GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering
Subject Code: 3150102
Semester –V
Subject Name: Fundamentals of Turbomachines

Type of course: Professional core course

Prerequisite: Fluid Mechanics, Thermodynamics

Rationale: Recent emphasis on energy problems has generated renewed interest in optimized design and performance of turbines and compressors, the main components of Aircraft jet engines. The course imparts fundamental understanding of flow physics, velocity and energy change across turbines and compressors and losses offered by them. The efficiency of each of them affects overall efficiency of aircraft engine and thrust developed.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	Weightage %
1	Fundamentals of Turbomachines: Turbo machines, Turbines, Pumps and compressors, Fans and blowers, Incompressible and compressible flow machine, Stages of Axial, radial, mixed, reaction and impulse. Variable reaction stage, Multistage, Stage velocity triangle, Design and off-design conditions	**4**	**10**
2	Axial Flow Compressor: Introduction, Geometry and working principle, Stage velocity triangles, H-S diagram, Flow through blade row, Stage losses and efficiency, Work done factor, Low hub-tip ratio, Supersonic and transonic stages, Performance characteristics	**10**	**25**
3	Centrifugal flow compressors: Introduction and different parts of centrifugal compressor, Principles of operation, H-S diagram, Nature of impeller flow, Slip factor, Diffuser, Volute casing, Performance characteristics and losses in centrifugal compressor.	**10**	**20**
4	Axial Turbine: Introduction, Stage velocity triangle, Single impulse stage, Multistage velocity compounded impulse and Multistage pressure compounded impulse, Reaction stages, Blade to gas speed ratio, Losses and efficiencies, Performance charts, Low hub-tip ratio stage, Turbine Blade Cooling techniques :-Internal cooling & External cooling	**10**	**25**
5	Radial Turbine: Elements of radial turbine stage, Stage velocity triangles, H-S diagram, Stage losses, Outward flow radial stage and Performance characteristics	**6**	**10**

6	Component Matching and Performance Evaluation: Introduction, Equilibrium running diagram, Determination and procedure to find equilibrium points, General matching procedure of jet engines	**5**	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
25%	**35%**	**25%**	**10%**	**5%**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Compressors Turbines and Fans: S.M.Yahya, Tata-McGraw Hill Publishing Company Ltd, New Delhi
2. Gas Turbine, Ganesan, Tata-McGraw Hill Publishing Company Ltd, New Delhi
3. Gas turbine theory, Cohen & Rogers, Longman Green & Co. Ltd, Orient
4. Elements of Gas Turbine Propulsion, Mattingly
5. Gas turbine Theory, Longman Private Ltd Khajooria & Dubey
6. Mechanics and Thermodynamics of Propulsion, Philip G. Hill & Carl Peterson Addison Wesely: Longman, Inc
7. A Treatise on Turbo machines, Gopalakrishnan .G and Prithvi Raj .D, Scifech Publications
8. Hand book of Turbomachinery, Earl Logan, Jr. Marcel Dekker Inc., 1992

Course Outcomes:

Upon completion of this course students should be able to:

Sr. No.	CO statement	Marks % weightage
CO1	Understand to apply physics of flow through turbomachines like compressors, fans, blowers and turbine	20
CO2	Perceive basic terms and effect of flow on the turbomachines	35
CO3	Interpret Matching and Performance Evaluation of the gas turbine engine components	15
CO4	Analyze the performance and losses in turbines and compressors	20
CO5	Choose turbine and compressor rotor/ rotor blade for particular application in aviation and gas turbine plants	10

List of Experiments:

1. To Study the different types of turbomachines.
2. To study about performance parameters of turbomachines.
3. Performance test on Impulse turbine.
4. Performance test on Reaction turbine.
5. Performance test on centrifugal pump.
6. Performance test on axial flow fan.
7. Performance test on centrifugal blower.
8. Performance test on axial compressor stage.
9. To design compressor rotor blade.
10. To study losses occurred in turbomachines.

List of Open Source Software/learning website:
https://nptel.ac.in/