



Gas Turbines Design and Analysis

ENPM809Q
Spring 2023

Course Overview

A course designed to acquaint the student with the design and analysis of modern gas turbine engines for land, sea and air use. The emphasis is on the constraints and limitations of the various components that comprise gas turbine engines such as axial and centrifugal compressors, combustors, axial and radial turbines, intercoolers, reheaters, regenerators and inlet/exit diffusers and nozzles. In addition, component matching and the problems associated with it will be studied. The course looks at the fundamentals of exhaust gas composition and the production of effluents. Also, future concepts in turbomachinery propulsion and energy management will be discussed. The course assumes a basic knowledge of thermodynamics and will add to the student's knowledge in such areas as compressible flow in turbomachinery, combustion analysis and emissions control. The culmination of the course is a final design project.

Learning Outcomes

After successfully completing this course you will be able to:

- a. Analysis and design of modern day gas turbine power systems that are utilized in the industry. Gas turbines analyzed will be both conventional and intercooled/recuperated gas turbines.
- b. Aircraft gas turbine engines shall include the turbojet, turbofan, turboprop, and turboshaft. The analyses will entail in-depth studies of inlets, combustors, axial and centrifugal compressors, axial turbines, intercoolers and recuperators/regenerators. Time permitting, advanced concepts will also be discussed.
- c. Learn analytical and computational methods to predict the performance of the above components and how to match components such as an axial turbine and an axial compressor.
- d. To familiarize the student with the diagnostics and working of such engines.
- e. Several short term design projects related to gas turbines will be worked on.

Course Outline

1. Introduction/Review/History of the Brayton Cycle
2. Single Shaft, Split-Shaft
3. Modified Split-shafts- Intercooled-Recuperated, Water injected
4. Optimization of Gas Turbine Cycles
5. Co-generation, Gas Cooled Reactors
6. Mechanics of Flight, Turbojets, Turbofans, Turboprops
7. Inlets/Diffusers, Ramjets
8. Turbomachinery, Compressors
9. Turbomachinery, Turbines

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Class Meets
Wednesday
4:00 PM to 6:40PM
Location :
JMP 2120

Office Hours
Wednesdays 3-4 PM
and by appt. via Zoom.

Course Communication
Students are welcome to contact me via email or phone anytime during business hours.

Prerequisite
Undergraduate thermodynamics, fluid mechanics and heat transfer.

10. Afterburners, Combustors
11. Heat Exchangers, Recuperators
12. Component Matching
13. Pollution
14. Design Projects

Course Evaluation

Homework Assignments	20%
Mid-Term Exam	25%
Final Exam	35%
Final Project	20%

Recommended Resources

Textbook:

There is NO required textbook. Class Notes will be posted.

Course website:

All registered students will have access to the course website. Please visit <https://myelms.umd.edu/login> for instructions on how to obtain a login/password.

Software:

Some homework assignments will require the use of computer software capable of simultaneously solving non-linear equations. The only acceptable software for this course is Engineering Equation Solver (EES). The EES software is available on the UMD School of Engineering Virtual Computer Lab portal.

Campus Policies

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses. Please visit <https://academiccatalog.umd.edu/graduate/policies/academic-record/> for the Office of Graduate Studies' list of campus-wide policies.

Accessibility and Reasonable Accommodations

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The University of Maryland provides reasonable accommodations to qualified individuals. Reasonable accommodations shall be made in a timely manner and on an individualized and flexible basis.

Discrimination against individuals on the grounds of disability is prohibited. The University also strictly prohibits retaliation against persons arising in connection with the assertion of rights under this Policy.

Accessibility & Disability Service (ADS) facilitates reasonable accommodations

to qualified individuals. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at [301.314.7682](tel:301.314.7682), or adsfrontdesk@umd.edu. More information is available from the [Counseling Center](#).

Get Some Help!

You are expected to take personal responsibility for your own learning. This includes acknowledging when your performance does not match your goals and doing something about it. Everyone can benefit from some expert guidance on time management, note taking, and exam preparation, so I encourage you to consider visiting <http://ter.ps/learn> and schedule an appointment with an academic coach. Sharpen your communication skills (and improve your grade) by visiting <http://ter.ps/writing> and schedule an appointment with the campus Writing Center. Finally, if you just need someone to talk to, visit <http://www.counseling.umd.edu>.

Everything is free because you have already paid for it, and **everyone needs help**... all you have to do is ask for it.

Names/Pronouns and Self Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more.

Additionally, how you identify in terms of your gender, race, class, sexuality, religion, and dis/ability, among all aspects of your identity, is your choice whether to disclose (e.g., should it come up in classroom conversation about our experiences and perspectives) and should be self-identified, not presumed or imposed. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

