

ME453: TURBOMACHINERY
CREDITS = 5 (L=3, T=0, P=2)

Course Objective:

To analyze and design turbo machines for efficient energy transfer.

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Assessment Scheme				Total Marks
L	T	P		Theory		Practical		
				ESE	CE	ESE	CE	150
3	0	2	5	70	30	30	20	

Course Contents:

Unit No.	Topics	Teaching Hours
1	<u>Introduction:</u> Definition of Turbomachine, Dimensional analysis and performance laws, incompressible fluid analysis, variable geometry turbomachines, compressible fluid analysis.	05
2	<u>Energy Transfer in Turbomachinery:</u> The continuity equation, Euler's turbine equation in terms of velocity and its application to different turbomachine, degree of reaction, efficiencies of turbomachine, small stage efficiency or polytropic efficiency.	06
3	<u>Two dimensional Cascade:</u> Nomenclature of blade and cascade, blade arrangement in compressor cascade and turbine cascade, analysis of cascade forces, efficiency of compressor cascade, cascade performance and working range of cascade.	06
4	<u>Centrifugal compressor:</u> Stage velocity triangle, enthalpy- entropy diagram, stage analysis, slip factor, diffuser, volute casing, stage losses and performance characteristics.	06

Unit No.	Topics	Teaching Hours
5	<p>Three Dimensional Flow in Axial Turbomachine: Theory of radial equilibrium, The indirect problem and the direct problem, Design with free vortex flow, forced vortex flow and general whirl distribution.</p> <p>Centrifugal and Axial fan stage: Fan applications, Types of centrifugal fan, design parameters, losses, fan bearings, fan noise; types of axial fan stages.</p>	12
6	<p>Radial flow Turbines: Velocity triangle and h-s diagram of radial turbine stage, Spouting velocity, stage efficiency and degree of reaction.</p> <p>Wind Turbine: Wind turbine aerodynamics, Analysis of Horizontal axis wind turbine and Vertical axis wind turbine.</p>	07
TOTAL		42

List of References:

1. S. L. Dixon, "Fluid Mechanics and Thermodynamics of Turbomachinery", Fourth Edition, Butterworth Heinemann, 1998.
2. B. K. Venkanna, "Fundamentals of Turbomachinery", First Edition, PHI Learning Pvt. Ltd.
3. S M Yahya, "Turbines, Compressors and Fans", Fourth Edition, Tata McGraw Hill Education Pvt. Ltd.
4. V. Kadambi & Manohar Prasad, "An Introduction to Energy Conversion Vol. III, Turbomachinery". First Edition, Wiley Eastern Limited.
5. H. Cohen, C. F. G. Rogers, HIH Saravanamuttoo, "Gas Turbine Theory"

Course Outcomes (COs):

At the end of this course students will be able to ...

1. Interpret and apply performance laws to turbomachines of different types.
2. Determine energy transfer in turbomachines of different designs
3. Analyze flow through two dimensional turbine and compressor cascade.
4. Analyze flow through centrifugal compressor and its performance.
5. Design axial flow turbomachine with radial equilibrium.
6. Analyze flow through radial flow turbine and wind turbine.