GUJARAT TECHNOLOGICAL UNIVERSITY

AERONAUTICAL ENGINEERING (01)
FUNDAMENTALS OF TURBO MACHINES
SUBJECT CODE: 2150102
B.E. 5thSEMESTER

Type of course: Engineering Science.

Prerequisite: Fluid Mechanics and Thermodynamics

Rationale: Turbomachines is required to study as all jet engines are having compressor and turbine as their basic rotating components. The subject offers the thorough knowledge of fluid flow pattern, basic working principles and need of rotating element as per its requirement in aircrafts.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	1	0	5	70	20	10	30	0	20	150

Content:

Sr. No	Topics	Teaching Hrs.	Module Weightage
1.	**Fundamentals of Turbomachines:** Turbo machines, Turbines, Pumps and compressors, Fans and blowers, Incompressible and compressible flow machine, Stages: Axial, radial, mixed, reaction and impulse. Variable reaction stage, Multistage, Stage velocity triangle, Design and off-design conditions.	**04**	**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**	**20 %**
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 ration stage.	**10**	**20 %**
5	**Radial Turbine:** Elements of radial turbine stage, Stage velocity triangles, H-S diagram, Stage losses, Outward flow radial stage and Performance characteristics.	**10**	**20%**
6	**Component Matching and Performance Evaluation:**	**08**	**10%**

	Introduction, Buckingham's theorem, Principle of similarity, Incompressible & compressible flow machine, Performance characteristics, Equilibrium running diagram, Determination and procedure to find equilibrium points, Performance evaluation of single spool turbojet engine, Operating line, General matching procedure and transient operation.		

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%**	**05%**	**05%**	**-**

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. Gas turbine Theory: Longman Private Ltd Khajooria & Dubey.
5. Elements of Gas Turbine Propulsion: Mattingly.
6. Mechanics and Thermodynamics of Propulsion: Philip G. Hill & Carl Peterson Addison Wesely: Longman, Inc.

Course Outcome:

After learning the course the students should be able to

1. Understand to apply physics of flow through turbomachines.
2. Understand the basics losses involved in turbomachines
3. Understand the radial machines and axial machines their need and applications for propulsion of jet engines.

List of Tutorial:

1. Introduction to turbomachines.
2. Numerical based on axial turbine stage
3. Numerical based on axial compressor stage
4. Numerical based on centrifugal stage
5. Numerical based on radial turbine stage
6. Matching of turbines and compressor
7. Study of flow pattern through turbomachines
8. Loss analysis for the cascade

Major Equipments:

CFD Tutor, Ansys, Matlab

List of Open Source Software/learning website: http://nptel.iitm.ac.in/courses.php

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.