

SE 164GS – Sensors and Data Acquisition
Under the UC San Diego Global Seminar:
How Shaky Structures Become the Safest Structures in Taiwan

Summer Session II
Course Syllabus

- Instructor:** Prof. Ken Loh
kenloh@ucsd.edu
- Dates:** Instruction begins Monday, August 5, 2024
Instruction ends Friday, September 6, 2024
- Format:** SE 164GS will be taught in Taiwan – at the National Taiwan University (NTU) and the National Center for Research on Earthquake Engineering (NCREE) in Taipei – to allow students to see and gain hands-on experiences in relevant course topics.
- Office hours:** Available anytime by e-mail appointment
In-person office hours TBD
Instructor: Prof. Ken Loh, kenloh@ucsd.edu
- References:** J. Fraden, *Handbook of Modern Sensors: Physics, Designs, and Applications 5th edn.* Springer International AG Publishing: Switzerland (2016). (optional text)

Course Description:

This course discusses theory, design, and applications of sensor technologies in the context of structural engineering and structural health monitoring. Topics include: sensors and sensing mechanisms; measurement uncertainty; signal conditioning and interface circuits; data acquisition; analog circuits; and emerging sensors.

Learning Objectives:

1. Students will understand the fundamental mechanisms and operating principles of how different types of transducers operate, as well as their intrinsic properties and limitations.
2. Students will know how data from sensors are acquired and how to quantify and analyze measurement uncertainties.
3. Students will understand signal conditioning techniques and know how to apply them to enhance the quality of measured data.

Course Requirements:

- Regular attendance in lectures and discussions
- Homework/technical summary assignments
- Projects
- Final report

Homework, Projects, and Reports:

You are allowed and encouraged to work in small groups, but you must solve and write up your own homework for submission. **Academic dishonesty and plagiarism are taken very seriously, and any suspicious of these activities will be immediately and directly reported to Academic Integrity Office.** Homework will be graded on a scale of 100.

Grading: The instructor reserves the right to change these weightings at any time.

- Participation: 10%
- Discussion presentations: 20%
- Group term project: 15%
- Technical summaries: 20%
- Final project report: 35%

**SE 164GS – Sensors and Data Acquisition
Course Topics**

1. Class #1: Fundamentals of measurement systems
2. Class #2: Sensor classifications
3. Class #3: Sensor characteristics
4. Class #4: Fundamentals of electric circuits
5. Class #5: Sensing mechanisms overview and resistive sensing
6. Class #6: Capacitive and inductive sensing mechanisms
7. Class #7: Piezoelectricity and thermoelectricity
8. Class #8: Analog sensor interfaces
9. Class #9: Introduction and getting started with NI LabVIEW
10. Class #10: Sensors' presentations
11. Class #11: Frequency-domain analysis and signal conditioning
12. Class #12: ADC and aliasing
13. Class #13: Measurement noise
14. Class #14: Wireless measurement solution
15. Class #15: Signal generation, reading, and plotting
16. Class #16: Current and voltage dividers
17. Class #17: Signal conditioning and amplification
18. Class #18: Radio frequency identification (RFID) theory of operations
19. Class #19: Passive RFID sensors
20. Class #20: Sensor and data acquisition in structural health monitoring applications I
21. Class #21: Sensor and data acquisition in structural health monitoring applications II