AE 3340 – Design and Systems Engineering Methods

HOURS: 2-0-2

CATALOG DESCRIPTION:
Overview of aerospace design and systems engineering. Tools to organize the design process and to support design decisions. Introduction to numerical optimization and trade studies.

PREREQUISITES:
    AE 1601 Introduction to AE
    CS 1371 Computing in Matlab
    Math 2551 Multivariable Calculus

COURSE OBJECTIVES: This course introduces students to the aerospace design and systems engineering process. The course situates the design process in terms of the customer, the requirements, and the organization of the engineering design firm. The course introduces a series of qualitative and quantitative tools that companies and government organizations use to organize and implement the systems engineering and design process.

LEARNING OUTCOMES:
Students will be able to:
1. describe the societal, market, and regulatory environment in which aerospace systems are developed
2. decompose the design problem in terms of system requirements and functions;
3. brainstorm and organize potential design architectures and concepts;
4. apply formal decision analysis methods to guide and defend their design choices;
5. determine the multidisciplinary influences on the design of aerospace systems.
6. understand the concept of design optimization;
7. be able to describe the basic operation of constrained line search algorithms and genetic algorithms, and to apply these algorithms for typical design optimization problems
8. understand the concepts of trade studies and robust design and be able to apply these concepts to aerospace design problems.

TOPICAL OUTLINE:

Topic	Hours
Introduction:	
• Introduction to Aerospace Design and Systems Engineering	1
Factors Influencing the Design and Systems Engineering Process	
• Markets, Customers, Stakeholders, and Regulators for Aerospace Systems	1
• System Performance/Mission Requirements	1
• Safety, Human Factors, Sustainment, and Operations	1
• Aerospace Manufacturing Considerations	1
• Cost and Product Lifecycle	2
• Work Breakdown Structure and the Organization of Engineering Firms	1
• Uncertainty in Design	1
Tools to Support Decisions in the Systems Engineering Process	
• Understanding the Design Problem (Affinity Diagrams, etc.)	1
• Requirements Analysis and Quality Function Deployment	1
• Concept Generation Methods (Functional & Physical Decompositions)	1
• Decision Analysis Methods	1
• Trade-Off Analysis and Multi-Attribute Decisions	1
• Managing Project Schedule (Gantt Chart and critical paths)	1
• Integrated CAD/CAE/PLM tools	2

Optimization and Quantitative Trade Studies
- Analysis Models for Engineering Design   1
- Multidisciplinary Design Analysis and Design Structure Matrices   1
- Design Optimization (constrained line search algorithms; genetic algorithms)   5
- Trade Space Visualization and Exploration   1
- Robust Design   1

Assessments
- Midterm Exam   1
- Design Project   3

    Total   **30**