EPET 400 ME 400: Space Mission Design

Course Description
Space Mission Design will cover all aspects of spacecraft design, subsystems, science payload, systems engineering, project management, and budgets that are important to producing a fully successful mission. The course is offered in Spring only.

Number of Credits
EPET 400 is a four-credit lecture/laboratory course. It is cross-listed as ME 400.

Relation to Curriculum
EPET 400/ME 400 is an integral part of the EPET certificate program.

Prerequisites:
EPET/ME 301 or ERTH 404

Class contact hours
Under COVID provisions the course is delivered as asynchronous hybrid. General class meetings are synchronous online with two TR 3-hour meetings per semester week. For laboratory and practice class will be split. Small class sections will meet F2F during the first weekly instruction day, while non-lab sections will meet online; to be reversed on the second weekly instruction day. Upon return to regular F2F instruction there will be two TR 3-hour meetings per semester week.

Course Details
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. The Model Content and Topics section provides an abbreviated list/description of course modules and course module activities. Lecture and laboratory activities support the learning objectives outlined in lecture topics. EPET 400/ME 400 project activities focus on the conceptualization and design of spacecraft able to complete defined space mission objectives. This EPET 400/ME 400 class project design will be used in the EPET 401/ME 401 Capstone Project - Producing a science satellite.

Course delivery
The main elements of course delivery are mini-lectures, guided Concurrent Design Sessions, and project-based learning activities. Students are engaged in designing a space mission with scientific value and produce a quality final report that can be used as baseline proposal.

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 practice and real problems underpinning lecture topics. Each of the break-out groups reports on the result of the exercise, 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). The difficulty of problems will increase.

Learning objectives are integrated through and culminate in a group-based research project: the design of spacecraft with a scientific instrument for a planetary exploration mission.
The requirement is to deliver a realistic design a mission concept that can be built during the EPET 401/ME 401 Capstone Project: Producing a science satellite.

Textbook

*Elements of Spacecraft Design*, C. Brown 2002 AIAA Education Series

**Model Content and topics**

**Module 1**
**Lecture, Lecture activities:** Setting the stage; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Setting the Stage.

**Module 2**
**Lecture, Lecture activities:** Space Environment; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** CAD and STK workshop (Computer Aided Design, Software Toolkit AGI).

**Module 3**
**Lecture, Lecture activities:** Orbital Mechanics; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** COSMOS workshop (Spaceflight management software)

**Module 4**
**Lecture, Lecture activities:** Spacecraft Systems Architecture; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Orbital dynamics workshop.

**Module 5**
**Lecture, Lecture activities:** Systems Engineering; Lecture demonstrations, tutorials, problem solving.
**Project activities:** Introduction of class research project: preliminary definition.

**Module 6**
**Lecture, Lecture activities:** Spacecraft Structures; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Model Based Systems Engineering workshop.
**Project activities:** Preliminary project definition.

**Module 7**
**Lecture, Lecture activities:** Spacecraft Guidance, Navigation and Control; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** GNC workshop (Guidance, Navigation, and Control).
**Project activities:** Preliminary project definition.

**Module 8**
**Lecture, Lecture activities:** Spacecraft Propulsion; Lecture demonstrations, tutorials, problem solving.
**Project activities:** First review of class research project: advanced definition.
Module 9
**Lecture, Lecture activities:** Spacecraft Sensors and Actuators; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Payload workshop.
**Project activities:** Advanced project definition.

Module 10
**Lecture, Lecture activities:** Electrical Power Systems; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** EPS workshop (Electrical Power Systems).
**Project activities:** Advanced project definition.

Module 11
**Lecture, Lecture activities:** Thermal Control; Lecture demonstrations, tutorials, problem solving.
**Project activities:** Final design review and implementation of class research project.

Module 12
**Lecture, Lecture activities:** Telecommunications; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** COMM workshop (Communication Systems).
**Project activities:** Project final design.

Module 13
**Lecture, Lecture activities:** On Board Computing/ Telemetry, Command Data Handling and Processing; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** OBCS workshop (On Board Computer System).
**Project activities:** Project final design.

Module 14
**Lecture, Lecture activities:** Ground Segment; Lecture demonstrations, tutorials, problem solving.
**Project activities:** Research project work.

Module 15
**Lecture, Lecture activities:** Spacecraft Mechanisms; Lecture demonstrations, tutorials, problem solving.
**Project activities:** Research project work

Module 16
**Lecture, Lecture activities:** Electromagnetic Compatibility; Lecture demonstrations, tutorials, problem solving.
**Project activities:** Research project work.

Module 17
**Lecture, Lecture activities:** Spacecraft Delivery and Launch, Product Assurance; Lecture demonstrations, tutorials, problem solving.
**Project activities:** Course summary; completion of research project.

Module 18
**Project activities:** Completion of research project.