

TO: The Faculty of the College of Engineering
FROM: The School of Aeronautics and Astronautics
RE: New Undergraduate Course, AAE 43800, Air-breathing Propulsion

The faculty of the School of Aeronautics and Astronautics have approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

AAE 43800 Air-breathing Propulsion

Sem. 2; Lecture 3, cr 3

Pre-requisites: AAE 33800 Minimum Grade of C, AAE 30000 Minimum Grade of S

Description:

Basic operating principles and analysis of performance characteristics of propulsion systems for air-breathing aerospace vehicles. Ramjet, turbojet, turbofan and turboprop cycle analysis. Propeller analysis and design. Analysis of flow through inlets, combustors, nozzles, compressors, and turbines. Component matching. Not open to students with credit in ME 43800.

Reason:

Students interested in the propulsion area of concentration within the AAE curriculum will now have a two-course sequence (beginning with AAE 33800) to strengthen their background. The course will provide increased depth relative to the current AAE 37200 offering. Course will strengthen distance offerings in propulsion and will be offered for distance learning every other year. Change from AAE 37200 to AAE 43800 indicates course is oriented toward seniors, and is complementary to AAE 43900 Rocket Propulsion.



*Tom I-P. Shin, Professor and Head
School of Aeronautics and Astronautics*

AAE 43800 Air-breathing Propulsion

Credits: 3
Contact hours: 3
Instructor: Prof. Li Qiao, Prof. William Anderson, Prof. Stephen Heister
Text: *Mechanics and Thermodynamics of Propulsion*, Hill and Peterson
Supplemental notes furnished by instructor.

Course description: Basic operating principles and analysis of performance characteristics of propulsion systems for air-breathing aerospace vehicles. Ramjet, turbojet, turbofan and turboprop cycle analysis. Propeller analysis and design. Analysis of flow through inlets, combustors, nozzles, compressors, and turbines. Component matching. Not open to students with credit in ME 43800.

Offered: Spring

Pre-requisite: AAE 33800, AAE 30000

Student Learning Outcomes

On completing this course the student shall be able to:

1. Determine the thrust and fuel consumption of gas turbine and turboprop engines
2. Understand advantages/disadvantages of turbojet, turboprop, turbofan, and ramjet air breathing propulsion systems
3. Understand the thermodynamics of the Brayton cycle and how they contribute to overall propulsion system performance
4. Understand the role and fundamental performance of gas turbine components
5. Determine the basic performance and/or design of axial turbines and compressors
6. Determine the basic performance of air breathing combustors

Topics

1. Introduction: Components of a jet engine and brief history of gas turbine propulsion for aerospace applications (1 lecture)
2. Thermodynamics and Combustion Fundamentals: Laws of thermodynamics, mixtures of perfect gases, reacting flow analysis assuming complete combustion. (6 lectures)
3. Fundamentals of 1-D Compressible Flow: 1-D isentropic flow, Fanno and Rayleigh flows, normal shocks. (6 lectures)
4. Powerplants and Jet Engine Ratings: Brayton thermodynamic cycle, air standard cycles, engine performance ratings, aircraft range. (4 lectures)

5. Turbojet Engine Cycle Analysis: Real and ideal engine cycle analysis, component efficiencies. (6 lectures)
6. Other Airbreathing Engine Cycles: Turbofan, turboprop, and ramjet engine cycles. (5 lectures)
7. Turbomachinery Fundamentals: Euler momentum equation, axial compressors, axial turbines, turbine/compressor matching. (7 lectures)
8. Combustors, Inlets and Nozzles: Constant pressure mixer analysis, subsonic and supersonic inlets, nozzles. (6 lectures)
9. Component matching. (2 lectures)
10. Tests (2 lectures)

PURDUE UNIVERSITY

REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

Print Form

EFD 28-14

Office of the Registrar
FORM 40 REV. 5/11

DEPARTMENT School of Aeronautics and Astronautics

EFFECTIVE SESSION Fall 2015

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- | | |
|---|---|
| <input checked="" type="checkbox"/> 1. New course with supporting documents | <input type="checkbox"/> 7. Change in course attributes (department head signature only) |
| <input type="checkbox"/> 2. Add existing course offered at another campus | <input type="checkbox"/> 8. Change in instructional hours |
| <input type="checkbox"/> 3. Expiration of a course | <input type="checkbox"/> 9. Change in course description |
| <input type="checkbox"/> 4. Change in course number | <input type="checkbox"/> 10. Change in course requisites |
| <input type="checkbox"/> 5. Change in course title | <input type="checkbox"/> 11. Change in semesters offered (department head signature only) |
| <input type="checkbox"/> 6. Change in course credit/type | <input type="checkbox"/> 12. Transfer from one department to another |

PROPOSED:

EXISTING:

TERMS OFFERED

Check All That Apply:

Subject Abbreviation AAE

Subject Abbreviation _____

Fall Spring Summer

Course Number 43800

Course Number _____

Long Title Air-breathing Propulsion

Short Title Air-breathing Propulsion

CAMPUS(ES) INVOLVED

Calumet N. Central
 Cont Ed Tech Statewide
 Ft. Wayne W. Lafayette
 Indianapolis

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

CREDIT TYPE

COURSE ATTRIBUTES: Check All That Apply

1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range:
 Minimum Cr. Hrs. _____
 (Check One) To Or
 Maximum Cr. Hrs. _____
3. Equivalent Credit: Yes No

1. Pass/Not Pass Only
2. Satisfactory/Unsatisfactory Only
3. Repeatable
 Maximum Repeatable Credit: _____
4. Credit by Examination
5. Fees: Coop Lab Rate Request
 Include comment to explain fee _____

6. Registration Approval Type
 Department Instructor
7. Variable Title
8. Honors
9. Full Time Privilege
10. Off Campus Experience

ScheduleType	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	3	16	100
Recitation	_____	_____	_____	_____
Presentation	_____	_____	_____	_____
Laboratory	_____	_____	_____	_____
Lab Prep	_____	_____	_____	_____
Studio	_____	_____	_____	_____
Distance	_____	_____	_____	_____
Clinic	_____	_____	_____	_____
Experiential	_____	_____	_____	_____
Research	_____	_____	_____	_____
Ind. Study	_____	_____	_____	_____
Pract/Observ	_____	_____	_____	_____

Cross-Listed Courses

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Pre-requisites: AAE 33800 Minimum Grade of C, AAE 30000 Minimum Grade of S
 Basic operating principles and analysis of performance characteristics of propulsion systems for air-breathing aerospace vehicles. Ramjet, turbojet, turbofan and turboprop cycle analysis. Propeller analysis and design. Analysis of flow through inlets, combustors, nozzles, compressors, and turbines. Component matching. Not open to students with credit in ME 43800.

***COURSE LEARNING OUTCOMES:**

1. Determine the thrust and fuel consumption of gas turbine and turboprop engines, 2. Understand advantages/disadvantages of turbojet, turboprop, turbofan, and ramjet air breathing propulsion systems, 3. Understand the thermodynamics of the Brayton cycle and how they contribute to overall propulsion system performance, 4. Understand the role and fundamental performance of gas turbine components, 5. Determine the basic performance and/or design of axial turbines and compressors 6. Determine the basic performance of air breathing combustors

Calumet Department Head _____ Date _____	Calumet School Dean _____ Date _____
Fort Wayne Department Head _____ Date _____	Fort Wayne School Dean _____ Date _____
Indianapolis Department Head _____ Date _____	Indianapolis School Dean _____ Date _____
North Central Faculty Senate Chair _____ Date _____	Vice Chancellor for Academic Affairs _____ Date _____
West Lafayette Department Head <u>ARK</u> <u>5/28/14</u> _____ Date _____	West Lafayette College/School Dean _____ Date _____

West Lafayette Registrar _____ Date _____

OFFICE OF THE REGISTRAR