Data Acquisition and Measurement: Course Materials

This page contains **Syst** Data Acquisition and Measurement course materials and relevant information. Toggle the tabs below to view all the content of this course area.

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Traditional View

Most AAS electronic technology degree programs do not have an instrumentation or data acquisition course. The traditional view is that test equipment operation and use is taught in the regular courses as needed. For example, digital multimeters are taught in DC, scopes in AC and solid state, scopes and logic analyzers are used in the digital course and a spectrum analyzer and other RF test gear is taught in a communications course if one is available.

Furthermore, most AAS curricula also do not include a data acquisition course. The traditional view is that this is not a mainstream subject so most colleges ignore it. There are exceptions, of course.

New Systems View

In analyzing what modern technicians do on the job today, it is clear that their function is still largely testing and measuring in manufacturing, troubleshooting and maintenance. A large portion of the work involves using test equipment and other instruments to make measurements. Other work includes the collection of data by setting up data acquisition systems. Most of this work involves sophisticated test and measurement instruments and systems. Most schools do not do an inadequate job of teaching such instruments and how they are used. It has also been found that when use of test instruments is taught in the regular courses, the outcome is typically that students know only the barest minimum knowledge of how these instruments work or are applied. A case can be made for creating a separate course covering the operation, specifications and use of advanced test equipment.

In addition, studies show that data acquisition is a very widespread operation used in a wide range of companies, industries and facilities around the world. Large systems and equipment are commonly instrumented with huge data acquisition systems. Technicians are the ones who set up and test these systems then capture the data that is later usually analyzed by engineers and others. Virtual instrumentation is widely used in such systems and the LabVIEW software is more often than not is the central capture and processing effort.

A general view is that technicians need to know more about test instruments and how to use them and data acquisition systems are common and should be taught in all AAS degree programs.

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Data Acquisition and Measurement Instructional Materials List
Last Update: June 10, 2010

Click on the desired materials to download. By downloading, you agree to the terms of use of eSyst.

1. Student Guide: Agilent U3000 Oscilloscope Lab Activity Part 3
   *NOTE: This lab can stand alone. Part 1 Power Supply lab, and Part 2 Multimeter lab, are found in DC/AC course materials.

   This lab activity introduces you to the basic theory and operation of a lab oscilloscope. The lab is focused on using the oscilloscope as a tool to measure voltage, time, and frequency. Oscilloscope measurement theory, terminology, and operation are stressed. Since most all system tests require a oscilloscope for complex signal measurement, a technician needs to understand the basic theory of operation, the common terminology used with all oscilloscopes, and, ultimately, their efficient use. Technicians setup and use oscilloscopes in virtually all job classifications. Therefore, oscilloscope operation becomes a required skill of the job.

2. Student Guide: Electro Cardiograph Lab Activity
   The purpose of this lab is to introduce the student to biological electrical signals and how they can be captured.

3. Student Guide: Introduction to Computer-Based Data Acquisition
   The purpose of this lab is to familiarize the student with the basic principles of computer based data acquisition, data store, and display. With the advent of low cost data conversion hardware and modules, plus the availability of configurable software, the capability of interfacing an analog measurement system to a computer is very easy and used throughout industry. Being able to explain and implement computer-based data acquisition becomes a valuable skill for any technician.

4. Student Guide: Temperature Measurement Using a Thermocouple
   Using electronics hardware for temperature measurement is one of the most common data acquisition processes. Using a thermocouple to accomplish that measurement is by far the most common method. The purpose of this lab is to teach you to assemble, troubleshoot, and calibrate such a system for accurate temperature reporting.

5. Instructor and Student Resource: WRE Module - Data Acquisition
Data acquisition systems are very widely used in industry process control, manufacturing, factory automation, testing centers, and research labs. This module provides an introduction and overview of data acquisition systems such as: data acquisition systems used in industry process control, manufacturing, factory automation, testing centers, and research labs; data acquisition software, and applications of data acquisition systems.

6. Instructor Guide: Building a Web Server
The purpose of this lab is give an instructor the necessary information and instructions for setting up a web server through which server I/O can be controlled. There are five different projects included in this lab.

7. Instructor Guide: FPGA Beer Module - Lab Documents
The goal of this lab is to learn the use of Spartan 3E FPGA development board from Xilinx and how to create the hardware connections between the development board and your PC.

* Instructors should contact Tom McGlew , eSyst Project Manager, for an answer key.

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Student Learning Outcomes

Toggle the arrows to view the SLOs. New student learning outcomes (SLOs) are listed in red.

Data Acquisition and Measurement

1. Draw a block diagram of a modern digital oscilloscope and explain how it works.
2. Make measurements on analog and digital signals using a digital oscilloscope.
3. Explain the concept of virtual instrumentation.
4. Define synthetic instrumentation.

5. Explain the need for automated test equipment (ATE) systems and state an example case.

6. Define boundary scan and JTAG instrumentation.

7. Explain the need for and operation of GPIB and LXI systems in ATE systems.

8. Explain the operation and specifications of a modern digital frequency synthesizer including an arbitrary waveform generator (AWG).

9. Draw a block diagram of a modern spectrum analyzer, explain how it works and indentify at least three common applications.

10. Demonstrate the use of common test instruments like LCR testers, function generators and spectrum analyzers.

11. Define data acquisition.

12. Draw a generic block diagram of a data acquisition (DAQ) system and identify each section and explain how it works.

13. Name and explain the operation of the most commonly used sensors including thermocouples, thermistors, RTDs, strain gages, pressure sensors, light sensors, solid state sensors, and motion/position sensors.

14. State and defined the various methods of signal conditioning in a DAQ system.

15. State the function of a multiplexer in a DAQ system.

16. Name the main specifications of an analog-to-digital (ADC) used in a DAQ system.

17. Explain how data acquired in a DAQ system is stored.

18. State what LabVIEW is, basically how it works and how it is used in a DAQ system.

Laboratory

1. Make both analog and digital measurements using a modern digital oscilloscope.

2. Demonstrate the use of common test instruments like LCR testers, function generators and spectrum analyzers.

3. Build a simple DAQ system with sensors, signal conditioning, ADC and other components as needed to collect data.

4. Build and test a simple DAQ system using LabVIEW.

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Detailed Course Outline

Toggle the arrows to view the outlines. New topics are listed below in red.

Instrumentation And Data Acquisition Course

1. Electrical and Electronic Measurement Principles
   a. Atomic Structure
   b. Accuracy
   c. Precision
   d. Error
   e. Standards

2. Survey of common test instruments, specifications, applications, measurement examples
   a. Digital multimeters
   b. Oscilloscopes
   c. Function generators/signal generators including arbitrary waveform generators
   d. Spectrum analyzers
   e. LCR meters
   f. RF test equipment (frequency counters, field strength, SWR, power, EMI)
   g. Digital signal analyzers

3. Systems of instrumentation
   a. Segments of the electronics industry
   b. How the industry works
   c. Jobs and careers

4. Introduction to systems
   a. Virtual instruments
   b. Synthetic instruments
   c. Automatic test instrument systems
   d. GPIB, PXI and LXI instruments
   e. Boundary scan and JTAG

5. Data Acquisition Fundamentals
   a. Data acquisition defined
   b. Block diagram analysis of a data acquisition system
   c. Sensors overview
   d. Signal Conditioning
   e. Multiplexing

f. AD/DA principles review
g. Data capture and storage
h. Data acquisition software and processing
i. Introduction to LabVIEW. Build a basic electronics system

6. Application examples of data acquisition systems