

EECE461 INSTRUMENTATION
AMERICAN UNIVERSITY OF BEIRUT
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
COURSE SYLLABUS
SPRING 2016

COURSE TITLE: Instrumentation

INSTRUCTOR: Imad H. Elhajj, Associate Professor

LAB INSTRUCTORS: Mihran Gurunian and Nadeen Rishani

OFFICE HOURS:

MWF 9am -10am and by appointment

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CATALOG DESCRIPTION:

A design course for complete instrumentation systems, including measurements, sensors, data acquisition, and component integration. Application areas and course projects include industrial control, laboratory measurements, automation systems, and others. The course is complemented with a set of laboratory experiments.

PREREQUISITES:

By topic: Electric circuits and electronics, microprocessors, basic control systems

TEXTBOOK:

Figliola and Beasley: *Theory and Design for Mechanical Measurements*, 4th or 5th edition, Wiley, 2006. ISBN 978-0-471-44593-7.

Additional material posted on Moodle.

TOPICS COVERED:

- 1) Basic Measurement Theory:
 - Factors: error, validity, reliability, repeatability, accuracy and precision, resolution
 - Measurement errors: theoretical, static, dynamic, and instrument insertion errors
 - Calibration
- 2) Analog Signal Conditioning:
 - Principles (signal levels, linearization, conversions, filtering and impedance matching, loading)
 - Passive Circuits (divider, bridge circuits, RC filters)
 - Operational Amplifiers (characteristics, specifications, applications)
 - Design Guidelines
- 3) Digital Signal Conditioning & Acquisition:
 - Digital Fundamentals
 - Converters (comparators, DAC, ADC)
 - Data Acquisition Systems (hardware & software)
- 4) Thermal Sensors:
 - Principles
 - Resistance Temperature Detectors
 - Thermistors
 - Thermocouples
 - Design Consideration
- 5) Mechanical Sensors:
 - Displacement, Location, or Position Sensors
 - Strain Sensors
 - Motion Sensors
 - Pressure Sensors
 - Flow Sensors
- 6) Geotechnical, Structural Health Monitoring and Environmental Sensors
- 7) Controllers & Interface:
 - Relay Controllers and Ladder Diagram
 - Programmable Logic Controllers (PLC)
 - Microcontroller acquisition
 - PC based acquisition and control
 - Design and Integration Guidelines

LEARNING OUTCOMES: At the end of the course, students will be able to:

- Select the appropriate sensor for a specific application
- Design and implement the appropriate signal conditioning needed for a specific sensor
- Assess the performance of a sensor or instrument (accuracy, repeatability, etc...)
- Calibrate a measurement system using industry standards
- Design and implement a data acquisition system using NI's LabVIEW and PLCs
- Describe the functionality of thermal, mechanical, geotechnical and environmental sensors

DROP QUIZZES & FINAL:

- There will be **unannounced** quizzes during this course given at the beginning of some lectures based on previous material presented
- The final exam will be comprehensive

LABORATORY & PROJECT:

- Laboratory work is a significant part of this course. This will include weekly pre and post lab work. Specific instructions will be given regarding the laboratory work
- There will be a substantial hands-on project in the course. More details later

ASSESSMENT: The final grade will be based on the following weights:

Lab Experiments	30%
Drop Quizzes	5%
Project	20%
Midterm	20% (March 9 th 2016)
Final Exam	25%

GENERAL RULES & REGULATIONS:

- All graded work should be based on individual effort with NO external help, unless otherwise indicated. If in doubt ask ahead of time. Any suspected misconduct will be handled according to the American University of Beirut rules and regulations. Consult the AUB's website for details of these policies.
- Any deliverables submitted are subject to scrutiny using Turnitin.com or other tools.
- Every class is considered as an appointment and thus please be on time.
- **Late material is not accepted.**
- No makeup for drop quizzes and exams.
- Keep checking the class website (Moodle) for information and updates.
- As per AUB policy, students who miss more than one fifth of the lectures in the first ten weeks of the semester will be dropped from the course.
- If you have documented special needs and anticipate difficulties with the content or format of the course due to a physical or learning disability, please contact me and/or your academic advisor, as well as the Counseling Center in the Office of Student Affairs (Ext. 3196), as soon as possible to discuss options for accommodations. Those seeking accommodations must submit the Special Needs Support Request Form along with the required documentation.

GOOD LUCK!