ECG 722 Mixed-Signal Circuit Design

UNIVERSITY OF NEVADA LAS VEGAS

Department of Electrical and Computer Engineering

Spring 2022

Time: TBA
Class Location: TBA
Office Hours: Appointment Only
WebCampus: https://webcampus.unlv.edu

Note: The instructor reserves the right to change the syllabus as it relates to how the course is administered.

Course Description

Design of data converters using sigma-delta techniques. Operation and design of custom digital filters for decimating and interpolating in analog-to-digital interfaces.

Required Text

"CMOS Mixed-Signal Circuit Design," R. Jacob Baker, 2nd Edition, John Wiley & Sons, 2009, ISBN 9780470290262.

Learning Outcomes

After completing ECG 722, students will be able to:

1. Design noise–shaping data converters given a set of requirements such as bandwidth, clock speed, and signal–to-noise ratio.
2. Design, simulate, and implement the digital interpolation and decimation filters used in noise-shaping data converters.
3. Design, simulate, and implement the analog filters used for anti-aliasing and reconstruction in a data conversion system.
4. Discuss the limitations of op–amps and comparators used in noise–shaping data converters.
5. Simulate noise–shaping data converting circuits and systems and the filtering used.
6. Design a high–speed noise–shaping converter using a cascaded modulator or the K–Delta–1–Sigma topology.

Evaluation Methods

Assignments: 25%
Midterm Exam: 25%
Term Project: 25%

chedule

	Work Assigned/Due
als – 1.1.1 The Pendulum 1.2 The Complex (z-) Plane 1.2.1 The Digital Comb Filter, al Differentiator, 1.2.3 An Intuitive e z-Plane, 1.2.4 Comb Filters with Elements, and 1.2.5 The Digital	Homework 1 due
- 2.1.1 Impulse Sampling and - 2.1.3 The Sample-and-Hold (S/H), -and-Hold (T/H)	Homework 2 due
- 2.1.5 Interpolation - 2.1.6 K-	Homework 3 due

Module/Week #	Content	Work Assigned/Due
	5.2 Signal-to-Noise Ratio (SNR) - 5.2.1 Clock Jitter and 5.2.2 A Tool: The Spectral Density	
7	5.3 Improving SNR using Averaging - 5.3.1 Using Averaging to Improve SNR, 5.3.2 Linearity Requirements, 5.3.3 Adding a Noise Dither, 5.3.4 Jitter, and 5.3.5 Anti-Aliasing Filter 5.4 Using Feedback to Improve SNR 6.1 Passive Noise-Shaping	Homework 9 due Homework 10 due
8	Review for the midterm exam 6.1	

Module/Week #	Content	Work Assigned/Due
	8.1.2 Active–Component Bandpass Modulators, and 8.1.3 Modulators for Conversion at Radio Frequencies 8.2 Switched–Capacitor Bandpass Noise–Shaping – 8.2.1 Switched–Capacitor Resonators, 8.2.2 Second–Order Modulators, 8.2.3 Fourth–Order Modulators, and 8.2.4 Digital I/Q Extraction to Baseband	
15	9.1 The Topology (of a high–speed data converter) – 9.1.1 Clock Signals, 9.1.2 Implementation, 9.1.3 Filtering, 9.1.4 Discussion, and 9.1.5 Understanding the Clock Signals Review for final exam	Term project report due
16	Final Exam	

University Policies

Public Health Directives

Face coverings are currently mandatory for all faculty and students in the classroom. Students must follow all active UNLV public health directives while enrolled in this class. UNLV public health directives are found at Health Requirements for Returning to Campus, https://www.unl0 g0 G[htt)-3(ps:/)-4(/www)4(.unl0 gr)-4( )11(f)-3(i)-4(n)11(al)-5( )11(exa)-2(m)]TJETQ85nr r0

as students taking the course for a grade, but will be excused from exams, assessments, and other evaluative measures that serve the primary purpose of assigning a grade.

Classroom Conduct

Students have a responsibility to conduct themselves in class and in the libraries in ways that do not interfere with the rights of other students to learn, or of instructors to teach. Use of devices such as cellular phones and pagers, or other potentially disruptive activities are only permitted with the prior explicit consent of the instructor. Students are specifically prohibited to record classes without instructor authorization, including online/remote classes (either audio only, or

Final Examinations

The University requires that final exams given at the end of a course occur on the date and at the time specified in the Final Exam schedule. The Final Exam schedule is typically available at the start of the semester, and the classroom locations are available approximately one month before the end of the semester. See the Final Exam Schedule, https://www.unlv.edu/registrar/calendars.

Identity Verification in Online Courses

All UNLV students must use their Campus-issued ACE ID and password to log in to WebCampus-Canvas.

UNLV students enrolled in online or hybrid courses are expected to read and adhere to the Student Academic Misconduct Policy, https://www.unlv.edu/studentconduct/misconduct/policy, which states that "acting or attempting to act as a substitute for another, or using or attempting to use a substitute, in any academic evaluation or assignment" is a form of academic misconduct. Intentionally sharing ACE login credentials with another person may be considered an attempt to use a substitute, and could result in investigation and sanctions, as outlined in the Student Academic Misconduct Policy.

UNLV students enrolled in online courses are also expected to read and adhere to the Acceptable Use of Computing and Information Technology Resources Policy, https://www.it.unlv.edu/policies/acceptable-use-computing-and-information-technology-resources-policy, which prohibits sharing university accounts with other persons without authorization.

To the greatest extent possible, all graded assignments and assessments in UNLV online courses should be hosted in WebCampus-Canvas or another UNLV-managed platform that requires ACE login credentials for access.

Incomplete Grades

The grade of "I" (Incomplete) may be granted when a student has satisfactorily completed three-fourths of course work for that semester/session, but cannot complete the last part of the course for reason(s) beyond the student's control and acceptable to the instructor, and the instructor believes that the student can finish the course without repeating it. For undergraduate courses, the incomplete work must be made up before the end of the following regular semester. Graduate students receiving "I" grades in 500-, 600-, or 700-level courses have up to one calendar year to complete the work, at the discretion of the instructor. If course requirements are not completed within the period indicated, a grade of "F" will be recorded, and the student's GPA will be adjusted accordingly. Students who are fulfilling an Incomplete grade do not register for the course, but make individual arrangements with the instructor who assigned the "I" grade.

Library Resources

Librarians are available to consult with students on research needs, including developing research topics, finding information, and evaluating sources. To make an appointment with a subject expert for this class, please visit the Libraries' Research Consultation website, https://guides.library.unlv.edu/appointments/librarian. You can also ask the library staff questions via chat and text message at https://ask.library.unlv.edu/.

Missed Classwork

Any student missing class, quizzes, examinations, or any other class or laboratory work because of observance of religious holidays will be given an opportunity during that semester to make up the missed work. The make-up opportunity will apply to the religious holiday absence only. It is the responsibility of the student to notify the instructor within the first 14 calendar days of the course for Fall and Spring courses (except for modular courses), or within the first 7 calendar days of the course for Summer and modular courses, of their intention to participate in religious holidays which do not fall on state holidays or periods of class recess. For additional information, please visit the Missed Classwork policy, under Registration Policies, on the Academic Policies webpage,

ways in which students receive official University communications, information about deadlines,

UNLV is situated on the traditional homelands of Indigenous groups, including the Nuwu or Nuwuvi, Southern Paiute People, descendants of the Tudinu, or Desert People. We honor and offer gratitude for those who have stewarded the land; for the land itself; and for the opportunity to cultivate a thriving, diverse, inclusive, and just scholarly community here today that works for a better tomorrow for all.