ROCHESTER INSTITUTE OF TECHNOLOGY
Kate Gleason College of Engineering
Department of Mechanical Engineering

Course: 0304-280 Measurement, Instrumentation & Controls 1 (Class 4, Credit 2) Required

Course Description (10-11 Bulletin): This course is designed to introduce students to fundamental laboratory techniques and familiarize them with hardware and software tools. Students learn how to obtain and interpret measurements of physical properties such as temperature, pressure, and flow rate. Students learn how to interface a computer to physical devices using analog and digital input/output schemes. The primary vehicle for exploring these concepts is LabVIEW from National Instruments, which is an integrated, graphical programming environment. Classroom demonstrations, hands-on examples, in-class and project exercises provide students with an appreciation for engineering applications. **Computer Lab 4, Credit 2**

Prerequisite(s): none.

Textbook(s) and/or Required Materials: All resources created &/or compiled by John D. Wellin, and available on-line: http://people.rit.edu/jdweme/emem280.htm.

Course Outcomes / Relationship to Program Outcomes (1 = slightly, 2=moderately, 3=significantly):

Course Learning Outcomes	RIT Mechanical Engineering Program Outcomes								
	1	2	3	4	5	6	7	8	9
Level 1: Knowledge									
1.1 Learn LabVIEW fundamentals				2					
1.2 Gain exposure to Test Engineering.	1			2				1	
Level 2: Comprehension									
2.1 Interpret sensor calibration data & understand DAQ concepts				2		3		1	
Level 3: Application									
3.1 Programming control structures (i.e., case, loop, array)				2		2			
3.2 Alarms & Reporting				2		2		2	
3.3 Programmatic flow, logic, selection, decisions				2		2		1	
3.4 Temperature & pressure sensing & analog I/O				2		3		1	
3.5 Encoders & digital I/O				2		3		1	
3.6 Serial communication control				2		2		1	
Level 4: Analysis									
Level 5: Synthesis									
5.1 Adapt & extend algorithms & use LabVIEW Examples as algorithm development tool	1			2		2			1
5.2 Project task (template) completion				2		2		2	
Level 6: Evaluation									
6.1 MAX &sequential-operation debugging	1								1

Topics Covered:

- Course introduction & relevance
- Introduction to LabVIEW, virtual instruments (VI)
- Syntax & data types
- Functions in LabVIEW, subVI's, Express VI's, polymorphism
- Case structures, sequences, conditional (while) loops
- Iterated (for) loops, expression nodes
- Arrays, indexing in loops, array functions
- Charts & graphs
- Waveform data type, and LabVIEW "signals"
- Clusters & cluster operations
- Error clusters & basic error handling
- Modular programming and subVI's, documentation, file management
- MIC: DAQ fundamentals, digital I/O examples, relays & other output controls
- Local & shared variables
- MIC: Analog input essentials, A/D conversion, bit resolution, instrumentation amplifiers
- MIC: Analog input essentials (continued), basics of signal conditioning

- MIC: Low-level DAQmx, NI examples, simulated devices, auto code generation,
- custom scales, global tasks & channels
- Introduce course project, demo LabVIEW interface and hardware

A student who successfully fulfills the course requirements *(0304-280)* will have demonstrated the ability to:

1. Conduct computerized data acquisition (DAQ) with an understanding of concepts, terminology, and technology involved.
2. Interpret and extract meaningful information from sensing equipment specifications and use it for DAQ purposes.
3. Use simple algorithms and programming control structures (i.e., for-loop, while-loop, and case) to solve DAQ and data analysis problems involving numeric and Boolean data arrays.
4. Develop DAQ algorithms for analog and/or digital signal input/output (I/O) involving pressure, temperature, and encoded data.
5. Develop user-alerting (alarm), data reporting, and serial instrument communication code attributes.
6. Troubleshoot a DAQ application using Measurement Automation Explorer (MAX) and LabVIEW debugging tools.
7. Adapt previous developed code to new problems and/or projects.

Class/Lab Schedule: The class meets for 2 two-hour computer & experimentation laboratory sessions each week.

Contribution of Course to Meeting Professional Component:
College Level Mathematics and Basic Sciences = 0 credits
Engineering Topics = 2 credits (2 engineering science)
General Education = 0 credits

Prepared By: Mark H. Kempski **Date:** April 22, 2010 **Revised**: April 22, 2010