AE 2610 – Introduction to Experimental Methods in Aerospace

HOURS: 0-3-1

CATALOG DESCRIPTION: 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 Intro. to AE
With concurrency
PHYSICS 2212 Physics II
MATH 2551 Multivariable Calculus
COE 2001 Statics
Corequisite
AE 2611 Technical Communications

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:

8. Validating an experimental system
9. Lab safety

TOPICAL OUTLINE:

	Topics	Weeks
1.	Course Overview and Introduction to Experiments	1
2.	Stress/Strain Measurements and Strain Gauges	3
	• Lab safety	
	• Mechanical transducers: strain gauge, extensometer, load cell	
	• Tensile testing and load frames	
	• Data analysis: stress, strain and material behavior	
3.	Aerodynamic Forces on a Wing in a Subsonic Windtunnel	3
	• Lab safety	
	• Measurements: use of sting balance, pitot-static probes	

- Operation of a wind tunnel
- Experimental decision making
- Data analysis: lift and drag – drag polars; moments
- Uncertainty analysis

4. Dynamic Response of a 3-DOF Helicopter Model 3
    - Lab safety
    - Measurements and dynamic response of helicopter model: damped response and step inputs
    - Optical shaft encoders
    - Calibration
5. Combustion Dynamics in a Rijke Tube 3
    - Labe safety
    - Resonance, mode frequencies and shapes, feedback
    - Piezoelectric pressure transducers, rotameters, photomultiplier tubes
    - Frequency analysis