* 4 0 7 7 *

Engineering Thermodynamics
(123102 / 213102)

P. Pages : 3

Time : Three Hours **Max. Marks : 80**

Instructions to Candidates :
1. Do not write anything on question paper except Seat No.
2. Answer sheet should be written with blue ink only. Graph or diagram should be drawn with the same pen being used for writing paper or black HB pencil.
3. Students should note, no supplement will be provided.
4. Solve **any two** parts from each question.
5. Use of non programmable electronic calculator, steam table, Mollier diagram is allowed.
6. Figure to the right indicate full marks.
7. Assume suitable data, if necessary.

1. a) Explain the following terms : **8**

i) Working substance

ii) Pure substance

iii) Process

iv) Open system.

b) Differentiate the following : **8**

i) Macroscopic view and microscopic view of thermodynamics.

ii) Closed system and isolated system.

c) i) Convert the following reading of pressure to kPa, assuming that the Barometer reads 760 mm of Hg. $\rho_{Hg} = 13596 kg/m^3$ **4**

i) 90 cm of Hg.

ii) 1.2 meter of water.

ii) With the help of neat sketch explain Bourdon Pressure Gauge. **4**

2. a) Derive steady flow energy equation on mass basis and apply it to steam turbine and centrifugal compressor. **8**

b) Explain the following : **8**

i) Joules experiment.

ii) Steady flow process.

c) A non flow system undergoes a friction less process according to law. **8**

$$P = \frac{4.5}{V} + 2$$

where pressure P is in bar, and volume V is in m^3/kg. During this process volume changes from $0.12 m^3/kg$ to $0.04 m^3/kg$ and temperature increases by 133ºC. The change in internal energy of the fluid. $du = C_V.dT$ where $C_V = 0.71 KJ/kg\,K$ and dT is temperature change.

Find out :

i) Heat transfer

ii) Change in enthalpy

Assume fluid mass of 5 kg.

3. a) Define : **8**

i) Boyle's Law

ii) Charles's Law

iii) Avogadro's Law

iv) Adiabatic process.

b) Define specific heat. Prove that $C_P - C_V = R$. Also prove $C_V = \frac{R}{r-1}$. **8**

c) 2.5 kg of oxygen at a pressure of 1 bar and 27ºC is compressed isentropically to a pressure of 15 bar. The gas is then cooled at constant volume till it reaches its original pressure. **8**

Calculate :

i) Heat Transferred

ii) Work done

iii) Change in entropy

Take $C_P = 0.922\,kJ/kg-k$

$C_V = 0.662\,kJ/kg-k$

4. a) With neat sketch explain Carnot cycle. Derive an expression for efficiency of the cycle. **8**

b) i) State the Kelvin Plack & Clausins statement of Second Law of thermodynamics. **4**

ii) Find out the relation between cop of heat pump and cop of refrigerator. **4**

c) It takes 15kw to keep the interior of a theatre at 22ºC when the outside temp. is 2ºC. The heat flow is obtained by oil. Calculate the power required if the 15kw of heat flow were supplied by operating a reversible heat pump with the house as the upper reservoir and the outside surrounding as the lower reservoir. **8**

i) Find the power required to drive the heat pump.

ii) What is the saving in power by using heat pump.

5. a) Explain the terms : **8**

i) Sensible heat

ii) Latent heat

iii) Dryness fraction

iv) Degree of superheat

b) i) Explain the significance of Critical point. **4**

ii) With neat sketch explain Mollier diagram. **4**

c) A vessel contains 1 kg of steam at 12 bar pressure and 208ºC temperature. **8**

Find :

i) Enthalpy

ii) Specific volume

iii) Entropy

iv) Internal energy.

****