

AE-715 Intermediate Space Dynamics

Spring, 2014

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Office Hours	Tue: 4:30–5:30 PM, Fri: 10:30–11:30 AM (walk-in hours) Anytime else (Please e-mail to check availability)
Classroom/ Days/Time	Wallace Hall 215/ Tue, Thu/ 5:35–6:50 PM
Prerequisites	AE-415 or instructor's consent

How to use this syllabus?

This syllabus provides you with information specific to this course, and it also provides information about important university policies. This document should be viewed as a course overview; it is not a contract and is subject to change as the semester evolves.

Course Description

- Total number of classes: 30 (excludes final exam)
- Review topics: Two-body problem, Orbit descriptions, Position as a function of time (5 classes)
- Lambert's problem (3 classes)
- Impulsive transfers (3 classes)
- Interplanetary mission analysis (6 classes)
- Restricted three-body problem (2 classes) - preliminary concepts
- Relative motion (linearized equations of motion) (2 classes) - preliminary concepts
- Earth oblateness (1 class)
- Rocket propulsion (2 classes)
- Atmospheric entry (3 classes)
- Review of all topics (1 class)
- Mid-terms (2 classes)

Course Workload Expectations

Since this is a standard 3-credit hour AE course, the standard (approximately) $7\frac{1}{2}$ -hours of study per week outside of class is expected.

Course Objective

The objective of this course is to provide students with an advanced knowledge of orbital mechanics by building up on the material taught in AE 415. However, this course is taught like a first course for graduate students who may not have had an exposure to an undergraduate level astrodynamics course. Hence, the first few classes of this course will be spent on reviewing some of the important concepts originally introduced in AE-415. Upon completion of this course, the students are expected to:

- Have acquired knowledge in the field of orbital mechanics relevant to geocentric and interplanetary space missions
- Think critically and independently on topics related to the field of astrodynamics, as demonstrated by effective writing and speaking skills
- Develop problem solving skills required to design impulsive spacecraft maneuvers for various space missions

Required Text/Readings

- (A) Prussing and Conway, “Orbital Mechanics,” Oxford University Press, Second Edition, 2013.
- (B) Roy Myose, “Fundamentals of Astronautical Engineering,” Pre-publication Edition, Version 0.8b, 2012 (AE-415 textbook).

Class Protocol

- Use of cell phone or laptop is not permitted in class.
- Students are allowed to discuss assignment (homework) problems amongst themselves but each student should write their homework independently, that is, they should work out the problems themselves individually.
- Assignments should be submitted at the beginning of class on the due date.
- All exams will be closed-book and closed-notes. However, each student is allowed to bring a calculator and one letter-sized sheet with equations written from text-book and/or class-notes. This sheet must be submitted along with the answers. Sharing of equation sheets during the exam is not allowed.
- Assignment and exam problems will be graded on the correct solution method. Obtaining the correct final solution without proper explanation of steps and methodology used is of little value.

- If any book or internet material is used to solve an assignment problem, it must be cited.
- Assignments must be submitted in letter-sized paper ($8\frac{1}{2}$ " \times 11") properly stapled together. Only one side of the sheets should be used for answering questions. Also, each problem should start on a new page.

Grading Policy

- Assignments – 20%
- Midterm 1 – 25%
- Midterm 2 – 25%
- Final exam – 30%

Grading Scale

Score (Undergrad)/(Grad)	Letter Grade	Grade Points	Interpretation
93+ /95+	A	4.00	The A range denotes excellent performance.
88+ /90+	A-	3.70	
84+ /86+	B+	3.30	
81+ /83+	B	3.00	The B range denotes good performance.
78+ /80+	B-	2.70	
74+ /76+	C+	2.30	
72+ /73+	C	2.00	The C range denotes satisfactory performance.
68+ /70+	C-	1.70	
64+ /66+	D+	1.30	
61+ /63+	D	1.00	The range D denotes unsatisfactory performance.
58+ /60+	D-	0.70	
<58 /<60	F	0.00	F denotes failing performance.

Note: The Graduate Catalog states that in “mixed classes” of undergraduates and graduates, “a discernably higher level of performance by graduate students is expected.”

Assignments

- Total number of assignments = 5.
- Assignments must be submitted at the beginning of class on the date it is due.
- Tentative due dates for these assignments are outlined in the comments row of the schedule at the end of this document.

Extra Credit

- Watch out for questions with bonus points in the assignments and exams!

Late Assignments

- Late submission of homework is allowed, but discouraged. Hence, there is an associated penalty with late submission of assignments.
- Assignments will typically worth 100 points. Assignments submitted 1 day late will have a penalty of 25 points that will be deducted from the score obtained by the student on that assignment. Assignments submitted 2 days late will have a penalty of 60 points that will be deducted from the score obtained by the student on that assignment.
- Assignments submitted more than 2 days late will not be accepted and will receive a score of 0.

Missed Assignments and Exams

Exam make-up is only allowed for documented case of illness, personal emergency, or work related business trip. Make-up involves replacing the missed excusable exam with the final (comprehensive) exam score. No more than one make-up will be allowed. If the final exam is missed for a valid documented reason, a make-up final will be arranged.

There will be no provision for make-up assignments. In the event of a valid documented reason when a student submits an assignment late but within two days of due date, no penalty will be imposed. In the event of a valid documented reason when a student misses an assignment submission, the average of the remaining assignments will be awarded for the missed assignment. Again, only one such make-up will be allowed for a student during the duration of the course.

University Policies

About this Syllabus

This syllabus is not a contract. The instructor reserves and retains the right to alter the course requirements and/or assignments based on new materials, class discussions, current events or other legitimate pedagogical objectives.

Inclusive Excellence

Wichita State University is committed to achieving Inclusive Excellence and institutional strength through curricula, co-curricula, and other practices, which promote and encourage the intermingling of its students, faculty, and staff from different backgrounds, in a challenging intellectual and multicultural climate that is marked by respect and appreciation for the spectrum of human diversity. The University is also committed to an all-inclusive diversity

and does not discriminate on the basis of race, ethnicity, gender, gender identity/expression, sexual orientation, age, socioeconomic status, disability, religion, national origin, or military status.

Academic Integrity

Students are responsible for knowing and following the Student Code of Conduct¹ and the Student Academic Honesty policy².

Intellectual Property

Wichita State University students are subject to Board of Regents and University policies³ regarding intellectual property rights. Any questions regarding these rights and any disputes that arise under these policies will be resolved by the President of the University, or the Presidents designee, and such decision will constitute the final decision.

Disabilities

If you have a physical, psychiatric/emotional, or learning disability that may impact on your ability to carry out assigned course work, I encourage you to contact the Office of Disability Services (DS). The office is located in Grace Wilkie Annex, room 150, (316) 978-3309 (voice/tty). DS will review your concerns and determine, with you, what academic accommodations are necessary and appropriate for you. All information and documentation of your disability is confidential and will not be released by DS without your written permission.

Counseling and Testing

The WSU Counseling and Testing Center provides professional counseling services to students, faculty and staff; administers tests and offers test preparation workshops; and presents programs on topics promoting personal and professional growth. Services are low cost and confidential. They are located in room 318 of Grace Wilkie Hall, and their phone number is (316) 978-3440. The Counseling and Testing Center is open on all days that the University is officially open. If you have a mental health emergency during the times that the Counseling and Testing Center is not open, please call COMCARE Crisis Services at (316) 660-7500.

Student Health Services

WSUs Student Health clinic is located in Ahlberg Hall. Hours are 8:00am to 4:00pm (3:00pm on Fridays), though the clinic may be closed occasionally on Wednesdays from noon to 1:30pm. In addition to outpatient and preventive care (including immunizations, a prescription service, and testing/counseling for sexually transmitted infections), Student

¹http://webs.wichita.edu/inaudit/ch8_05.htm

²http://webs.wichita.edu/inaudit/ch2_17.htm

³http://webs.wichita.edu/inaudit/ch9_10.htm

Health can handle minor injuries. All services are confidential. For more information see www.wichita.edu/studenthealth.

The Heskett Center and Campus Recreation

Whether you are wanting to be active on campus, relieve the stress from classes or take care of your body, Wichita State Campus Recreation is the place for you. Campus Recreation, located inside the Heskett Center, contributes to the health, education, and development of Wichita State University students, faculty, staff, alumni, and community members by offering quality programs and services. With many programs and facilities which are free to all students and members, Campus Recreation offers its members limitless opportunities. For more information about our services see www.wichita.edu/heskett.

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Important Academic Dates

- Classes begin Tuesday, January 21 2014, and end Thursday, May 8 2014.
- Last date to drop a class and receive a W (withdrawn) instead of F (failed) is Friday, April 4 2014.
- There are no classes during Spring Break (Mar 17 – Mar 23, 2014).
- Dates for the two mid-term examinations are Tuesday, March 4 2014, and Thursday, April 17 2014.
- The final exam period is on Tuesday, May 13, 2014 between 5:40-7:30pm.

Course Schedule

Day	Date	Topics	References	Comments
01	01/21	Course overview, Introduction, Two-body model	A: 1.1, 1.3 (pp. 1–4, 8–11)	
02	01/23	Two-body problem, Conic sections	A: 1.4, 1.5, 1.6 (pp. 11–17)	
03	01/28	Orbital energy, position and time	A: 1.7, 2.1, 2.2 (pp. 17–20, 25–29)	
04	01/30	Eccentric anomaly, Orbital elements	A: 2.3, 3.1, 3.2 (pp. 29–31, 46–50)	
05	02/04	Orbit description	A: 3.3 (pp. 50–55)	Assignment 1 Due
06	02/06	Transfer orbits, Lambert’s theorem	A: 5.1, 5.2, 5.3 (pp. 79–84)	
07	02/11	Solutions to Lambert’s equations	A: 5.4 (pp. 86–91)	
08	02/13	Applications of Lambert’s problem	A: 5.5, 5.6 (pp. 91–95)	
09	02/18	Two-impulse transfers	A: 7.1, 7.2, 7.3 (pp. 119–123)	
10	02/20	Hohmann transfers	A: 7.4, 7.5 (pp. 123–130)	Assignment 2 Due
11	02/25	Noncoplanar transfers, Intercept, Rendezvous	A: 7.6, 7.7 (pp. 130–136)	
12	02/27	Introduction to Interplanetary transfers	A: 9.1, 9.2 (pp. 130–136)	
13	03/04	EXAM 1		Days 1–11
14	03/06	Patched conic methodology	A: 9.3 (pp. 158–162)	
15	03/11	Velocity change from circular to hyperbolic orbit	A: 9.4 (pp. 162–166)	
16	03/13	Planetary fly-by	A: 9.5 (pp. 166–171)	
–	03/18	–	–	Spring Break
–	03/20	–	–	Spring Break
17	03/25	Gravity Assist Applications	A: 9.6 (pp. 171–179)	
18	03/27	Examples of Interplanetary Missions	NASA, ESA websites	Assignment 3 Due
19	04/01	Restricted three-body problem	A: 4.1, 4.2, 4.3 (pp. 60–66)	
20	04/03	Equilibrium points and stability	A: 4.4, 4.5 (pp. 66–70)	
21	04/08	C-W equations	A: 10.1, 10.2, 10.3 (pp. 179–184)	
22	04/10	Linear impulsive rendezvous	A: 10.4, 10.5 (pp. 184–192)	Assignment 4 Due
23	04/15	Earth oblateness	A: 11.4 (pp. 206–209)	
24	04/17	EXAM 2		Days 14–22
25	04/22	Rocket dynamics	A: 6.1, 6.2, 6.3 (pp. 101–107)	
26	04/24	Ballistic missile	B: 6.6 (pp. 6–1–6–7)	
27	04/29	Atmospheric entry	B: 7.1, 7.2 (pp. 7–1 – 7–5)	
28	05/01	Ballistic entry	B: 7.3 (pp. 7–5 – 7–10)	
29	05/06	Lifting entry	B: 7.4 (pp. 7–10 – 7–12)	
30	05/08	Review class		Assignment 5 Due
31	05/13	FINAL EXAM		Days 1–30