EPET 302: 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.

Number of Credits
EPET 302 is a four-credit lecture/laboratory course.

Relation to Curriculum
EPET 302 is an integral part of the EPET certificate program.

Prerequisites:
EPET 301

Class contact hours
Two 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 301 project activities focus on the conceptualization and design of spacecraft able to complete defined space mission objectives. This EPET 301 class project design will be used in EPET 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 Capstone Project.

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.