Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2021-22

Course Handout Part II

Date: 15/01/2022

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 F341
Course Title	:	PRIME MOVERS AND FLUID MACHINES
Instructor-in-Charge	:	JEEVAN JAIDI
Tutorial Instructors	:	K. Uday Kumar Reddy, G. Prashanth Kumar Reddy, B. Ramana Murthy, B. Sravya, Mrinal Ketan Jagirdar, Jeevan Jaidi
Lab Instructor	:	K. Uday Kumar Reddy, G. Prashanth Kumar Reddy, B. Ramana Murthy, Santanu Prasad Datta, Mrinal Ketan Jagirdar, Pardha Saradhi Gurugubelli

1. Course Description:

Introduction on fluid machines; basic principles of thermodynamics and fluid dynamics; dimensional analysis and model parameters; working principle, design and analysis of centrifugal and reciprocating pumps, centrifugal and axial compressors, centrifugal and axial turbines, steam and gas turbine power plants; compounding; multistage axial flow turbines; axial fans; centrifugal fans and blowers.

2. Scope and Objective:

The objective of this course is to familiarize students with different fluid machines. The course primarily aims at giving the analytical treatment of turbomachines, which will help students to understand practical situations at a design stage as well as during the operations. Also, the overall knowledge gained on fluid machinery would help in selection of fluid machines with right specifications for various practical requirements.

3. Text Books (TBs):

(a) TB1: Venkanna B. K., Fundamentals of Turbomachinery, 6th Print (2009), PHI, New Delhi.
(b) TB2: Dr. Jagdish Lal, Hydraulic Machines, 6th Edition (1975), Metropolitan Book Company Pvt. Ltd., New Delhi.

4. Reference Books (RBs):

(a) RB1: Kadambi V., Manohar Prasad, An Introduction to Energy Conversion, vol. III, 2nd Edition (2011), NAIL
(b) RB2: Agarwal S. K., Fluid Mechanics and Machinery, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

5. Course Plan:

Lecture No.	*Learning objectives*	*Topics to be covered*	*Chapter in the Text Book*
1-2	To review the basics of thermodynamics, fluid dynamics, and fluid machines.	Basics of Thermodynamics and Fluid Dynamics; Classification and elements of turbomachines; Energy conversion/Euler equation.	TB1: Ch 2; RB1: Ch 1
3-5	Application of dimensional analysis and similitude techniques to fluid machines.	Dimensional analysis; Buckingham theorem; Dimensionless parameters; Principles of similarity; Model testing; Problem solving.	TB1: Ch 1
6-8	To understand the types of pumps, and the analytical treatment of centrifugal pumps.	Introduction and classification of pumps; Basic elements and equations of centrifugal pumps; Blade profiles and velocity triangles; Problems solving.	TB1: Ch 4; RB1: Ch 7
9-11	To understand the working principle, and the analytical treatment of reciprocating pumps.	Basic elements, equations and analysis of reciprocating pumps; Air-vessels; Problem solving.	TB2: Ch 11; RB2: Ch 14
12-14	To understand the classification and working principles of compressors.	Introduction and classification of compressors; Reciprocating compressors; Multi-stage compression with inter cooling; Problem solving.	TB1: Ch 5; RB2: Ch 15
15-17	To understand the analytical treatment of centrifugal and axial compressors.	Centrifugal compressors; Slip and stagnation properties; Axial flow compressors; Cascade flow; Velocity triangles; Work done and degree of reaction; Problems solving.	TB1: Ch 5; RB1: Ch 5
18-19	To understand the classification, working principles, and analysis of hydraulic turbines.	Elements of hydro power plant; Classification of hydraulic turbines; Fundamental equations; Head, work done and turbine efficiencies.	TB2: Ch 4; RB1: Ch 6
20-22	To understand the performance of various hydraulic turbines.	Impulse turbines; Reaction turbines; Application of aerofoil theory; Characteristics of turbines; Draft tube; Selection criterion; Problems solving.	TB1: Ch 7
23-24	To understand the classification, and working principles of steam turbines.	Introduction to steam turbines; Velocity and pressure compounding; Velocity triangles.	TB1: Ch 6; RB1: Ch 4
25-26	To understand the analysis of various steam turbines.	Impulse steam turbines; Reaction steam turbines; Work done and degree of reaction; Stage efficiency; Reheat factor; Losses in steam turbines; Problems solving.	TB1: Ch 6
27-28	To understand the analytical treatment of fluid flow through nozzles and blade passages.	Critical pressure ratio; Maximum discharge; Nozzle efficiency; Meta-stable flow of steam in nozzles; Effect of super saturation.	TB1: Ch 3; RB1: Ch 3
29-30	To understand the classification, working, and analytical principles of gas turbines.	Introduction; Elementary designs; Gas turbine blading; Problems solving.	TB1: Ch 6; RB1: Ch 4

6. Evaluation Scheme:

Component	*Duration (min.)*	*Weightage (%)*	*Date & Time*	*Nature of Component*
Midsem Test	90	25	11/03 9.00am to10.30am	Closed Book
Tutorial Tests (#4)	20	10	To be conducted in lectures (#2), and tutorials (#2)	Open Book
Laboratory Experiments (#10): Reports & Viva	120	25 (15+10)	Continuous throughout the semester	Open Book
Comprehensive Examination	120	40	09/05 FN	Closed Book

7. **Chamber Consultation Hour:**

To be announced in the class.

8. 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.

9. 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.

10. Laboratory Experiments:

The experiments include different power producing and consuming fluid machinery (pumps, compressors, blowers, turbines) and performance tests on various IC engines. Details of experiments with titles, and operation modalities (submission of reports, evaluation, viva, etc.) shall be discussed and shared on the first day of laboratory session.

11. **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)