



Faculty of Engineering & Technology
Department of Electrical & Computer Engineering
Second Semester 2019 – 2020

Course Information	
Course Title	Instrumentation and Measurement
Course Number	ENEE4304
Prerequisites	ENEE3304 and ENCS238 (او متزامن)
Instructor	Nasser Ismail (nismail@birzeit.edu)
Office Location	Masri220
Office Hours	S,M 10-11:15 & S,W 11:25-12:40

Objectives & Intended Learning Outcome

By the end of this course, students will be :

- Familiar with the basic concepts of traditional and modern measurement and instrumentation systems; instrument types and performance characteristics and factors affecting their accuracy such as errors during measurement, noise sources and grounding techniques.
- Able to apply different measurement techniques in dc and ac analog measurement and instrumentation systems.
- Able to select different types of transducers in different applications
- Able to Interface transducers and sensors to the remainder of the measurement system, which can be analog or digital.
- Familiar with different digital interfaces in measurement systems with emphasis on A/D and D/A converters; serial and parallel data communication and GPIB (IEEE-488) bus.
- Able to analyze, digital, and computer controlled instrumentation and data acquisition systems.
- Able to design and build measurement and instrumentation related hardware while working in groups to enhance team work and interpersonal communication and organization skills

Course Contents

1. Introduction to Measurement:
Measurement Units; Measurement System Applications; Elements of Measurement System;
2. Instrument Types and Performance Characteristics:
Review of Instrument Types: Active, Passive, Null and Deflection type, Analog and Digital instruments. Indicating Instruments; Instruments with a signal output.
Static Characteristic of Instruments: Accuracy; Precision; Repeatability; Tolerance; Range; Linearity; Sensitivity; Threshold; Resolution; Hysteresis effects; Dead-Space.
Dynamic Characteristic of Instruments: Zero Order, First Order and Second Order Systems. Necessity for Calibration.
3. Errors During Measurement Process [1]:
Sources of Systematic Errors and their reduction; Random errors and statistical analysis
Combined effect of Systematic and Random Errors.
4. Measurement Noise and Signal Conditioning [1]:
Sources of Measurement Noise and techniques for its reduction; Analog Signal Filtering and processing operations. Grounding Techniques.
5. Sensors/Transducers (Selected types from the following):

Sensor Technologies: Capacitive, Resistive, Magnetic and Hall effect Sensors. Piezoelectric Transducers; Strain Gauges; Piezoelectric Sensors; Ultrasonic Transducers.

Temperature Measurements: Thermocouples, Thermistors, RTDs.

Pressure Measurements; Translational Motion Transducers.

6. Digital Signal Processing: Signal Sampling; Sample and Hold; Analog to Digital Conversion; Digital to Analog Conversion.
[3]; [4]; [6]; [7]

7. Electrical Indicating and Test Instruments:
Analog Meters: Moving Coil Meters; Moving Iron Meters; Electro-dynamic Meters; Analog Multi-meter; Digital Meters.
AC Measurements; Calculation of RMS waveform Values. CR Oscilloscopes; Digital Storage Oscilloscopes.

8. Variable Conversion Elements [1]:
Bridge Circuits: Null type DC Bridge; Wheatstone Bridge; Deflection Type DC Bridge; Error Analysis; Remote Sensing.
AC Bridges: null-type Impedance Bridge; Maxwell Bridge; Deflection Type AC Bridge. Resistance, Inductance and Capacitance Measurements.

9. IEEE-488 (GPIB) based Instrumentation. [3] and [6] Digital Interfaces in measurement systems: Serial and parallel interface protocols. [8]

10. Data Acquisition System

s (DAS) and DAQ cards, Sampling Techniques on DAQ boards:
Continuous Scanning, Simultaneous Sampling and Block-Mode Sampling [3]

References

[1]	* Measurement and Instrumentation principles by Alan S. Moris Elsevier , 2006	[2]	* Electronic Instrumentation and Measurement Techniques W.D. Cooper & A.D. Helfrick Third Edition
[3]	*Practical data acquisition for Instrumentation and Control systems, by John Park, Steve Mackay 2003	[4]	Instrumentation Reference Book Editor Walt Boys Butterworth Heinemann, 2003
[5]	Newnes Interfacing Companion “ Computers, Transducers, Instrumentation and Signal Processing” by A.C. Fischer-Cripps; 2002	[6]	The Measurement, Instrumentation and Sensors Handbook John G. Webster CRC Press, 1999
[7]	Electronic Instrument Handbook. Clyde F. Coombs Jr, 3 rd Edition, MacGraw Hill , 1999	[8]	Introduction to Instrumentation and Measurement, 2 nd edition by Robert Northrop CRC , 2005

* main references

Grading Scheme		
Assessment Type	Date	%
Midterm Exam	Week 10	25%
Final Exam	End of Semester	45%
Sensing Techniques Research	Week 8	10%
Group Hardware Design Project	Proposal + Hardware + technical report + in class presentation	20 %

Note: Details of Hardware project will be provided separately