AE 4610: Dynamics and Control Laboratory

HOURS: 1-3-2

CATALOG DESCRIPTION: Experiments in dynamics and control related to aerospace engineering topics

PREREQUISITES:
AE 2010 Thermodynamics and Fluids Fundamentals
AE 2610 Introduction to Experimental Methods in Aerospace
AE 3531 Control System Analysis and Design

COURSE OBJECTIVE: Provide students in Aerospace Engineering a hands-on experience with experiments involving dynamic system modeling and simulation, controller synthesis, design and evaluation in order to the basic concepts learnt in system dynamics and vibration, control system analysis and design and fluid dynamics courses.

Learning Outcomes:

Master
- Creating Effective Graphics
- Technical Communications: How to Write an Effective Technical Report
- Relationship of Time and Frequency Domains

Basic
- Critical Reasoning and Strategic Thinking, Decision Making
- Team Skills
- Documentation of Test Conditions/Procedures
- Frequency Content and Application of Transforms
- Data fitting including sensitivity analysis
- Programming real time embedded systems

Expose
- Lab safety
- Practical control system elements (sensors, actuators, gyroscopes, control surfaces)

TOPICAL OUTLINE:

Topics:
1. System identification, different forms of feedback, position and rate sensing, digital control (sampling and quantization effects)
2. Gyroscopic principle, gyroscopic instruments, gyroscopic stabilization
3. Roll/yaw control coupling, aerodynamic uncertainty, controller robustness, command tracking
4. Rigid and flexible motion coupling, collocated and non-collocated sensor and actuator pairs, disturbance rejection
5. Nonlinear dynamics, linearization, MIMO control
6. Flexible modes and mode shapes, non-minimum phase system control
7. Spacecraft attitude and angular rate sensors, reaction wheels for spacecraft attitude control, MIMO system modeling and control, wireless data transmission
8. Wave propagation in fluids
9. Real time embedded software, autonomous control

Experiments:

		No. of weeks
1.	DC servomotor experiment	2
2.	Gyro-stabilized platform experiment	2
3.	Three DOF helicopter experiment	2
4.	Torsional pendulum experiment	2
5.	Inverted pendulum experiment	1
6.	Flexible beam experiment	1
7.	Rijke tube experiment	1
8.	Spacecraft attitude stabilization and control experiment	1
9.	UAV system control	2
	Fall recess/spring break	1
	Total	15