EPET 301: Space Science & Instrumentation  [model syllabus]

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 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 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 Mineralogy; Lecture demonstrations, tutorials, problem solving.
Lab activities: Intro labs on mineralogy and remote sensing.

Module 2
Lecture, Lecture activities: Principles of in-situ and orbital remote sensing; 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: The Lunar surface; Lecture demonstrations, tutorials, problem solving.
Lab activities: VINR introductory experiments
Project activities: External project brief (2)

Module 4
Lecture, Lecture activities: The Lunar surface; Lecture demonstrations, tutorials, problem solving.
Lab activities: High energy radiation introductory 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: High energy radiation introductory experiments.
Project activities: Introduction & selection of class research projects.

Module 6
Lecture, Lecture activities: The Martian surface; Lecture demonstrations, tutorials, problem solving.
Lab activities: VINR radiation detectors and measurements.
Project activities: Research project work: definition.

Module 7
Lecture, Lecture activities: The Martian surface; Lecture demonstrations, tutorials, problem solving.
Lab activities: VINR 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:** VINR radiation detectors and measurements.

**Project activities:** First review of class research project: advanced definition.

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**Module 9**

**Lecture, Lecture activities:** Differentiated meteorites and asteroids; Lecture demonstrations, tutorials, problem solving.

**Lab activities:** High energy radiation detectors and measurements.

**Project activities:** Research project work.

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**Module 10**

**Lecture, Lecture activities:** Differentiated meteorites and asteroids; Lecture demonstrations, tutorials, problem solving.

**Lab activities:** High energy radiation detectors and measurements.

**Project activities:** Research project work.

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**Module 11**

**Lecture, Lecture activities:** Long wavelength remote sensing (mid to thermal infrared, radar); Lecture demonstrations, tutorials, problem solving.

**Lab activities:** High energy radiation detectors and measurements.

**Project activities:** Final design review and implementation of class research project.

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**Module 12**

**Lecture, Lecture activities:** Primitive materials; Lecture demonstrations, tutorials, problem solving.

**Lab activities:** Long wavelength radiation detectors and measurements.

**Project activities:** Research project work

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**Module 13**

**Lecture, Lecture activities:** Primitive materials; Lecture demonstrations, tutorials, problem solving.

**Lab activities:** Long wavelength radiation detectors and measurements.

**Project activities:** Research project work.

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**Module 14**

**Lecture, Lecture activities:** Data and information processing; Lecture demonstrations, tutorials, problem solving.

**Project activities:** Research project work.

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**Module 15**

**Lecture, Lecture activities:** Extraterrestrial materials analysis; Lecture demonstrations, tutorials, problem solving.

**Project activities:** Research project work.

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**Module 16**

**Lecture, Lecture activities:** Extraterrestrial materials analysis; Lecture demonstrations, tutorials, problem solving.

**Project activities:** Research project work.

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**Module 17**
Lecture: Course summary; Completion of group research project
Project activities: Research project work

Module 18
Project activities: Completion of group research project