

TABLE OF CONTENTS

Title Page
Copyright
Dedication
About the Author
Acknowledgments
Preface

Chapter 1: Space in Our Lives

1.1 Why Space?
1.2 Elements of a Space Mission
Mission Profile: Voyager

Chapter 2: Exploring Space

2.1 Early Space Explorers
2.2 Entering Space
2.3 Space Comes of Age
Mission Profile: Corona

Chapter 3: The Space Environment

3.1 Cosmic Perspective
3.2 The Space Environment and Spacecraft
3.3 Living and Working in Space
Mission Profile: ISS

Chapter 4: Understanding Orbits

4.1 Orbital Motion
4.2 Newton's Laws
4.3 Laws of Conservation
4.4 The Restricted Two-body Problem
4.5 Constants of Orbital Motion
Mission Profile: Apollo

Chapter 5: Describing Orbits

5.1 Orbital Elements
5.2 Computing Orbital Elements
5.3 Spacecraft Ground Tracks
Mission Profile: Disaster Monitoring Constellation (DMC)

Chapter 6: Maneuvering In Space

6.1 Hohmann Transfers
6.2 Plane Changes
6.3 Rendezvous
6.4 Relative Motion
Mission Profile: Gemini



TABLE OF CONTENTS

Chapter 7: Interplanetary Travel

- 7.1 Planning for Interplanetary Travel
- 7.2 The Patched-conic Approximation
- 7.3 Special Trajectories
- Mission Profile: Juno

Chapter 8: Predicting Orbits

- 8.1 Predicting an Orbit (Kepler's Problem)
- 8.2 Orbital Perturbations
- 8.3 Predicting Orbits in the Real World
- Mission Profile: Skylab

Chapter 9: Getting To Orbit

- 9.1 Launch Windows and Times
- 9.2 When and Where to Launch
- 9.3 Launch Velocity
- Mission Profile: Kourou

Chapter 10: Returning from Space: Re-entry

- 10.1 Analyzing Re-entry Motion
- 10.2 Options for Trajectory Design
- 10.3 Options for Vehicle Design
- 10.4 Lifting Re-entry
- Mission Profile: Space Shuttle

Chapter 11: Systems Engineering & Project Management

- 11.1 Systems Engineering
- 11.2 Project Management
- Mission Profile—Mars Science Laboratory

Chapter 12: Space Payloads and Control Systems

- 12.1 Remote-sensing Payloads
- 12.2 Control Systems
- 12.3 Attitude Control
- 12.4 Orbit Control
- Mission Profile—GPS

Chapter 13: Spacecraft Systems

- 13.1 Communication and Data-handling Subsystem (CDHS)
- 13.2 Electrical Power Subsystem (EPS)
- 13.3 Thermal Control Subsystem
- 13.4 Environmental Control and Life Support Subsystem (ECLSS)
- 13.5 Structures and Mechanisms
- Mission Profile: HST



TABLE OF CONTENTS

Chapter 14: Rockets and Launch Vehicles

- 14.1 Rocket Science
- 14.2 Propulsion Systems
- 14.3 Launch Vehicles
- Mission Profile—SpaceX Falcon 9

Chapter 15: Space Operations

- 15.1 Mission Operations Systems
- 15.2 Operating Space Missions
- Mission Profile—Apollo 13

Chapter 16: Using Space

- 16.1 The Space Enterprise
- 16.2 Space Politics
- 16.3 Space Economics
- Mission Profile—Iridium

Appendix A: Math Review

Appendix B: Units and Constants

Appendix C: Derivations

Appendix D: Solar and Planetary Data

Appendix E: Motion of Ballistic Vehicles

Appendix F: Answers to Numerical Mission Problems

