MECA 380: Measurements and Instrumentation

Catalog description: 3.0 units

Measurement of steady-state and dynamic phenomena using common laboratory instruments. Calibration of instruments, dynamic response of instruments, and statistical treatment of data. 2.0 hours discussion, 3.0 hours laboratory. Special fee required; see *The Class Schedule*.

Prerequisites: EECE 211, EECE 211L, either EECE 135 or MECH 306
Recommended: CIVL 302

Course objectives: For students to

1. Learn how to measure steady-state and dynamic phenomena
2. Study the dynamic response and the calibration of instruments for such measurements
3. Apply simple statistical methods to experimental data to quantify it accordingly
4. Learn to use computer-assisted/computer-controlled instrumentation and data acquisition systems
5. Learn about various measurement devices, their characteristics, their operation and their limitations
6. Learn to write technical papers/reports using a professional standard

Course outcomes: Students shall be able to

1. Find information on and select the proper instrumentation for making measurements of physical quantities (e.g., pressure and temperature) commonly encountered by mechanical and mechatronic engineers
2. Plan and carry out measurements of physical quantities commonly encountered by mechanical and mechatronic engineers using common laboratory instruments
3. Use personal computers as instrument controllers and develop simple computer programs to assist in or automate the collection and analysis of experimental data
4. Prepare technical papers/reports

Topics covered

1. Purpose of experimentation, the experimental test and data analysis plan. General stages in measurement systems. Definitions of terms and standards.
2. Signal and measurand characteristics. Measurement system behavior, frequency response
3. Probability distributions, central tendency, mean, variance, and standard deviation; Gaussian (normal error) distribution, confidence intervals; Student's t-statistic, difference between two means, Chi-square test for goodness-of-fit, data rejection criteria; estimating the required number of measurements; design-stage uncertainty estimation
4. Computer-as-controller concept, GPIB instrument control using QuickBASIC with command libraries; graphical object-oriented instrument control programming using Agilent's (formerly HP's) Visual Engineering Environment (HP Vee®)

5. Thermistors, thermocouples, pressure transducers, and strain gages
6. Technical paper writing based on ASME Publication MS-4 guidelines with peer review and revision

Class/Laboratory schedule

One hundred minutes of lecture and one hundred fifty minutes of laboratory per week

Contribution of course to meet the professional component: none

Relationship of course to Mechanical Engineering Program Outcomes

This course contributes principally to Program Outcomes A, B, D, E, and H. Students must achieve a grade of C or better in the portion of the course devoted to HP Vee® to pass the course and satisfy Program Outcome D. Students must demonstrate competence in written communication in a technical paper in the course to pass the course and satisfy Program Outcome E.