

Grading Scheme		
Assessment Type	Date	%
Midterm Exam	Week 10	30%
Final Exam	TBD	40%
Group Hardware Design Project (includes 10% individual task on sensing for each student)	Proposal + Sensing techniques detailed study+ Hardware + technical report + in class presentation	30 %

Note:

Details of Hardware project will be provided separately

Course Outcomes (According to ABET a-k)

Upon completion of the course the students will have:

Program ILO (a) : An ability to apply knowledge of mathematics, science, and electrical engineering

القدرة على تطبيق المعارف التي اكتسبها في مجال الرياضيات والعلوم والهندسة الكهربائية.

	Student Outcomes (SO's) (verified in Midterm and Final Exams)
1	Students will understand key principles and definitions of traditional and modern instrumentations and measurements systems and will apply these principles to creative design
2	Recommend and apply suitable grounding, noise reduction and measurement techniques for measurements systems (dc and ac)
3	Compare between different types of popular serial and parallel data communication interfaces including GPIB (IEEE-488) bus
4	Study characteristics of ADC, DAC and data acquisition boards (DAQ), calculate their main performance and recommend the suitable one for specific application .
5	Analyze and calculate instrument, sensor and transducer performance characteristics and merits (static and dynamic)

Program ILO (c) ability to design a system, component, or process to meet desired needs

القدرة على تصميم الأنظمة والعناصر الهندسية والعمليات لتحقيق متطلبات التصميم في أطر من المحددات.

	Student Outcomes (SO's) (verified in Midterm and Final Exams and in Group Project)
6	Design signal conditioning and variable conversion elements to facilitate interfacing transducers and sensors to the remainder of the measurement system.
7	Design and build measurement and instrumentation related hardware , test and debug it

Program ILO (g) An ability to communicate effectively

القدرة على التواصل بشكل فعال.

	Student Outcomes (SO's) (verified in project report and presentation and work during the semester)
8	Present the design of the hardware project in the form of written technical report and orally through in-class presentation
9	Function effectively as part of project design team

Program ILO (k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

القدرة على استخدام التقنيات والمهارات والأدوات الهندسية الحديثة الضرورية للعمل الهندسي.

	Student Outcomes (SO's) (verified in HW assignments)
10	Program Microcontroller Boards (Arduino/PIC) to perform different calculation, signal generation and decision making functions

ENEE4304 “Instrumentation and Measurement” Design Project (2016)

Objectives:

Each group must design, build, test and demonstrate an instrumentation and measurement device controlled by a **Microcontroller (a PIC or Arduino Board containing a microcontroller)**. The device should have functioning elements in all six categories listed below (exceptions can exist depending on project complexity and with prior approval from the instructor). The device will be rated (graded) on the level of functionality achieved in each category. There will also be grading adjustments for qualitative attributes and how well the project is documented. Projects will be ranked in comparison to each other.

Project Deliverables:

D1. Student list and main topic (group due W 2-3-2016)

D2. A project proposal written in a word document with functional block diagram and a summary of each functional element (group due W 16-3-2016)

Note that projects will not be accepted if the proposal was not approved by the instructor.

D3. A study of latest state of the art sensing techniques and latest existing specific sensor types for the quantity(s) to be sensed in the project (individual due S 26-3-2016) document needs to be checked using Turnitin program.

D4. Final choice of sensor, acquiring the sensor, simulation/testing and characterization of the sensor, Signal conditioning circuit design , Microcontroller programming to be shown in the Project Progress meeting (group due M 25-4-2016)

D5. Finished Project due M 16-5-2016 which includes:

D5.1) Final project report which includes: complete schematics, parts list, simulation and test results.

D5.2) Functional Hardware

D5.3) Power point slides for 10 minute in-class group presentation (date will be specified later 20 & 22-5-2016)

Project Details

Each group (consisting of 3 students) must come up with a unique idea for a device that performs some useful function related to instrumentation and measurement except a temperature measurement device, water level indication, line following robot and any project that was submitted as a requirement for any other course (in particular Electronics and Control systems) by the group or anybody else, **if this happens this will be considered cheating and will be dealt with according to university academic rules.**

Required Functional Element Categories (see general block diagram below)

- A. **Data Input Element: Switch; Potentiometer; keypad; keyboard..etc**
- B. **At least one Sensor/Transducers which is used to measure the different levels of input quantity and (avoid using the sensor to just detect the presence or absence of the measurand)**
- C. **Signal Conditioning (Amplification, Linearization, bias removal, filtering, isolation, etc) according to particular project needs)**
- D. **Digital Control Unit (Microcontroller) to perform functions such as: Calculation, Counting, Integration, Logic, Decision Making and Control Function.**
- E. **Output Device/ Actuator (at least one actuator): for example**
 - DC motor (controlled on/off, forward and reverse, PWM speed control)
 - Stepper motor (unipolar/bipolar)
 - Closed loop feedback servo motor
 - Relay(s) – Valves - Solenoids
- F. **An Output LCD Display that shows the quantity being measured**