Sensors and Data Acquisition Systems

Instructor: Dr F Rahman – 377 Stocker Center Class Number: 14664

Phone: (740)-593-2462 Catalogue Number:

Tuesdays, Thursdays – 12:00 PM to 1:20 PM ARC 108

This course is suitable for students who are interested in learning about the basics of widely used electronic and optical sensors. Sensors are encountered in all fields of science and technology. These range from temperature and humidity sensors to various types of biomedical sensors, cameras, microphones, vibration sensors and gas sensors, to name a few. The aim of this course is to teach the operating principles and characteristics of a variety of common sensors as well as the electronics that is used for collecting data from sensors. Sensor electronics includes such topics as low-noise amplifiers, signal filters and analog-to-digital conversion systems. All of these topics will be covered in this course together with practical information on how to procure suitable components and integrate a working sensor system.

Course administration:

There will be two lectures and a lab/project-activity per week. Homework assignments will be given every Friday. During the course, there will be two mid-semester exams and a final two-hour exam. Students will also be required to write an individual project report. The breakdown of course marks is given below:

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| Course component | % Marks |
| Homework assignments | 20% |
| Mid-semester 1 | 15% |
| Mid-semester 2 | 15% |
| Final exam | 30% |
| Project report | 20% |

This is a continuously-assessed course and at completion a minimum of 50% marks are required to pass the course. Full attendance in all lectures as well as participation in all homework assignments and exams is strongly recommended for getting the full benefit of taking this course. Skipping classes can make it harder to understand subsequent classes. Students who regularly miss lectures without informing the instructor will be warned and if this conduct persists then they will be required to withdraw from the course. All assignments must be returned on time. Late assignments will not be accepted for grading. Project report will be checked for plagiarism. Academic misconduct, such as copying others’ work, referring to other work without due acknowledgements, creating false information etc. will be punished by refusal of grading and the case may be reported to relevant School/College officials.

There are no pre-requisites for this course but a good understanding of elementary physics and basic electronics will be very helpful. This course is open to all undergraduate and graduate students.

Course contents

An outline of the course is given below. Roughly half of the course covers sensors whereas the other half deals with sensor electronics:

1. Introduction to sensors and data acquisition systems
2. Material properties that form the basis of sensors (mechanical)
3. Material properties that form the basis of sensors (chemical)
4. Material properties that form the basis of sensors (electronic)
5. Material properties that form the basis of sensors (optical)
6. Environmental sensors
7. Process monitoring sensors
8. Biomedical sensors
9. Sensors in portable and mobile devices
10. Scientific sensors
11. Space-based sensors
12. Front-ends electronics for data acquisition: Low-noise op-amps
13. Noise reduction strategies for data acquisition systems
14. Signal filtering
15. Analog-to-digital conversion systems
16. Storing and manipulating sensor data

Intended learning objectives:

1. Appreciation of the need for sensors in different practical settings
2. Understanding of material properties relevant for sensor applications
3. Good knowledge of the structure and functioning of a wide variety of sensor types
4. Knowledge of the availability of a variety of sensors from different commercial sources
5. Ability to read and understand sensor datasheets
6. Ability to select suitable sensors for given applications
7. Practical ability to design frontend electronics for sensors
8. Understanding of noise reduction techniques for sensors and data acquisition systems
9. Basic understanding of sensor data processing

At the completion of this course students will have a good working knowledge of modern commercial and scientific sensor systems. They will be in a position to apply this knowledge to further courses and to research projects.

Any student who suspects s/he may need an accommodation based on the impact of a disability should contact the class instructor privately to discuss the student’s specific needs and provide written documentation from the Office of Student Accessibility Services. If the student is not yet registered as a student with a disability, s/he should contact the Office of Student Accessibility Services.

Recommended texts:

There are no mandatory required textbooks for this course. Sources for further information on all covered topics will be provided by the instructor during the course of lectures. The following texts can be consulted for more information relevant to this course.

Handbook of Modern Sensors: Physics, Designs, and Applications – Jacob Fraden – 4th Edition, Springer

Sensor Technologies: Healthcare, Wellness and Environmental Applications (Expert's Voice in Networked Technologies) – Michael J. McGrath and Cliodhna N. Scanaill – Apress publications