EAS4510 - Astrodynamics
Spring 2020

COURSE INSTRUCTOR

Instructor: Dr. Anil V. Rao, MAE-A 314, E-mail: anilvrao@ufl.edu. Tel: 352-392-5523 (Office); (352) 672-1529 (Mobile, for Calls and Texts). All contact methods are acceptable!

COURSE OBJECTIVES

- Characterize and understand the key properties of the motion of a spacecraft in orbit under central body gravitation.
- Design basic impulsive in-plane and out-of-plane maneuvers to transfer a spacecraft between two orbits.
- Perform preliminary analysis for space missions including missions where a spacecraft is transferred between two bodies.
- Understand the motion of a spacecraft under the influence of non-central gravity perturbations.

IMPORTANT NOTE

I consider it an honor and a privilege to be able to teach all of you, and I intend to provide the best instruction possible in order to enable you to learn the material well. If you cannot make office hours, please contact me and we will set up a time for you to get help. Regardless of how busy I am with other things, I will do what I am able to make myself available.

APPROXIMATE SCHEDULE AND COVERAGE OF TOPICS

Mechanics	Rigid Body Kinematics and Kinetics	1 and 2
Motion of a Spacecraft Under Central Body Gravitation	Formulation and Solution of Two-Body Differential Equation	Week 3
Parameterization of Orbit in Space Using Position and Velocity	Computation of Orbital Elements from Position and Velocity	Week 4
Determination of Position and Velocity from Orbital Elements	Computation of Position and Velocity Given Orbital Elements	Week 5
Determination of Time on an Orbit and Position on an Orbit Given Time	Definition of Eccentric Anomaly. Solution of Kepler's Equation Using Eccentric Anomaly	Weeks 6 and 7
In-Plane and Out-of-Plane Impulsive and Non-Impulsive Orbital Transfer	Hohmann/Bi-Elliptic Transfer; Phase / Apsis / Inclination Change; Rocket Equation	Weeks 8 Through 10
Inter-Body Trajectories and Orbital Transfer Between Two Bodies	Patched-Conics; Launch Windows; Mid-Course Corrections; Fly-Bys	Weeks 11 and 12
Non-Central Body Gravitation	Perturbations, Rendezvous, and Relative Motion	Weeks 13 and 14

COURSE LOCATIONS AND CLASS PERIODS

MWF Period 6 (12:50 PM to 1:40 PM). Room: Pugh Hall 170

OFFICE HOURS

Name	Hours and Location	E-mail Address
Anil Rao (Instructor)	Monday/Wednesday/Friday: 2:00 PM — 4:00 PM	anilvrao@ufl.edu

Location: Reitz Union Food Court

Note: I am also *most definitely* available by appointment or via e-mail, mobile phone, or text message. Please do not hesitate to contact me by any of these methods if you need help!

Elisha Pager (TA)	None	epager@ufl.edu
Rachel Keil (TA)	None	rekeil@ufl.edu

Note: if for some reason you are unable to make my office hours, you can always schedule an appointment at a time that is mutually agreeable to both you and I.

TEXTBOOK

1. Prussing, J. E. and Conway, B. A, *Orbital Mechanics* , Second Edition. Oxford University Press, 2012
2. *MATLAB for Dummies*, Second Edition, John Wiley & Sons, 2014.

COURSE NOTES

I have created a set of typeset notes for the course. These notes are continually being updated. The current version of the notes are available by clicking here.

PROGRAMMING LANGUAGE REQUIREMENTS

All coding in this course will be done using MATLAB. It is REQUIRED that everyone have a legally obtained STUDENT VERSION of MATLAB for use with the course. Anyone using UF Apps will not receive help during office hours or otherwise because of inefficiency of using UF Apps (that is, the time delays and other issues due to the UF network). It is required that anyone who wants help must have a legally obtained STUDENT license of MATLAB installed to their computer.

HOMEWORK ASSIGNMENTS

Florida E-learning website. The bonus assignments (STK Level 1 and STK Level 2 Certifications) can be completed by by clicking here.

Assignment	Assignment	Due Date
Homework #0	Background Material	17 January 202
Homework #1	Chapter 1 Problems	3 February 202
Homework #2	Chapter 2 Problems	24 February 202
Homework #3	Chapter 3 Problems	20 March 2020
Homework #4	Chapter 5 Problems	8 April 2020
Homework #5	Chapter 6 Problems	22 April 2020
Bonus #1	STK Level 1 Certification	24 April 2020
Bonus #2	STK Level 2 Certification	24 April 2020

MINI-PROJECT SCHEDULE

Mini-Project		Contents		Date Assigned		Date Due
Mini-Project #1		Material Through HW #1		3 February 2020		10 February 2
Mini-Project #2		Material Through HW #2		24 February 2020		2 March 202
Mini-Project #3		Material Through HW #3		23 March 2020		30 March 20:
Mini-Project #4		Material Through HW #4		13 April 2020		20 April 202

IN-CLASS QUIZ SCHEDULE

In-Class Quiz	Contents	Date

| In-Class Quiz #2 | Based on Material Through HW #3 | In-Class 25 March 2020 |
| In-Class Quiz #3 | Based on Material Through HW #4 | In-Class 20 April 2020 |

MINI-PROJECT ORMAT

The course will have four mini-projects. Each mini-project will be made available at 5:00 PM on a Friday and will be due the following Friday by noon. Late mini-projects will not be accepted under any circumstances except the usual exceptions (illness or other emergency). Each mini-project will require the use of MATLAB along with an understanding of the key concepts. Thus, it is *extremely important* that you understand the theory in addition to just being able to solve problems. Furthermore, the mini-projects will require knowledge gained in the process of completing the homework assignments. Your grade on the mini-projects will be reflected via any procrastination in completing homework assignments.

IN-CLASS QUIZ FORMAT

The course will have three *in-class* quizzes. Each of these quizzes will be during the regular class period and will be 45 minutes in duration. These quizzes will consist of short answer questions or questions that can be answered with calculations that can be performed using a scientific calculator. The objective of these quizzes is to test an understanding of basic concepts studied to that point in the course.

MATERIALS PERMITTED FOR USE DURING EXAMS

All mini-projects and in-class quizzes are open book and open notes. Aside from the notes and the book, no other materials except a computer (to use MATLAB) or a calculator (for in-class quizzes) is permitted. Copying from any unallowable source (including, but not limited to, other students quizzes and resources available on the internet) will be considered cheating. All mini-projects and quizzes will be sent through the TurnItIn software on Canvas to check against all aforementioned material. Any student found to have copied will be in violation of the cheating policy in the course (see below).

ATTENDANCE RULES

Regular attendance is expected of all students. All attendance rules will be follow the official University of Florida Attendance Policies as found by clicking here. Attendance will be monitored via in-class quizzes that will not be

CHEATING

Cheating of any kind in this course will be enforced in accordance with the university rules. Any violation of any kind (even something as simple as a single line of code that is identical in the homework of two students) will automatically result in an "E" in the course and will reported as appropriate to the Dean of Students Office.

MAKE-UP QUIZ POLICIES

The following list comprises the only legitimate reasons to request a make-up for a quiz: (1) a student illness with a note from a physician that the student was ill on the date of the exam; (2) a family emergency that requires immediate attention; (3) a legitimate absence based on the University of Florida approved absence policy; (4) University of Florida exam policies based on a conflict with an exam in another course. Because the quizzes are being held in class, no make-up will be permitted for any exams in other courses that may be held that same day.

COURSE GRADING

Item	Point Value
Homework Assignments	6 @ 5 Points = 30 Points
Take-Home Quizzes	4 @ 10 Points = 40 Points
In-Class Quizzes	3 @ 10 Points = 30 Points
Bonus #1 (STK Level 1 Certification)	5 Points
Bonus #2 (STK Level 2 Certification)	5 Points
Total	**100 Points + 10 Points Bonus**

IMPORTANT NOTES: The unannounced in-class quizzes are purely for attendance purposes. As such, these in-class quizzes will not be graded (they are purely self-diagnostic so that each of you can get a sense as to whether or not you understand a particular concept), but missing a quiz on account of an unexcused absence will result in a lowering of a student's final grade in the manner described above (that is, a deduction of one step for each missed quiz on account of an unexcused absence).

Grades in this course are determined using the following scale:

Letter Grade	Score Range
A	95 and Above
A-	90 to less than 95
B+	85 to less than 90
B	80 to less than 85
B-	75 to less than 80
C+	70 to less than 75
C	65 to less than 70
C-	60 to less than 65
D+	55 to less than 60
D	50 to less than 55
D-	45 to less than 50
E	Less Than 45

NOTES ON ASSIGNMENT OF FINAL LETTER GRADES

- The grading scale posted above is not flexible.
- Any score on the boundary between two ranges will receive the higher grade (for example, a 94 receives a grade of "A-").
- Finally, it is noted that while your individual scores for assignments, exams, and quizzes will be posted on E-learning (Canvas), the Canvas portal may not accurately reflect a student's relative standing in the class. Regardless of the information that is seen in Canvas, computation of final grades will be based on the criteria set forth above and a student's grade will only be final when grades have been computed at the end of the semester.

IMPORTANT NOTE: Any assignment either not submitted or not completed with a good faith effort (where the judgment of "good faith effort" rests wholly with me) will result in a full letter grade deduction in the course. For example, if the final score falls into the category of an "A-" and one homework or quiz is not submitted or is