III B.Tech I Semester

15AME30 - ADVANCED THERMAL ENGINEERING

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Course Objective:

- This subject is designed to provide a sound knowledge in various aspects of thermal equipment's.
- This subject has an increasingly dominant role to play in the vital areas of power generation ,Automobiles, R&AC and energy sector. .

UNIT I

Basic Concepts: Rankine Cycle - Schematic Layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat Addition, Methods to Improve Cycle Performance - Regeneration - Reheating- Combined- Cycles.

Learning Outcome & Suggested Student Activities:

Student can be able to illustrate the power generation through Rankine cycle. Student can able understand efficiency enhancement methods of Reheating and regeneration. Student can able to understand the key role of quality of steam after evaporation.

Students are advised to be acquainted with the terms related to steam, steam tables and mollierchart. Also, students are advised to visit the thermal power station to get real expose.

UNIT II

Boilers: Classification Based on Working Principles & Pressures of Operation - L.P & H.P. Boilers

Steam Condensers: Requirements of steam condensing plants – Classification of condensers – working principles of different types – vacuum efficiency and condenser efficiency, air pump – cooling water requirement

Learning Outcome & Suggested Student Activities:

Student can able to understand the working of different high pressure and low pressure boilers. Student can distinguish mountings and accessories. The student can calculate the chimney height for maximum discharge. Student can know the draughts and its application in the steam generator. Students are advised to visit the Boilers in the power generation units to get better expose.

UNIT III

Steam Nozzles: Function of Nozzle - Applications - Types, Flow through Nozzles, Thermodynamic Analysis - Assumptions - Velocity of Nozzle at Exit-Ideal And Actual Expansion in Nozzle, Velocity Coefficient, Condition for Maximum Discharge, Critical Pressure Ratio. Criteria for Design of Nozzle Shape: Super Saturated Flow and its Effects, Degree of Super Saturation and Degree of Under Cooling - Wilson Line -Shock at the Exit.

Learning Outcome & Suggested Student Activities:

Student can be able to distinguish the ideal flow and actual flow through nozzle. Student can know the importance of maximum discharge through nozzle. Student can able to entail the concept of Critical pressure ratio in calculations. Student can able to understand the effect of metastable flow/ super saturation flow through nozzle.

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UNIT IV

Impulse Turbine: Mechanical Details - Velocity Diagram - Effect of Friction - Power Developed Axial Thrust Blade or Diagram Efficiency - Condition for Maximum Efficiency. De-Laval Turbine - Its Features. Methods To Reduce Rotor Speed - Velocity Compounding And Pressure Compounding, Velocity And Pressure Variation Along The Flow - Combined Velocity Diagram For A Velocity Compounded Impulse Turbine.

Reaction Turbine: Mechanical Details - Principle of Operation, Thermodynamic Analysis of A Stage, Degree of Reaction -Velocity Diagram - Parson's Reaction Turbine - Condition for Maximum Efficiency.

Learning Outcome & Suggested Student Activities:

At the end of unit, student can able to distinguish the working of impulse and reaction turbines. Student can able to construct the velocity triangle and combined velocity triangle and can learn its importance in determining the power produced by the turbine. Student can know why to reduce the rotor speed and methods to reduce. Students are advised to visit thermal power stations for better understanding the working of turbines. Students are suggested to participate in science exhibitions based on the concept of thermal power plants.

UNIT V

Gas Turbines: Simple Gas Turbine Plant - Ideal Cycle, Essential Components - Parameters of Performance - Actual Cycle - Regeneration, Inter Cooling and Reheating - Closed And Semi-Closed Cycles - Merits and Demerits.

Jet Propulsion: Principle of Operation - Classification of Jet Propulsive Engines - Working Principles with Schematic Diagrams and Representation on T-S Diagram - Thrust, Thrust Power and Propulsion Efficiency - Turbo Jet, Turbo Prop, Pulse Jet Engines - Schematic Diagram, Thermodynamic Cycle. Introduction to Rocket Propulsion.

Learning Outcome & Suggested Student Activities:

After the study of the unit, Student can be familiar with the basic components of a gas turbine power plant. Student can illustrate the power generation using Joule Cycle. Student can know the methods to increase the specific power output and efficiency of the cycle. Also, Student can able to know the working of various propulsive devices. Student can aware of using thrust equations in solving problems. Students advised to visit Gas power generation plants.

TEXT BOOKS

1. Thermal Engineering, R.K. Rajput, 9/e, Lakshmi Publicatndons, 2013.
2. Basic and Applied Thermodynamics, P.K. Nag, TMH , 2 Edition,2012.

REFERENCE BOOKS

1. Gas Turbines, V. Ganesan, TMH
2. Thermodynamics and Heat Engines, R.Yadav, Central Publishing House, Allahabad, 2002.
3. Gas Turbines and Propulsive Systems, P.Khajuria&S.P.Dubey, Dhanpatrai.
4. Thermal Engineering, R.S Khurmi& JS Gupta, S.Chand, 2012.
5. Thermal Engineering-M.L.Mathur&F.S.Mehta, Jain bros, 2006.
6. Thermal Engineering Data Book, B.S. Reddy and K.H. Reddy, I.K. International, 2007.
7. Steam Tables SI Units- Dr.B.UmamaheswarGowd and A. Nagraju, Siri Publ.

NOTE: Steam tables and Mollier charts to be supplied for exam.

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