Measurements Lab Fall 06
2-Week Lab Choices

Group:

Team Members:

1.

2.

3.

Lab name	**1st**	**2nd**	**3rd**	**4th**
A. Comparison of Model and Experiment				
Building as a Learning Tool (BLT): Heat Transfer in the ITLL				
Vibrating Table				
B. Performance Measurements				
Electric Motor Comparison				
Fluid Flow (perform 3 modules): 1-Energy Losses in Bends, 2- Flowmeter Comparison, 3- Tube Flow				
Musical Signal Analysis: Guitar & Voice				
Series and Parallel Pumps				
C. Reference Measurements				
Static Tensile Test: Material Properties using Strain Gages				
Shock in an Electro-Mechanical System				
Ultrasonic Measurements: Material Properties using Ultrasound				

Please choose and rank your choice of four labs from the above options for your two-week lab classes. You will complete three of your four choices during the rest of the semester. You must choose at least one lab from each Section A, B, and C above.

-Profs Miller and Stoldt

A brief summary of each experimental module is contained below. More details for each module, including the laboratory procedure & related documentation, can be found at the ITLL website

1. http://itll.colorado.edu/modules/
2. Click on: “View Modules Used by” -> “Course”
3. Scroll down and click on: “MCEN 3027”
4. Scroll/click on the desired module name to access the module description.

A. Comparison of Model and Experiment

Building as a Learning Tool (BLT): Heat Transfer in the ITLL

Heat transfer through the four walls of the south light monitor (raised roof portion) is measured on a continuous basis using thermistors, and the data is available on the Web. When combined with solar insolation and air temperature data, the measured data can be compared to a transient one-dimensional heat transfer model.

Vibrating Table: A Second Order System

A table mounted on leaf springs with an oil damper attached forms a spring-mass-damper system. The system is driven sinusoidally by a rotating eccentric weight. The motion of the table is measured with an accelerometer. Both transient and frequency responses are measured and compared to second order system theory.

B. Performance Measurements

Electric Motor Comparison

The performance of two electric motors is compared in terms of efficiency, speed regulation and power factor. Motor output is measured with a dynamometer, speed with a digital tachometer, and power factor with a watt meter and clamp-on ammeter.

Musical Signal Analysis: Guitar & Voice

The spectral (FFT) analysis of voice and guitar signals is compared to the frequency response of a guitar amplifier and loudspeaker system. Response of pre amp, power amp and loudspeaker (using a sound pressure level meter) to sine wave inputs are measured separately.

Fluid Flow (perform 3 modules): 1-Energy Losses in Bends, 2- Flowmeter Comparison, 3- Tube Flow

These experiments are performed using the Armfield hydraulics bench.

1- The Bernoulli lab: Please see the course website for a description.

2- Flowmeter comparison: The performance of several obstruction flow meters in a water circuit is measured using measured results and comparisons with theoretical calculations based on the Bernoulli equation.

3- Tube flow: Horizontal tubes of different lengths and diameters are attached to a cylindrical tank. An adjustable standpipe maintains a constant pressure head. Measured friction factors and volumetric discharge rates can be compared with laminar pipe flow theory. Transition between laminar and turbulent flow can be seen and Reynold's number calculated.

Series and Parallel Pumps

Pressure (head) versus flow rate data is obtained for identical water pumps configured singly, in series, and in parallel, and is compared to a simple model. Pressures are measured using analog gages, and flow rate is calculated from a time and volume measurement in the Armfield hydraulic bench.
Note: Documentation for this module is contained under the “Armfield Hydraulics Bench” module description on the ITLL website.

C. Reference Measurements

Static Tensile Test: Material Properties Using Strain Gages

Material properties are calculated from measurements of strain in a uniaxially stressed aluminum bar. Strain measurements are made using an assortment of resistance strain gages, including both simple gages and rosettes. Comparison to deformation measured by dial indicator is made. A tensile testing machine from Instron Corporation is used to conduct the tests.
Note: The operating procedure for the Instron Tensile testing machine is contained under the “Instron Universal Testing Machine” module description on the ITLL website.

Shock in an Electro-Mechanical System

Study the response of an electro-mechanical system (a floppy disk drive) to an impulse force and determine the threshold acceleration that causes servo errors. Additionally, a dynamic cushioning curve for a sample foam thickness can be measured and the cushioning system can be optimized to minimize the effect of an impact on the floppy disk drive

Ultrasonic Measurements: Material Properties Using Ultrasound

Young's Modulus and Poisson's Ratio are determined for quartz, aluminum, steel and brass samples using the pulse-echo ultrasound technique. Two sets of equipment are available for this experience, but the specimens must be shared between groups.