Department of Physics and Engineering

EGR3113 Measurement and Instrumentation

3 Units

Fall 2024

TR | 11:00 AM - 12:15 PM

Meeting location Rohr Science Hall (RS) 265

Final Exam: 12/17 10:30 AM - 1:00 PM

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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

This course provides an in-depth analysis of a variety of commonly used instrumentation in industry and academic research settings. Example instrumentation include: lock-in amplifiers, waveform generators, low-noise preamplifiers, spin-coaters, tensile loading systems, and micromanipulator probe stations. Equipment will be used to carry out a variety of engineering experiments such as: electrical transport, temperature dependent resistivity, and stress-strain of materials.

Prerequisite(s): EGR 2024 with a grade of C- or higher.

Program and Course Learning Outcomes

Student Outcomes:
- Assess electrical safety hazards and implement proper grounding and short-circuit protection measures for measurement systems.
- Measure DC and AC voltages, currents, and resistances using appropriate instrumentation and techniques.
- Operate signal generators and oscilloscopes to produce and analyze waveforms for testing and characterization.
- Utilize software tools for data acquisition and instrumentation systems.
- Design and construct amplifier circuits for signal conditioning.
- Design measurement systems by integrating various transducer sensors.
- Interface sensors with data acquisition systems for Internet of Things (IoT) applications

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 develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (LO6)

Required Texts and Recommended Study Resources

- Morris, A., Langari, R. Measurement and Instrumentation: Theory and Application, 3rd ed. Academic Press. ISBN: 9780128171417.

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 three ways to assess knowledge and learning, described as follows.
1. Homework Checks: Short 10-minute quiz related to a pre-session reading.
2. Practical skills tests: One-hour hands-on evaluations on a group of related topics.
3. 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
Homework Checks	20	20	400
Practical Skills Tests	150	3	450
Final Project	300	1	300
Total			**1150**

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 <u>one</u> 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 furtherpolicy 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
3-Sep	Welcome
5-Sep	Electrical Safety (Short-circuits and ground)
10-Sep	Voltage Measurement
12-Sep	Current Measurement
17-Sep	Resistance Measurement
19-Sep	Practical Skills Test 1
24-Sep	Oscilloscopes
26-Sep	Waveform Generators
1-Oct	Connectors and Impedance Matching
3-Oct	Exploring the Analog Discovery 2
8-Oct	Sampling, Aliasing, and Noise
10-Oct	Error Analysis, Precision, and Accuracy
15-Oct	Final Project Proposal Presentations
17-Oct	Practical Skills Test 2
22-Oct	Intro to LabVIEW
24-Oct	No class - Fall break
29-Oct	Intro to LabVIEW Pt. 2

31-Oct	Amplifiers and INAS
5-Nov	Final Project Progress Presentations
7-Nov	Temperature Sensing
12-Nov	Humidity Sensing
14-Nov	Strain & Force Sensing
19-Nov	Vibration Sensing
21-Nov	Light Sensing
26-Nov	Practical Skills Test 3
28-Nov	No class - Thanksgiving
3-Dec	Liquid Level Sensing
5-Dec	IoT Pt. 1
10-Dec	Iot Pt. 2
12-Dec	Design of Measurement Systems
17-Dec	Comprehensive Project Presentations