17958

16117

3 Hours / 100 Marks Seat No. | | | | | | | | |

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 Non-programmable Electronic Pocket Calculator is permissible.

Marks

1. a) **Attempt any SIX of the following:** **12**

(i) Define dryness fraction of steam.

(ii) State zeroth law of thermodynamics.

(iii) Represent Isothermal process on P-V and T-S diagram.

(iv) Define intensive property and extensive property of system.

(v) State Fourier's Law of heat conduction.

(vi) Define enthalpy and write its unit.

(vii) A refrigerator works between the temperature limits -5°C and 35°C. Determine its COP.

(viii) What is meant by governing in steam turbine.

Marks

b) **Attempt any <u>TWO</u> of the following:** **8**

(i) State the sources of air leakage into the condenser and its effects on performance of condenser.

(ii) What is thermodynamic system? Explain its different types.

(iii) Write steady flow energy equation and apply it to boiler and nozzle.

2. Attempt any <u>FOUR</u> of the following: **16**

a) Draw T-S chart for steam generation at constant pressure and show following features on it.

(i) Critical point

(ii) Saturated liquid curve

(iii) Superheated region

(iv) Saturated steam line

b) State the types of cooling towers. Explain any one with neat sketch.

c) State the function of

(i) Safety valve

(ii) Fusible plug

(iii) Air preheater

(iv) Economiser

d) Determine the quality of steam in the following cases:

(i) Pressure is 10 bar and specific volume is 0.18 m^3/kg.

(ii) Pressure is 8 bar and temperature is 200°C.

e) Steam at a pressure of 10 bar and 80% dry is to be converted into dry saturated steam at constant pressure. Calculate the quantity of heat to be added if its mass is 1.5 kg.

f) Differentiate between induced and forced draughts related to boiler.

Marks

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

a) State Kelvin-planck and Classius statements of second law of thermodynamics.

b) Explain convergent-divergent nozzle with a neat sketch.

c) Explain Bleeding of steam in steam turbine.

d) Represent the Isochoric and Adiabatic gas processes on P-V and T-S diagram.

e) One kg of air initially at a temperature of 165°C and a pressure of 7 bar is heated at constant pressure till the volume is doubled. Determine the work done, heat exchange and the change in entropy. Take C_p = 1.005 kJ/kg K, C_v = 0.718 kJ/kg K

f) Differentiate between Adiabatic and Isothermal process.

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

a) Determine the rate of heat flow through the boiler wall made of 2 cm thick steel and covered with an insulating material of 0.5 cm thick. The temperatures at the inner and outer surfaces of the wall are 300°C and 50°C respectively.

K_{steel} = 58 W/mk, $K_{insulation}$ = 0.116 W/mk.

b) Explain the modes of heat transfer.

c) Define the following terms.

(i) Thermal conductivity

(ii) Emissivity

(iii) Black body

(iv) Gray body

d) Explain with neat sketch shell and tube heat exchanger.

e) Differentiate between impulse and reaction turbine.

f) Define vacuum and condenser efficiency.

Marks

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

a) Define Nozzle? Explain its types.

b) Explain the construction and working of surface condenser.

c) Explain the process of regenerative feed heating with neat sketch.

d) Differentiate between heat and work.

e) Explain natural draught cooling tower with neat sketch.

f) State

(i) Dalton's law of partial pressure

(ii) Stefan-Boltzman law.

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

a) Explain with neat sketch construction and working of Lamount boiler.

b) State the necessity of compounding of steam turbines. State the types of compounding. Explain any one with neat sketch showing the variation of pressure, velocity and specific volume.

c) Nitrogen is expanded in a cylinder fitted with weightless and frictionless piston from 10 bar and 177°C to 1 bar pressure as per the law $PV^{1.25}$ = constant. Determine for one kg of N_2

(i) Gas constant for Nitrogen

(ii) Work developed

(iii) Heat transferred

Take $\gamma = 1.4$ for Nitrogen.

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