Department of Physics and Engineering

EGR4103 Electrical Signals and Systems

3 Units

Fall 2024

MWF | 1:30 - 2:25 PM

Meeting location Rohr Science Hall (RS) 265

Final Exam: 12/18 1:30 - 4:00 PM

Instructor title and name:	Dr. José Manjarrés
Phone:	(619) 849-2451
Email:	josemanjarres@pointloma.edu
Office location and hours:	RS 276 | Schedule office hours here

PLNU Mission

To Teach ~ To Shape ~ To Send

Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

Department Mission

The Physics and Engineering Department at PLNU provides strong programs of study in the fields of Physics and Engineering. Our students are well prepared for graduate studies and careers in scientific

and engineering fields. We emphasize a collaborative learning environment which allows students to thrive academically, build personal confidence, and develop interpersonal skills. We provide a Christian environment for students to learn values and judgment, and pursue integration of modern scientific knowledge and Christian faith.

Course Description

Advanced techniques for the analysis of analog electrical systems. Topics include: frequency domain analysis, Laplace transforms, Fourier series, Fourier transforms, and continuous versus discrete signal analysis. Frequency response is analyzed using transfer functions, Bode plots, and spectral plots. Digital Signal Processing (DSP) is introduced.
Prerequisite(s): EGR 2024 with a grade of C- or higher and MTH 3033 with a grade of C- or higher.

Program and Course Learning Outcomes

Student Outcomes:

- Understand and apply mathematical representations of signals and systems
- Analyze signals in both time and frequency domains
- Design and implement digital filters for audio processing
- Apply sampling theory and understand its implications in digital signal processing
- Utilize Fourier analysis techniques for signal processing
- Implement and analyze discrete-time systems
- Use Python and specialized libraries for signal processing tasks
- Design and conduct audio processing experiments
- Interpret spectral representations of audio signals

Program Outcomes:

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (LO1)
- 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. (LO2)
- An ability to communicate effectively with a range of audiences. (LO3)

Required Texts and Recommended Study Resources

- McClellan, J., Schafer, R., Yoder, M. DSP First, 2nd ed. Pearson. ISBN: 9780137848188.

Course Credit Hour Information

In the interest of providing sufficient time to accomplish the stated Course Learning Outcomes, this class meets the PLNU credit hour policy for a 3-unit class delivered over 15 weeks. It is anticipated that students will spend a minimum of 37.5 participation hours per credit hour on their coursework. For this course, students will spend an estimated 112.5 total hours meeting the course learning outcomes.

Assessment and Grading

This course will have four ways to assess knowledge and learning, described as follows.

1. Entry Tickets: Brief handwritten summaries of the pre-class readings, including key concepts and a lingering question.
2. Practical Assignments: Programming assignments to apply concepts in real-world audio processing scenarios.
3. Tests: Evaluations of theoretical understanding.
4. Final Project: A comprehensive design problem encompassing topics from the beginning to the end of the course. It includes a report and a presentation to the general public during the time designated for the final exam.

The table below outlines the assessment criteria for this course.

Activity	Points Per Activity	Quantity	Total Points
Entry Tickets	20	28	560
Practical Assignments	60	6	360
Tests	100	6	600
Final Project	200	1	200
Total			1720

Grades will be based on the following:

Sample Standard Grade Scale Based on Percentages

A	B	C	D	F

A 93-100	B+ 87-89	C+ 77-79	D+ 67-69	F Less than 59
A- 90-92	B 83-86	C 73-76	D 63-66	
	B- 80-82	C- 70-72	D- 60-62	

Final Examination Policy

Successful completion of this class requires taking the final examination on its scheduled day. The final examination schedule is posted on the Class Schedules site. If you find yourself scheduled for three (3) or more final examinations on the same day, you are authorized to contact each professor to arrange a different time for one of those exams. However, unless you have three (3) or more exams on the same day, no requests for alternative final examinations will be granted.

Incompletes and Late Assignments

All assignments are to be submitted/turned in by when they are due—including assignments posted in Canvas. Late assignments are deducted 20% of its grade. Incompletes will only be assigned in extremely unusual circumstances.

Missed Exams

No examination shall be missed without prior consent or a well-documented emergency beyond the student's control. A score of zero will be assigned for an examination that is missed without prior consent or a well-documented emergency beyond the student's control. If a student misses an online test, any attempt to complete it outside of the classroom will be considered an act of academic dishonesty and will nullify the test score as well as disciplinary actions.

Class Enrollment

It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

PLNU Attendance and Participation Policy

Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. Unjustified absences or late attendance (i.e., more than 10 minutes) are penalized with a 1% deduction on the overall grade. If the student is absent for more than 10 percent of class sessions, the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent,

the student may be de-enrolled without notice until the university withdrawal date or, after that date, receive an "F" grade.

Artificial Intelligence (AI) Policy

You are allowed to use Generative Artificial Intelligence (GAI) tools (e.g., ChatGPT, Claude, Gemini, etc.) in this course as a **study support tool**. You may not use GAI to write content for any kind of evaluation; if you do so, it'll be considered a case of academic dishonesty and prompt disciplinary action.

PLNU Copyright Policy

Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

PLNU Recording Notification

In order to enhance the learning experience, please be advised that this course may be recorded by the professor for educational purposes, and access to these recordings will be limited to enrolled students and authorized personnel.

Note that all recordings are subject to copyright protection. Any unauthorized distribution or publication of these recordings without written approval from the University (refer to the Dean) is strictly prohibited.

PLNU Academic Honesty Policy

Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. For all student appeals, faculty and students should follow the procedures outlined in the University Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

PLNU Academic Accommodations Policy

PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities in accordance with the Americans with Disabilities Act (ADA). Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will work with the student to create an Accommodation Plan (AP) that outlines allowed accommodations. The EAC makes accommodations available to professors at the student's request.

PLNU highly recommends that students speak with their professors during the first two weeks of each

semester/term about the implementation of their AP in that particular course. Accommodations are not retroactive so clarifying with the professor at the outset is one of the best ways to promote positive academic outcomes.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC. Students cannot assume that because they had accommodations in the past, their eligibility at PLNU is automatic. All determinations at PLNU must go through the EAC process. This is to protect the privacy of students with disabilities who may not want to disclose this information and are not asking for any special accommodations.

State Authorization

State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students. If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that state. It is the student's responsibility to notify the institution of any change in his or her physical location. Refer to the map on State Authorization to view which states allow online (distance education) outside of California.

Semester Schedule Outline

Date	Topic
4-Sep	Welcome
6-Sep	Python Review
9-Sep	Numpy and Scipy
11-Sep	Mathematical Representation of Signals and Systems
13-Sep	Sound Device Library & Tuning Fork Experiment
16-Sep	Sinusoidal Signals
18-Sep	Complex Exponentials and Phasors
20-Sep	Test 1
23-Sep	Spectrum of Sinusoids
25-Sep	Sinusoidal Amplitude Modulation
27-Sep	Operations on the Spectrum
30-Sep	Periodic Waveforms
2-Oct	Fourier Series

4-Oct	Time-Frequency Spectrum
7-Oct	Test 2
9-Oct	Sampling, The Sampling Theorem
11-Oct	Spectrum View of Sampling and Reconstruction
14-Oct	Test 3
16-Oct	Discrete-Time Systems and Running-Average Filters
18-Oct	The General FIR Filter
21-Oct	The Unit Impulse Response and Convolution
23-Oct	Implementation of FIR Filters
25-Oct	No class - Fall break
28-Oct	Convolution and LTI Systems
30-Oct	Filter Design with PyFDA
1-Nov	Test 4
4-Nov	Sinusoidal Response of FIR Systems
6-Nov	Frequency Response
8-Nov	Practical Session on Frequency Response of FIR Filters
11-Nov	Running-Sum Filtering
13-Nov	Filtering Sampled Continuous-Time Signals
15-Nov	Test 5
18-Nov	DTFT
20-Nov	DTFT Properties
22-Nov	Practical FIR Filters
25-Nov	DFT
27-Nov	No class - Thanksgiving
29-Nov	No class - Thanksgiving
2-Dec	DFT Properties
4-Dec	Inherent Time-Domain Periodicity of the DFT
6-Dec	The Spectrogram
9-Dec	The FFT

11-Dec	Final Project Progress Presentations
13-Dec	Test 6
16-Dec	Final Project Presentations