

## ME 4620(5620) Turbomachinery

- 2007 Catalog Data:** ME 4620(5620). Turbomachinery. Lec. 3. Credit 3.  
Prerequisite: ME 3720. Presents a generalized description and unified theory of the design and operation of rotating machinery in which energy transfer occurs due to velocity changes; design methods for various types of turbomachines – pumps, fans, compressors, and turbines. [Elective Course]
- Prerequisites by Topic:**
1. Conservation equations (mass, momentum, and energy for a control volume)
  2. Second law of thermodynamics
  3. Viscous flow theory
  4. One-dimensional isentropic compressible flow theory
- Textbook and Resources:** Turbomachinery: Basic Theory and Applications, E. Logan, Jr.  
Fundamentals of Fluid Mechanics, Munson, Young and Okiishi
- Course Objectives:** To provide the student with a working knowledge of the fluid mechanics of turbomachinery. Emphasis will be on the similarities in operating principles for all types of turbomachines. Dimensional analysis, Eulers turbine equation and velocity diagrams will be used to correlate, classify and predict machine performance.
- Course Topics:**
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|---|--------|
| T1. Introduction, overview and machinery classification   | ( 5 %) |
| T2. Review of conservation laws   | ( 7 %) |
| T3. Dimensional analysis and scaling laws   | ( 7 %) |
| T4. Axial flow fans and compressors   | (14 %) |
| T5. Centrifugal pumps, fans and compressors   | (10 %) |
| T6. Axial and radial flow hydraulic turbines  | ( 7 %) |
| T7. Fluid/rotor energy transfer, velocity diagrams  | (12 %) |
| T8. Section analysis and design using airfoil data  | (12 %) |
| T9. Cascade theory and use of cascade data  | ( 7 %) |
| T10. Inlets, scrolls and diffusers  | ( 7 %) |
| T11. Applied, student interest topics (wind mills/wind turbines, helicopters, prop-driven human-powered vehicles, reversible pump/turbines, turbine flow meters, automotive turbochargers, model airplane propellers, MEMS compressors and turbines, etc. | (12 %) |
- Class/Lab Schedule:** Minimum student contact time - 2200 minutes
- Course Outcomes:** Upon completion of this class, the student will be able to:
- C1. Recognize and explain the differences between true turbomachines and positive displacement devices. [e g]
  - C2. Analyze incompressible, inviscid fluid/rotor energy transfer using Euler's turbine equations. [a e]
  - C3. Construct and analyze velocity diagrams for axial and centrifugal rotors and rotor/stator sets. [a e]
  - C4. Read and interpret performance curves for pumps, fans and turbines. [b e]
  - C5. Use scaling laws to predict turbomachine performance, by interpolation or extrapolation from known performance data. [a e]
  - C6. Specify the appropriate class of prime mover for a given application, based on head, flow and specific speed. [e]
  - C7. Distinguish between cases where "single airfoil" analysis and "cascade" analysis apply. [e]
  - C8. Use section analysis and airfoil data to specify/design a simple axial flow rotor or propeller (to include thrust and torque prediction). [a b c e]
  - C9. Explain the role of inlets, scrolls and diffusers on the operation and performance of pumps, fans and turbines. [e g]

C10. Identify and explain the general loss-producing mechanisms for flow through turbomachine rotors and stators. [e g]

**Professional Component:**

This is an elective course for Mechanical Engineering students who follow an Area of Concentration (AOC) related to "thermal/energy systems." It builds on foundational course material, primarily in the areas of fluid mechanics and thermodynamics, with a blend of additional theory and applications to provide the student with the basic knowledge necessary to engage in professional activities relating to the use of turbomachinery.

**Contribution of Course to Meeting the Professional Component:**

Math and Basic Science:  
General Education:  
Engineering: 3 credit hours  
Other:

**Relation to Program Objectives:**

This course gives students a basic understanding of the types, uses and principles of operation of turbomachines, with which they can: 1) become productively engaged in engineering activities that involve the selection, specification and use of turbomachines and 2) move on into a more advanced, self-directed study of turbomachinery, based on professional need and/or personal interest.

**5000-Level Credit:**

Students registered for 5000-level credit will be given additional assignments commensurate with a graduate-level course. The exact nature of these assignments will be specified by the instructor in the Course Policy for that semester.

**Course Coordinator:**

Undergraduate Program Committee

**Prepared by:**

Jeff A. Marquis

**Date:** 1-15-08