Philadelphia University
Faculty of Engineering
Department of Mechatronics
Second Semester, 2008/2009

Course Syllabus

Course Title: Sensors and Actuators	**Course code: 640364**
Course Level: 3rd year	**Course prerequisite (s) and/or corequisite (s):** **Electronic Eng (650222); Applied Statistics & Probability (640202)**
Lecture Time: 9:00-10:00	**Credit hours:3**

Academic Staff Specifics

Name	Rank	Office Number and Location	Office Hours	E-mail Address
Dr. Ashraf Saleem	**Assistant Professor**	**C607, Mechatronics Dep.**	**10-11 STT**	**asaleem@philadelphia.edu.jo**

Course module description:

To introduce the student to the different types of sensors, signal conditioning circuits, and actuators. The student also should be familiar with the basic techniques of designing the required signal conditioning for a particular sensor.

Course module objectives:

- Specify the fundamental SI units. Define terminology related to data, including accuracy, precision, sensitivity, resolution, linearity, error, and uncertainty.
- Calculate the average deviation, and standard deviation of a set of data.
- Explain the use of Wheatstone bridge and operational amplifier circuits for signal conditioning
- Explain the operation of single-slope and dual-slope analogue to digital converters.
- Discuss the criteria for selecting a sensor for a particular measurement.
- Explain the characteristics of various types of mechanical sensors, including the strain gauge, the linear variable differential transformer, and the variable area/distance capacitive transducers. Describe the operation of digital encoders,

proximity sensors, and ultrasonic sensors. Also design signal-conditioning circuits for mechanical sensors.
- Explain the characteristics of thermal sensors and transducers like the thermistor, the resistance-temp detector, the thermocouple, and the bimetal strip. Design signal-conditioning circuits for thermal sensors.
- Describe the construction and characteristics of light sensors and transducers, including the photo-conductive cell, the photodiode, the photo transistor, and the photovoltaic cell. Design signal-conditioning circuits for light sensors
- Specify the types of actuators: electrical, pneumatic, and hydraulic and explain their operation.

Course/ module components

- **Books (title , author (s), publisher, year of publication)**
  1. Process Control Instrumentation Technology, by Curtis Johnson, Prentice Hall 7th Edition, 2003
  2. Introduction to Mechatronics & Measurement Systems, Histand, M.B. & Alciatore,D.G., McGraw-Hill, 2003

- **Support material (s) (vcs, acs, etc).**
- **Study guide (s) (if applicable)**
- **Homework and laboratory guide (s) if (applicable).**

Teaching methods:

Lectures, tutorials, and problem solving.

Learning outcomes:

- Knowledge and understanding

It is anticipated that the student will have a good knowledge about analog and digital sensors and their applications in Mechatronics systems. Furthermore, it is expected that the student will be able to design the necessary conditioning circuit which should facilitate the output of the sensor for further processing.

- Cognitive skills (thinking and analysis).

The student should have the capability on analyzing Mechatronic systems that include sensors in terms of behavior or response to external physical variables such as temperature, pressure, force….etc.

- Practical and subject specific skills (Transferable Skills).

This course should improve the student's skills in conditioning circuit design through a small practical project. This project demands reasonably good skills in electronic circuits and good knowledge about sensor function.

Assessment instruments

- Short practical projects
- Home works
- Final examination: 50 marks

Allocation of Marks	
Assessment Instruments	**Mark**
First exam	**20 marks**
Second exam	**20 marks**
Final exam	**50 marks**
Home works and Projects	**10 marks**
Total	**100 marks**

Documentation and academic honesty

- Documentation style (with illustrative examples)
  The student is given a power point slides that summarize all course topics
- Protection by copyright
- Avoiding plagiarism.

Course/module academic calendar

week	Basic and support material to be covered	Homework/reports and their due dates
(1)	Units, Standards, and Definitions	
(2)	Absolute error, resolution, accuracy, precision, average deviation, and standard deviation	
(3)	Analogue signal conditioning and amplifiers	
(4)	Analogue filters and bridge circuits	
(5)	Digital Signal Conditioning: Comparators,	**Practical Project (10/1/2008)**
(6)	Successive Approximation and Dual-Slope ADCs	
(7)	Digital to analog converter (DAC)	**H. W. (16/12/2007)**
(8)	Analogue Sensors: Variable Resistance	
(9) Midterm exam	Variable Inductance Sensor	
(10)	Variable Capacitance, Permanent Magnet , ,	
(11)	Strain Gages, Torque Sensors,	
(12)	Thermal Sensors	
(13)	Optical Sensors, Ultrasonic Sensors	
(14)	Electrical Actuators:	
(15) Project Oral Exam	Pneumatics and Hydraulic Actuators	
(16) Final Exam		

Expected workload:

On average students need to spend 2 hours of study and preparation for each 50-minute lecture/tutorial.

Attendance policy:

Absence from lectures and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse acceptable to and approved by the Dean of the relevant college/faculty shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

Module references

Books

1. Mechatronics: An Integrated Approach by Clarence W. Silva, CRC Press 2005
2. Mechatronics; Electronic Control Systems in Mechanical and Electrical Engineering, W. Bolton, Longman,1999

Websites

1. www.sensorsmag.com
2. www.eesensors.com
3. www.bannerengineering.com
4. www.nxp.com
5. www.metrol.co.jp