SPST502

Course Summary

Description

Course Description: CORE COURSE: What is an orbit? How does a spacecraft fly to the Moon or Mars? What does NORAD use to track all of the satellites currently in orbit around Earth? How does a spacecraft move from one orbit to another? These questions and more are answered in this course. From Kepler and Newton to the modern telecommunications, navigation, and remote sensing spacecraft, knowledge of orbital mechanics is essential for the modern Space Manager to be able to plan future space missions and to converse with orbital analysts that perform the day-to-day calculations determining IT IS HIGHLY RECOMMENDED THAT YOU HAVE PREVIOUSLY COMPLETED COLLEGE ALGEBRA BEFORE TAKING THIS COURSE. Prereq: SPST500 and SPST501

Course Scope:

Upon completion of this course you will have a basic understanding of orbital mechanics and be able to discuss simple principles with engineers and scientists involved in the more complex details of launching, tracking, maneuvering, and maintaining spacecraft orbits in daily operations.

Objectives

After successfully completing this course, you will be able to:

- **CO-1** Describe the laws of planetary motion and gravitation that illustrate the effects that gravity has on two-body mechanics.
- **CO-2** Identify the four different types of orbits and their special characteristics.
- **CO-3** Calculate the orbital components and perturbations for elliptical and circular orbits.
- **CO-4** Determine orbital elements and organize them into two-line element sets given an orbit's radius and velocity vectors.
- **CO-5** Analyze spacecraft maneuvers including transfer orbits and rendezvous.
- **CO-6** Compute the ΔV, escape trajectories, impact requirements, and time-of-flight required for a patched-conic section transfer orbit from Earth to another planet.

Outline

Week 1:

Learning Objective(s)

LO-1: List and describe the unique advantages of space and some of the missions that capitalize on them.

LO-2: Identify the elements that make up a space environment.

LO-3: Explain where space begins.

LO-4: List and describe the major hazards of the space environment and their effects on spacecraft and the problems they pose for humans living and working in space.

Reading(s)

Sellers:

Chapters 1-3

Week 1 Lesson Module

Assignment(s)

Introduction Forum

Week 1 Forum

Week 2:

Learning Objective(s)

LO-5: Explain the basic concepts of orbital motion and describe how to analyze them.

LO-6: Define a coordinate system and use the Motion Analysis Process to describe two-body orbital motion.

LO-7: Use two constants of orbital motion (specific mechanical energy and specific angular momentum) to determine important orbital variables.

Reading(s)

Sellers: Chapter 4

Week 2 Lesson Module

Assignment(s)

Homework #1

Week 2 Forum

Week 3:

Learning Objective(s)

LO-8: Define the classic orbital elements (COEs) used to describe the size, shape, and orientation of an orbit and the location of a spacecraft in that orbit.

LO-9: Determine the COEs given the position, **R**, and velocity, **V**, of a spacecraft at one point in its orbit.

Reading(s)

Sellers: Chapter 5

Week 3 Lesson Module

Assignment(s)

Week 3 Forum

Week 4:

Learning Objective(s)

LO-10: Determine the velocity change (ΔV) needed to perform a Hohmann Transfer between two orbits.

LO-11: Explain plane changes and how to determine the required ΔV to accomplish them.

LO-12: Explain orbital rendezvous and how to determine the required ΔV and wait time needed to start one.

Reading(s)

Sellers: Chapter 6

Week 4 Lesson Module

Assignment(s)

Homework #2

Week 4 Forum

Week 5:

Learning Objective(s)

LO-13: Describe the basic steps involved in getting from one planet in the solar system to another.

LO-14: Determine the required ΔV needed for interplanetary transfer.

Reading(s)

Sellers: Chapter 7

Week 5 Lesson Module

Assignment(s)

Midterm Exam

Week 5 Forum

Week 6:

Learning Objective(s)

LO-15: Determine the time of flight between two spacecraft positions within a given orbit.

LO-16: Determine a spacecraft's future position using Kepler's Equation.

LO-17: Describe the effects of perturbations on orbits and explain their practical applications.

Reading(s)

Sellers: Chapter 8

Week 6 Lesson Module

Assignment(s)

Homework #3

Week 6 Forum

Week 7:

Learning Objective(s)

LO-18: Describe launch windows and how they constrain when we can launch into a particular orbit.

LO-19: Determine when and where to launch, as well as the required velocity and direction, to reach a specific orbit.

LO-20: Describe the competing design requirements for re-entry vehicles.

LO-21: Describe the basic trajectory and vehicle options/tradeoffs in re-entry design.

Reading(s)

Sellers: Chapters 9-10

Week 7 Lesson Module

Assignment(s)

Homework #4

Week 7 Forum

Week 8:

Learning Objective(s)

None

Reading(s)

Week 8 Lesson Module

Assignment(s)

Final Exam

Evaluation

Midterm/Final Exams

The Midterm and Final Exams are both open book/open note exams. You will have 24 hours to upload your responses from the time you access the exams. You can access the exams multiple times but will only be allowed to submit your answers once, so make sure you are complete with your exam before submitting it.

The Rich Text Editor in Sakai can be challenging to use at times, especially for equations. In addition to your answers in the exams, try to show as much of your work as possible. To ensure that you get at least partial credit for your answers, **I strongly recommend** that you send me your work via a message in the classroom. **To get full credit for your answers, you MUST show me your work either in the exams themselves or in the worksheets that you send me via a message.**

Your exam answers must be submitted by Sunday (11:55 pm, Eastern time zone) of the week in which the exam is due.

Homework Assignments

Homework assignments make up 48 percent of your overall course grade. Questions will require you to have previously read the chapter(s) assigned in order to comprehend and correctly respond. Each homework assignment will be posted in the Assignments area of the classroom at the beginning of the week listed in the Course Outline (below). ***Be sure to work through the practice problems provided in the book before working on your homework problems!!!***

Your homework assignments must be submitted by Sunday (11:55 pm, Eastern time zone) of the week in which the assignment is due.

Forums

12 percent of your course grade is earned through participation with other students in the Forum area of the classroom. Your knowledge of assigned readings will be reflected in your ability to actively participate and discuss key course concepts. Postings will occur every week throughout the course. You must make your posts in each forum during the week in which it is due in order to receive full credit for this assignment.

Your initial posts must be 200-400 words in length. Additionally, I expect these posts to be well written and grammatically correct. And, if applicable, I expect you to cite your sources using the Turabian citation style. ***With the exception of the Week 8 forum, you must also comment on one other student's posting***. As a guideline, your response should be at least 50 words and needs to have substance; simply saying "good point" and/or "I agree" isn't adequate.

Your forum postings are due by Sunday (11:55 pm, Eastern time zone) of the week in which the forum is due.

The purpose of the forums is for you to engage your fellow students and learn from them. For this to occur, *your interactions in the forums need to be timely. Therefore, I will deduct a maximum of 10 points for late posts from your overall score for a forum*. **Additionally, postings more than one week after the due date for a forum will NOT be accepted (with the exception of approved course extensions).**

Re-accomplishment of Work

If you do very poorly on any assignment and want to re-accomplish the work, I will let you do that with the following stipulation: the highest grade you can obtain is 85% for the first resubmission; 80% for the second resubmission; and 75% for the third resubmission.

Due Dates

All assignments in this course are given to you prior to the due date. The “due date” for all assignments is the week in which the assignment is due. For the purposes of this course, a “**week**” is defined as the time period between Monday – Sunday. The **first week** begins on the first day of the session and ends on 11:55 pm (Eastern time zone) the following **Sunday**. As a general rule, I will grade an assignment once everyone has submitted it. *If you need additional time to complete an assignment, please contact me before the due date so we can discuss your situation and determine an acceptable resolution.* **If you submit an assignment after the due date without making prior arrangements with me, you will lose points from your final grade for the assignment.**

Grading:

Name	Grade %
Forums	12.00 %
Introduction Forum	1.33 %
Week 1	1.33 %
Week 2	1.33 %
Week 3	1.33 %
Week 4	1.33 %
Week 5	1.33 %
Week 6	1.33 %
Week 7	1.33 %
Week 8	1.33 %
Homework Assignments	48.00 %
Homework #1	12.00 %
Homework #2	12.00 %
Homework #3	12.00 %
Homework #4	12.00 %
Midterm Exam	20.00 %
Midterm	20.00 %
Final Exam	20.00 %
Final	20.00 %

Materials

Book Title: Understanding Space (custom)- (The custom ISBN may have more competitive pricing in hard copy or electronic format. The non-custom ISBN is: 9780077230302, please use this one to search for the book from other booksellers.)

Author: Sellers

Publication Info: McGraw-Hill

ISBN: 9780073407753

Web Sites

There are numerous online sources to help you better understand the objectives outlined in this course. Websites that may be of help are listed below:

Site Name	Web Site URL/Address
	http://www.braeunig.us/space/orbmech.htm
	http://www2.jpl.nasa.gov/basics/bsf4-1.php
	http://www.celestrak.com/

Course Guidelines

Citation and Reference Style

- Attention Please: Students will follow the APA Format as the sole citation and reference style used in written work submitted as part of coursework to the University. Assignments completed in a narrative essay or composition format must follow the citation style cited in the APA Format.

Tutoring

- Tutor.com offers online homework help and learning resources by connecting students to certified tutors for one-on-one help. AMU and APU students are eligible for 10 free hours* of tutoring provided by APUS. Tutors are available 24/7 unless otherwise noted. Tutor.com also has a SkillCenter Resource Library offering educational resources, worksheets, videos, websites and career help. Accessing these resources does not count against tutoring hours and is also available 24/7. Please visit the APUS Library and search for 'Tutor' to create an account.

Late Assignments

- Students are expected to submit classroom assignments by the posted due date and to complete the course according to the published class schedule. The due date for each assignment is listed under each Assignment.
- Generally speaking, late work may result in a deduction up to 20% of the grade for each day late, not to exceed 5 days.
- As a working adult I know your time is limited and often out of your control. Faculty may be more flexible if they know ahead of time of any potential late assignments.

Turn It In

- Faculty may require assignments be submitted to Turnitin.com. Turnitin.com will analyze a paper and report instances of potential plagiarism for the student to edit before submitting it for a grade. In some cases professors may require students to use Turnitin.com. This is automatically processed through the Assignments area of the course.

Academic Dishonesty

- Academic Dishonesty incorporates more than plagiarism, which is using the work of others without citation. Academic dishonesty includes any use of content purchased or retrieved from web services such as CourseHero.com. Additionally, allowing your work to be placed on such web services is academic dishonesty, as it is enabling the dishonesty of others. The copy and pasting of content from any web page, without citation as a direct quote, is academic dishonesty. When in doubt, do not copy/paste, and always cite.

Submission Guidelines

- Some assignments may have very specific requirements for formatting (such as font, margins, etc) and

submission file type (such as .docx, .pdf, etc) See the assignment instructions for details. In general, standard file types such as those associated with Microsoft Office are preferred, unless otherwise specified.

Disclaimer Statement

- Course content may vary from the outline to meet the needs of this particular group.

Communicating on the Forum

- Forums are the heart of the interaction in this course. The more engaged and lively the exchanges, the more interesting and fun the course will be. Only substantive comments will receive credit. Although there is a final posting time after which the instructor will grade comments, it is not sufficient to wait until the last day to contribute your comments/questions on the forum. The purpose of the forums is to actively participate in an on-going discussion about the assigned content.
- "Substantive" means comments that contribute something new and hopefully important to the discussion. Thus a message that simply says "I agree" is not substantive. A substantive comment contributes a new idea or perspective, a good follow-up question to a point made, offers a response to a question, provides an example or illustration of a key point, points out an inconsistency in an argument, etc.
- As a class, if we run into conflicting view points, we must respect each individual's own opinion. Hateful and hurtful comments towards other individuals, students, groups, peoples, and/or societies will not be tolerated.

University Policies

Student Handbook

- Drop/Withdrawal policy
- Extension Requests
- Academic Probation
- Appeals
- Disability Accommodations

The mission of American Public University System is to provide high quality higher education with emphasis on educating the nation's military and public service communities by offering respected, relevant, accessible, affordable, and student-focused online programs that prepare students for service and leadership in a diverse, global society.