

17410

15162

3 Hours / 100 Marks

Seat No.

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- Instructions* – (1) All Questions are *Compulsory*.
(2) Answer each next main Question on a new page.
(3) Illustrate your answers with neat sketches wherever necessary.
(4) Figures to the right indicate full marks.
(5) Assume suitable data, if necessary.
(6) Use of Steam tables, logarithmic, Mollier's chart is permitted.

Marks

1. a) Attempt any SIX of the following:

12

- (i) State Avogadro's law.
- (ii) Draw P-V and T-S diagram for isothermal process.
- (iii) Define:
 - (1) Drymen fraction
 - (2) Degree of superheat
- (iv) What is vacuum efficiency of condenser?
- (v) List out losses in steam turbines (any two)
- (vi) Define:
 - (1) Mach number
 - (2) Critical pressure
- (vii) State Fourier's law of heat transfer.
- (viii) Define:
 - (1) Transmissivity
 - (2) Emessivity

P.T.O.

b) Attempt any TWO of the following:

8

- (i)
 - (1) Explain zeroth law of thermodynamics with suitable example.
 - (2) Differentiate between thermodynamic heat and work transfer (min. 4 points)
- (ii) Write steady flow energy equation. State significance of each term in it.
- (iii) Classify the steam boiler on the basis of:
 - (1) Content in the tube
 - (2) Circulation of water and steam.
 - (3) According to boiler use
 - (4) According to axis of shell

2. Attempt any FOUR of the following:

16

- a) Differentiate between heat engine and heat pump (any four differences)
- b) A gas at 7 bar and 400°K occupies a volume of 0.2m³. The gas expands according to the law $PV^{1.5} = C$ upto pressure of 1.5 bar. Determine work transfer.
- c) Classify steam turbines in detail.
- d) Differentiate between impulse turbine and reaction turbine.
- e) What is regenerative feed heating? What are the advantages of regenerative feed heating?
- f) A reactor's wall, 320mm thick is made up of an inner layer of fire brick ($K = 0.84 \text{ W/m}^\circ\text{C}$) covered with a layer of insulation ($K = 0.16 \text{ W/m}^\circ\text{C}$) The reactor operates at a temperature of 1325°C and ambient temperature is 25°C. Find:
 - (i) Thickness of brick and insulation which gives maximum heat loss.
 - (ii) Calculate heat loss presuming that insulating material has maximum temperature of 1200°C.

3. Attempt any FOUR of the following:**16**

- a) State:
 - (i) Charle's law
 - (ii) Boyle's law
- b) State first law of thermodynamics. Explain perpetual motion machine of the first kind (PMMI).
- c) Write equation for:
 - (i) Change in internal energy
 - (ii) Work done for polytropic process
- d) Describe the formation of steam at constant pressure with the help of temperature-enthalpy diagram.
- e) Draw a neat sketch of Loeffler boiler and explain its working.
- f) State the function of :
 - (i) Superheater
 - (ii) Economiser
 - (iii) Air preheater
 - (iv) Feed pump used in steam boilers.

4. Attempt any FOUR of the following:**16**

- a) Steam enters a condenser at 35°C. The barometer readings is 760 mm of Hg. If a vacuum of 690 mm of Hg is recorded. Calculate the vacuum efficiency.
- b) Explain intensive and extensive properties of system with example.
- c) Write basic function of condenser. How condensers are classified?
- d) Draw T-S diagram of simple Rankine cycle for a thermal power plant. Show all the process on it. (Consider steam at inlet of turbine as superheated)
- e) Discuss important provisions made on IBR (Indian Boiler Regulation)
- f) Steam expands isentropically from initial condition of 30 bar and 400°C to final condition of 0.05 bar. Find:
 - (i) Final condition of steam
 - (ii) Drop in enthalpy/kg of steam. (Use mollier chart)

5. Attempt any TWO of the following:**16**

- a) (i) State Kelvin-planck and clausius statement of second law of thermodynamics.
- (ii) Prove that the Kelvin-planck and clausius statements are equivalent.
- b) Write various modes of heat transfer. Give one e.g. for each mode. Give any four application of heat exchangers for thermal system.
- c) Explain construction and working of natural draught cooling tower with a neat sketch.

6. Attempt any TWO of the following:**16**

- a) Classify heat exchangers. Explain with neat sketch, plate type heat exchanger.
 - b) What is compounding of steam turbine with a neat sketch explain variation of pressure and velocity of steam in impulse turbine.
 - c) Explain the construction and working of two tube pass surface condenser with neat sketch.
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