AE 4580 – Introduction to Avionics Integration

Hours: 3-0-3

CATALOG DESCRIPTION (25 words or fewer):
Avionics in modern aerospace vehicle systems, including impact on design and performance. Specific case-studies; covers: navigation, GPS, stability augmentation, radar, health monitoring, databases, human factors, and software.

PREREQUISITES:
AE 3521 Flight Dynamics or AE 3530 System Dynamics & Vibration
ECE 3710 Circuits and Electronics

COURSE OBJECTIVES: Provide students with an understanding of the scope and extent of avionics in modern aerospace vehicle systems, and how they impact vehicle design and performance. Introduce specific systems to be used as case-studies, covering: navigational systems, GPS, radar, autoflight systems, alerting/health-monitoring systems, data buses, human-interaction issues, and flight software.

LEARNING OUTCOMES:
Students will gain working knowledge, sufficient to:

1) perform basic design and integration of avionics systems;
2) be familiar with common methods for analyzing avionics system design, including prediction of such metrics as reliability and accuracy;
3) know the basic methods of aircraft and spacecraft navigation systems;
4) understand the key benefits and limitations of electromagnetic radiation for avionics systems;
5) be familiar with the key challenges associated with avionics system development, including requirements development, software development, and human factors.

TOPICAL OUTLINE:	**Hrs**
1. Introduction	1
2. Radio Navigation Systems	8
Antennas, Frequency vs. propagation, line-of-sight	
Characteristics of transmitters and receivers, modulation principles	
Time and phase difference position fixing	
Specific systems: LORAN, VOR, TACAN, ILS, DME, GPS	
3. Inertial Navigation Systems	6
Inertial sensors, strapdown techniques	
Integration of GPS and INS	
4. Principles of Radar Systems	6
Radar range equation and the constraints it imposes	
Range and doppler tracking	
Applications to safety and military requirements	
5. Communication Systems	2
Communication methods, rates, and reliability	
Over-view of major communication networks (e.g., IntelSat)	
6. Flight Control Systems	5
Stability augmentation, autopilot, and flight management systems	
Elements of the control loop: actuators, flight computer, sensors	
Impact on aircraft design, e.g. relaxed static stability, load alleviation	

7. Reliability and Redundancy	5
Reliability theory, including models	
Redundancy and its affects	
Parity space and analytic methods of redundancy	
8. Systems-Level Analysis of Avionics	3
Decomposition methods and important component interactions	
Information passing and databuses	
9. Safety-Critical Software	2
Processes for developing and testing software	
New challenges to aircraft flight test and certification	
10. Human Interaction Concerns	5
Controls and displays, complexity	
Supervisory control issues and problems	
11. Exams	2
Total	**45**