The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2020/2021

Course: **Instrumentation and Measurements – 0933341 (3 Cr. – Required Course)**

Instructor: Prof. Othman Alsmadi
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Office Hours: Will be posted soon

Course website: http://elearning.ju.edu.jo/

Catalog description: General electric and magnetic units. Experimental data and error. Analyzing measurements using statistical analysis methods: measures of central tendency (mean, median, mode), measures of variation (range, interquartile, variance, standard deviation, coefficient of variation, Chebyshev's rule and empirical rule), graphical data analysis, frequency distributions, standard error, goodness of fit. Analog and digital instrumentation of current, voltage and power. R, L, C components measuring instruments. RF power and voltage measurement. Oscilloscopes. Signal generation and analysis. Wave and spectrum analyzers. Transducers. Digital data acquisition and test systems. Capacitive interference. Grounding. Project.

Prerequisites by course:	**EE**	**0953321**	Probability and Random Variables	(pre- or co-requisite)
	EE	**0903261**	Electronics (I)	(pre-requisite)

Prerequisites by topic: Students are assumed to have a background in the following topics:
- Electrical circuit analysis techniques.
- DC and AC signal analysis.
- Magnetic and electric fields.

Textbook: **Electronic Instrumentation and Measurements by David A. Bell, Oxford University Press, 3rd edition, 2013.**

References:
1. Electronic instrumentation and measurement techniques by William David Cooper, Prentice-Hall, 3rd edition, 1985.
2. Introduction to Instrumentation and Measurements by Robert B. Northrop, 3rd edition, CRC Press, 2017.
3. Instrumentation for Process Measurement and Control by Norman A. Anderson, 3rd edition, CRC Press, 1997.
4. Measurement, Instrumentation, and Sensors Handbook: Two-Volume Set by John G. Webster and Halit Eren (Editors), 2nd edition, CRC Press, 2014.

5. Instrumentation and Measurement in Electrical Engineering by Roman Malaric, Brown Walker Press, 1st Edition, 2011.
6. Measurement and Instrumentation: Theory and Application by Alan S Morris and Reza Langari, Academic Press, 2nd Edition, 2015.
7. Electrical and Electronics Measurements and Instrumentation by Prithwiraj Purkait, Budhaditya Biswas and Santanu C. K. Das, 1st edition, McGraw Hill Education, 2013.

Schedule: 16 Weeks, 42 lectures (50 minutes each) plus exams.

Course goals: The overall objective is to introduce the student to the principles of electrical measurements and to the different analysis methods used in measurements. Students will also be provided with basic understanding of the operation and behavior of some electrical test instruments, which leads to gaining practical information on their use.

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will: **[SO]**

1. Recognize the basic terms and standards of common measurements: accuracy, precision, sensitivity, resolution, standard deviation and error, international standards, primary, secondary and working standards. **[1]**
2. Be able to estimate the accuracy and precision of a measurement by utlizing proper statistical analysis techniques, and also identify possible sources of measurement error. **[1]**
3. Understand the operation of analog and digital (I, V, and O) meters, and solve for R, L, and C using bridges. **[1]**
4. Demonstrate the general operation of oscilloscopes, signal generators and spectrum analyzers. **[1]**
5. Be able to identify and illustrate ground resistance measurement and faults and ground loops. **[1]**
6. Select suitable transducers for certain purposes. **[1]**
7. Understand the operation of moedrn digital data acquisition and test systems. **[1]**

Course topics:

Hrs

1. Definition of an instrument, accuracy, precision, sensitivity, resolution and error. Systems of units. Electric and magnetic units. International system of units. Conversion of units. Standard of units. **5**
2. Significant figures. Range of doubt. Types of error. Statistical analysis: measures of central tendency (mean, median, mode), measures of variation (range, interquartile, variance, standard deviation, coefficient of variation, Chebyshev's rule and empirical rule), graphical data analysis, frequency distributions, standard error, goodness of fit. Probability of error. Limiting error. Stadards systems. **5**
3. DC ammeters (Shunt resistor, Aytron shunt). DC voltmeter (multi-range voltmeter, voltmeter sensitivity, loading effect). Series type ohmmeter. Shunt type ohmmeter. Multi-meters. Calibration of DC instruments. Digital voltmeter. Digital multi-meter. **7**
4. DC bridges (Wheatstone bridge, Kelvin bridge). AC bridges (Maxwell bridge, Hay bridge). **6**

5.	Oscilloscopes: Cathode-Ray Tube (CRT) circuits. Vertical deflection system. Delay line. Multiple trace. Horizontal deflection system. Digital Oscilloscopes. Oscilloscope probes.	**4**
6.	Grounds and grounding (AC power line, ground faults, Neon and LED wire receptacle analyzer). Ground Loops (inductive coupling, capacitive coupling, common-mode noise).	**4**
7.	Selecting transducers. Resistive changing transducer. Self generating transducer. Capacitive transducer. Inductive transducer.	**5**
8.	Frequency-selective wave analyzer. Harmonic distortion analyzers. Spectrum analysis.	**4**
9.	Moedrn digital data acquisition and test systems.	**2**

Ground rules: Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes.

Assessment & grading policy:

Assignments	0%	Quizzes	0%
First Exam	30%	Projects	0%
Midterm Exam	30%	Lab Reports	0%
Final Exam	40%	Presentation	0%
		Total	**100%**

Last Revised: March 2021