**EENG398BB Course Syllabus**

**Introduction to LabVIEW for Instrumentation and Control**

**Summer Field Session 2018**

Course description: The course will focus on introducing the LabVIEW programming environment, specifically for the purpose of creating customized instrumentation and control systems. Students will learn basic LabVIEW programming concepts, including:

1. User Interface Design: controls, indicators, dialogs, graphs, charts, tab controls, user interface best practices
2. Software Development: basic software architecture, loops, arrays, binary logic, mathematics, data management
3. Instrumentation basics: connecting sensors to National Instruments hardware, acquiring data, analyzing instrumentation accuracy, examining resolution and noise characteristics of a signal
4. Control basics: create pulse-width modulated (PWM) signals for controlling motors, servos, amplifiers, and heaters. Utilize transistors as power amplifiers. Create a PID control algorithm to control a dynamic system.

Students will spend half of the course learning fundamental syntax. The other half will be spent implementing open-ended projects.

Pre-requisites: an entry-level understanding of programming basics, electronic theory and construction practices, power systems, signal processing, mathematics, feedback control systems, and digital to analog conversion theory.

Preparation: It is recommended that you look through the day’s slides and exercises before each class period. All information for the class is contained within the LabVIEW Core 1 and Core 2 slides and exercises provided by National Instruments. It is also recommended that you review course materials for the concepts discussed in “Pre-requisites”.

Textbooks and other recommended materials:

Required: LabVIEW Core 1 and Core 2 Participant Guides (provided in PDF format)

Daily Activities:

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| **Date** |  |
| **5/14** | **MyDAQ Introduction: DMM, Oscope, Function Generator**  **LabVIEW Core Slides and Exercises: Core 1**  **Lesson 0: Welcome to LabVIEW. Why LabVIEW? Why not LabVIEW? LabVIEW vs. Arduino vs. Matlab vs. C vs. Visual Basic vs. Raspberry PI?**  **Lesson 1: LabVIEW Environment** |
| **5/14** | **LabVIEW Core Slides and Exercises: Core 1**  **Lesson 2: Creating your first application**  **Lesson 3: Debugging and Troubleshooting VIs** |
| **5/14** | **LabVIEW Core Slides and Excercises**  **Lesson 4: Using Loops**  **Lesson 8: Acquiring Measurements with Hardware: Take measurements with the myDAQ and with existing lab hardware, including the DMMs and Oscilloscopes.** |
| **5/15** | **Open-Ended Projects: Basic Sensing and Control Project 1**  **Control a servo. Use the microphone input to record and play back sound. Play back a recorded file. Add an audio effect to sound.**  **Report: Write a short report documenting each VI (front panel and block diagram). Write a short description of each VI and its functionality. Include pictures of hardware used.** |
| **5/15** | **Open-Ended Projects: Basic Sensing and Control Project 1**  **Control a servo. Use the microphone input to record and play back sound. Play back a recorded file. Add an audio effect to sound.**  **Report: Write a short report documenting each VI (front panel and block diagram). Write a short description of each VI and its functionality. Include pictures of hardware used.** |
| **5/15** | **LabVIEW Core Slides and Exercises: Core 1**  **Lesson 5: Creating and Leveraging Data Structures**  **Lesson 6: Using Decision-Making Structures**  **Lesson 7: Modularity (SubVIs)** |
| **5/16** | **Open-Ended Projects: Basic Sensing and Control Project 2**  **Build a bi-directional power amplifier to control a DC motor. Control the motor open-loop using LabVIEW. Use a microphone to control the motor.**  **Report: Write a short report documenting each VI (front panel and block diagram). Write a short description of each VI and its functionality. Include pictures of hardware used.** |
| **5/16** | **Open-Ended Projects: Basic Sensing and Control Project 2**  **Build a bi-directional power amplifier to control a DC motor. Control the motor open-loop using LabVIEW. Use a microphone to control the motor.**  **Report: Write a short report documenting each VI (front panel and block diagram). Write a short description of each VI and its functionality. Include pictures of hardware used.** |
| **5/16** | **LabVIEW Core Slides and Exercises: Core 1**  **Lesson 9: Accessing files in LabVIEW**  **Lesson 10: Using Sequential and State-Based Designs**  **Lesson 11: Next Steps**  **LabVIEW Core Slides and Exercises: Core 2**  **Lesson 1: Welcome**  **Lesson 2: Variables**  **Lesson 3: Communicating Data Between Loops** |
| **5/17** | **Open-Ended Projects: Closed-Loop Motion Control Project 1**  **Control motor position using encoder as feedback. Move motor in both directions.**  **Report: Write a short report documenting each VI (front panel and block diagram). Write a short description of each VI and its functionality. Include pictures of hardware used.** |
| **5/17** | **LabVIEW Core Slides and Exercises: Core 2**  **Lesson 3: Design Patterns**  **Lesson 4: Controlling the User Interface**  **Lesson 5: File I/O Techniques**  **NI Hardware Discussion: DAQ, CompactRIO, Motion, Vision** |
| **5/17** | **Final Project:**  **Vending Machine: create a LabVIEW “Virtual” Vending Machine using provided DC motor and encoder. Populate nine “item” buttons from a data file. Take money from the user using the keyboard. Rotate a DC motor to a correct angular position based on selected item.**  **Final Report Discussion:**  **Create a final report that documents your final project. Include images of the LabVIEW Front Panel and Block diagram, images of your team, and images of your vending machine hardware. Document your code and how it works. Discuss improvements that could be implemented in the future. Finally, include in your report one interesting example of how LabVIEW is being used in the world. Discuss the role of this technology, as well as the role of LabVIEW and other languages, in current and future society.** |
| **5/18** | **Final Project:**  **Vending Machine**  **Ethics Module: Review IEEE Code of Ethics** |
| **5/18** | **Final Project:**  **Vending Machine presentation and final report.** |

Grading:

1. LabVIEW Exercise Completion: 20%
2. Basic sensing and control project 1: 10%
3. Basic sensing and control project 2: 10%
4. Closed Loop Motion Control Project: 20%
5. Final project: 20%
6. Final report: 20%

Attendance: Attendance is mandatory for each section unless you are given explicit permission from the instructor.