Birla Institute of Technology & Science, Pilani
Hyderabad Campus

FIRST SEMESTER 2022-2023

Course Handout Part II

Date: 01/09/2022

In addition to Part-I (a general handout for all the courses appended in the time table) this portion gives further specific details regarding the course.

Course No. : ME G514
Course Title : TURBOMACHINERY
Instructor-in-Charge : JEEVAN JAIDI
Lab Instructors : Jeevan Jaidi, N. Jalaiah, G Prashanth Kumar Reddy

1. Course Description:

Introduction, thermodynamics, gas turbine plants, steam turbine plants, fluid dynamics, dimensional analysis and performance parameters, flow through cascades, axial turbine stages, high temperature turbine stages, axial compressor stages, centrifugal compressor stages, radial turbine stages, axial fans and propellers, centrifugal fans and blowers, and wind turbines.

2. Scope and Objective:

The broad objective of this course is to introduce and familiarize students with various elements of turbomachinery. The course mainly aims at giving analytical treatment to various turbomachines (pumps, compressors, fans, blowers and turbines), which will help to understand practical situations at the design stage as well as during their operations.

3. Text Book (TB):

(a) TB1: B. K. Venkanna, *Fundamentals of Turbomachinery*, PHI Learning Pvt Ltd. 2012.

4. Reference Book (RB):

(a) RB1: B. U. Pai, *Turbomachines*, Wiley India Pvt. Ltd., 1st edition, 2013.
(b) RB2: S. L. Dixon, and C. A. Hall, *Fluid Mechanics and Thermodynamics of Turbomachinery*, Elsevier, 6th edition, 2010.
(c) RB3: Rama S.R. Gorla, Aijaz A. Khan, *Turbomachinery: Design and Theory*, CRC Press, 2003.
(d) RB4: Budugur Lakshminarayana, *Fluid Dynamics and Heat Transfer of Turbomachinery*, John Wiley & Sons, 1995.

5. Course Plan:

Lecture No.	*Learning objectives*	*Topics to be covered*	*Chapter/ Section*
1-7	Introduction to principles of thermodynamics and fluid	Introduction, comparison between PDM and TM, types of TM, basic laws and	TB: Ch. 1

	mechanics, types of turbomachines, gas turbine plants and steam turbine plants	equations, dimensional analysis, model parameters and their significance, unit quantities	
8-12	Energy transfer in turbomachines	Euler equation, components of energy transfer, degree of reaction, utilization factor, velocity triangles, analysis of turbomachines	TB: Ch. 2
13-20	Operation principle and key parameters of centrifugal compressors and pumps	Working principle, main parts, work done and pressure rise, influence of key parameters and surging, work done analysis	TB: Ch. 4
21-25	Operation principle and key parameters of axial flow compressors	Principle of operation T-E diagram, influence of key parameters, combined velocity analysis, work done analysis	TB: Ch.5
26-32	Operation principle and key parameters of steam and gas turbines	Principle of operation, method of compounding velocity triangle analysis, multi-stage analysis	TB: Ch. 6
33-38	Operation principle and key parameters of hydraulic turbines	Classification, main components, unit quantities, velocity triangles, work done and efficiencies, draft tube, comparison of hydraulic turbines	TB: Ch. 7
39-40	Operation principle and key parameters of wind turbines	Principle of operation, classification blade design, siting constraints, maintenance issues	Class notes

6. Evaluation Scheme:

Component	*Weightage (%)*	*Duration (min.)*	*Date & Time*
Midsem	20	90	Closed book; 05/11 1.30 - 3.00PM
Lab Experiments (#12) with Reports and Vivas (#2)	25 (= 15+10)	–	Open book: Evenly spaced throughout the semester
Project Seminars (Mid- and End-sem)	15	–	Open book: Evenly spaced throughout the semester
Comprehensive Examination	40	180	Closed book: 30/12 AN

7. List of Experiments:

Sr. No.	*Name of Experiment*	*Laboratory*
1.	Performance Study of Centrifugal Pump in Series and Parallel Arrangements	Hydraulic Machines
2.	Performance Study of Submersible Pump Test Rig	Hydraulic Machines
3.	Centrifugal Blower with Constant and Variable Speeds (Radial Curved Blades)	Hydraulic Machines
4.	Centrifugal Blower with Variable Speed (Forward and Backward Curved Blades)	Hydraulic Machines
5.	Centrifugal Blower with Constant Speed (Forward and Backward Curved Blades)	Hydraulic Machines
6.	Performance Study of Axial Fan	Hydraulic Machines
7.	Performance Study of Francis Turbine	IC Engines
8.	Performance Study of Kaplan Turbine	IC Engines
9.	Performance Study of Pelton Wheel	IC Engines
10.	Steam Power Plant Test Rig; (a) Boiler Efficiency (b) Plant Efficiency (c) Heat Balance Sheet	IC Engines
11.		
12.		

8. Chamber Consultation Hour:

To be announced in the class.

9. Notices:

All notices concerning this course will be displayed in *CMS (institute's web-based Course Management System)*. Students are advised to visit *CMS* regularly for all notices and updates.

10. Make-up Policy:

Make-up request for tests shall be granted only for the *genuine* case with sufficient evidence. Request letter duly signed by the student must reach the undersigned at least one day before the scheduled test.

11. Academic Integrity Policy:

It is expected that in compliance with institute rules and regulations, academic integrity should be adhered to in all the evaluation components. No type of academic dishonesty is acceptable and malpractice in any form will have serious implications.

INSTRUCTOR-IN-CHARGE (ME G514)