Stony Brook University

Syllabus

ESE 518

Advanced Design of Low-Noise and Low-Power Analog Circuits

1. Course Staff and Office Hours

Instructor: Gianluigi De Geronimo
gianluigi.degeronimo@stonybrook.edu
degeronimo@ieee.org
Office Hours: To be announced in Brightspace

2. Course Description

This Course provides the fundamental knowledge on low-noise electronics for sensors, with particular attention to radiation detectors. Students will learn about signal and noise sources in electronic circuits, low-noise charge amplification, optimal and sub-optimal filters, frequency-domain and time-domain noise analysis, signal discrimination, amplitude and timing measurement circuits, analog and digital signal processing, and the implementation in application-specific integrated circuits (ASICs).

The Course may include laboratory activities where students, using circuit simulators and, if possible, multi-function instruments and electronic components, learn the basics of low-noise design, simulation, and measurement.

The acquired knowledge is applicable to research and commercial instruments for defense, industrial, medical, physics, safety, security, and space applications.

Prerequisites: ESE411
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

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

Eleven in-person Lectures in 14 weeks

Lecture 1	Introduction
Lectures 2	Sensor modeling and signal formation
Lectures 3	Noise modeling and noise sources
Lecture 4	Signal-to-noise ratio and equivalent noise charge
Lectures 5	Filters in frequency domain
Lectures 6	Filters in time domain
Lecture 7	Charge amplifier design
Lectures 8	Input transistor optimization
Lecture 9	Low-noise design and reset
Lectures 10	Analog and mixed-signal processing for sensors
Lectures 11	Digital signal processing for sensors

7. Assignments and Exams

Assignments every lecture and one Final Exam

8. Grading

Grade will be based on Assignments and Final Exam
Homework Assignments 40%, Final Exam 60%

9. Brightspace

This is an in-person course where you will use Brightspace to access class information, learning modules, documents, and Assignments. Please consult Brightspace regularly. Brightspace will also be used to post class-related announcements. To learn more about Brightspace please visit: https://brightspace.stonybrook.edu

11. Electronic Communication Statement

Email and especially email sent via Brightspace 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.

12. 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.

13. 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.