CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

COLLEGE OF ENGINEERING
COURSE OUTLINE

ET Major	Course Classification: ET Core	Major Core	Tech Elect	GE	Course Title: Electronic Test Instr. with LabVIEW/Lab Course No ETE 420/420L Prepared by: G. K. Herder Date of Last Revision: 6/23/99 Revised by: G. K. Herder Approved by:
CET ECET ET			(3/1)		

I. Course Description

ETE 420/420L Electronic Test Instrumentation with LabVIEW/Lab (3/1)

Fundamentals of electronic test instrumentation and computer data acquisition systems, theory and function of electronic measurements, signal conditioning and instrumentation. Computerized data acquisition and programmable instrument control (IEEE-488) utilizing LabVIEW graphical programming software. Prerequisites: ETE 305, ETE 310.

II. Required Background of Experience

Junior level ET background including Op- Amp fundamentals and Digital systems. Scientific Programming, working knowledge of C useful but not required.

III. Detailed Description of the Course

A. Expanded Description of the Course

1. **Brief History of Electronic Measurement** (1 week)
   Fundamentals and limitations of Analog PMMC meters, Ammeter and Voltmeter loading effects, 4-wire Ohms Measurement and Power Supply operation.

2. **The Wheatstone Bridge** (1 week)
   Analysis of ¼, ½ and Full bridge circuits

3. **Force Measurement using Strain Gage Bridge circuits** (2 weeks)
   Stress-Strain curves, Strain Gage characteristics, Temperature compensation, Load Cells

4. **Temperature Measurement** (2 weeks)
   Thermocouples, RTD's, Thermistors, and IC sensors

5. **Op Amp Signal Conditioning Techniques** (2 weeks)
   Differential and Instrumentation Amplifiers, Gain and Offset (Span and Zero) compensation

6. **Introduction to Data Acquisition Systems** (2 weeks)
   A/D converters (Flash, Successive Approximation, Dual Slope Integrating), Resolution and Error

B. Methods of instruction and Evaluation

Instruction: Classroom lecture and Demonstrations

Evaluation: Periodic exams and quizzes, homework problems, and computer assignments.

C. Expected Outcomes

Upon successful completion of this course, each student will be able to:

1. Calculate the loading effects of ammeters and voltmeters in circuits
2. Create circuits for Signal Conditioning using Op-Amps.
3. Implement and Analyze Span and Zero concepts having to do with transducers.
4. Understand Bridge Circuits used in Force and Strain Gage applications.
5. Understand the merits of various A/D converters.
6. Be able to determine the number of bits needed for a given resolution or allowable error.
7. Understand the basic use of LabVIEW programming environment.
8. Understand the basic use of LabVIEW in Data Acquistion systems (A/D boards and IEEE-488)

D. Minimum Student Materials

Text, scientific calculator, access to an IBM PC or equivalent with National Instruments LabVIEW software, and data acquistion or IEEE-488 bus controller interface cards.

E. Minimum University Facilities

Standard classroom for lectures, with black (or white) board and overhead projector with screen, computer projection system when needed.

IV. Text and References

Text: LabVIEW 5.0 Student Edition, National Instruments, Prentice-Hall
References: Johnson, Gary. LabVIEW Programming, 2nd Edition, 1997

V. Detailed Description of the laboratory

A. Typical laboratory experiments

1. For the first month of laboratories the students go through 7 lessons of LabVIEW tutorial.

2. Concurrent with 1 specific instrumentation setups (Force-Strain Gage, Temperature, etc) are demonstrated and group experiments performed.

3. A/D converter lab performed, A/D staircase and error plot created.

4. Upon completion of 1. Intermediate LabVIEW sample programs are analyzed and dissected for understanding.

5. LabVIEW applications using A/D boards and IEEE-488 data acquisition systems are demonstrated and group experiments performed.

B. Methods of instruction and Evaluation

Instruction: Typical computer laboratory with students working on projects under faculty supervision. This may include some lecture, as appropriate.
Evaluation: Quizzes on LabVIEW tutorials. Total laboratory projects including VI's and lab reports.

C. Expected Outcomes

Upon successful completion of this laboratory, each student will be able to:

1. Understand the use of the LabVIEW interface (control panel and diagram).

2. Operate and use Debugging Tools in LabVIEW environment.

3. Create basic VI's using hierarchical VI structures.

4. Analyze the operation and document intermediate level LabVIEW VI's.

5. Understand the basic use of LabVIEW applications involving A/D boards and IEEE-488 data acquisition systems.

D. Minimum Student Materials

Floppy diskettes; access to an IBM PC, or equivalent, MS Visual C++ for Windows, or equivalent.

E. Minimum University Facilities

Computer laboratory with IBM PCs or equivalent with LabVIEW installed. Hardware computer lab with A/D boards and IEEE-488 data acquisition systems.

F. Text and References

Text: Laboratory materials are locally prepared.
Reference: Lecture text(s).

ECET Course Outline Addendum

Course Number and Title: ETE 420/420L Electronic Test Instrumentation with LabVIEW /Lab (3/1)

Computer usage:

In lecture and lab, use of National Instruments LabVIEW graphical programming environment for VI creation and analysis.

In addition, each group is required to write a word-processed report for each laboratory exercise. This report must describe what they learned from each laboratory, as well as including VI code.

Laboratory projects:

The laboratory work associated with this course requires the use of the LabVIEW, implemented on IBM PC computers, or equivalent. Laboratory instrumentation Data Acquisition systems (A/D boards and IEEE-488) and miscellaneous sensors.

Oral and written communication requirements:

In lab each individual/group of students is required to complete a word-processed semiformal laboratory report detailing what they learned from the respective laboratory exercise, following the specifications given in a locally-generated laboratory writing guide, ETE 401 Report Writing Guide, is available from a local copy center

Calculus usage:

There is no direct calculus usage in this class.

Library usage:

Local or on-line access to manufacturers catalogs or pdf's for sensor, transducer data. Access to OMEGA engineering application manuals (local or on-line).

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