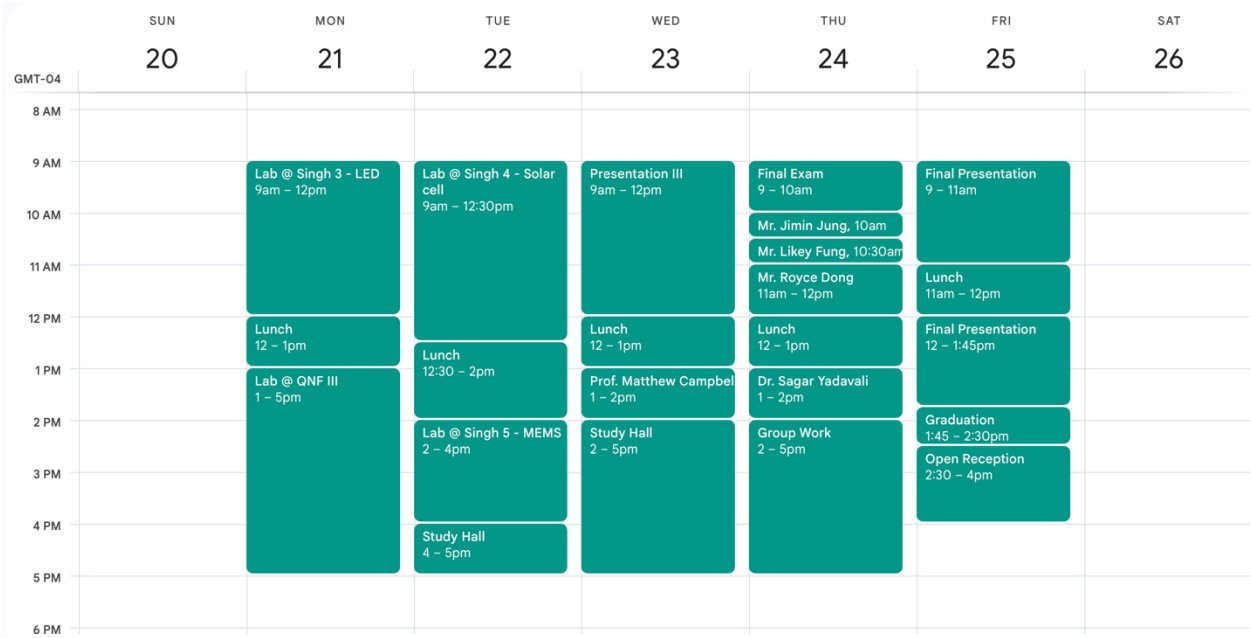
Grading

Your grade will depend on two quizzes (10% each), a final exam (15%), laboratory worksheets (12%), three lab presentations (10% each), a final presentation (13%) and participation (10%). The participation will be based on your attendance, level of engagement, and participation in the laboratory and lecture sessions. The presentations will be a team effort; quizzes, exams and participation will be individual efforts.

Tentative Schedule (EDT)






SUN 20
MON 21
TUE 22
WED 23
THU 24
FRI 25
SAT 26
GMT-04
8 AM
9 AM
10 AM
11 AM
12 PM
1 PM
2 PM
3 PM
4 PM
5 PM
6 PM
Lab @ Singh 3 - LED
9am – 12pm
Lunch
12 – 1pm
Lab @ QNF III
1 – 5pm
Lab @ Singh 4 - Solar cell
9am – 12:30pm
Lunch
12:30 – 2pm
Lab @ Singh 5 - MEMS
2 – 4pm
Study Hall
4 – 5pm
Presentation III
9am – 12pm
Lunch
12 – 1pm
Prof. Matthew Campbel
1 – 2pm
Study Hall
2 – 5pm
Final Exam
9 – 10am
Mr. Jimin Jung, 10am
Mr. Likey Fung, 10:30am
Mr. Royce Dong
11am – 12pm
Lunch
12 – 1pm
Dr. Sagar Yadavali
1 – 2pm
Group Work
2 – 5pm
Final Presentation
9 – 11am
Lunch
11am – 12pm
Final Presentation
12 – 1:45pm
Graduation
1:45 – 2:30pm
Open Reception
2:30 – 4pm