

Mechanical Engineering Instrumentation

ME240
Fall 2011

Instructor:
Mr. Mitch Cottrell

What is this class about?

- This course is designed to provide:
 - Background in a broad number of
 - transducers and
 - measurement systems for
 - Methods of recording and controlling real world processes and conditions.
 - This course will combine a combination of
 - lecture
 - laboratory
 - hands on assignments

Instrumentation????

□ What is instrumentation?

- Can be defined as any system or device that converts a physical condition into information usable by either man or machine.

□ First instrument:

- Human Finger



First instrument



Some cave man stuck his finger into the ashes of a fire and said:

UGG UGG OHHH AH HH

(Loosely translated means "Dang that's hot!")

Development of Instrumentation

Ever since that first cave man, we have been looking for better ways to measure conditions.

This course will look at many of the current methods and devices that you will see in industry, as well as how to acquire that data for use.

Heavily included in this course!

Data Acquisition!

Data Acquisition!

Data Acquisition!

Data Acquisition!

If you don't record it, it didn't
happen!

Classroom interaction

- We will be using clickers!
 - Help reinforce information
 - Help keep you focused on the lecture
 - Give you the opportunity for some bonus points

 - Total points for the semester will be normalized to a total of 50 homework points.
-

Hardware required

- ☐ MyDAQ Data acquisition board
 - LabVIEW 2011 (Student edition)
 - NI-DAQ device driver software and NIElvis (Instrument suite)
 - ☐ \$205 From bookstore
 - ☐ \$199 From Studica.com
 - ☐ MST parts kit
 - \$35 From department office (Toomey 194)
 - ☐ Cash or check only
-

Personal hardware used for:

- ❑ Homework assignments and problems

 - ❑ In a number lab experiments
 - Circuits
 - Data Acquisition experiment
 - Calibration experiment
 - Motion Experiment

 - ❑ Some will require more than one board, so bring it to lab with you!
-

Logistics

Class roll call

Section Adds

- If your still trying to get into lab, see me after class!
-

Attendance

- ❑ Lecture attendance is **mandatory**
 - I don't take attendance every week.
 - Act as a professional!
 - ❑ Attendance at your scheduled laboratory section is **mandatory**.
 - MUST contact your TA and Group BEFORE your absence!
 - If you must miss it is your responsibility to work with your group and TA to obtain any missed information!
-

Attendance

- Recitation section
 - New this semester
 - 11:00 – 12:00 every Friday
 - Room 251 Toomey hall
 - **OPTIONAL!!!!!!**

 - Answer questions and reinforce topics covered. Usually start with labVIEW programming
-

Grading

	Weight
Lab experiments and Experiment exams:	50%
Application Problems	35%
Daily Assignments	5%
Project	10%

Blackboard

- ☐ Gradebook will show your grades for individual assignments.
 - ☐ It will NOT be generating the overall course grade!!!!
 - ☐ I will download the data, and calculate the grade in Excel
-

Structure

- Lecture twice each week
 - Recitation (optional) once per week
 - Friday 11:00 – 12:00 Toomey 251
 - Lab section that meets once each week
 - Groups sizes of 2 or 3
-

Lab Schedule

- A complete lab schedule is on blackboard

Content | Course Information

9-Feb
L: temperature
case statements / selection lists
Dice game due in lab section
G1: Daq G2: Instruments G3: Circuits

Lab Schedule

- Lab is located in 317 Toomey Hall
 - Labs start **THIS** week!!!
 - Download and read the write-up before you go to lab. Be prepared! Know what you need to do and have some idea of how to use the instruments you will be using! (Manuals on the class website)
 - **If you don't.... You will probably not be able to complete the labs in the given time.**
-

Lab experiments

- ☐ Lab experiments consist of two parts
 - Basic experiment
 - Extension experiment
 - ☐ May be more than one
 - ☐ One is required
 - ☐ Additional extensions are bonus points
-

Lab grading

- Labs are done as a group
 - Receive participation points for the base lab and the extensions you do.
 - After lab do plots and consider the questions. (Individually or group)
-

Lab grading

- ☐ Lab exams are individual effort
 - Base exam available after the TA enters Participation points.
 - Selector test available after base exam attempted
 - ☐ Select which extension you want to take the test on. BE SURE you got participation points for it or you wont be allowed to take the exam.
 - Extension exam will be available after selector question
-

Homework

- Homework assignments (Application Problems)
 - Designed to help reinforce a key topic.
 - You are allowed to work individually or in groups of **2** *as specified by the assignment sheet!*
 - Total points worth 35% of your grade.
 - Due at the beginning of the lecture on the assigned due date (unless otherwise indicated)
 - ***Late homework lose 50% per day.***
-

Homework Reports

- ☐ Engineering memo format
 - ☐ Format found on the class website
 - ☐ Grading rubric for each assignment is provided with the assignment.
-

Daily assignments

- Short LabVIEW assignment every day
 - Designed to only take a few minutes
 - Reinforces the LabVIEW lecture portion
 - Short online quiz on blackboard
 - Available for 48 hours
 - Usually only about 3 multiple choice questions
 - Each question worth a point or two
 - Total of all questions will equal 5% of your semester grade
-

Project

- There will be a project toward the end of the course.

 - Grading:
 - Class presentation (during lab hours)
 - Combined worth 10% of your grade

 - More information to come later in the semester!
-

IMPORTANT!!!



There are no points for
obviously obfuscatory text,
and no points for
“I didn’t learn anything”
in any memo or report you
write for this course!

Let's look at Blackboard

- Locations of
 - lab exams
 - Labs
 - Daily assignments

 - Gradebook
-

Questions so far??

New Engineers ???

- Most new engineers haven't learned how to apply what they learned...
 - We are going to stress concepts and applications equally.
 - It does no good to learn if you can't apply it.
 - Instrumentation is an applied science!
-

SO... Back to instrumentation!

- We talked about what instrumentation is.
 - Now lets look at why you, as an engineer, care...
-

Example 1



Engine

- Coolant temperature
- Oil temperature
- Oil pressure
- Fuel flow
- Fuel level
- Engine RPM
- Engine crank angle (electronic fuel injection)
- Battery / alternator power

Example 1



Hydraulics

- Temperature
- Flows
- Pressures
- Position of cylinders
- Speed of rotating components

Example 1



Cab

- Air temperature
- Position of controls
 - ☐ Drive by wire?
- Safety devices?
 - ☐ Roll over detectors?
- Automated position / level system

Example 2

- Engine
 - Coolant temperature
 - Oil temperature
 - Oil pressure
 - Fuel flow
 - Fuel level
 - Engine RPM
 - Engine Air flow
 - Engine crank angle (electronic fuel injection)
 - Battery / alternator power



Example 2

- Engine
 - Coolant Level
 - Oil Level
 - Oxygen content in exhaust gas
 - Fuel temperature
 - Fuel Pressure
 - Engine Air flow



Example 2

- Transmission
 - Road Speed
 - Engine speed
 - Oil temperature
 - Oil pressure
 - Selector position
 - Mode (tow / haul)



Example 2

- Brakes
 - Wheel speed (individually)
 - Brake pressure
 - Fluid level
 - Booster pressure



Example 2

- Cabin
 - Inside Air temp
 - Outside Air temp
 - Engine coolant temp
 - Desired interior temp
 - (maybe two?)
 - Seat Positions
 - Air bags?
 - Tire Pressure



Example 2



- ☐ Other Features?
 - Light levels?
 - ☐ Auto headlights
 - ☐ Auto dimming mirrors
 - Turn signal warnings?
 - Trailer brake systems?
 - Onstar?
 - ☐ Remote diagnostics
 - Seat belt warnings?
 - Fuel monitoring?
 - Multi fuel compatibility?

Example 3



- ❑ Chemical Plant
 - Where do we start???
 - Temperature
 - Pressure
 - Flow
 - ❑ Liquid
 - ❑ Gases
 - Level
 - PH
 - Viscosity
 - Weight / volume
-

Example 3



- ❑ Washing Machine
 - Water flow
 - Water temperature
 - Water Level
 - Drum RPM / direction
 - Time
 - DRUM BALANCE !!
 - Door status (open?)

That's it!

If you need into a lab section come
see me now!