Stony Brook University

Syllabus

ESE/EEO 414

Fundamentals of Low-Noise Electronics for Sensors

1. Course Staff and Office Hours

Instructor: Gianluigi De Geronimo
gianluigi.degeronimo@stonybrook.edu

Office Hours: To be announced

TAs: To be announced

Office hours and locations may change. Please check Blackboard for most up-to-date information.

2. Course Description

This course provides the fundamental knowledge on electronics for sensors, with particular attention to radiation detectors. Students will learn about signal and noise sources in electronic circuits, low-noise amplification, optimal and sub-optimal filters, frequency-domain and time-domain noise analysis, discrimination, amplitude and timing measurement circuits, analog and digital signal processing, front-end application-specific integrated circuits (ASICs).
The acquired knowledge is applicable to research and commercial instruments for defense, industrial, medical, physics, safety, security and space applications.

Prerequisites: ESE411 for ESE 414 and EEO 311for EEO 414

Credits: 3

3. Textbook

Recommended reading: “CMOS Front-End Electronics for Radiation Sensors” Angelo Rivetti, CRC Press 2015, ISBN 9781138827387

4. Course Learning Objectives

- Understand signal and noise sources in circuits
- Understand and apply signal-to-noise ration and noise analysis
- Understand and apply filter design and optimization
- Understand and apply circuit design for low-noise and high-resolution

5. Student Learning Outcomes

	Student Outcomes	% contribution
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.	40%
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.	10%
3	an ability to communicate effectively with a range of audiences.	5%
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	5%
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.	10%
6	an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.	20%
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.	10%

6. Schedule

- 19 lectures will be held asynchronously.

Lecture 1	• Introduction
Lectures 2-3	• Sensor modeling and signal formation
Lectures 4-5	• Noise modeling and noise sources
Lecture 6	• Signal-to-noise ratio and equivalent noise charge
Lectures 7-9	• Filters (shapers) in frequency domain
Lectures 10-11	• Filters (shapers) in time domain
Lecture 12	• Charge amplifier design
Lectures 13-14	• Input transistor optimization
Lecture 15	• Low-noise design and reset
Lectures 16-17	• Analog and mixed-signal processing for sensors
Lectures 18-19	• Digital signal processing for sensors

7. Assignments and Exams

7.1. Homework Assignments and Exams

Homework Assignments will be issued roughly every lecture. A mid-term and a final exam will also be given.

Homework assignments and exams must be completed individually. You may *discuss* them with your classmates. (In fact, you are encouraged to do so.) However, you must write up your own solution individually without any help from any other person.

8. Grading

Your grade will be based on homework assignments and two examinations.

Homework Assignments	20%
Exams	80%

9. Academic Honesty

Any academic dishonesty on a written homework or lab will result in a zero grade for the assignment for all parties involved.

All exam work must be entirely your own with no collaboration or outside materials/information. Any academic dishonesty on the midterm exams or the final exam will result in failing the course.

The case will be submitted to the College of Engineering's Committee on Academic Standing and Appeals.

10. Electronic Communication Statement

Email and especially email sent via Blackboard (http://blackboard.stonybrook.edu) is one of the ways the faculty officially communicates with you for this course. It is your responsibility to make sure that you read your email in your official University email account

If you choose to forward your official University email to another off-campus account, faculty are not responsible for any undeliverable messages to your alternative personal accounts.

If you need technical assistance, please contact Client Support at (631) 632-9800 or supportteam@stonybrook.edu.

11. Student Accessibility Support Statement

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, 128 ECC Building, (631) 632-6748, or at sasc@Stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

12. Academic Integrity Statement

Each student must pursue their academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

13. Critical Incident Management Statement

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.