EAS4510 - Astrodynamics
Fall 2020

COURSE INSTRUCTOR

Name: Dr. Anil V. Rao

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YouTube Channel: https://www.youtube.com/user/anilvrao2

All contact methods are acceptable! I strongly prefer texting to or calling me on my mobile as it is more effective and more efficient! Thanks!

COURSE LOCATIONS AND CLASS PERIODS

This is an online class. Lectures will be held asynchronously via online lecture videos and via Zoom for material that is not covered in the lecture videos.

Class Period: MWF 12:50 - 1:40 PM (Period 6). Attendance is expected and will be taken online at random.

Online Lectures: Click here for Astrodynamics 2020 Playlist (On My YouTube Channel).

Zoom Meeting Information:

- Meeting ID: **927 4908 9862**
- Passcode: E-mail me at anilvrao@ufl.edu if you need the passcode
- Click here for Zoom link or copy and past the following URL into your browser:
  https://ufl.zoom.us/j/92749089862?pwd=clBUQ2tXZjc0UFBXNzhkSFI0aXpSUT09

Please note that I will not be lecturing three times per week because a good portion of the course material will be provided via the lecture videos. That being said, the synchronous Zoom lectures during the regular class period will provide important information that might otherwise be difficult to cover in a lecture video. As a result, I highly recommend that everyone attend the synchronous lectures. Attendance is expected during the Zoom lectures.

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

Topic	Material Covered	Schedule
Review of Newtonian Mechanics	Particle Kinematics and Kinetics, Rigid Body Kinematics and Kinetics	Weeks 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

OFFICE HOURS

Name	Hours and Location	E-mail Address
Anil Rao (Instructor)	Monday/Wednesday/Friday: 2:00 PM — 4:00 PM Tuesday/Thursday 10:00 AM — 12:00 PM Location: Zoom **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!	anilvrao@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. Bate, R. R., Mueller, D. D., and White, J. E., *Fundamentals of Astrodynamics*, Dover Publications, 1971.
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

The homework will consist of three major homework assignments and a final project. **All assignments are due at 5:00 PM on the due date and must be submitted through the Canvas course page on the University of 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	**7 September 20:**
Homework #1	Chapter 1 Problems	**21 September 20**
Homework #2	Chapter 2 Problems	**12 October 202**
Homework #3	Chapter 3 Problems	**2 November 202**
Homework #4	Chapter 5 Problems	**16 November 20**
Homework #5	Chapter 6 Problems	**7 December 202**
Bonus #1	STK Level 1 Certification	**7 December 202**
Bonus #2	STK Level 2 Certification	**7 December 202**

PROJECT SCHEDULE

Project		Contents		Date Assigned		Date Due
Project #1		Material Through HW #1		**25 September 2020**		**2 October 20**
Project #2		Material Through HW #2		**16 October 2020**		**23 October 2(**
Project #3		Material Through HW #3		**6 November 2020**		**13 November 2**
Project #4		Material Through HW #4		**20 November 2020**		**4 December 2**

TAKE-HOME QUIZ SCHEDULE

Take-Home Quiz	Contents	Date
Take-Home Quiz #1	Material Through HW #2	**23 - 26 October 2(**
Take-Home Quiz #2	Material Through HW #3	**13 - 16 November 2**
Take-Home Quiz #3	Material Through HW #4	**4 - 7 December 2(**

PROJECT ORMAT

The course will have four projects. Each project will be made available at 5:00 PM on a Friday and will be due the following Friday by noon. Late projects will not be accepted under any circumstances except the usual exceptions (illness or other emergency). Each 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 projects will require knowledge gained in the process of completing the homework assignments. Your grade on the projects will be reflected via any procrastination in completing homework assignments.

TAKE-HOME QUIZ FORMAT

The course will have three take-home quizzes. Each quiz will be a problem that will have both a theory (derivation) component along with a programming component. The quizzes will be significantly shorter than the projects, but will still require programming. The quizzes must be completed independently (but, of course, you can ask me for help).

ATTENDANCE RULES

Regular attendance is expected of all students on days when Zoom lectures are held. I will try to record the Zoom lectures, but please realize that recorded Zoom lectures are not necessarily the easiest to follow.

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 POLICY

Because all assignments in this course are not time limited (in the same manner as that a usual in-class exam), make-ups will be provided on a case-by-case basis. If you have an issue (illness, other urgent matter), please discuss it with me and we will work to find a fair and reasonable solution.

COURSE GRADING

Item	Point Value
Homework Assignments	6 @ 5 Points = 30 Points
Mini-Projects	4 @ 10 Points = 40 Points
Take-Home 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).

GRADING SCALE

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 deemed to not have been performed with a good faith effort, the final grade will be a "B-". This policy is not flexible.

IMPORTANT NOTE REGARDING RECORDING OF SESSIONS

This class contains sessions that may be audio visually recorded for students in the class to refer back and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live. The chat will not be recorded or shared. As in all courses, unauthorized recording and unauthorized sharing of recorded materials is prohibited.

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