Course-Plan

School : ENGINEERING
Department : Mechanical Engineering
Course Code : ME 429
Course Name : Gas Turbine and Compressor

Instructor: Ms. Shikha Bhuyan

1. Abstract:

ME 429 is an elective course offered for the B. Tech. programme under the Department of Mechanical Engineering. The course is developed inline with the analysis used in engine companies. The entire focus of the course is on developing an approach to analyze the gas turbine unit as a complete system. The different components of gas turbine unit are discussed in detailed manner. Centrifugal and axial flow compressors and its elementary airfoil theory is discussed for a clear idea for its wide engineering applications.

2. Objective:

The course shall be taught with the following objectives:

(i) To understand the basic thermodynamics principles behind gas turbines.
(ii) To analyse the basic operation of a gas turbine and its components.
(iii) To understand the various classifications of gas turbine.
(iv) To orient the students for design consideration of turbines, compressors and their blades.
(v) To be able to analyse overall performance of gas turbine power plant.

3. Prerequisites of the course:

ME211 (Thermodynamics)

4. Course outline:

Introduction - Development, classification and field of application of gas turbines.
Gas Turbine Cycle - Ideal and actual cycles; multi-stage compression; reheating, regeneration, combined and cogeneration.
Energy Transfer and Fluid Flow Characteristics - Energy transfer between fluid and rotor; axi-symmetric flow in compressors and gas turbines.
Centrifugal Compressors - Principles of operation; compressor losses; adiabatic efficiency; slip factor; pressure coefficient; power unit; design consideration for impeller and diffuser systems; performance characteristics.
Axial Flow Compressors - Elementary theory; vortex theory; degree of reaction; simple design; elementary air-foil theory; isolated airfoil and cascade theory; three dimensional flow; stages; stage efficiency and overall efficiency; performance characteristics.
Turbines - Axial flow and radial flow turbines; impulse and reaction turbines; fundamental relations and velocity triangles; elementary vortex theory; limiting factors in turbine design; application of airfoil theory to the study of flow through turbine blades; aerodynamic and thermodynamic design considerations; blade materials; blade attachments and blade cooling.
Gas Turbine Power Plants - Fuel and fuel feed systems; combustion systems-design considerations and flame stabilization; regenerator types and design; gas turbine power; plant performance and matching; applications.

5. (a)Time-Plan

Tentative Lecture	Topics
2 lectures	**Introduction:** Development, classification and field of application of gas turbines.
5 lectures	**Gas Turbine Cycle:** Ideal and actual cycles; multi-stage compression; reheating, regeneration, combined and cogeneration.
3 lectures	**Energy Transfer and Fluid Flow Characteristics:** Energy transfer between fluid and rotor; axi-symmetric flow in compressors and gas turbines.
5 lectures	**Centrifugal Compressors**: Principles of operation; compressor losses; adiabatic efficiency; slip factor; pressure coefficient; power unit; design consideration for impeller and diffuser systems; performance characteristics.
6 lectures	**Axial Flow Compressors:** Elementary theory; vortex theory; degree of reaction; simple design; elementary air-foil theory; isolated airfoil and cascade theory; three dimensional flow; stages; stage efficiency and overall efficiency; performance characteristics.
7 lectures	**Turbines:** Axial flow and radial flow turbines; impulse and reaction turbines; fundamental relations and velocity triangles; elementary vortex theory; limiting factors in turbine design; application of airfoil theory to the study of flow through turbine blades; aerodynamic and thermodynamic design considerations; blade materials; blade attachments and blade cooling.
7 lectures	**Gas Turbine Power Plants:** Fuel and fuel feed systems; combustion systems-design considerations and flame stabilization; regenerator types and design; gas turbine power; plant performance and matching; applications.

Textbooks

1. Cohen and Rogers. Gas Turbine Theory (Longman, 4/e, 1996)
2. Dixon, S.L. Fluid Mechanics, Thermodynamics of Turbomachinery (Pergamon Press, 5/e, 2005).

References

1. Vincent, Theory & Design of Gas Turbine and Jet Engines (McGraw Hill, 1950)
2. Gas Turbine Principles and Practice (Cox Newnes, 1955)
3. Introduction to the Gas Turbine (Shepherd Constable, 1960)
4. Zucrow, Jet Propulsion and Gas Turbine (John Wiley, 1951)

5. (b) Evaluation Plan:

Test No.	Marks	Duration (minutes)
I	25	45
II (Major I)	40	75
III	25	Assignment type
IV (Major II)	60	120
Total Marks	150	

All the tests will be held as per the schedule notified by the Controller of Examinations, Tezpur University

6. Pedagogy:

Teaching-learning methods to be used:
Lecture and Discussion
Presentations
Assignments
Class Tests/Quiz

7. Expected outcome:

The contents which are covered in "**Gas Turbine and Compressor**" are the concepts towards Mechanical Engineering in industrial applications. Towards the end of the course the student would be able to:

i. Discuss the basic energy equation and thermodynamics law behind the gas turbine.
ii. Understand the improvements brought to gas turbine plants in terms of performance.
iii. Explain the elementary theories for compressors
iv. Design the gas turbine units and its blades.