

Introduction to Aerospace Engineering

EAS 2011

Fall 2020, M W F, 3rd Period, 9:35 AM – 10:25 AM

Zoom: <https://ufl.zoom.us/j/99161514975?pwd=WGNzeHdLc2MyWSszcEU0aUZadUJLQT09>

Zoom Meeting ID: 991 6151 4975; Zoom Meeting Password: 376799

This Zoom meeting is restricted to UFL participants only.

Modifications to this syllabus may be required during the semester. Any changes that are made will be reflected in a posted version of the syllabus and announced in class.

COVID-19 Lecture Delivery Statement

To approximate the on-campus experience as closely as possible, course lectures will be delivered **synchronously** at the designated class meeting times over the Zoom online platform. Similar to on-campus delivery, lectures will **not** be recorded and provided for later access. During lecture delivery, students are not obligated to share their video. Students are encouraged to unmute their microphones and ask questions when they have them, to facilitate oral participation and more interactive lectures. As in all UF courses, **unauthorized recording and unauthorized sharing of class materials** (e.g., homework solutions) **is prohibited**.

Professor

Assistant Professor **Amor A. Menezes**, Ph.D. (min-AY-zis)

Department of Mechanical and Aerospace Engineering

University of Florida, Gainesville, FL 32611-6250

WERT 489

Please contact through the Canvas website <https://elearning.ufl.edu>

Any emails to ufl email address must include EAS 2011 in the subject line

Office Hours

- M W F, 1:30 PM – 2:30 PM, Zoom:
<https://ufl.zoom.us/j/99161514975?pwd=WGNzeHdLc2MyWSszcEU0aUZadUJLQT09>
Zoom Meeting ID: 991 6151 4975; Zoom Meeting Password: 376799
- Or via confirmed written appointment

Graduate Student Teaching Assistant

Damon Ghetmiri

Email: s.ghetmiri@ufl.edu

Office Hours: M W 12:00 PM – 1:00 PM

Zoom: <https://ufl.zoom.us/j/93651376768>

Undergraduate Student Teaching Assistants

Oren Anderson

Alexander Krestan

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Office Hours: T Th 2:00 PM – 3:00 PM

T Th 1:00 PM – 2:00 PM

Zoom: <https://ufl.zoom.us/j/93651376768>

Course Description

Course Catalog: “Overview of aerospace engineering. Standard atmosphere, basic aerodynamics, airplane performance, stability and control, propulsion, and space flight.”
(Credits: 3)

Asst. Prof. A. A. Menezes, Ph.D.

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Course Objectives

This course introduces aircraft and spacecraft vehicles. By the end of this course, you will:

- Know the basic principles of flight in the atmosphere: the physics of flight, and steady aircraft flight and performance.
- Know the basic principles of flight in space: the two-body problem, spacecraft orbits, orbital transfers, and orbital analysis of space missions.
- Be able to effectively communicate this technical knowledge while accounting for realistic economic constraints.

Course Pre-Requisites

PHY 2048 (Physics with Calculus 1) or PHY 2060 (Enriched Physics with Calculus 1) with a minimum grade of C.

Materials and Supply Fees

None.

Professional Component (ABET)

This course contributes to the Aerospace Engineering student's aeronautical knowledge of: aerodynamics, propulsion, flight mechanics, and stability and control. This course contributes to the Aerospace Engineering student's astronautical knowledge of: orbital mechanics, space environment, attitude determination and control, and rocket propulsion. The content of this course is approximately 10% engineering design, 30% mathematics, and 60% engineering science.

Relation to Program Outcomes (ABET)

Outcome	Coverage
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	High
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	
3. An ability to communicate effectively with a range of audiences	Low
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Low
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Low
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	

Coverage is given as high, medium, or low. An empty box indicates that this outcome is not part of the course.

Required Textbooks, Software, and Hardware

- N. Harris McClamroch, "Steady Aircraft Flight and Performance," Princeton University Press, ISBN: 9780691147192, 2011.
- Howard D. Curtis, "Orbital Mechanics for Engineering Students," 4th Ed., Butterworth-Heinemann, ISBN: 9780081021330, 2020.

A revised printing is scheduled to be released on September 7, 2020.

- MATLAB (MathWorks), any recent release.
- Scientific calculator (not your phone).

Alternate (Reference) Textbooks

- John D. Anderson, Jr., "Introduction to Flight," 8th Ed., 2016.
- Steven A. Brandt, Randall J. Stiles, John J. Bertin, Ray Whitford, "Introduction to Aeronautics: A Design Perspective," 3rd Ed., 2015.
- Roger R. Bate, Donald D. Mueller, Jerry E. White, "Fundamentals of Astrodynamics," Dover Publications, Inc., ISBN: 9780486600611, 1971.
- John E. Prussing, Bruce A. Conway, "Orbital Mechanics," 2nd Ed., 2012.

Important Dates

- Classes Begin: Aug 31 (Monday)
- Holidays/Reading Days: Sep 7 (Monday), Nov 11 (Wednesday), Nov 25 – 27 (Wednesday – Friday), Dec 10 – 11 (Thursday – Friday)
- Classes End: Dec 9 (Wednesday)
- Classes Canceled:
- Software tutorial dates stated in this syllabus will be confirmed in class
- Homework and quiz dates stated in this syllabus will be confirmed in class
- Quizzes will be held during the last 15 minutes of lecture
- Team Report 1 Due: Oct 26 (Monday) 5:00 PM
- Team Report 2 Due: Dec 14 (Monday) 5:00 PM
- Review for Midterm Exam: Oct 19 (Monday)
- Midterm Exam: Oct 23 (Friday) 8:20 PM – 10:10 PM
- Review for Final Exam: Dec 9 (Wednesday)
- Final Exam: Dec 17 (Thursday) 12:30 PM – 2:30 PM

Attendance Policy

- The class has no attendance policy. Students are expected to attend.
- Absences are excused consistent with university policies in the undergraduate catalog (<https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/>) and require appropriate documentation.
- **Make-up Policy:** Instructor notifications are required in all circumstances. See <https://care.dso.ufl.edu/instructor-notifications>. Note that, "Instructors have the right to accept or reject the Instructor Notification."
- **No quiz make-ups are permitted.** If an excused absence occurs on a quiz day, then that quiz will be omitted from the student's total quiz score. Unexcused quizzes receive zero.

Class Expectations

- The student is solely responsible for their education. The professor is the guide to their understanding of the field.

- Cell phones, laptops, etc.: **under no circumstances will electronic devices be used in the classroom without the permission of the professor. Students are expected to take handwritten notes with pen/pencil and paper.**
- Respect and disruption: the professor and students will be respectful at all times. Classroom disruption of any kind will not be tolerated.
- **The principles of the Honor Code must be adhered to at all times.** Individual effort is required on homework assignments, quizzes, and exams. Groups will be treated as individuals for team reports. The honor pledge that you explicitly or implicitly sign is:

On my honor, I have neither given nor received unauthorized aid in doing this homework/quiz/report/exam.

The Honor Code process (<https://sccr.dso.ufl.edu/process/honor-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. 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 professor or TA.

Course Zero-Tolerance Policy: Any violation or suspected violation of the Honor Code by a student will result in that student receiving a grade of E for the course.

Homework

The purpose of homework is to learn and understand the material. **Students are responsible for performing and understanding the homework problems and solutions on their own.**

Software

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.

Quizzes and Exams

All quizzes are closed-book, closed-notes, closed-electronic devices. A scientific calculator (that is **not** your cell phone or laptop) will be permitted. **All exams are open-book, open-notes, closed-electronic devices except for a scientific calculator.**

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
- Robin Bielling, Director of Human Resources, 352-392-0903, rbielling@eng.ufl.edu

- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

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>

Students Requiring Accommodations

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, <https://disability.ufl.edu/students/get-started/>) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Health and Wellness

U Matter, We Care

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

COVID-19

COVID-19 is a highly infectious respiratory illness caused by a new, or novel, virus. COVID-19 is spreading quickly throughout the world and within the United States. COVID-19 symptoms can range from mild to severe, and some people have died from the illness. The main symptoms are fever, cough, and shortness of breath. Some people may have no symptoms at all or have some, but not all, of the symptoms. Other cold or flu-like symptoms also may appear, including: fatigue, body aches, runny nose, sore throat, diarrhea, loss of sense of smell (anosmia) or taste (ageusia).

To minimize the spread of COVID-19 in the current pandemic environment, this class is 100% online. Accordingly, there will be no, or very little, face-to-face contact. All students must wear masks ahead of any face-to-face contact. Accommodations will not be granted for disability-related requests to not wear a face covering. Students, faculty, and staff can use the GatorSafe app to share COVID-19 concerns, ranging from a space needing a hand sanitizer dispenser to someone not upholding mask policies. UF staff will review every concern and follow up as appropriate.

Students who feel unwell should contact the Student Health Care Center (352-392-1161, <https://shcc.ufl.edu/>) to schedule an appointment. Excused absence protocols (see above) are to be followed. Students can email UF Health Screen, Test & Protect student-screening@ufl.edu if they are having issues with their status or need testing (<https://coronavirus.ufhealth.org/screen-test-protect-2/students/>). Alternatively, students can submit a question at: <https://uf.tfaforms.net/439>.

Counseling and Wellness Center

<https://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 (<https://titleix.ufl.edu/>), located at Yon Hall Room 427, 1908 Stadium Road, 352-273-1094, 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.
<https://lss.at.ufl.edu/help.shtml>

Career Resource Center

Reitz Union, 392-1601. Career assistance and counseling. <https://www.crc.ufl.edu/>

Library Support

<http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

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/>.

Students Complaints: On-Campus

<https://ombuds.ufl.edu/student/>

Students Complaints: Distance Learning

<https://distance.ufl.edu/getting-help/student-complaint-process/>

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/>.

Evaluation of Grades and Grading Policy

Evaluation Mechanism on a Percent Basis

Homeworks (9)	27%
Quizzes (4)	8%
Team Reports (2)	22%
Midterm Exam	21%
Final Exam	22%

Homework

Students will submit solutions of the homework problems only via the course website. Students who turn in homework before the due date and time will have their homework graded. Not all homework problems will be graded; instead, a selection of problems will be randomly chosen for grading after the homework due date and time. Submitted homework that is partially- or fully-missing solutions to these chosen problems will not be eligible for partial or any credit for those problems, respectively, even if other non-chosen homework problems were completed. Homework solutions will be posted on the class website after the due date.

Exams

All students are expected to take all exams. If a student is unable to take an exam for unforeseeable reasons, then the other exams will count toward the percentage of the grade that makes up the exams if an appropriate DSO instructor notification is accepted.

Final Grade

Final grades may be calculated by the following table. For example, if a student earns 86.60% (Percent Grade Earned %GE = 86.60) then their grade point will be 3.33 (B+). %GE are rounded to the hundredths decimal place. For example, if a student earns 77.995% (Percent Grade Earned %GE = 77.995) it will be rounded up to 78.00%, and their grade point will be 2.67 (B-). Shifts in the grading table are at the discretion of the professor.

Table 1. Grading Table. %GE = Percent Grade Earned.

Percentage Range	Grade Point
$92.00 \leq \%GE < 100.00 \implies A$	4.00
$88.00 \leq \%GE < 92.00 \implies A-$	3.67
$85.00 \leq \%GE < 88.00 \implies B+$	3.33
$81.00 \leq \%GE < 85.00 \implies B$	3.00
$78.00 \leq \%GE < 81.00 \implies B-$	2.67
$74.00 \leq \%GE < 78.00 \implies C+$	2.33
$71.00 \leq \%GE < 74.00 \implies C$	2.00
$67.00 \leq \%GE < 71.00 \implies C-$	1.67
$64.00 \leq \%GE < 67.00 \implies D+$	1.33
$61.00 \leq \%GE < 64.00 \implies D$	1.00
$60.00 \leq \%GE < 61.00 \implies D-$	0.67
$00.00 \leq \%GE < 60.00 \implies E$	0.00

Grade Corrections

Corrections of grades should be submitted promptly in writing within three business days of the grade posting. Include a concise statement of why you believe there has been an error. Note that the professor has the final determination in the grade assigned. If a grade change is determined it may result in a lower or higher grade.

Course Schedule, Approximately by Lecture Number

1	Aug 31	Course Introduction, History of Flight	NHM Ch. 1
2	Sept 2	Flight Environment	NHM Ch. 2
3	Sep 4	Flight Environment, Physics of Flight	NHM Ch. 2
4	Sep 9	Physics of Flight	NHM Ch. 2
5	Sep 11	Matrices Review	
	Sep 11, 6:15 PM	MATLAB Tutorial (TA-led)	
6	Sep 14	Coordinate Systems and Rotations	NHM Ch. 3
Approximate End of Coverage for Homework 1			
7	Sep 16	Rotations, Kinematics, Aerodynamic Forces	NHM Ch. 3
Homework 1 Due Sep 16 (Wednesday), 5:00 PM			
8	Sep 18	Aerodynamic Forces	NHM Ch. 3
Approximate End of Coverage for Quiz 1			
9	Sep 21	Aircraft Attitude	NHM Ch. 3
10	Sep 23	Aircraft Attitude and Rotations	NHM Ch. 3
11	Sep 25	Aerodynamic Moments	NHM Ch. 3
Quiz 1 at end of lecture on Sep 25 (Friday)			
Approximate End of Coverage for Homework 2			
12	Sep 28	Propulsion, Steady Flight Lift and Drag	NHM Ch. 4, 5
Approximate End of Coverage for Homework 3			
Homework 2 Due Sep 28 (Monday), 5:00 PM			
13	Sep 30	Performance Optimization Intro, Gliding	NHM Ch. 5, 6
14	Oct 2	Gliding, Level Flight	NHM Ch. 6, 7
15	Oct 5	Level Flight	NHM Ch. 7
Homework 3 Due Oct 5 (Monday), 5:00 PM			
16	Oct 7	Level Flight	NHM Ch. 7
17	Oct 9	Climbing and Descending Flight	NHM Ch. 8
Approximate End of Coverage for Quiz 2			
18	Oct 12	Climbing and Descending Flight	NHM Ch. 8
Quiz 2 at end of lecture on Oct 12 (Monday)			
Approximate End of Coverage for Homework 4			
19	Oct 14	Take-off, Landing; Range and Endurance	NHM Ch. 11
Homework 4 Due Oct 14 (Wednesday), 5:00 PM			
20	Oct 16	Turning Flight	NHM Ch. 9
Approximate End of Coverage for Homework 5			
End of Coverage for Midterm Exam			
21	Oct 19	Review for Midterm Exam	
22	Oct 21	History of Space Flight, Gravitation	BMW Ch. 1.1
Homework 5 Due Oct 21 (Wednesday), 5:00 PM			
23	Oct 23	Modern Space Flight, MAE Space Research	
Midterm Exam Oct 23 (Friday), 8:20 PM			
24	Oct 26	Space Bioengineering, N-Body Problem	BMW Ch. 1.2
Team Report 1 Due Oct 26 (Monday), 5:00 PM			
25	Oct 28	2-Body Problem, Constants of Motion	BMW Ch. 1.3-1.4
26	Oct 30	Constants of Motion	BMW Ch. 1.4
27	Nov 2	Position and Time in Orbit	
Approximate End of Coverage for Homework 6			
28	Nov 4	Trajectory Equation	BMW Ch. 1.5-1.6
29	Nov 6	Conic Section Orbits Intro, Circular Orbits	BMW Ch. 1.5-1.6, 1.8

Approximate End of Coverage for Quiz 3

Homework 6 Due Nov 6 (Friday), 5:00 PM

30 Nov 9 Circular Orbits BMW Ch. 1.8

Quiz 3 at end of lecture on Nov 9 (Monday)

31 Nov 13 Circular Orbits, Elliptic Orbits BMW Ch. 1.8, 1.7

Nov 13 , 6:15 PM STK Tutorial (TA-led)

32 Nov 16 Elliptic Orbits, Burnout BMW Ch. 1.7, 3.1

33 Nov 18 Burnout, Orbit in 3D BMW Ch. 3.1-3.2, 2.2

Approximate End of Coverage for Homework 7

34 Nov 20 Orbit in 3D, Ground Tracks BMW Ch. 2.2, 2.15

Homework 7 Due Nov 20 (Friday), 5:00 PM

35 Nov 23 Parabolic and Hyperbolic Orbits BMW Ch. 1.9-1.10

36 Nov 30 Hyperbolic Orbits, Intro to Orbit Maneuvers BMW Ch. 1.10, 3.3

Approximate End of Coverage for Quiz 4

37 Dec 2 One- and Two-Impulse Orbit Transfers BMW Ch. 3.3-3.4

38 Dec 4 Extensions of the Hohmann Transfer

Quiz 4 at end of lecture on Dec 4 (Friday)

Approximate End of Coverage for Homework 8

39 Dec 7 Interplanetary Transfers, Rocket Equation BMW Ch. 8

Approximate End of Coverage for Homework 9

Homework 8 Due Dec 7 (Monday), 5:00 PM

End of Coverage for Final Exam

40 Dec 9 Review for Final Exam

Homework 9 Due Dec 14 (Monday), 5:00 PM

Team Report 2 Due Dec 14 (Monday), 5:00 PM

Final Exam Dec 17 (Thursday), 12:30 PM