

**AAE 590 Aerospace Propulsion  
Course Organization and Information  
Fall Semester, 2017**

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**Objectives:** Provide survey of jet propulsion applications that use gas turbine engines and rockets. Review of compressible flow and thermodynamics fundamentals of propulsion. Students shall demonstrate an understanding of basic concepts and the ability to apply it to propulsion system performance and top-level sizing calculations including thrust; turbine engine flows, components, and efficiencies; velocity triangles; space applications and rocket design; engine cycles and components; solid rocket motors. Students shall be able to apply that understanding to performance and top-level sizing calculations.

**Text:** Hill and Peterson, *Mechanics and Thermodynamics of Propulsion*, Addison Wesley; also texts by Flack, Cumpsty, Sutton, ...

**Prerequisites:** Undergraduate background in compressible flows and thermodynamics.

**Homework:** Homework will typically be assigned on a weekly basis. No late assignments will be accepted.

**Exams:** Three exams approximately equally distributed.

**Grading:** Homework – 25%  
Exams (3) – 60%  
Term paper – 15%

## AAE 490 Course Outline

1. Introduction (Chapter 1, ~ 1 week)
  - Brief history of gas turbine and rocket propulsion development
  - Classification of aerospace propulsion systems
  - Overview of rocket and airbreathing engine configurations
2. Mechanics and Thermodynamics of Fluid Flow (Chapter 2, ~ 2 weeks)
  - Control volumes and thrust equation
  - First and second laws of thermodynamics, gas properties
  - fundamental energy balances
  - Chemical reactions and equilibrium
3. One-Dimensional Flow (Chapter 3, ~ 1 week)
  - Brief review of 1-D compressible isentropic flow
  - Non-isentropic flow

Exam 1 third week in September (approximately)

4. Airbreathing Engines (Chapter 5, ~ 1 week)
  - Turbine engines and ramjets
  - Thermodynamics, performance, and efficiencies
5. Inlets, Combustors, and Nozzles (Chapter 6, ~ 1 week)
6. Compressors and Turbines (Chapters 7-9, ~ 3 weeks)
  - Euler momentum equation, basic concepts
  - Axial compressor and turbine on-design analysis
  - Centrifugal compressor/pump on-design analysis
  - Compressor/turbine maps

Exam 2 last week in October (approximately)

7. Rockets (Chapter 10, ~ 1 week)
  - Rocket types and performance parameters
  - The rocket equation
  - Staging
  - Space and launch missions
8. Liquid Rocket Engines (Chapter 11, ~ 2 weeks)
  - Cycles
  - Combustion chambers and combustor heat transfer
  - Nozzles: types, flow, and thermochemistry
9. Rocket Combustion and Expansion (Chapter 12, ~ 2 weeks)
  - Propellants
  - Solid rocket motors
  - Combustion instability

Exam 3 final exam week during scheduled time