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:**  

**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.

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*Tom I-P. Shan, 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)

DEPARTMENT: School of Aeronautics and Astronautics
EFFECTIVE SESSION: Fall 2015

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

- [X] New course with supporting documents
- [ ] Add existing course offered at another campus
- [ ] Expiration of a course
- [ ] Change in course number
- [ ] Change in course title
- [ ] Change in course credit/type
- [ ] Change in course attributes (department head signature only)
- [ ] Change in instructional hours
- [ ] Change in course description
- [ ] Change in course requisites
- [ ] Change in semesters offered (department head signature only)
- [ ] Transfer from one department to another

**PROPOSED:**

**EXISTING:**

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<th>Subject Abbreviation</th>
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<tr>
<td>Course Number</td>
<td>43800</td>
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<tr>
<td>Long Title</td>
<td>Air-breathing Propulsion</td>
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<td>Short Title</td>
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Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

**CREDIT TYPE**

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 ☐

**COURSE ATTRIBUTES:**

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**COURSE DESCRIPTION (INCLUDE PREREQUISITES/RESTRICTIONS):**

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


**COURSE LEARNING OUTCOMES:**

1. Determine the thrust and fuel consumption of gas turbine and turboprop engines, 2. Understand advantages/disadvantages of turbojet, turboprop, turbobfan, 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

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