

King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 427: TURBOMACHINERY

Catalogue Description: (3-0-3)

Thermo-fluid dynamics aspects of fluid flow. Kinematic relations and efficiencies of turbomachines. Two dimensional cascades; Turbine and Compressor cascade correlations and performance. Axial Turbines (two dimensional analysis), Axial Flow Compressors and Fans (two dimensional analysis), Centrifugal Compressors and Fans, Radial Flow Turbines, and preliminary design fundamentals of turbomachines and three dimensional considerations.

Status in Curriculum (Required or Elective): Elective

Prerequisites: ME 204, ME 311

Co-requisites: None

Prerequisites by Topics:

- First and second laws of thermodynamics (ME204)
- Gas power cycles (ME204)
- Laws of fluid flow (ME311)

Textbook: **Gas Turbine Theory**, 6th Edition, by H. I.H. Saravanamuttoo, G. F. C. Rogers and H. Cohen, 2009, Prentice Hall.

References:

- 1) **Fluid Mechanics Thermodynamics of Turbomachinery**, S. L. Dixon, Pergamon Press, 1994
- 2) **Principles of Turbomachinery**, R. K. Turton, Chapman and Hall, 1995.
- 3) **Turbomachinery Performance Analysis**, R. I. Lewis, Arnold, 1996

Coordinator: **Dr. M. A. Habib**, Professor of Mechanical Engineering

Goals: (general objectives)

The purpose of the course is to introduce the means by which the energy transfer is achieved in the main types of turbomachines and the different behaviors of individual types in operation. The course aims at introducing preliminary design fundamentals of turbomachines including axial and radial flow turbines and axial and centrifugal flow compressors.

Course Outline (Lecture Topics):

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| 1. Introduction | (1 class) |
| 2. Definition and classification of turbomachines | (2 classes) |
| 3. Basic thermodynamic and fluid mechanics equations | (5 classes) |
| 4. Basics of turbomachinery and efficiency calculations. | (7 classes) |
| 5. Dimensional Analysis and performance laws | (2 classes) |
| 6. Two dimensional cascades | (3 classes) |
| 7. Centrifugal compressors and their preliminary design | (7 classes) |
| 8. Axial flow compressors and their preliminary design | (8 classes) |
| 9. Axial and radial flow turbines and their preliminary design | (8 classes) |
| 10. Tests | (2 classes) |

Design Activities/Projects:

Design analogy introduced in the course is utilized by students in computer assignments and project(s) in which students learn modeling practices necessary to obtain reliable results. One open-ended turbomachinery design project is assigned

Computer Usage:

Design analogy introduced in the course is utilized by students in computer assignments and project(s) in which students learn the proper role of computer simulations in industrial problems. One open-ended turbomachinery computer simulation project is assigned

Laboratory: None

Assessment Tools:

- i- Mid-term Examinations
- ii- Homework Assignments
- iii- Quizzes
- iv- Final Exam
- v- Design project and computer simulations

Course Learning Outcomes:

- I- Demonstrate a basic understanding of laws of fluid flow and thermodynamics in association with the turbomachinery
- II- Tackle turbomachinery problems associated with industry
- III- Design some parts in gas turbine systems.
- IV- Develop computational skills to analyze and design of components such compressor intake, diffusers, and gas turbine exits

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
Course-to-Student outcome mapping	I, II, III, IV	III	III, IV	II	II, III, IV	IV	III, IV	II, IV		IV	II, III
Emphasis*	S	M	M	M	S	L	M	L	L	M	M

* L:: Little/None M: Moderate S: Strong

Status of Continuous Improvement review of this Course:

Date reviewed: -----
Prepared by: Dr. M. A. Habib

Reviewed by: Thermofluids Group
Date prepared: February 24, 2015