

TURBO MACHINES
B.E, VSemester, Mechanical Engineering
[As per Choice Based Credit System (CBCS) scheme]

Course Code	17ME53	CIE Marks	40
Number of Lecture Hours/Week	04	SEE Marks	60
Total Number of Lecture Hours	50(10 Hours per Module)	Exam Hours	03

Credits – 04

Course Objectives:

- The course aims at giving an overview of different types of turbomachinery used for energy transformation, such as pumps, fans, compressors, as well as hydraulic and steam turbines.
- Explain the working principles of turbomachines and apply it to various types of machines
- It will focus on application of turbo machinery in power generation, power absorption and transportation sectors.

Module - 1

Introduction: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynolds number, Unit and specific quantities, model studies.

(Note: Since dimensional analysis is covered in Fluid Mechanics subject, questions on dimensional analysis may not be given. However, dimensional parameters and model studies may be given more weightage.)

Thermodynamics of fluid flow: Application of first and second law of thermodynamics to turbo machines, Efficiencies of turbo machines, Static and Stagnation states, Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process

Module - 2

Energy exchange in Turbo machines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.

General Analysis of Turbo machines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.

Module - 3

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor.

Reaction turbine – Parsons's turbine, condition for maximum utilization factor, reaction staging. Problems.

Module - 4

Hydraulic Turbines: Classification, various efficiencies. **Pelton turbine** – velocity triangles, design parameters, Maximum efficiency. **Francis turbine** - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. **Kaplan and Propeller turbines** - velocity triangles, design parameters. Problems.

Module - 5

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems. **Centrifugal Compressors:** Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems. **Axial flow Compressors:** Expression for pressure ratio developed in a stage, work done factor, efficiencies and stalling. Problems.

Course outcomes:

- Able to give precise definition of turbomachinery
- Identify various types of turbo machinery
- Apply the Euler's equation for turbomachinery to analyse energy transfer in turbomachines
- Understand the principle of operation of pumps, fans, compressors and turbines.
- Perform the preliminary design of turbomachines (pumps, rotary compressors and turbines)
- Analyze the performance of turbo machinery.

TEXT BOOKS:

1. An Introduction to Energy Conversion, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008.
2. Turbo Machines ,B.U.Pai , 1st Editions, Wiley India Pvt, Ltd.
3. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill Co. Ltd., 2nd edition, 2002

REFERENCE BOOKS

1. Principals of Turbo machines, D. G. Shepherd, The Macmillan Company (1964).
2. Fluid Mechanics & Thermodynamics of Turbo machines, S. L. Dixon, Elsevier (2005).
3. Text Book of Turbo machines, M. S. Govindgouda and A. M. Nagaraj, M. M. Publications, 4Th Ed, 2008.


H. O. D.