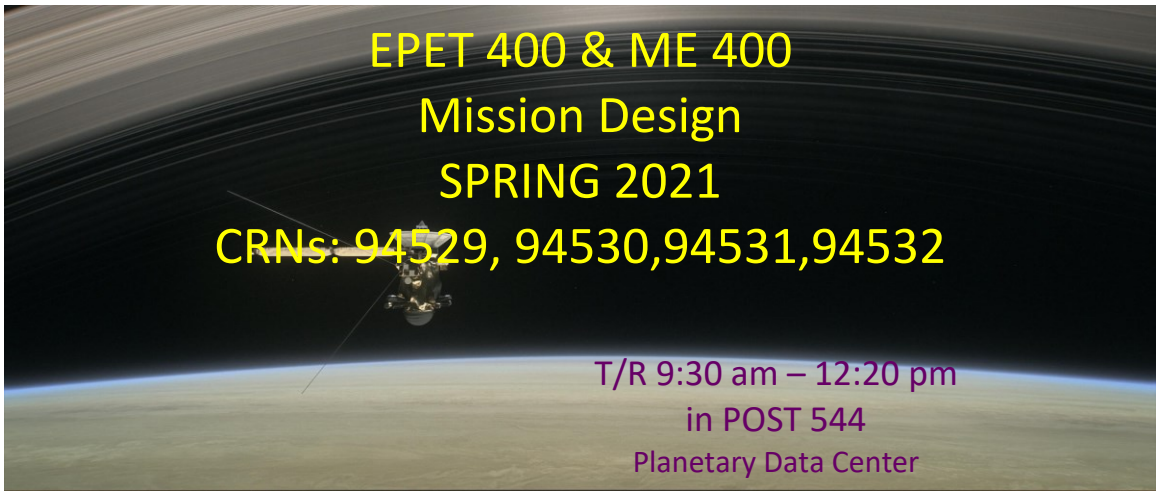

Contact information:
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Course Delivery: 2021 spring semester EPET 400/ME 400 'Spacecraft Mission Design' will be delivered as a hybrid course with much of the formal lecture instruction and homework assignments being online, the laboratory and project component being taught in person, in POST 544, to class subgroups in assigned/selected sections 1 & 2, and scheduled on T/R 9:30 am - 12:30 pm. There will be online Zoom office hours, to be typically scheduled on Wednesdays at a time convenient to all participants.

Office Hours: Zoom office hours, to be typically scheduled on Wednesdays at a time convenient to all participants or by appointment.

Course Description:
Design a spacecraft from concept to component selection with consideration for science, budget, and risk. Convey engineering design concepts and reasoning effectively to engineers outside your design team. Work in teams where each individual is simultaneously a specialist (subsystem expert) and generalist (systems engineer)

Number of Credits:
EPET 400/ME 400 is a four-credit lecture/laboratory course.
The expectation of work is that 3-6 hours are spent in the lab/classroom and 8-12 hours, averaging 16 hours of commitment total.

Relation to Curriculum
EPET 400/ME 400 is an integral part of the Earth and Planetary Exploration Technology certificate.

Prerequisites:
EPET 301/ME 301

Textbooks

Spacecraft Mission Design, F. Zhu et al., 2020

Course Materials and Laulima Website: At the beginning of the semester or a major instructional section, instructional materials will be posted on Laulima in the EPET 400/ME 400 resources folder, embedded within the open source textbook, or on Dr. Zhu's course website.

Course Structure: The course is structured into learning modules generally aligned with semester weeks. The lecture/laboratory course structure allows about 50% of instruction time for lectures and lecture activities and about 50% for laboratory activities and course project activities. EPET 400/ ME 400 project activities focus on the conceptualization and design of spacecraft, specifically cube satellites, able to complete defined space mission objectives. The EPET 400/ME 400 class project designs will be used in EPET 401 Capstone Project.

Course Delivery:
PLEASE NOTE THE FOLLOWING COURSE DELIVERY CHANGES DUE TO COVID-19 RULES AND REGULATIONS

EPET 400/ME 400 teaching delivery consist of three elements, a lecture and discussion part, a laboratory component and a project component. All of these elements will initially be taught online. Should COVID19 rules and regulations change during the course of the semester, individual instructors may offer the opportunity for small group F2F laboratory instruction, in addition to the on-line mode.

Instructors have a choice of using the regular class time for 'synchronous' ZOOM lectures and discussions or may choose to post their lectures (videos or narrated PowerPoints) on Laulima for 'asynchronous' study.

You will be informed in advance about the detailed schedule via announcements on Laulima.

[The main elements of course delivery are mini-lectures, guided group discussions, and project-based learning activities. Students are engaged in the systems engineering process to design small satellites on paper, in developing hardware and software concepts, in participating in lab modules, and in implementing design decisions into a small satellite kit.

The laboratory component of the course is characterized by the integration of theory and practice. In the initial weeks break-out group work and group discussions focus on real problems underpinning lecture topics. Each of the break-out groups reports on the result of their exercises, leading to the advancement of the session topic. Later in the semester, break-out group work will increase in time to about half of the time assigned to the lecture component on a weekly basis.

Learning objectives are integrated through and culminate in a group-based research project: the design of a spacecraft supporting a space science instrument for a planetary exploration mission. The requirement is to provide a design and proof of concept. Where possible, a functional prototype, that can be used during the EPET 401 Capstone Project, will be built.]

Class contact hours:
The class period, TR 9:30 am - 12:30 pm, will be used for ZOOM lectures, ZOOM laboratories, and ZOOM project work. You will be informed in advance about the detailed schedule via announcements on Laulima.

[The class period combines lecture and laboratory all in one. Each meeting is about 3 hours long to allow time for brief lectures, exercises, collaborating on projects, analyzing data, and testing hypotheses. We anticipate that group project work will take place during the class period, but some work on projects needs to be completed outside of class time.]

Learning Objectives/Course Objectives

University-Level Learning Objectives

The design and structure of the course delivers learning outcomes aligned with the University of Hawai‘i Institutional Learning Objectives for Undergraduate Students. The course:

- Gives in depth experience in the conduct of scientific inquiry and research
- Engages students in continuous practice with critical and creative thinking
- Is structured around procedures of the engineering process
- Engages students through intensive interaction with instructors and peers by means of classroom activities and projects
- Directly cultivates the habits of scholarly inquiry and intellectual curiosity, including inquiry across disciplines

Department-Level Learning Objectives

- Students can explain the relevance of space mission design outcomes to human needs
- Students can apply knowledge of relevant research methods, and the supporting disciplines to solve real world problems
- Students use design methods to define, critically analyze, and solve a problem in planetary exploration
- Students can report mission design knowledge in both oral presentations and written reports
- Students can evaluate, interpret, and summarize the basic principles of mission design, and its context in relationship to other core disciplines to explain complex phenomena

Course-Level Student Learning Objectives:

1. Explain how the Design Method works, apply it to evaluate good versus bad design, and to analyze and assess data and draw conclusions about the world
2. Develop a better understanding and appreciation for the world we live and our solar system.
3. Improve cooperation, communication, and teamwork skills by collaborating in writing, presenting, and displaying data to communicate your knowledge, analysis and synthesis of data and ideas, and assessment of what they mean.

Topics

Exact content and order of topics will depend on progress and student interest:

- Context for Spacecraft
    - History and Future (when?)
    - Different Players in Field (who?)
    - Applications (why?)
    - Define Spacecraft (what?)
    - General Process (how?)
- Systems Engineering
    - Program Phases
    - Requirements
    - Project Management
    - Decision Analysis
    - Managing Risks

- Spacecraft Design Drivers
    - Design Process
    - Mission Components
    - Payload
- Space Environment
- Orbital Mechanics
- Structures and Mechanisms
    - Design Properties
    - Mechanisms
    - Structural Analysis
- Power
    - Generation, Storage, and Distribution
    - Budget and Profiles
- Command and Data Handling
    - Avionics Selection
    - Simulations
    - Flight Software
- Communications
    - Technology Selection
    - Modulation Schema
    - Link Budgets
- Attitude Determination Control and Sensing
    - Dynamics
    - Sensing
    - Determination
    - Control
- Thermal Control System
    - Heat Transfer
    - Thermal Analysis
    - Thermal Control
- Propulsion
    - Survey of Technologies
    - Rocket Equation
    - Delta-V Budget
- Diversity of spacecraft
    - UAS, balloons, suborbital/sounding rockets, missiles, rovers, hoppers, landers

Grading of Homework

Homework will count 20% toward your grade. There will be about 10 homework assignments to be completed by their respective due dates.

Grading of Group Projects

Group project teams will be established through class discussion led by the instructors. Each group will work on a spacecraft project. At the start of the project, a grading rubric will clearly establish how each project will be graded. Grading will vary slightly with each project.

A group project will count 80% towards your grade. Overall project grading will be broken down into components that will add up to the final grade percentage. The components are: Project briefing reports (paper) 15%; Group project definition, preliminary design review (paper and presentation) 15%; Final design review (paper and presentation) 15%; Proof of concept (and/or prototype production) (paper and presentation) 35%.

Grading

Grading is not curved and therefore everyone can potentially get an A. Grades are greatly weighed by the group project. Grading will be based on homework and each individual's grades in the group projects.

Percentage	*Activity*
20%	Homework
80%	Individual's Grade on Group Project

Letter grade breakdown:

A- = 90 – 92%, A = 93 – 96%, A+ = 97 – 100%
B- = 80 – 82%, B = 83 – 86%, B+ = 87 – 89%
C- = 70 – 72%, C = 73 – 76%, C+ = 77 – 79%
D- = 60 – 62%, D = 63 – 66%, D+ = 67 – 69%
F = < 60%

In-Group Participation

Your group's assessment of your participation in and contribution to each project will impact your individual project grade.

Other Group Assessments

Each group will also be provided an opportunity to give formative and summative assessment of the other group's projects. These assessments will NOT formally count toward your grade.

Extra Credit

Opportunities for extra credit will be announced during the semester.

Plagiarism

You will be preparing short written reports and short oral presentations for each project. DO NOT JUST COPY text from the Internet or from a book without a citation. Put your findings in your own words. Plagiarized text in a group report will result in a grade reduction by 2 levels (e.g., grade drop from an A to a C) for the first occurrence. A second occurrence will result in a zero for that project.

Other Resources

Disability Access:

The Earth Science Department will make every effort to assist those with disability and related access needs. For confidential services, please contact the Office for Students with Disabilities (known as "KOKUA") located in the Queen Lili'uokalani Center for Student Services (Room 013): 956-7511, kokua@hawaii.edu, www.hawaii.edu/kokua

Learning Assistance Center (LAC) is here to help students:

- Use appropriate study skills to achieve academic goals.
- Learn how to adjust learning approaches to fit their individual learning needs.

- Learn how to study effectively with others.
- Use effective learning practices.
- Use self-reliant learning behaviors.
- Have a functional understanding of course content.www.manoa.hawaii.edu/learning

Gender-Based Discrimination or Violence

University of Hawai‘i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources to support and assist you. Staff can also direct you to community resources. Here are some options:

- If you wish to speak with someone **CONFIDENTIALLY**, contact the confidential resources available here: http://www.manoa.hawaii.edu/titleix/resources.html#confidential
- If you wish to **REPORT** an incident of sex discrimination or gender-based violence, contact: **Dee Uwono**, Title IX Coordinator, Hawai‘i Hall 124, t9uhm@hawaii.edu, (808) 956-2299
- **As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator.** Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.