Vidyalankar

S.Y. Diploma : Sem. IV [ME/MH/MI]

Thermal Engineering

Time: 3 Hrs.] Prelim Question Paper **[Marks : 100**

Instructions : (1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

1. (a) Attempt any **SIX** of the following: **[12]**
(i) Define thermodynamic system?
(ii) Define extensive property and intensive property.
(iii) Define thermodynamic work. Give its unit.
(iv) Define Zeroth Law of thermodynamics.
(v) State Charles's Law.
(vi) Define sensible heat and Latent heat.
(vii) Define Mach Number with formula.
(viii) What is vacuum efficiency of condenser?

1. (b) Attempt any **TWO** of the following: **[8]**
(i) Differentiate between forced convection and natural convection related host transformer.
(ii) At the beginning of compression, a cylinder contains 750 cm^3 of gas at a pressure of 100 kN/m^2 absolute. Compression takes place according to Law $PV^n = C$, until to pressure is 780 kN/m^2 (absolute). If the final volume is 150 cm^3, find the value of index. Also determine to work done during compression and host rejected during compression. Take $\gamma = 1.4$.
(iii) Explain concept of PMM-II.

2. Attempt any **FOUR** of the following: **[16]**
(a) Define Point function and Path function with neat sketch and example.
(b) A refrigerator operated between -3 °C and 27 °C. The cooling load is 6.3 kJ/sec. Determine COP of the system and power required to operate the refrigerator.
(c) Differentiate between heat pump and refrigerator. (any four point)
(d) Represent isothermal process on P-V and T-S diagram and explain the process.
(e) 2.5 m^3 of gas at 8 bar and 180 °C is heated at constant pressure till volume is doubled. If C_p = 1 kJ/Kg-K and C_v = 0.715 kJ/Kg-K.
Find (a) change in internal energy, (b) work transferred, (c) heat transferred, (d) change in enthalpy, (e) change in entropy.
(f) Explain steam generation process for 1 kg of water at 0 °C under constant pressure with the help of T-h diagram.

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

(a) Draw labeled sketch of thermal power plant. State two application of it.

(b) Explain throttling process.

(c) Determine the quantity of heat required to generate 1 kg of steam at pressure of 10 bar absolute from water at a temperature of 50 °C, if the steam generated is (1) 30% dry, (2) Dry and saturated, (3) Superheated upto 240 °C. Take $C_{p\ (water)}$ = 4.126 kJ/Kg-K, $C_{p\ (steam)}$ = 2.1 kJ/Kg-K

(d) Explain various types of Nozzle.

(e) Give the classification of steam turbine.

(f) Explain velocity compounding with sketch.

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

(a) Give the classification of steam condensers.

(b) Explain natural draught cooling tower with sketch.

(c) State Fourier's Law of heat transfer with expression.

(d) Define block body used in heat transfer.

(e) Explain Shell and tube type of heat exchangers with advantages and disadvantages.

(f) What are the applications of heat exchangers?

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

(a) A wall of refrigerator van of 1.5 mm steel sheet at outer surface, 10 mm plywood at the inner surface and 2 cm of glass wool in-between. Calculate the ratio of heat flow, if the temperature at the inside and outside surfaced are −15 °C and 24 °C. Take K_{steel} = 23.2 W/mK, $K_{glass\ wool}$ = 0.14 W/mK, $K_{plywood}$ = 0.052 W/mK.

(b) Represent isobaric process on P-V and T-S diagram and explain (i) workdone, (ii) heat, (iii) enthalpy, (iv) entropy.

(c) Draw temperature entropy diagram for steam generation and explain it.

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

(a) Explain the performance of a refrigerator. How it coefficient of performance of a refrigerator determined? Also prove $(COP)_{Heat\ pump} = (COP)_R + 1$

(b) A cyclic heat engine operated between a source temperature of 800 °C and a sink temperature of 30 °C. What is the least ratio of heat rejection per KW net output of an engine?

(c) Prove a neat sketch of Bourdon's pressure gauge.

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