AE 8803 Special Topics - Syllabus

Hamiltonian Mechanics in Space Dynamics. 3 Credit Hours.

General Information

Description

Space dynamics of artificial and natural objects are complex, given many forces and torques. Building quantitative approaches has been developed for centuries since Newton found his groundbreaking laws of gravity. Among them is Hamilton Mechanics, which appears in many space applications nowadays. This course will offer the concepts and applications of Hamiltonian Mechanics in Celestial Mechanics. The course will start by briefly reviewing Lagrangian Mechanics to dive into Hamiltonian Mechanics. The course will then discuss the concept of Hamiltonian, canonical equations, and canonical transformation. We will apply the fundamental concepts of Hamiltonian Mechanics to build the concepts of symplectic integrators. The final part of this course will discuss space applications of the given topics.

Pre- &/or Co-Requisites

- AE2220 Dynamics or equivalent, or equivalent
- AE3330 Vehicle Performance, or equivalent
- AE4531 Advanced Flight Dynamics, or equivalent
- AE6353 Orbital Mechanics, or equivalent

Course Goals and Learning Outcomes

- Better understanding of mathematical formulations of Hamiltonian Mechanics.
- Learning symplectic structures and numerical algorithms to solve Hamiltonian systems.
- Getting better application skills in formulating and characterizing complex space dynamics.

Course Requirements & Grading

Note: Graded components of a course may vary with each offering. The example below is typical but subject to change.

Description of Graded Components

- Homework assignments (every other week in general)
- One mid-term exam
- Final exam
- Term-project

Grading Scale

The final grade will be assigned as a letter grade according to the following scale:

A	90-100%
B	80-89%
C	70-79%
D	60-69%
F	0-59%

Topics Covered

Note: The exact topics covered in a course may vary with each offering. The example below is typical but subject to change.

- Lagrangian Dynamics
- Hamiltonian Dynamics
- Symplectic Integrators
- Applications to space dynamics

Course Materials

Note: Course materials may vary with each offering. The example below is typical but subject to change.

Textbook

- Not assigned.
- Online references are available at: https://phys.libretexts.org/Bookshelves/Classical_Mechanics/Variational_Principles_in_Classical_Mechanics_(Cline)

Course notes

- Summary notes will be available prior to each lecture.