EPET 301: Space Science & Instrumentation

Course Description

*Essential techniques for remote compositional analysis of planets; understanding spectroscopy, mineralogy, and geochemistry of planetary surfaces and their measurement. Design of space flight instrumentation.*

Number of Credits

EPET 301 is a four-credit lecture/laboratory course.

Relation to Curriculum

EPET 301 is an integral part of the proposed EPET certificate program.

Prerequisites:

EPET 201, or ERTH 101 and ERTH 101L and ERTH 105, or ERTH 101 and ERTH 107, and CHEM 161 and PHYS 272.

Class contact hours

Two 3-hour hours 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 space instruments 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 group discussions, and project-based learning activities. Students are engaged in studying foundational publications in the field of planetary science and are asked to critically evaluate research design, data acquisition, and data analysis and research outcomes.

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.

Learning objectives are integrated through and culminate in a group-based research project: the design of an instrument for a planetary exploration mission. The requirement is to deliver a design that can be built/implemented during the EPET 401 Capstone Project: Producing a science satellite.
Textbook
*Remote Compositional Analysis: Techniques for Understanding Spectroscopy, Mineralogy, and Geochemistry of Planetary Surfaces*, Editors: Janice L. Bishop, Jeffrey E. Moersh, and James F. Bell, III. Publisher: Cambridge University Press 2019


**Model Content and topics**

**Module 1**
**Lecture, Lecture activities:** Setting the stage; Overview over remote sensing; Principles of planetary surface components; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Intro labs on mineralogy and remote sensing.

**Module 2**
**Lecture, Lecture activities:** Optical camera modalities; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Advanced view of the electromagnetic spectrum with exercises.
**Project activities:** External Project Brief (1).

**Module 3**
**Lecture, Lecture activities:** Visible and circum-visible remote sensing (VNIR); Lecture demonstrations, tutorials, problem solving.
**Lab activities:** VNIR introductory experiments
**Project activities:** External project brief (2)

**Module 4**
**Lecture, Lecture activities:** Visible and circum-visible remote sensing (VNIR); Lecture demonstrations, tutorials, problem solving.
**Lab activities:** VNIR radiation detectors & measurement experiments.
**Project activities:** External project brief (3).

**Module 5**
**Lecture, Lecture activities:** Visible and circum-visible remote sensing (VNIR); Lecture demonstrations, tutorials, problem solving.
**Lab activities:** VNIR radiation detectors & measurement experiments.
**Project activities:** Introduction & selection of class research projects.

**Module 6**
**Lecture, Lecture activities:** Raman spectroscopy of planetary surfaces; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Raman light sources, radiation detectors and measurements.
**Project activities:** Research project work: definition.

**Module 7**
**Lecture, Lecture activities:** Raman spectroscopy of planetary surfaces; Lecture demonstrations, tutorials, problem solving.
**Lab activities:** Raman light sources, radiation detectors and measurements.
**Project activities:** Research project work: definition.
Module 8
Lecture, Lecture activities: High energy spectroscopy and remote sensing (UV to gamma rays, alphas, neutrons); Lecture demonstrations, tutorials, problem solving.
Lab activities: High energy radiation detection and measurement.
Project activities: First review of class research project: advanced definition.

Module 9
Lecture, Lecture activities: High energy spectroscopy and remote sensing (UV to gamma rays, alphas, neutrons); Lecture demonstrations, tutorials, problem solving.
Lab activities: High energy radiation detectors and measurements.
Project activities: Research project work.

Module 10
Lecture, Lecture activities: High energy spectroscopy and remote sensing (UV to gamma rays, alphas, neutrons); Lecture demonstrations, tutorials, problem solving.
Lab activities: High energy radiation detectors and measurements.
Project activities: Research project work.

Module 11
Lecture, Lecture activities: Long wavelength remote sensing (mid to thermal infrared, radar); Lecture demonstrations, tutorials, problem solving.
Lab activities: Long wavelength radiation detectors and measurements.
Project activities: Final design review and implementation of class research project.

Module 12
Lecture, Lecture activities: Long wavelength remote sensing (mid to thermal infrared, radar); Lecture demonstrations, tutorials, problem solving.
Lab activities: Long wavelength radiation detectors and measurements.
Project activities: Research project work.

Module 13
Lecture, Lecture activities: Extraterrestrial materials laboratory analysis; Lecture demonstrations, tutorials, problem solving.
Lab activities: Analysis of extraterrestrial materials laboratory.
Project activities: Research project work.

Module 14
Lecture, Lecture activities: Extraterrestrial materials laboratory analysis; Lecture demonstrations, tutorials, problem solving.
Lab activities: Analysis of extraterrestrial materials laboratory.
Project activities: Research project work.

Module 15
Lecture, Lecture activities: Data and information processing; Lecture demonstrations, tutorials, problem solving.
Project activities: Research project work.

Module 16
Lecture, Lecture activities: Data and information processing; Lecture demonstrations, tutorials, problem solving.
Project activities: Research project work.