SIE 452/552: Space Systems Engineering
Final Syllabus
Fall 2011

Course Instructor

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Course Meetings and Distance Learning

Monday & Wednesday 4:30-5:45PM, room ENGR 301 (Old Engineering Building).

The lectures will be broadcasted in real-time as well as videotaped and stored at webcast.engr.arizona.edu. Students will have the ability to view the lectures on-demand from the office or from home.

Course Description and Objectives

The main objective of the course is to introduce the fundamentals of space systems engineering to senior undergraduate and graduate engineering students. Designing a system for a space mission (e.g., spacecraft or planetary lander) is a complex endeavor that requires the understanding of a variety of specialized subjects (e.g., structure and mechanisms, orbital mechanics, thermal control design, telecommunications, attitude determination and control, propulsion, and power systems design). More importantly, it requires an understanding of the fundamental system engineering process that must be implemented to assure that the mission goals and objectives are successfully accomplished. The course structure is organized to provide the students with the skills and methodologies required to complete a preliminary design of a space system at system and subsystem levels. Fundamentals of spacecraft subsystem design are introduced and embedded in a model-based system engineering process resulting in a preliminary design of a full-scale space system. At the beginning of the course, the students are presented with a specific space mission to be designed. The end goal is to provide a final report that presents the preliminary analysis and design of the space systems that satisfies the objectives of the mission. The lectures provide the technical content that governs the system and subsystem design that will be developed throughout the semester. At the end of the course the students are expected to:

1. Master the model-based, system engineering process required to design a space mission;
2. Have a solid understanding of the principles behind spacecraft subsystem design;
3. Be able to analyze each spacecraft subsystem; and
4. Be able to perform a preliminary sizing of the full space system.

Semester Assignments and Final Project

The students will be presented space mission goals and objectives, as well as with top-level requirements, and are expected to execute a full scale system and subsystem design and analysis. The students are required to prepare a design workbook that will be updated with multiple assignments over the course of the semester. The approach is to progress incrementally toward a final design through the development and application of individual system and subsystems trades and analyses. The final grade will be computed by evaluating a set of eight (8) assignments that will be submitted during the semester (5% each) along with a final report (60%). Graduate students are required to execute in-depth analysis of a specific subsystem of the proposed space mission (e.g. design of algorithms for trajectory guidance and attitude control, study of navigation algorithms, development of detailed thermal and vibration models, or design and analysis of science payloads).
NOTE: The work is done individually, except in cases where teaming activities are required.

Grades Distribution

A regular grade (A, B, C, D, F) will be assigned to both undergraduate and graduate students. The grade will be assigned according to the following grade percentage distribution:

A: 85-100%
B: 70-84 %
C: 55-69%
D: 40-54%
F: < 40%

Class Schedule

The following class schedule is tentative and assumed to be developed over a course of 14 weeks. Special topics will provide in-depth understanding of subjects that are relevant to the specific space mission analyzed during the course of the semester.

Week 1: Introduction to Space Systems;

Week 2: System Engineering Process for a Space Mission; NASA System Engineering Process

Week 3: Fundamentals of Mission Analysis and Design

Week 4: Structure and Mechanism Subsystem Design

Week 5: Propulsion Subsystem Design

Week 6: Attitude Control Subsystem Design

Week 7: Power Subsystem Design

Week 8: Thermal Control Subsystem Design

Week 9: Command and Data Handling Subsystem Design

Week 10: Communication Subsystem Design

Week 11: Design and Analysis Progress Discussion; Special Topics I

Week 12: Design and Analysis Progress Discussion; Special Topics II

Week 13: Design and Analysis Progress Discussion; Special Topics III

Week 14: Design and Analysis Progress Discussion; Special Topics IV

Textbooks

Charles D. Brown, Elements of Spacecraft Design, AIAA Educational Series, Reston, VA, American Institute of Aeronautics and Astronautics, Inc., ©2002. (Required)

Paluszek, Michael, et. al., Spacecraft Attitude and Orbit Control, 2nd edition, Princeton Satellite Systems, 2009. (Recommended)

Software
MATLAB and Spacecraft Control Toolbox (Princeton Satellite Systems Inc.)