**AE 2610 – Introduction to Experimental Methods in Aerospace**

**Hours:** 0-3-1

**Catalog Description (25 words or fewer):** Introduction to laboratory instrumentation and measurement techniques used in aerospace. Basic application of sensor principles, uncertainty analysis, interpretation and analysis of experimental data, and documentation.

**Prerequisites:**

AE 1601

PHYSICS 2212 (with concurrency)

MATH 2401 (with concurrency)

COE 2001 (with concurrency)

AE 2611 (corequisite)

**textbooks:**

Lab notes.

**Course Objectives:**

1) Exposure to laboratory instrumentation and experimental measurement techniques commonly utilized in aerospace engineering;

2) introduction to fundamental principles governing common sensors, transducers and actuators, and modes of operation;

3) basic application of digital data acquisition, uncertainty analysis, and experimental data analysis and interpretation;

4) exposure to basic concepts in aerodynamics, deformable bodies, and system dynamics through experiments.

**Learning Outcomes:**

Students will have a basic ability to:

1. Apply experimental uncertainty analysis (confidence levels, error estimation)
2. Document test conditions/procedures
3. Analyze and graph data
4. Effectively use digital data acquisition approaches
5. Use and understand the operation of basic sensors, transducers, actuators
6. Apply critical reasoning and strategic thinking to experimental problems
7. Work in teams

Students will have an exposure level understanding of:

1. Validating an experimental system
2. Lab safety

**topical outline:**

**Topics Weeks**

1. Course overview and introduction to experiments 1
2. Introduction to the strain gage and the Wheatstone bridge circuit 2
   * Lab safety
   * Construction, calibration, and characterization of a simple link-type load cell
3. Elastic, yield, and failure strength properties of engineering materials 2
   * Lab safety
   * Use of a tensile testing device
   * Data analysis: the stress-strain curve
4. Force measurements on airfoils and wings 3
   * Lab safety
   * Use of sting balance, pitot-static probes
   * Operation of a wind tunnel
   * Experimental decision making
   * Data analysis: Lift and drag – drag polars
   * Uncertainty analysis
5. Digital sampling of periodic signals 2
   * Principles of digital data acquisition systems
   * Sampling theory and Nyquist frequency
   * Introduction to frequency analysis of time-dependent signals
   * Filtering
6. Bending of a flexible beam under periodic loads 2
   * Use of DC motor, signal generator, stroboscope
   * Application of frequency analysis
   * Exposure to natural frequencies and natural modes
   * Uncertainty analysis
7. Response of a DC motor 2
   * Use of potentiometer and tachometer for position and rate sensing
   * Introduction to model identification
   * Effect of damping, sampling and discretization