**ELEN 4460– Sensor Devices: Theory, Design, and Applications**

**Class Schedule:** 3 Credits

**Course Coordinator:** Dr. Fabien Josse

**Course Materials:**

**Required:** Lecture Notes from Instructor.

Various Journals and Articles on Sensors in the Library.

R. Pallas-Areny and J. G. Webster, Sensors and Signal Conditioning. John Wiley&Son, 2st ed., 2001.

**Optional:**

Jacob Fraden, AIP Handbook of Modern Sensors. American Institute of Physics, N.Y., 1996, 2nd ed.

D. S. Ballantine et al, Acoustic Wave Sensors: Theory. Design, and Physico-Chemical Applications. Academic Press, 1997.

**Course Description:**

Sensor classification and transduction principles. Fundamental principles and theory of operation of various types of sensors, based on various technologies which include optical, electrical, acoustical, thermal, magnetic, mechanical and chemical. Analysis of sensor signals. Study of sensor characteristics which include hysteresis, non-linearity, saturation, repeatability, sensitivity, selectivity and resolution. Design and practical implementations of various sensors for scientific, industrial and consumer applications.

**Prerequisites:** Senior Standing.

**Selected Elective** in the Electronic Devices and Systems area.

**Professional components:**

Engineering Science – 50%

Engineering Design – 50%

**Course Goals:**

To provide students with the fundamentals and critical aspects of sensing, so that they may acquire the tools for analysis and design of practical sensors for scientific, industrial and consumer applications.

**Course Objectives:**

*By the end of this course, you should....*

* Know how to classify and select sensors. Knowledge of units of measurements is necessary.
* Know all the sensor characteristics: Sensitivity, Selectivity, Resolution, Reproducibility, Nonlinearity, Saturation, etc.
* Know the fundamental principles and theory of operation of various types of sensors based on different technologies which include:
	+ Electrical
	+ Acoustical
	+ Optical
* Be able to analyze/design or use resistive sensors (potentiometers, strain gages, resistive temperature detectors, thermistors) for various applications.
* Be able to analyze/design or use reactance variation and electromagnetic sensors (capacitive sensors, inductive sensors and sensors based on Faraday's Law and the Hall effect) for various applications.
* Know the fundamentals of acoustic wave-based sensors (thickness-shear mode quartz resonator sensors, surface acoustic wave sensors) as mass sensors, mechanical load sensors and chemical sensors.
* Know the fundamentals of optical-fiber sensor technology as intensity sensors and phase sensors based on Moving Gratings, Fabry-Perot, Microbending, Modified Cladding, Mach-Zehnder and Michelson configurations.
* Be able to design/analyze/specify/use various basic sensors based on the above listed technologies or be able to specify systems' needs for sensors.

**Student outcomes addressed by the course:**Partial fulfillment of Criterion 3 objectives A, C, E, G, and K

**In the Text**

Fraden: Chap 1 Lecture Notes

Fraden: Chap. 2 Lecture Notes

Pallas-Areny: Chap. 2 Lecture Notes

Pallas-Areny: Chap. 4

Lecture Notes Ballantine et al:

Chap. 2, 3

Notes from Tutorial Sessions on Optical Fiber Sensors.

**Course Topics:**

Sensor Classification, Systems and Definitions

Sensor Characteristics, Description, Analysis of

Various Methods of Sensing

Resistive Sensors: Principles of Operation and

Applications

Reactance Variation and Electromagnetic Sensors

(Capacitive Sensors, Inductive Sensors,

Electromagnetic Sensors): Principles of Operation

and Applications

Acoustic Wave-based Sensors: Fundamentals of

Acoustic Wave and Sensing- Principles of Operation,

Design and Applications

Optical-Fiber Sensor Technology: Principles of

Operation and Applications.