II YEAR-II Semester

ME4T2 APPLIED THERMODYNAMICS Credits: 3

Lecture: 3 periods/week **Internal assessment: 30marks**
Tutorial: 1 period/week **Semester end examination: 70 marks**

Course Objectives:

- Explain the basic concepts of steam power plant
- Describe the working principle of various components of steam power cycle

Course Outcomes:

Upon completion of this course the student will be able to:

1. Describe the thermodynamic analysis of Rankine cycle, combustion phenomenon.
2. List the classifications and working principles of different boilers and steam nozzles
3. Classify the steam turbines along with the thermodynamic analysis
4. Recall the requirement and working principles of steam condensers
5. Reproduce the mechanical details and principle of operation for different types of compressors

UNIT – I BASIC CONCEPTS:

Rankine cycle - schematic layout, thermodynamic analysis, methods to improve cycle performance – regeneration & reheating. COMBUSTION: Fuels and combustion, adiabatic flame temperature.

UNIT II

BOILERS :

Classification – working principles – with sketches including H.P.Boilers – mountings and accessories – working principles, boiler horse power, equivalent evaporation, efficiency and heat balance – draught, classification – height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught- induced and forced.

STEAM NOZZLES:

Function of a nozzle – applications – types- velocity of fluid at nozzle exit-Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, Super saturated flow

UNIT- III

STEAM TURBINES:

Classification Impulse turbine; mechanical details – velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. De-laval turbine - methods to reduce rotor speed velocity compounding, pressure compounding and velocity & pressure compounding,

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 – calculation of blade height.

Unit IV

STEAM CONDENSERS:

Requirements of steam condensing plant – classification of condensers – working principle of different types – vacuum efficiency and condenser efficiency – air leakage, sources and its affects, air pump.

UNIT – V

COMPRESSORS –

Classification RECIPROCATING COMPRESSORS: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.

DYNAMIC COMPRESSORS:

Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams.

AXIAL FLOW COMPRESSORS: Mechanical details and principle of operation – velocity triangles and energy transfer per stage, degree of reaction, work done factor - isentropic efficiency- pressure rise calculations – Polytropic efficiency.

Learning Resources

Text Books:

1. Cengle and Boles, "Engineering Thermodynamics" MC Graw Hill publications , 2002
2. V.P. Vasandani and D.S. Kumar "Treatise on Heat Engineering" Metropolitan book Co Pvt Ltd , 2000

Reference Books:

1. Achuthan ,"Engineering Thermodynamics", PHI, 2005.
2. Rajput, "Thermal Engineering", Lakshmi publications, 2005