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| B. E. MECHANICAL ENGINEERING<br>Choice Based Credit System (CBCS) and Outcome Based Education (OBE) | | | |
|---|---|---|---|
| SEMESTER - V | | | |
| TURBO MACHINES | | | |
| Course Code | 18ME54 | CIE Marks | 40 |
| Teaching Hours/Week (L:T:P) | 3:0:0 | SEE Marks | 60 |
| Credits | 03 | Exam Hours | 03 |

Course **Learning Objectives:**

- Understand typical design of Turbo machine, their working principle, application and thermodynamics process involved.
- Study the conversion of fluid energy to mechanical energy in Turbo machine with utilization factor and degree of reaction.
- Analyse various designs of steam turbine and their working principle.
- Study the various designs of hydraulic turbine based on the working principle.
- Understand the various aspects in design of power absorbing machine.

**Module-1**

**Introduction**: Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Unit and specific quantities, model studies and its numerical.

(Note: Since dimensional analysis is covered in Fluid Mechanics subject, questions on dimensional analysis may not be given. However, dimensional parameters and model studies may be given more weightage.)

**Thermodynamics of fluid flow**: Application of first and second law of thermodynamics to turbo machines, Efficiencies of turbo machines, Static and Stagnation states, overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process. Simple Numerical on stage efficiency and polytropic efficiency.

**Module-2**

**Energy exchange in Turbo machines**: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.

General **Analysis of Turbo machines**: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Effect of blade discharge angle on energy transfer and degree of reaction, Effect of blade discharge angle on performance, , General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Numerical Problems.

**Module-3**

**Steam Turbines**: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Numerical Problems.

**Reaction turbine** – Parsons's turbine, condition for maximum utilization factor, reaction staging. Numerical Problems

**Module-4**

**Hydraulic Turbines**: Classification, various efficiencies.

**Pelton Wheel** – Principle of working, velocity triangles, design parameters, maximum efficiency, and numerical problems.

**Francis turbine** – Principle of working, velocity triangles, design parameters, and numerical problems

**Kaplan and Propeller turbines** - Principle of working, velocity triangles, design parameters and Numerical Problems. Theory and types of Draft tubes.

**Module-5**

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**Centrifugal Pumps**: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Theoretical head – capacity relationship, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

**Centrifugal Compressors**: Stage velocity triangles, slip factor, power input factor, Stage work, Pressure developed, stage efficiency and surging and problems.

**Course Outcomes:** At the end of the course, the student will be able to:

CO1: Model studies and thermodynamics analysis of turbomachines.

CO2: Analyse the energy transfer in Turbo machine with degree of reaction and utilisation factor.

CO3: Classify, analyse and understand various type of steam turbine.

CO4: Classify, analyse and understand various type of hydraulic turbine.

CO5: Understand the concept of radial power absorbing machine and the problems involved during its operation.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

| Sl | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbook/s** | | | | |
| 1 | An Introduction to Energy Conversion, Volume III, Turbo machinery | V. Kadambi and Manohar Prasad | New Age International Publishers | reprint 2008 |
| 2 | Turbo Machines | B.U.Pai | Wiley India Pvt, Ltd | 1st Edition |
| 3 | Turbo machines | M. S. Govindegowda and A. M. Nagaraj | M. M. Publications | 7Th Ed, 2012 |
| 4 | Fundamentals of Turbo Machinery | B.K Venkanna | PHI Publishers | |
| **Reference Books** | | | | |
| 1 | Turbines, Compressors & Fans | S. M. Yahya | Tata McGraw Hill Co. Ltd | 2nd edition, 2002 |
| 2 | Principals of Turbo machines | D. G. Shepherd | The Macmillan Company | 1964 |
| 3 | Fluid Mechanics & Thermodynamics of Turbo machines | S. L. Dixon | Elsevier | 2005 |