Syllabus for ME 597 Small Spacecraft Design I (3 credit hours)

Spring 2019

Instructor: Dr. Chris Hall **Email:** Use Course Messages

Office Location: MECH 430 **Office Phone:** (505) 277-0210

Office Hours: By Appointment **Course Credits:** 3 hours

Lectures Online: http://www.learn.unm.edu

Text: *Space Mission Engineering: The New SMAD,* Edited by: Wertz, Everett, and Puschell, Microcosm Press, 2011.

Small Spacecraft Design I. This course introduces engineering students to the design of complex space systems, integrating space science and engineering material. The course covers the fundamentals of each of the subsystems in a spacecraft, from propulsion to the spacecraft structure and from attitude determination and control to thermal control of spacecraft.

Goal: The goal is to expose students to the fundamentals of each of the subsystems in a spacecraft to a depth that permits students to carry out the conceptual design of a spacecraft to meet specified mission objectives.

Objectives: Students will be able to identify spacecraft payloads and missions. Students will be able to apply spacecraft dynamics to mission analysis and design. Students will be able to design spacecraft subsystems to meet mission objectives.

Discussions: Each module includes one or more discussion topics. Participation in discussion is graded and is required.

Homework Policy: All assignments will be submitted online. Each student will have two individual presentation and writing assignments (one on an historical or current event, and one on a chosen spacecraft technology). There will be several mini-project assignments. Each student will be required to evaluate other students' work. Each student will complete one major project assignment.

Quizzes and Exams: There will be quizzes between the lectures. You will not be allowed to proceed to the next lecture until you have made at least one attempt for the preceding quiz. You are allowed two attempts, and your quiz grade for each quiz will be the average of your attempts.

Grading Policy:

Discussions	10%
Quizzes	15%
Mini-Projects	15%
Event	10%
Technology	10%
Evaluation	10%
Project Report	30%

Grading Scale: The grading scale is given below, where the numbers are the percentage of the total weighted grades as defined in the Grading Policy above.

98-100	A+
93-97.99	A
90-92.99	A-

87-89.99	B+
83-86.99	B
80-82.99	B-
77-79.99	C+
73-76.99	C
70-72.99	C-
67-69.99	D+
63-66.99	D
60-62.99	D-
Below 60	F

Attendance Policy: Regular attendance is required, which for an online course means regular participation in each week's course activities. UNM Pathfinder policies apply, which in part means instructor drops based on non-attendance are possible. This policy applies regardless of the grading option you have chosen.

Academic Integrity: The University of New Mexico believes that academic honesty is a foundation principle for personal and academic development. All University policies regarding academic honesty apply to this course. Academic dishonesty includes, but is not limited to, cheating or copying, plagiarism (claiming credit for the words or works of another from any type of source such as print, Internet or electronic database, or failing to cite the source), fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. The University's full statement on academic honesty and the consequences for failure to comply is available in the college catalog and in the *Pathfinder*.

Topics: *Learning Outcomes*

1. Space Systems Design
   Students will be able to list and describe the steps in the spacecraft design process.
2. Introduction to Astrodynamics
   Students will be able to quantify relationships between space flight dynamics and space mission requirements.
3. The Space Environment
   Students can describe the key environmental factors affecting the operation of a space system operating in Earth orbit, and can relate these factors to design requirements.
4. Spacecraft Propulsion
   Students can describe the basic types and applications of spacecraft propulsion systems, and can apply basic techniques for preliminary design and sizing of propulsion systems.
5. Launch Vehicles
   Students can relate mission requirements to launch vehicle selection.
6. Attitude Determination and Control
   Students can describe the basic types and applications of spacecraft attitude determination and control systems. Students can apply basic techniques for preliminary design and sizing of ADCS systems.
7. Structures and Mechanisms

Students can describe the typical interfaces and environmental effects that a spacecraft structural design must accommodate. Students can apply basic techniques for preliminary design and sizing of structural systems.

8. Power Systems
   Students can describe the basic types and applications of spacecraft power systems. Students can apply basic techniques for preliminary design and sizing of power systems.
9. Thermal Control
   Students can analyze the thermal environment and its effects on a spacecraft and its subsystems. Students can apply basic techniques for preliminary design and sizing of active and passive thermal control systems.
10. Communications
    Students can describe the fundamental elements of radio communications used for spacecraft. Students can organize and compute a link budget for a space application. Students can apply basic techniques for preliminary design and sizing of communication systems.
11. Small Satellite Design
    Students can integrate all course design topics into a single small spacecraft design.

Schedule of Topics:

Week One: *Introduction and Overview of Spacecraft Design; Review of Basic Orbital Dynamics and Mission Analysis*

Week Two: *Space Environment*

Week Three: *Space Propulsion; Launch Vehicles*

Week Four: *Attitude Determination and Control; Structures and Mechanisms*

Week Five: *Power Systems; Thermal Control*

Week Six: *Communications*

Week Seven: *Small Satellite Design*

Week Eight: *Small Satellite Design; Project*

Supplementary References:

- P. Fortescue and J. Stark (editors), Spacecraft Systems Engineering, 2nd edition, 1997, Wiley.
- V. L. Pisacane and R. C. Moore (editors), Fundamentals of Space Systems, 1994, Oxford University Press, 1994.

Accommodation Statement: Accessibility Services (Mesa Vista Hall 2021, 277-3506) provides academic support to students who have disabilities. If you think you need alternative accessible formats for undertaking and completing coursework, you should contact this service right away to assure your needs are met in a timely manner. If you need local assistance in contacting Accessibility Services, see the Bachelor and Graduate Programs office.

Title IX Statement: In an effort to meet obligations under Title IX, UNM faculty, Teaching Assistants, and Graduate Assistants are considered "responsible employees" by the Department of Education (see pg 15 - http://www2.ed.gov/about/offices/list/ocr/docs/qa-201404-title-ix.pdf). This

designation requires that any report of gender discrimination which includes sexual harassment, sexual misconduct and sexual violence made to a faculty member, TA, or GA must be reported to the Title IX Coordinator at the Office of Equal Opportunity (oeo.unm.edu). For more information on the campus policy regarding sexual misconduct, see: https://policy.unm.edu/university-policies/2000/2740.html