

[Time: Three Hours]

[Max. Marks: 80]

"Please check whether you have got the right question paper."

N.B

- i) Q.No.1 from section A and Q.No.6 from section B are compulsory.
- ii) Attempt any two questions from the remaining questions in each section.
- iii) Use of steam tables, Mollier charts, non-programmable calculator is permitted.
- iv) Assume suitable data, if necessary.

## SECTION-A

- Q.1 Solve any five. 10
- a) Define boilers and list the primary requirements of boilers.
  - b) Explain internally fired and externally fired boilers.
  - c) Discuss the significance of equivalent evaporation.
  - d) Explain the friction in boiler chimney.
  - e) Define natural draught and artificial draught.
  - f) Enumerate and explain heat losses in boiler plant.
  - g) What is steam nozzle? List the types of steam nozzle.
  - h) Discuss the functions of the convergent portion, the throat and the divergent portion of a convergent-divergent nozzle with reference to flow of steam.
- Q.2 a) Explain with neat sketch the working principle of LaMont (high pressure) boiler. 07  
 b) A boiler generates 42000kg/hr of steam at 19 bar the steam temperature being 324<sup>0</sup>C. The feed water temperature is 47.2<sup>0</sup>C. The efficiency of the boiler is 78%. When using oil of calorific value 42500kJ/kg, the steam generated is supplied to a turbine developing 400KW, and exhausting at 1.7 bars, the dryness of exhaust steam is 0.97. Calculate the oil burnt per hour. Also find the energy available in the exhaust steam. 08
- Q.3 a) Show that the temperature of hot gases (T<sub>g</sub>) bears certain ratio to the temperature of cold air (T<sub>a</sub>) under maximum discharge condition. 08  
 b) Derive the equation for height and diameter of chimney for a given draught (hw). 07
- Q.4 a) Dry saturated steam at a pressure of 12 bars enters in a nozzle and it discharged at a pressure of 1.6 bars. Find the final velocity of the steam, when the initial velocity of the steam is negligible. If 15% of the heat drop is lost in friction, find the percentage reduction in the final velocity. 08  
 b) Derive the equation of mass of steam discharged through nozzle. 07
- Q.5 Write short notes on (any two) 15
- a) Advantages of artificial draught
  - b) Benson boiler
  - c) Effect of friction in steam nozzle.

SECTION -B

- Q.6 Solve any five. 10
- a) Explain the term 'vacuum'. How is it measured?
  - b) Explain condenser? List the classification of condenser.
  - c) Define vacuum and condenser efficiency.
  - d) Discuss the effect of lowering the condenser pressure.
  - e) Explain effect of inlet and back pressure on performance of Rankine cycle.
  - f) Explain in short the necessary of modification of Rankine cycle.
  - g) Explain effect of clearance volume on capacity of the reciprocating compressor.
  - h) Define and explain isothermal efficiency of compressor.
- Q.7 a) Explain condenser and vacuum efficiency. 07
- b) The air entering a steam condenser with steam is estimated at 7kg/hr. the temperature at inlet to air cooler section is 32<sup>0</sup>C and at the outlet 28<sup>0</sup>C. the vacuum in the shell is essentially constant throughout and is 728MM of Hg, while the barometer reads 762 MM of Hg. Calculate 08
- i) Volume of air entering the cooling section per hour.
  - ii) mass of moisture contained in air
  - iii) Mass of steam condensed per hour in the cooling section.
- Q.8 a) Explain why the Rankine cycle rather than Carnot cycle is used as standard reference for the steam power plants. 07
- b) In a steam cycle, the steam supply is at 10 bars and dry and saturated. The condenser pressure is 0.6 bars. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pumps work. 08
- Q.9 a) Air is to be compressed in a single stage reciprocating compressor from 1.2 bars and 18<sup>0</sup>C to 12 bars. Calculate the indicated power required for FAD of 0.4m<sup>3</sup>/min. the compression process follows the law of  $pV^{1.28} = \text{constant}$ . 07
- b) Obtain the condition of maximum efficiency of a two stage air compressor with perfect intercooling. 08
- Q.10 Write short notes on (any two). 15
- a) Jet condenser
  - b) Rotary compressor
  - c) Regenerative cycle.