

PHY-466 Space Mission Management

Credit Hours: 3 (3-0)

Prerequisite: None

Course Objective:

This is an undergraduate course that will create an understanding for the students related to the elements of spacecraft design in the light of the mission requirements, managing space missions with the case study of various Apollo missions, and also space laws and policies that should be taken into account while constructing, launching, and gathering data after launch of the space mission.

Course Contents:

Introduction to Space Missions, Fundamentals of Space Mission Design, Spacecraft Design and Subsystems, Payload design and Integration, Launch system and Mission Planning, Ground segment operations, Space Mission Management, Introduction to Space Law, National Space Laws and Policies, Intellectual Property and Space Activities, Space Debris and Environmental Considerations, Commercial Space and Emerging Trends, International Collaborations and Competitions, Case Studies of Major Space Missions, Future Trends and Challenges in Space Missions.

Detailed Course Contents:

Introduction and overview of the course, The Space Mission Life Cycle, Definition of Mission Objectives

Preliminary Estimate of Mission Needs, Requirements, and Constraints, Identifying Alternative Mission Concepts, mission architecture needs, Computational Requirements Analysis and Performance Budgeting, Requirements Documentation and Specifications, A short overview of the orbital geometry, Orbit Perturbations, Orbit Maneuvering, Launch Windows, Orbit Maintenance, The Orbit Design Process through computation and theory, The Earth Coverage, The ΔV Budget, Selecting Orbits for Earth-Referenced Spacecraft, Selecting Transfer, Parking, and Space-Referenced Orbits, The requirements for mission, Requirements, Constraints, and the Design Process, Spacecraft Configuration, Design Budgets

Designing the Spacecraft Bus, Integrating the Spacecraft Design, Some Examples, Mission Operations Developments and Implementations, Ground System Design

and Sizing, Spacecraft computer and Launch systems, Space mission Laws and Policy Considerations, Orbital Debris—A Space Hazard

Computational tools to analyze the space mission designs, algorithms to design and test the space missions, Case study of APPOLLO I and II missions, Case study of Artemis I and II, Designing and analyzing your own space mission as an exercise.

Learning Outcomes:

- Designing a space mission and understanding the management requirements to design that mission.
- Learning how to design a cost effective space mission.
- Learning space laws and policies.
- Applying the theory by case studying the very old and newly launched space missions.

Text Books:

“Space Mission Analysis and Design” by James R. Wertz and Wiley J. Larson 3rd Edition (1999). (JW)

Weekly Breakdown		
Week	Section	Topics
1	JW 1.1 – 1.3	Introduction and overview of the course, The Space Mission Life Cycle, Definition of Mission Objectives
2	JW 1.4 – 1.7	Preliminary Estimate of Mission Needs, Requirements, and Constraints, Identifying Alternative Mission Concepts, mission architecture needs
3	JW 4.1 – 4.3	Computational Requirements Analysis and Performance Budgeting, Requirements Documentation and Specifications
4	JW 4.4 – 4.6	A short overview of the orbital geometry, Orbit Perturbations, Orbit Maneuvering, Launch Windows, Orbit Maintenance
5	JW 5.1 – 5.3	The Orbit Design Process through computation and theory, The Earth Coverage, The ΔV Budget

6	JW 5.4 – 5.6	Selecting Orbits for Earth-Referenced Spacecraft, Selecting Transfer, Parking, and Space-Referenced Orbits, The requirements for mission
7	JW 10.1 – 10.3	Requirements, Constraints, and the Design Process, Spacecraft Configuration, Design Budgets
8	JW 10.4 – 10.6	Designing the Spacecraft Bus, Integrating the Spacecraft Design, Some Examples
Mid Term Exams		
9	JW 11.1 – 11.3	Mission Operations Developments and Implementations, Ground System Design and Sizing, Spacecraft computer and Launch systems
10	JW 11.4 – 11.6	Space mission Laws and Policy Considerations, Orbital Debris—A Space Hazard
11	JW 12.1 – 12.4	Computational tools to analyze the space mission designs, algorithms to design and test the space missions
12	By tutor	Case study of APPOLLO I and II missions
13	Will be assigned by tutor	Case study of Artemis I and II
14	Will be assigned by tutor	Designing and analyzing your own space mission as an exercise
15		Revisions
16	Final Exams	