17410

16172

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.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(8) Use of Steam tables, logarithmic, Mollier's chart is permitted.

Marks

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

(i) Define path function and point function.

(ii) State Clausius statement of second law of thermodynamics.

(iii) Represent isobaric process on P-V and T-S charts.

(iv) State the relationship between universal gas constant and characteristic gas constant. Write the meaning of each term.

(v) Differentiate between boiler mountings and accessories (any two points)

Marks

(vi) State the meaning of the terms 'governing' and 'compounding' of steam turbines.

(vii) Write continuity equation of steam nozzle and state the meaning of each term.

(viii) Define condenser efficiency.

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

(i) Define following terms:

1) Dryness fraction

2) Degree of superheat

3) Dry saturated steam

4) Superheated steam

(ii) State Dalton's law of partial pressures. Apply it to steam condenser with the help of suitable diagram.

(iii) Define black body, grey body, emissivity and absorptivity.

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

a) Differentiate between heat engine and heat pump. (any four points)

b) A tank of 2.2 m^3 capacity contains air at 260°C and 0.1 MPa. Some air is taken from the tank without changing temperature until pressure becomes 4 KPa. Calculate:

(i) Mass of air left in the tank

(ii) Mass of air pumped out. (Take R = 0.287 KJ/kg°K)

c) What is boiler draught? State various types of boiler draughts with meaning.

d) Compare impulse and reaction turbine on the basis of following points:

(i) Shape of blade

(ii) Admission of steam

(iii) Power generated

(iv) Speed

e) Enlist various losses in steam turbines.

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

Marks

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

a) State and explain various types of thermodynamic systems with examples.

b) Represent isothermal and adiabatic processes on P-V and T-S diagrams.

c) Draw neat sketch of cochran boiler. Label all the parts.

d) Explain nozzle control governing of steam turbine with neat sketch.

e) Compare jet and surface condensers on the basis of following points:

(i) Amount of cooling water required

(ii) Vacuum efficiency

(iii) Construction

(iv) Operation of heat exchange

f) What is heat exchanger? Give three examples of heat exchangers with their applications in thermal engineering.

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

a) Prove the equivalence of Kelvin Plank and clausius statements of second law of thermodynamics.

b) Represent steam generation process at constant pressure on T-S diagram and show following on it:

(i) Saturated liquid line

(ii) Saturated vapour line

(iii) Critical point

(iv) Wet Region

c) Explain working principle of reaction turbine with suitable sketch.

d) A composite wall is made up of 0.2 m thick fire clay brick, faced with 0.1 m thick insulation. If temperatures of inner and outer surfaces are 870°C and 210°C respectively, calculate heat flow rate per unit area. Also find interface temperature.
Take K_{brick} = 1.039 W/m°k, $K_{insulation}$ = 0.228 W/m°k.

Marks

e) Vacuum measured at the inlet of condenser is 710 mm of Hg and barometer reads 760 mm. Hot well temperature is 30°C. Calculate vacuum efficiency.

f) Write the formulae to calculate enthalpy and entropy of the following:

(i) Wet steam

(ii) Superheated steam

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

a) (i) Differentiate between heat and work.

(ii) Explain zeroth law of thermodynamics.

b) Sketch and explain pressure compounded and velocity compounded impulse turbine showing pressure and velocity variations along the axis.

c) A certain gas has Cp = 1.968 KJ/kg°K and Cv = 1.507 KJ/kg°K. Find its molecular weight and gas constant. A constant volume chamber of 0.3 m^3 capacity contains 2 kg of this gas at 5°C. Heat is transferred to gas until temperature is 100°C. Find work done, heat transfer and change in internal energy.

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

a) (i) Draw neat sketch of any one type of surface condenser. Label parts.

(ii) State any two sources and effects of air leakage into steam condenser.

b) (i) A sample of 3 kg of steam at a pressure of 3 MPa exists in dry and saturated condition. For this sample, calculate enthalpy and entropy using steam table.

(ii) Steam at 8 bar and 0.85 dry is throttled to a pressure of 1 bar. Find final quality of steam. Use steam table.

c) Explain various modes of heat transfer with suitable examples.