**ECE 105: Introduction to Electrical Engineering**

**Fall 2024**

**Sections:** 30884D

**Days/Times:** Tuesday, Thursday 2:00–3:50PM

**Location:** OHE 230

**Instructors:**

Prof. Yasser Khan

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Offices: MCB 270D

Office hours: Tuesday/Thursday 12-1 PM (and by email appointment)

Prof. Rehan Kapadia

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Offices: PHE 626

Office hours: Wednesday 10-12 PM (and by email appointment)

**Staff:**

Atiyeh Abbasi Jalal (Teaching Assistant)

Email: [abbasija@usc.edu](mailto:abbasija@usc.edu)

Office hours: Wednesday 4-6 PM PHE 320

Vikas Addepalli (Course Mentor)

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Office hours: Tuesday/Thursday 4-5 PM EEB

**Course Introduction**

This introductory course offers a broad overview of electronic systems, integrating both hardware and software perspectives. Students will explore the fundamental building blocks of electronics, including basic circuits and key components such as resistors, capacitors, inductors, diodes, transistors, optoelectronic devices, and sensors. A central feature of the course is the hands-on design, construction, and testing of an optical biosensor that synthesizes concepts learned throughout the semester. Students will also be introduced to foundational topics in signals and systems, as well as neural networks, culminating in the implementation of a simple image classification system using embedded machine learning. Another major focus is on communication systems, particularly free-space optical communication, where students will build and experiment with paired light emitters and detectors. Hands-on learning is supported by a custom demonstration board, which includes modules for circuits, devices, system integration, and AI/ML-based image processing. In summary, this course provides an engaging introduction to electrical engineering, emphasizing experiential learning through the development of intelligent hardware and software systems.

**Assigned Readings, Materials and Platforms**

There is no textbook for the course, however, required readings, viewings, and other course resources are available via web links on this dynamic syllabus, posts on Brightspace, and through email. Brightspace will be used for general announcements, for posting of course documents and information.

**Course Requirements, Structure & Grading Policy**

**Grade Distribution**

**Homework: 30%**

**Midterm: 30%**

**Final: 40%**

**Academic Integrity**

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university’s mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](https://policy.usc.edu/studenthandbook/). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or “recycle” work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage. The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the [student handbook](https://policy.usc.edu/studenthandbook/) or the [Office of Academic Integrity’s website](https://academicintegrity.usc.edu/), and university policies on [Research and Scholarship Misconduct](https://policy.usc.edu/research-and-scholarship-misconduct/).

**Incompletes**

An incomplete (IN) is given when work is not completed because of a documented illness or some other emergency occurring after 80% of the course has been completed. Arrangements for the IN and its removal should be initiated by the student and agreed to by the instructor prior to the final exam. The University policy on IN is detailed in the USC Catalog.

**Illnesses and Emergencies**

In this course, students are expected to attend class in person. Students who miss class due to illness or other emergencies are expected to make up missing classwork; if medical issues arise that preclude meeting the published deadlines, please contact the instructors as soon as possible.

**University Emergencies and Course Continuity**

During an emergency, USC will post emergency announcements on this website: <https://emergency.usc.edu>. USC Safety has guidelines for emergency preparedness for fire, earthquake or active shooter situations: <https://safety.usc.edu/emergency-preparedness/>.

**ECE 105: WEEKLY COURSE SCHEDULE**

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| --- | --- | --- | --- | --- |
| Week | Day | Dates | Topic | Deliverables |
| Week 1 | Tuesday | 8/27 | Introduction to EE, ECE 105 |  |
|  | Thursday | 8/29 | Electronic system design |  |
| Week 2 | Tuesday | 9/3 | Circuit analysis |  |
|  | Thursday | 9/5 | Circuit analysis |  |
| Week 3 | Tuesday | 9/10 | Devices: semiconductors | HW1 on circuits released |
|  | Thursday | 9/12 | Devices: semiconductors |  |
| Week 4 | Tuesday | 9/17 | Devices: semiconductors | **HW1 on circuits due** |
|  | Thursday | 9/19 | Devices: optoelectronics |  |
| Week 5 | Tuesday | 9/24 | Sensors | HW2 on devices released |
|  | Thursday | 9/26 | Sensors |  |
| Week 6 | Tuesday | 10/1 | Biosensing system | **HW2 on devices due** |
|  | Thursday | 10/3 | Biosensing system |  |
| Week 7 | Tuesday | 10/8 | Biosensing system | HW3 on system released |
|  | Thursday | 10/10 | Fall break |  |
| Week 8 | Tuesday | 10/15 | Biosensing system |  |
|  | Thursday | 10/17 | Mid review | **HW3 on system due** |
| Week 9 | Tuesday | 10/22 | **Midterm** |  |
|  | Thursday | 10/24 | Introduction to AI/ML |  |
| Week 10 | Thursday | 10/31 | Linear algebra |  |
| Week 11 | Tuesday | 11/5 | Neural networks |  |
|  | Thursday | 11/7 | Neural networks |  |
| Week 12 | Tuesday | 11/12 | Neural networks | HW4 on linear algebra released  HW5 on neural network released |
|  | Thursday | 11/14 | Imager |  |
| Week 13 | Tuesday | 11/19 | Introduction to communication systems |  |
|  | Thursday | 11/21 | Optical communications |  |
| Week 14 | Tuesday | 11/26 | Optical communications | **HW4 and HW5 due**  HW6 on optical comm released |
|  | Thursday | 11/28 | Thanksgiving |  |
| Week 15 | Tuesday | 12/3 | Quantum computing | **HW6 on optical comm due** |
|  | Thursday | 12/5 | Final review |  |
|  | Tuesday | 12/12 | **Final (2pm – 4pm)** |  |

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| Module | Date | Topic | Details |
| Module 0 – Introduction to EE 105 | Aug 26 | Introduction to Electrical Engineering | Hand out the boards |
|  | Aug 28 | Introduction to EE 105 | Show demo of the board |
|  | Sep 02 | Arduino Review |  |
|  | Sep 04 | iPython Review |  |
| Module 1 – Circuits | Sep 09 | Circuits 1 | Probe symmetric touch panel, in-class calc |
|  | Sep 11 | Circuits 2 | Show asymmetric touch panel, in-class calc |
|  | Sep 16 | Circuits 3 | Circuit problems |
|  | Sep 18 | Circuits 4 | Thermistor demo and lab |
| Module 2 – Device | Sep 23 | Device 1 | Semiconductor problems |
|  | Sep 25 | Device 2 | Diode analysis |
|  | Sep 30 | Device 3 | Transistor analysis |
|  | Oct 02 | Device 4 | Device problems |
|  | Oct 07 | — | — |
|  | Oct 09 | — | — |
| Module 3 – Sensors | Oct 14 | Sensors 1 | PPG demo |
|  | Oct 16 | Sensors 2 | Oximeter demo |
|  | Oct 21 | Sensors 3 | Op Amp problems |
|  | Oct 23 | Sensors 4 | Op Amp problems |
| Module 4 – Machine Learning | Oct 28 | Neural Network 1 | Image processing |
|  | Oct 30 | Neural Network 2 | Arduino image processing |
|  | Nov 04 | Neural Network 3 | Problems |
|  | Nov 06 | Neural Network 4 | Arduino TinyML |
| Module 5 – Communications | Nov 11 | — | — |
|  | Nov 13 | Communications 1 | LED–PD combo |
|  | Nov 18 | Communications 2 | Optical communication |
|  | Nov 20 | Communications 3 | Noise |
|  | Nov 25 | Communications 4 | Problems |
|  | Nov 27 | — | — |
| Module 6 – Final Project | Dec 02 | Final Project Presentations | — |
|  | Dec 04 | Final Project Presentations | — |

**Statement on Academic Conduct and Support Systems**

**Students and Disability Accommodations:**

USC welcomes students with disabilities into all of the University’s educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at [osas.usc.edu](http://osas.usc.edu/). You may contact OSAS at (213) 740-0776 or via email at [osasfrontdesk@usc.edu](mailto:osasfrontdesk@usc.edu).

**Support Systems:**

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*

<https://sites.usc.edu/counselingandmentalhealth/>

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call*

[988lifeline.org](http://988lifeline.org/)

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call*

<https://sites.usc.edu/clientservices/>

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

*Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086*

[eeotix.usc.edu](https://eeotix.usc.edu/)

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

*Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298*

[usc-advocate.symplicity.com/care\_report](https://usc-advocate.symplicity.com/care_report/)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

*The Office of Student Accessibility Services (OSAS) - (213) 740-0776*

[osas.usc.edu](http://osas.usc.edu/)

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

*USC Campus Support and Intervention - (213) 740-0411*

[campussupport.usc.edu](https://campussupport.usc.edu/)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity, Equity and Inclusion - (213) 740-2101*

[diversity.usc.edu](https://diversity.usc.edu/)

Information on events, programs and training, the Provost’s Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

*USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call*

[emergency.usc.edu](http://emergency.usc.edu/)

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

*USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call*

[dps.usc.edu](http://dps.usc.edu/)

Non-emergency assistance or information.

*Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)*

[ombuds.usc.edu](http://ombuds.usc.edu/)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

*Occupational Therapy Faculty Practice - (323) 442-2850 or*[*otfp@med.usc.edu*](mailto:otfp@med.usc.edu)

[chan.usc.edu/patient-care/faculty-practice](https://chan.usc.edu/patient-care/faculty-practice)

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.