

17410

11718

3 Hours / 100 Marks

Seat No.

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- Instructions* – (1) All Questions are *Compulsory*.
(2) Figures to the right indicate full marks.
(3) Assume suitable data, if necessary.
(4) Use of Non-programmable Electronic Pocket Calculator is permissible.
(5) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.
(6) Use of Steam tables, logarithmic, Mollier's chart is permitted.

Marks

1. a) **Attempt any SIX of the following:** **12**
- (i) Define:
 - 1) Thermodynamic state
 - 2) Thermodynamic cycle
 - (ii) State Zeroth law of thermodynamics.
 - (iii) Define ideal gas and state the assumptions made for ideal gas.
 - (iv) State Avagadro's law.
 - (v) Define the terms:
 - (i) Dryness fraction and
 - (ii) Degree of superheat
 - (vi) Write continuity equation of steam nozzle.
 - (vii) What is the necessity of compounding of steam turbine?
 - (viii) State Dalton's law of partial pressure.

P.T.O.

b) **Attempt any TWO of the following:****8**

- (i) Classify the steam boiler on the basis of:
 - 1) Content in the tube
 - 2) Circulation of water and steam (method of circulation)
 - 3) No. of tubes
 - 4) Axis of shell
- (ii) State the sources of air leakage in condenser and its effect.
- (iii) Define:
 - (i) Black body
 - (ii) Gray body
 - (iii) Absorptivity
 - (iv) Reflectivity

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

- a) What is thermodynamic system? State its different types with one example each.
- b) One kg of air initially at 1 bar and 156°C is compressed isothermally till the volume is reduced to 0.28 m³. Determine the work done and change in internal energy.
- c) Explain the process of formation of steam under constant pressure on T-H plane or diagram.
- d) Classify the steam turbine with respect to:
 - (i) Action of steam (principle of action)
 - (ii) Direction of steam flow
 - (iii) Steam pressure
 - (iv) Exhaust steam pressure
- e) Define Mach number and give its significance.
- f) State Kelvin planks and Clausius statement of second law of thermodynamics.

3. Attempt any FOUR of the following: 16

- a) Define thermodynamic work and heat transfer. Also give sign conventions used for transfer of work and heat.
- b) Draw P-V and T-S chart of following gas processes:
 - (i) Isobaric process
 - (ii) Isothermal process
- c) Explain with neat sketch working of air preheater in boiler.
- d) Explain with sketch regenerative feed heating system.
- e) Explain with neat sketch, working of 2-pass surface condenser.
- f) Explain the working of shell and tube type heat exchanger with neat sketch.

4. Attempt any FOUR of the following: 16

- a) State the limitations of first law of thermodynamics.
- b) Define boiler draught and state its necessity. Give its classification.
- c) Explain the working of impulse steam turbine with neat sketch. Also show pressure and velocity variation for the same.
- d) A boiler is made of iron plates 12 mm thick. If the temperature of the outside surface is 120°C and that of inner is 100°C . Calculate the mass of water evaporated per hour. Assume that the area of heating surface is 5 m^2 , K for iron as 84 W/mk and latent heat of water at $100^{\circ}\text{C} = 2260\text{ kJ}$.
- e) Find the condenser efficiency, when cooling water enters a condenser at a temperature of 28°C and leaves at 39°C . The vacuum produced is 705 mm of Hg and barometer reads 760 mm of Hg.
- f) Define heat transfer. State different modes of heat transfer and explain any one with suitable example.

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

- a) Write steady flow energy equation stating the meaning of each term in equation and apply it to boiler, steam nozzle and steam turbine.
- b) What is compounding of steam turbine? Explain with sketch pressure compounding.
- c) A CO₂ gas expands adiabatically from a pressure and volume of 7 bar and 0.03 m³ respectively to a pressure of 1.4 bar. Determine:
 - (i) Final volume
 - (ii) Work done
 - (iii) Changes in internal energy
 - (iv) Heat transfer

Take $C_p = 1.046 \text{ kJ/kgk}$ and $C_v = 0.752 \text{ kJ/kgk}$

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

- a) What is the function of cooling tower? Explain with neat sketch, the working of induced draught cooling tower.
- b) Draw a neat sketch of Loeffler boiler. Show the path of flue gases. Describe the working of this boiler also.
- c) (i) State Stefan's Boltzman law. 2
(ii) A wall of refrigerated van of 1.5 mm of steel sheet at outer surface, 10 mm plywood at the inner surface and 2 cm of glass wool in between. Calculate the rate of heat flow, if the temperature at the inside and outside surfaces are -5°C and 24°C . 6

Take K (for steel) = 23.2 W/mk,

K (for glass wool) = 0.14 W/mk,

K (for plywood) = 0.052 W/mk.
