Point Loma Nazarene University, Department of Physics and Engineering

EGR 4103 – Electrical Signals and Systems (3 Units, 3 contact hours)

Instructor (Fall 2022): Michelle Chen **E-mail:** MichelleChen@pointloma.edu
Office: Rohr Science 264 **Office Phone:** 619-849-2960 **Office Hours:** by appointment

Lecture: MWF 8:30 – 9:25 am, Rohr Science 265
Final Exam: 7:30 – 10:00 am, Monday December 12, 2022

Textbooks or Other Required Materials: Signals & Systems: Theory and Application by Ulaby and Yagle

Catalog 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 (DPS) is introduced.

Prerequisites: EGR 2024 with a grade of C- or higher and MTH 3033 with a grade of C- or higher.

Role in Program: Required

Course Learning Objectives/Outcomes:

1. Be competent with linear systems as approximate models of physical systems.
2. Know how Laplace Transforms are used to solve time domain problems modeled by linear differential equations and apply them to practical applications.
3. Be competent with Fourier analysis techniques for both time periodic and non-periodic signals.
4. Understand the modeling and analysis of discrete time systems and signals.
5. Be competent with basic Digital Signal Processing techniques.
6. Demonstrate capability to independently research and apply concepts from this course to an application area of interest, and communicate results to others.

Student Outcomes Addressed:

- An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (LO1)

Topics:

1. Introduction to signals and systems
2. Signal characteristics
3. Linear time-invariant systems
4. LTI properties
5. Laplace Transforms

6. Fourier Series and Fourier Transforms
7. Parseval's Theorem for Periodic Waveforms
8. Discrete time signals and systems
9. Z-Transform

ASSESSMENT AND GRADING

Graded Components

- **Homework:** Practicing working engineering problems is critical to your success in the class. Almost each week there will be homework assignment. You are strongly encouraged to discuss with your classmates, but to solve and submit your own work. Late homework receives a 20% reduction in possible value per day.

- **Examinations and Final Examination:** There will be two in-class exams during the semester and one comprehensive final exam. All exam dates are indicated in the course calendar in the syllabus. Exams will be closed book, but a sheet of formulas will be provided to you to use during your exam. Partial credit will be given for correct reasoning at any step of a problem, but only if it is communicated clearly enough for me to understand. For problems that call for solution or explanation, no credit will be given for an answer alone; the method or reasoning must also be shown. Exams are to be taken at the time indicated in the syllabus unless other arrangements are made in advance with the professor for some unavoidable circumstance, and otherwise cannot be made up. You must take ALL the exams in order to pass the class. **Final Examination Policy:** Successful completion of this class requires taking the final examination **on its scheduled day (Monday December 12th, 2022, 7:30 – 10:00 am)**.

Grading Scale

- Your course grade will be based on the following:

• Component	• Weight
• Homework	• 25%
• Research project	• 10%
• Midterm 1	• 20%
• Midterm 2	• 20%
• Final Exam	• 25%

- **Grading Scale:** The letter grade you will earn in this course is based on the following:

Standard Grade Scale Based on Percentages

A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
$S \geq 91.5$	$91.5 > S \geq 89.5$	$89.5 > S \geq 87.5$	$87.5 > S \geq 81.5$	$81.5 > S \geq 79.5$	$79.5 > S \geq 77.5$	$77.5 > S \geq 71.5$	$71.5 > S \geq 69.5$	$69.5 > S \geq 67.5$	$67.5 > S \geq 61.5$	$61.5 > S \geq 59.5$	$S < 59.5$

INCOMPLETES AND LATE ASSIGNMENTS

See Attendance and Grading section for details.

FINAL EXAM

The final exam date and time is set by the university at the beginning of the semester and may not be changed by the instructor. This schedule can be found on the university website and in th course calendar. No requests for early examinations will be approved. Only in the case that a student is required to take three exams during the same day of finals week, is an instructor authorized to consider changing the exam date and time for that particular student.

CREDIT HOUR

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 150 total hours meeting the course learning outcomes. The time estimations are provided in the Canvas modules.

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.

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.

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 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. Faculty should follow and students may appeal using the procedure 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. 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 issue an academic accommodation plan ("AP") to all faculty who teach courses in which the student is enrolled each semester.

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 and/or if they do not wish to utilize some or all of the elements of their AP in that course.

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.

PLNU ATTENDANCE AND PARTICIPATION POLICY

Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. 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 drop date or, after that date, receive the appropriate grade for their work and participation.

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.

SPIRITUAL CARE

Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith.

 If students have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Development.

Tentative Course Calendar (Subject to Update)

Date	Topic	Reading
T 08/30/22	Introduction	
W 08/31/22	Signals and Tranformations	1.1 - 1.2
F 09/02/22	Waveforms	1.3 - 1.4
M 09/05/22	*No Class: Labor Day*	
W 09/07/22	Non-periodic Waveforms, Power and Energy	1.4 - 1.5
F 09/09/22	LTI Systems, Convolution	2.1 - 2.3
M 09/12/22	Convolution, Causality and BIBO Stability	2.4 - 2.6
W 09/14/22	LTI and LCCDEs, Car Suspension System	2.6 - 2.9
F 09/16/22	Laplace Transforms	3.1 - 3.4
M 09/19/22	Poles and Zeros	3.5 - 3.8
W 09/21/22	Transfer Functions and Stability, Frequency Response	3.8 - 3.11
F 09/23/22	Applications of Laplace Transform	4.1 - 4.12
M 09/26/22	Fourier Series	5.1 - 5.3
W 09/28/22	Fourier Coefficients	5.4 - 5.5
F 09/30/22	Catch Up	
M 10/03/22	**Exam 1**	
W 10/05/22	Parseval's Theorem	5.6 - 5.6
F 10/07/22	Fourier and Parseval's Theorem	5.7 - 5.9
M 10/10/22	Phasor vs. Laplace vs. Fourier	5.10 - 5.13
W 10/12/22	System Response	6.1 - 6.5
F 10/14/22	Filtering, Noise	6.6 - 6.9
M 10/17/22	Modulation & Demodulation, Sampling Theorem	6.10 - 6.13
W 10/19/22	Discrete LTI System	7.1 - 7.3
F 10/21/22	*No Class: Fall Break*	
M 10/24/22	Discrete Time Convolution; z-Transform	7.4 - 7.6
W 10/26/22	Inverse z-Transform	7.7 - 7.9
F 10/28/22	BIBO Stability of H(z)	7.10 - 7.12
M 10/31/22	DTFS and DTFT	7.13 - 7.14
W 11/02/22	DFT and FFT	7.15 - 7.17
F 11/04/22	Catch Up	
M 11/07/22	**Exam 2**	
W 11/09/22	Discrete-Time Filters	8.1 - 8.3
F 11/11/22	Deconvolution and Inverse z-Transform	8.4 - 8.6
M 11/14/22	Spectral Analysis, Periodic/Non	8.7 - 8.10
W 11/16/22	Windowing, Spectrograms	9.1 - 9.2
F 11/18/22	Discrete Time Filter Design: FIT & IIR	9.3 - 9.4
M 11/21/22	Multirate Signal Processings, Downsampling	9.5 - 9.6
W 11/23/22	*No Class: Thanksgiving*	
F 11/25/22	*No Class: Thanksgiving*	
M 11/28/22	Upsampling; Interpolation	9.7 - 9.8
W 11/30/22	Multirate Signal Processings; Oversampling by Upsampling	9.9 - 9.10
F 12/02/22	Correlation, Audio & BioMedical Applications	9.11 - 9.13
M 12/05/22	Catch Up	
W 12/07/22	Presentation	
F 12/09/22	Review	
M 12/12/22	**Final Exam (7:30 - 10:00 am)**	
W 12/14/22		
F 12/16/22		