AE 4803–Advanced Aircraft Propulsion

HOURS: 3-0-3

CATALOG DESCRIPTION:

Turbomachinery and combustor design, compressor-turbine matching and off-design engine performance. Introduction to advanced propulsion architectures including scramjets, pressure gain combustion, and electric/hybrid-electric.

PREREQUISITES:

AE 4451

TEXTBOOKS (SUGGESTED):

Mechanics and Thermodynamics of Propulsion, 2nd Edition, Philip Hill and Carl Peterson, Addison-Wesley, 1992.
Aircraft Propulsion, S. Farokhi, Wiley, 2009.
Additional sources*:*
Gas Turbine Combustion, 3rd Edition, A. Lefebvre and D. Ballal, CRC Press, 2010.

COURSE OBJECTIVES:

1. Familiarize students with the preliminary design and analysis of turbomachinery components found in conventional aircraft engines: compressors and turbines.
2. Explore the concept and procedures for compressor-turbine (gas generator) matching and provide understanding of off-design performance of an engine based on compressor and turbine maps.
3. Familiarize students with the preliminary design and analysis of main combustor found in conventional aircraft engines.
4. Introduce students to advanced propulsion architectures for hypersonic aircraft, and for enhanced cycle efficiency or reduced fuel-consumption in subsonic or transonic aircraft.

LEARNING OUTCOMES:

Students will be able to:

1. Provide preliminary design parameters for compressors and turbines and characterize their performance based on a mean line approach.
2. Evaluate the operation and performance of a jet engine based on compressor and turbine maps for different operating conditions.
3. Provide preliminary design parameters and define key design issues, constraints and architectures for main combustors in jet engines.
4. Describe the advantages and drawbacks of various advanced propulsion architectures.

LEARNING ACCOMMODATIONS:

If needed, we will make classroom accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services. (http://disabilityservices.gatech.edu).

ACADEMIC INTEGRITY:

Academic dishonesty is not tolerated. This includes cheating, lying about course matters, plagiarism, or helping others commit a violation of the Honor Code. Plagiarism includes reproducing the words or visual/graphical expressions of others without clear attribution and citation. Students are reminded of the obligations and expectations associated with the Georgia Tech Academic Honor Code, available online at http://osi.gatech.edu/content/honor-code.

TOPICAL OUTLINE:

Topic	Lecture Hours
I. Aircraft Propulsion Review	**2**
A. Engine architectures	1
B. Performance characteristics	1
II. Turbomachinery Design and Analysis	**13**
A. Axial architectures, Euler equations and cascade nomenclature	2
B. Mean line design of compressors and compressor performance 1. Cascade flow angles and velocity triangles 2. Single-stage compressor characteristics 3. Blade design considerations 4. Multistage compressors	5½
C. Mean line design of turbines and turbine performance 1. Overview, Euler equations and maps 2. Degree of reaction 3. Stage inlet swirl, solidity, losses and other design requirements 4. Blade and disk stresses	3½
D. Compressor and turbine design point procedures	2
III. Engine Off-Design Performance	**6**
A. Gas turbine matching requirements and map scaling	1
B. Gas generator matching for off-design performance	2
C. Engine off-design performance	1½
D. Engine transient response	½
IV. Combustor Design	**10**
A. Overview: requirements and rationale for typical features	2
B. Inlet diffuser sizing & losses, combustor length scaling	1
C. Fuel atomization and evaporation	2
D. Ignition	1
E. Aerodynamics and swirl	2
F. Controlling emissions	½
G. Heat transfer and liner cooling	1½
V. Advanced Propulsion Architectures	**7**
A. Scramjets	3
B. Pressure gain combustion approaches	1
C. Electric and hybrid electric propulsion	3
Exams and reviews	**4**
Total	**42**