

**Dynamics and Control of Spacecraft**  
EAS 4412  
**Class Periods:** MWF, 4<sup>th</sup> (10:40 – 11:30)  
**Location:** CHE 316  
**Academic Term:** Spring 2023

**Instructor**

Norman Fitz-Coy  
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Office Hours: 8<sup>th</sup> MW (official) – open door policy in effect, make an appointment

**Teaching Assistant/Peer Mentor/Supervised Teaching Student**

- N/A

**Course Description**

Review of aerospace applications in current guidance and control systems. Includes synthesis of open and closed loop guidance and control systems using classical and modern control theory.

**Course Pre-Requisites / Co-Requisites**

EGM 4313 or MAP 4305 or MAP 5304

**Course Objectives**

To develop a proficiency with the concepts of guidance and control of aerospace systems. To develop an understanding of the analyses/techniques utilized in modelling the dynamical motion of spaceflight systems and to use those skills to passively and actively control the motion of spacecraft modelled as point masses (i.e., translational – aka orbit) or rigid bodies (i.e., rotational – aka attitude).

**Required Textbooks and Software**

Sidi, M. J., Spacecraft Dynamics & Control – A Practical Engineering Approach, Cambridge Aerospace Series)

**Recommended Textbooks**

- Wie, B., Space Vehicle Dynamics and Control, AIAA Educational Series
- Wiesel, W. E., Spaceflight Dynamics, CreateSpace; 3rd edition
- Schaub, H. and Junkins, J. L., Analytical Mechanics of Space Systems, AIAA Educational Series
- Wertz, J. R., editor, Spacecraft Attitude Determination and Control, Astrophysics and Space Science Library
- Bryson, A. E., Control of Spacecraft and Aircraft, Princeton Univ. Press.

**Course Schedule**

Concepts	Chapters (Sidi)
Review and orbit mechanics basics – scalars, vectors, matrices, reference/coordinate frames, vector representations, Keplerian motion, orbit perturbations	1, 2
Orbital maneuvers – single and multiple impulse maneuvers, Hohmann transfers, GTO/GEO transfers	3
Rigid body (S/C) kinematics and dynamics – attitude representations	4
Passive & active control attitude control – gravity gradient, single- and dual-spin, nutation control	5, 6
Attitude maneuvers and momentum exchange devices – attitude errors and control laws, momentum management, momentum bias, Y-Thompson spin	7, 8

### **Homework Assignments**

Problems will be assigned regularly and will be periodically collected with an advance notice of two (2) days. Late homework **will not** be accepted. **Quizzes will be administered without warning at the discretion of the instructor.** All assignments and related lecture materials will be posted under the **Announcements** tab.

### **Attendance Policy, Class Expectations, and Make-Up Policy**

Class attendance is not mandatory, but students are strongly encouraged to attend all lectures. When in class, however, ALL personal communication devices (cell phones, etc.) must be turned off (or in the silent mode). Excused absences must be in compliance with university policies in the Undergraduate Catalog and require appropriate documentation (<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>).

### **Evaluation of Grades**

Assignment	Total Points	Percentage of Final Grade
Homework/project/quiz	TBD	25%
Exam 1 (TBD February)	100	25%
Exam 2 (TBD March)	100	25%
Final Exam (D on May 2)	100	25%
		100%

### **Grading Policy**

Percent	Grade	Percent	Grade	Percent	Grade
90.0 - 100.0	A	87.0 - 89.9	A-	84.0 - 86.9	B+
81.0 - 83.9	B	78.0 - 80.9	B-	75.0 - 77.9	C+
72.0 - 74.9	C	69.0 - 71.9	C-	66.0 - 68.9	D+
63.0 - 65.9	D	60.0 - 62.9	D-	0 - 59.9	E

More information on UF grading policy may be found at: <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>

### **Students Requiring Accommodations**

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

### **Course Evaluation**

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

### **In-Class Recording**

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil

proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

### ***University Honesty Policy***

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.”

The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor (or TAs in this class).

### ***Commitment to a Safe and Inclusive Learning Environment***

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, [jpennacc@ufl.edu](mailto:jpennacc@ufl.edu)
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, [taylor@eng.ufl.edu](mailto:taylor@eng.ufl.edu)
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, [nishida@eng.ufl.edu](mailto:nishida@eng.ufl.edu)

### ***Software Use***

All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### ***Student Privacy***

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

### ***Other Student Resources:***

- **University Counseling Center** - (352) 392-1575 - <http://www.counsel.ufl.edu/default.asp>
- **Mental Health Services** - (352) 392-1171 - <http://www.health.ufl.edu/shcc/smhs.htm>
- Alachua County Crisis Center - (352) 264-6789

### ***Campus Resources:***

#### *Health and Wellness*

- **U Matter, We Care:** If you or a friend is in distress, please contact [umatter@ufl.edu](mailto:umatter@ufl.edu) or 352 392-1575 so that a team member can reach out to the student.
- **Counseling and Wellness Center:** <http://www.counseling.ufl.edu>, and 352-392-1575; and the University Police Department: 352-392-1111 or 9-1-1 for emergencies.
- **Sexual Discrimination, Harassment, Assault, or Violence:** If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, [title-ix@ufl.edu](mailto:title-ix@ufl.edu)
- **Sexual Assault Recovery Services (SARS):** Student Health Care Center, 352-392-1161.
- **University Police Department:** (352) 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>

#### *Academic Resources*

- E-learning technical support, (352) 392-4357 (select option 2) or e-mail to [Learning-support@ufl.edu](mailto:Learning-support@ufl.edu). <https://lss.at.ufl.edu/help.shtml> .
- Career Resource Center, Reitz Union: (352) 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>
- Library Support, Various ways to receive assistance with respect to using the libraries or finding resources. <http://cms.uflib.ufl.edu/ask>
- Teaching Center, Broward Hall, (352) 392-2010 or (352) 392-6420. General study skills and tutoring. <https://teachingcenter.ufl.edu/>
- Writing Studio, 302 Tigert Hall, (352) 846-1138. Help brainstorming, formatting, and writing papers. <https://writing.ufl.edu/writing-studio/>
- Student Complaints Campus: <http://care.dso.ufl.edu>, <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>
- On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>