

**Philadelphia University
Mechatronics Engineering Department
Faculty of Engineering
First Semester 2013/2014**

Course Syllabus	
Course Title	Transducers and Sensors
Course Number	640
Course Level	3 rd year
Class Time	11:15 → 12:45 Mon/Wed
Instructor	Dr. Ibrahim Al-Naimi
email	inaimi@philadelphia.edu.jo
website	www.philadelphia.edu.jo/academics/inaimi
Text Book	"Mechanical Measurements" T. Beckwith, R. Marangoni, and J. Lienhard, Sixth edition, Pearson Prentice Hall 2009.

Course Description:

The students are expected to have a good grounding in the principles of measurement and instrumentation, including the characteristics of measurement systems, how to deal with errors, the measurement of the basic electrical quantities and the use of measurement devices. The course aims to introduce the candidate to the concepts and principles of transducers and signal conditioning as the most important elements of measurement systems. The measurement of non-electrical quantities is discussed in detail, covering displacement, pressure, temperature, flow, humidity, force, strain, torque, acceleration and vibration.

Course Objectives:

The aim of the course is twofold: to introduce the principle of measurement of a certain quantity, and to enable the student to select a suitable transducer and signal conditioning element for a certain application. By the end of the course, the students should have a good understanding of the principles of the measurement of the following non-electrical quantities: temperature, pressure, flow, humidity, displacement, force, strain, torque, acceleration and vibration.

Course Contents:

- **Introduction of measuring system**
- **Signal Conditioning and Signal Processing:** Voltage dividers; Wheatstone bridge; Operational Amplifiers; instrumentation amplifiers; filters; A to D and D to A conversion.
- **Transducer Technologies:** Types of transducers; characteristics of transducers; resistive transducer; differential transformer (inductive); capacitive transducer; piezoelectric effect; photoelectric effect; photoconductive transducer; photovoltaic cell; ionization transducer; magnetometer search coil; Hall effect transducer.
- **Measurement of displacement, level, distance/range and proximity detection:** potentiometer type transducers; Linear variable differential transformer (LVDT); Ultrasonic method; Laser distance transducers (time of flight; triangulation method); application to level measurement; Inductive; capacitive; infra-red..
- **Measurement of force, torque and strain:** Force, torque, stress and strain; introduction to strain gauges; characteristics of strain gauges; sensitivity of strain gauges; selection; use in bridges.
- **Measurement of temperature:** Mechanical means; Resistance Temperature Detector (RTD); thermistor; thermoelectric effect (thermocouple); radiation methods; dynamic response, dynamic compensation and calculation of time constant.
- **Measurement of flow:** Positive displacement methods; obstruction methods; drag effect methods; hot wire anemometers.

**Philadelphia University
Mechatronics Engineering Department
Faculty of Engineering
First Semester 2013/2014**

- **Measurement of moisture & humidity:** Definitions of humidity and related concepts; dry bulb and wet bulb; psychrometer method; Dunmore electrical method; monolithic integrated circuit capacitive transducers with temperature compensation.
- **Measurement of acceleration and vibration:** Seismic instruments; MEMS accelerometer; inertial methods of motion measurement;
- **Contact methods of speed measurement:** Shaft encoders, absolute and incremental.
- **Measurement of Sound:** Sound measurement; methods of measurement and units; introduction to frequency analysis in sound measurement.
- **Measurement of illumination:** Definition of units and quantities; types of transducers; measurement methods.

Allocation of Marks	
First Exam	20%
Second Exam	20%
Quizzes	10%
Project	10%
Final Exam	40%

References

Books

- **“Measurement, Instrumentation, and Sensors Handbook”** J.G. Webster, CRC Press 1999.
- **“Process Control Instrumentation Technology”** C.D. Johnson, Seventh Edition Prentice Hall 2003.
- **“Transducers and Instrumentation”** D.V.S Murty, Prentice Hall 1995.
- **“Instrumentation, Measurement, and Analysis”** B.C. Nakra, Second Edition McGraw-Hill 2004
- **“Measurement & Instrumentation Principles”**, Alan S. Morris, Elsevier, 2001.
- **“Advanced Measurements and Instrumentation”**, J.B. Gupta, Second Edition, 2005.
- **“Instrumentation for Engineering Measurement”** J.W. Dally, Second Edition John Wiley 2004.
- **“Principles of Measurement Systems”**, John P. Bentley, Pearson Prentice Hall, Fourth Edition 2005.
- **“Measurement Systems: Application and Design”**, Ernest O. Doebelin, Fifth Edition, McGraw Hill, 2003.