



THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Introduction to Turbomachinery

MECHENG 5427

Credit Hours:

3.00

Course Levels:

Undergraduate (1000-5000 level)

Graduate (5000-8000 level)

Course Components:

Lecture

Course Description:

Introduction to analysis and design of turbomachinery.

Prerequisites and Co-requisites:

Prereq: 3503 or 3504 (504), or Grad standing in MechEng.

Course Goals / Objectives:

- Review the fundamental principles of thermodynamics and fluid flow for steam, air, and combustion gases, and demonstrate their applicability in the analysis of turbomachinery
- Review compressible flow theory including flow through converging nozzles. Students are to develop mastery on how to determine the various flow quantities when inlet and some exit conditions are given
- Students are to learn to use concepts of polytropic exponent and nozzle efficiency in solving nozzle flows with friction and to calculate supersaturated states and states across condensation shocks
- Students are to be able to carry out calculations for impulse stages of turbines, including pressure and velocity compounding as well as reaction stages
- Students are to learn the Euler equation for turbomachinery and the relationships between absolute and relative velocity for flow through stator and rotor passages
- Students are to gain an intuitive understanding of the degree of reaction and how it relates to blade loading and to use principles of similitude
- Students are to learn axial flow turbine and compressor theories to be able to design turbine and compressor stages, including the common ways to account for losses
- Students are to learn the influence of three-dimensional effects on reaction and loading along the blades of an axial machine
- Students are to learn the fundamentals of centrifugal compressors, including the concept of slip and influence of compressibility. They are to learn how a volute is designed.
- The theory for the common types of hydraulic turbines are discussed and students will carry out exercises sufficient to master the methods to calculate the performance of these machines
- The relationship between fluid couplings and torque converters to the radial pumps and turbines will be discussed, as well as how hydrodynamic losses influence their performance
- Introduction to wind turbines is given. The students are to be able to write computer programs to calculate the performance of blades by both actuator disc theory and blade element theory

Course Topics:

- Introduction
- Review of thermodynamics and fluid flow
- Gas dynamics and nozzle flow
- Principles of turbomachinery
- Steam turbines
- Axial turbines
- Axial compressors
- Three dimensional effects
- Centrifugal compressors and pumps
- Hydraulic turbines
- Fluid couplings and torque converters
- Wind turbines

Designation:

Elective