

Gas Turbines and Jet Engines

EML 5515 Sections 1EF2, 2FED, CAMP

Class Periods: MWF 7th

Location: Virtual (UF EDGE)

Academic Term: Spring 2022

Instructor:

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352-392-7572

Office Hours: Online; hours TBD

Grader:

Julian Davis

Please contact through the Canvas website with grading questions only.

Course Description

Theory and analysis of gas turbine engines and major components.

Course Pre-Requisites / Co-Requisites

EGN 3353C or EAS 4101 or equivalent (fluid mechanics). At least an undergraduate-level understanding of thermodynamics is also expected.

Course Objectives

1. Utilize the fundamental principles of fluid mechanics and thermodynamics to analyze aircraft engines.
2. Understand the common gas turbine aircraft propulsion systems and be able to determine the applicability of each.
3. Be able to perform system studies of aircraft engine systems for specified cruise conditions at the preliminary design level.
4. Be able to perform preliminary aerothermal design of turbomachinery components.
5. Be able to analyze and perform preliminary design of terrestrial gas turbine systems, including alternative cycles.

These objectives will be assessed via homework, exams, and a final project.

Materials and Supply Fees

None

Required Textbook

- *Mechanics and Thermodynamics of Propulsion*,
- Hill & Peterson
- Addison-Wesley, 1992, 2nd Edition

Course Schedule

| Period | Date | Subject | Text Ref. |
|--------|--------|--|-----------|
| 1 | Jan. 5 | Introduction | 1.1 – 1.3 |
| 2 | 7 | Conservation Eqns | 2.1 – 2.3 |
| 3 | 10 | "" | |
| 4 | 12 | Equilibrium Combustion | 2.4 |
| 5 | 14 | "" | |
| | 17 | Holiday | |
| 6 | 19 | Equilibrium Combustion | |
| 7 | 21 | Equil. Comb with STANJAN | Notes |
| 8 | 24 | Review of Gasdynamics | 3.1 – 3.2 |
| 9 | 26 | "" | 3.3 – 3.5 |
| 10 | 28 | "" | 3.6 |
| 11 | 31 | Examples | |
| 12 | Feb. 2 | Review | |
| | 2 | Test #1 8:20-10:20 pm Eastern time | |
| 13 | 4 | Thermo of jet engines | 5.1 – 5.2 |
| 14 | 7 | Ramjets | 5.3 |
| 15 | 9 | Gas turbine engines | 5.4 – 5.6 |
| 16 | 11 | "" | |
| 17 | 14 | Engine/aircraft performance | 5.7 – 5.8 |
| 18 | 16 | "" | |
| 19 | 18 | Inlets, combustors & nozzles | 6.1 |
| 20 | 21 | Inlets | 6.2 – 6.3 |
| 21 | 23 | Combustors | 6.4 – 6.6 |
| 22 | 25 | "" | |
| 23 | 28 | Nozzles | 6.7 |
| 24 | Mar. 2 | Review | |
| | 2 | Test #2 8:20-10:20 pm Eastern time | |
| 25 | 4 | Axial compressors | 7.1 – 7.3 |
| 26 | 14 | Single and multi-staging | 7.4 – 7.5 |
| 27 | 16 | Instabilities | 7.6 |
| 28 | 18 | Efficiency | 7.7 – 7.8 |
| 29 | 21 | Radial equilibrium | 7.9 |
| 30 | 23 | Centrifugal compressors | 9.1 – 9.2 |
| 31 | 25 | Axial turbines | 8.1 – 8.3 |
| 32 | 28 | "" | |
| 33 | 30 | Cooling and performance | 8.5 – 8.6 |
| 34 | Apr. 1 | Matching compressor & turbine | 8.7 |
| 35 | 4 | Examples | |
| 36 | 6 | Review and project assignment | |
| | 7 | Test #3 8:20-10:20 pm Eastern time | |
| 37 | 8 | Intro to terrestrial gas turbines | Notes |
| 38 | 11 | Terrestrial systems | "" |
| 39 | 13 | Combined cycles | "" |
| 40 | 15 | "" | "" |
| 41 | 18 | Advanced cycles | "" |
| 42 | 20 | "" | "" |
| | 22 | Project due 4:00 pm (in lieu of exam) | |

Attendance Policy, Class Expectations, and Make-Up Policy

Lectures may be viewed online at your convenience; however, it is strongly recommended that you attend class online at the scheduled time to enable interaction with the instructor. Asking questions in real time is more effective than later because the rest of the lecture is then easier to follow.

Exam conflicts will be accommodated if you contact the instructor at least two weeks beforehand. Please check your schedule early in the course for potential conflicts.

Grading Policy

| | |
|----------|-----------------|
| Homework | 15% |
| Project | 15% |
| Tests | 30% Best score |
| | 15% Worst score |
| | 25% Other score |

The final grade will be determined using the breakpoint method. The class averages will be sorted and the appropriate gaps selected for the breaks between grades. The judgment of the instructor will be the determining factor in the placement of the breaks, influenced by such things as difficulty of exams and overall quality of the class. The grade ranges will be no stricter than the following: [A >92],[A- 90-92],[B+ 88-90],[B 82-88],[B- 80-82],[C+ 78-80],[C 72-78],[C- 70-72],[D+ 68-70],[D 62-68],[D- 60-62],[E <60].

HOMEWORK POLICIES:

1. You may work with your classmates in this course, e.g. discussing concepts or approaches to problems. However, the homework papers and project report which you submit must be your own individual work. Copying or comparison of final answers is not permitted. The University of Florida honor code is in force for this course.
2. Homework papers are due at the beginning of the period, without prior arrangements with the instructor or a written medical excuse. A paper submitted later than five minutes after the start of the period is late and will be penalized (one letter grade per calendar day). No papers will be accepted after the following class meeting. All papers are to be submitted electronically, by scanning (or photographing) and uploading via Canvas.

More information on UF grading policy may be found at:
<https://gradcatalog.ufl.edu/graduate/regulations/>

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.ua.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.ua.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 Conduct 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. 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
- 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

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>

Campus Resources:

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.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 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

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

COVID-19

- You are expected to wear approved face coverings at all times during class and within buildings even if you are vaccinated.
- If you are sick, stay home and self-quarantine. Please visit the UF Health Screen, Test & Protect website about next steps, retake the questionnaire and schedule your test for no sooner than 24 hours after your symptoms began. Please call your primary care provider if you are ill and need immediate care or the UF Student Health Care Center at 352-392-1161 (or email covid@shcc.ufl.edu) to be evaluated for testing and to receive further instructions about returning to campus.
- If you are withheld from campus by the Department of Health through Screen, Test & Protect, you are not permitted to use any on campus facilities. Students attempting to attend campus activities when withheld from campus will be referred to the Dean of Students Office.
- UF Health Screen, Test & Protect offers guidance when you are sick, have been exposed to someone who has tested positive or have tested positive yourself. Visit the [UF Health Screen, Test & Protect website](#) for more information.
- Please continue to follow healthy habits, including best practices like frequent hand washing. Following these practices is our responsibility as Gators.

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://career.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, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>; <https://care.dso.ufl.edu>.

On-Line Students Complaints: <http://www.distance.ufl.edu/student-complaint-process>.