BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE-PILANI - HYDERABAD CAMPUS
ACADEMIC - UNDERGRADUATE STUDIES DIVISION, SECOND SEMESTER 2024 - 2025
(COURSE HANDOUT PART II)

Date: 07/01/2025

In addition to part-I (general handout for all courses in the time-table), this handout provides the specific details regarding the course.

Course No.: ME F341

Course Title: PRIME MOVERS AND FLUID MACHINES

Instructor-in-charge: Nandanavanam Jalaiah

Instructor(s): Nandanavanam Jalaiah, Morapakala Srinivas, Kolanu Sai Sandeep, Meduri Sitaram, Sibin V Mathew, Lingampally Swetha, G Prashanth Kumar Reddy, Karthy A, Kaleru Sai Kiran, Joshua Kumar Saladi, Raviteja Nimmala

1. **Course Description**: Theoretical analysis of energy and momentum transfer between fluid and rotor; principles of axial, mixed and radial flow compressors, turbines and pumps; design considerations; cascade aerodynamics and performance limitations; applications to power plant systems; model similitude for turbo-machines; Introduction to fluid power system, laboratory exercises in testing reciprocating machines, rotary machines and fluid power system.

2. **Scope and Objective:** This course is intended to familiarize the students with theoretical analysis of energy and momentum transfer between the fluid and rotor. The working principles, design considerations, performance and application aspects of turbo machines will be dealt with. Classification, descriptive details and performance of rotary machines and reciprocating machines will be discussed.

3. **Text Book**:

   1. B.K. Venkanna, Fundamentals of Turbomachinery, PHI Learning Private Limited, New Delhi, 2009.
   2. Jagdish Lal, Hydraulic Machines, Metropolitan Book Company Private limited, New Delhi, 1975.

   Reference Books:

   1. V. Kadambi and M. Prasad, An Introduction to Energy Conversion, New Age International Private Limited, Vol III Turbomachinery, 2nd Edition, 2011.
   2. S. K. Agarwal, Fluid Mechanics and Machinery, Tata McGraw Hill Publishing Company Limited, New Delhi, 1999.

4. **Course Plan**:

Lecture Nos.	Learning Objectives	Topics to be covered	Reference Chapter in TB/RB
1	To review the basic concepts of fluid mechanics and machinery.	Fluid mechanics principles; components of turbo machines; classification; energy exchange in turbo machines.	TB1: Ch 2, RB1: Ch 1
2-3	To understand dimensional analysis as applied to fluid machines.	Methods of dimensional analysis; Buckingham π Theorem; dimension less numbers; principles of similarity; model testing of pumps and turbines.	TB1: Ch 1
4-5	To understand the classification of hydraulic turbines; principles of analysis.	Introduction; elements of hydroelectric power plant; classification of turbines; fundamental equation of hydraulic machines; head and efficiency of turbines.	TB2: Ch 4, RB1: Ch 6

Lecture Nos.	Learning Objectives	Topics to be covered	Reference Chapter in TB/RB
6-8	To understand the analytical principles of various hydraulic turbines.	Impulse turbines; reaction turbines; application of aerofoil theory; governing of turbines; characteristics of turbines; selection of turbines.	TB1: Ch 7
9-10	To understand the classification of pumps, and their working principles. analysis of reciprocating pumps.	Introduction; reciprocating pumps.	TB2: Ch 11, RB2: Ch 14
11-12	To understand the analytical principles of centrifugal pumps.	Centrifugal pumps; classification; basic equations of analysis; curvature of blades; velocity triangles; problems on the above topics.	TB1: Ch 4, RB1: Ch 7
13-15	To understand thermodynamic and analytical principles behind the flow of fluids through nozzles and blade passages.	Introduction; critical pressure ratio & maximum discharge; effect of nozzle efficiency; meta stable flow of steam in nozzles; effect of super saturation; numerical problems	TB2: Ch 3, RB2: Ch 2, & class notes
16-18	To understand the classification of steam turbines and basic principles of analysis.	Introduction; compounding of steam turbines; velocity diagrams of moving blades.	TB1: Ch 6
19-21	To understand the analysis of various steam turbines.	Impulse turbines; reaction turbines; degree of reaction; stage efficiency; turbine efficiency & reheat factor; losses in steam turbines; governing.	TB1: Ch 3, RB1: Ch 3
22-24	To understand classification; working & analytical principles of gas turbines.	Introduction; elementary design of turbines; gas turbine blading; numerical problems.	TB1: Ch 6, RB1: Ch 4
25-26	To understand classification; working & analytical principles of various compressors.	Introduction; classification; reciprocating compressors; multi stage compression with inter cooling.	TB1: Ch 5, RB2: Ch 15
27-28	To understand the analytical principles of centrifugal compressors and various other compressors.	Centrifugal compressors; slip in centrifugal compressors; stagnation values in centrifugal compressors; axial flow compressors; cascade flow; velocity triangles; work done and degree of reaction.	TB1: Ch 5, RB1: Ch 5

Tutorial Class		Practical Class	
No.	Topic	Cycle 1 (Venue: IC Engines Laboratory)	
1	Dimensional analysis	1	Performance characteristics of Pelton Turbine
2	Hydraulic Turbines – Impulse	2	Performance characteristics of Francis Turbine
3	Hydraulic Turbines – Reaction	3	Performance characteristics of Kaplan Turbine
4	Reciprocating Pump	4	Performance characteristics of Diesel Engine
5	Centrifugal Pump	5	Performance characteristics of Petrol Engine
6	Steam Nozzle	Cycle 2 (Venue: Hydraulics Machines Laboratory)	
7	Steam Turbines – Impulse	1	Performance studies on Reciprocating Pump Test Rig
8	Steam Turbines – Reaction	2	Performance studies on Centrifugal Pump in series and parallel combination
9	Gas Turbine	3	Performance studies on Gear Pump
10	Reciprocating Compressor & Centrifugal Compressor	4	Performance studies on Variable Speed Centrifugal Blower
		5	Performance characteristics of Axial Flow Fan

5. Evaluation Scheme:

Evaluation Component	Duration (min)	Weightage (%)	Date & Time	Nature of the Component
Tutorial Class Evaluation	15	15	Tutorial Class (Best 5 out of 6)	**OB**
Lecture Class Evaluation	15	10	Lecture Class (Best 3 out of 4)	**OB**
Lab Reports & Quiz*	-	15	Continuous	**OB**
Lab Compre	-	5	Last week of the semester	**CB**
Mid-Sem Test	90	20	08-03-2025 9.30 AM – 11.00 AM	**CB**
Comprehensive Exam	180	35	14-05-2025, FN	**CB**

* Lab Quiz (closed book) shall be conducted in the CAD Lab for two times.

6. Chamber Consultation Hour: To be announced in the classroom.

7. Notices: Students are advised to visit regularly **LMS** (institute's web-based course management system) for updates and notices.

8. Make-up Policy: Make-up will be granted only to genuine cases with prior permission from the IC. For cases related to illness, proper documentary evidence is essential.

9. Academic Honesty and Integrity Policy: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

Instructor-in-charge
ME F341