Seat No. | | | | | | |

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मठ - 003

Engg. Thermodynamics
(123102)

P. Pages : 3

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

Instructions to Candidates :

1. Do not write anything on question paper except Seat No.
2. Answersheet 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. Attempt **any two** sub-questions from each unit.
5. Diagrams / sketches should be given wherever necessary.
6. Assume suitable data wherever necessary.
7. Use of steam table is allowed.
8. Non-programmable calculator is allowed.

UNIT - I

1. a) Define thermodynamic property, state, path and process. **8**

b) Write short note on : **8**
i) Macroscopic and Microscopic Aspects.
ii) Thermodynamic work.

c) A barometer can be used as an altitude measuring device in an aeroplane. The ground control reports a barometric reading of 753mm. of Hg, while the pilot's reading in 690 mm of Hg. Calculate the altitude of the plane from the ground level if the average density is $1.25 kg/m^3$. **8**

UNIT - II

2. a) Explain the difference between a non-flow and a steady flow process. Also sketch work done in $\int pdv$ and $-\int v \cdot dp$ on p-v diagram. **8**

b) 90 kJ of heat is supplied to system at a constant volume. The system rejects 95 kJ of heat at constant pressure and 18 kJ of work is done on it. The system is brought to original state by adiabatic process. Sketch the cycle on p-v diagram. Determine.
i) The adiabatic work.
ii) The values of internal energy at all end states if its initial value is 105 kJ. **8**

c) A heat exchanger receiver air at a velocity of 25 m/sec and 20°C. The temperature of air increases to 780°C in heat exchanger. The air them passes through the turbine. The velocity of air, while entering the turbine is 25 m/sec. The air expands in the turbine, where its temperature polls to 630°C. On leaving the turbine, air passes through the nozzle is 60 m/sec. The air expands in the nozzle till its temperature polls to 500°C. the air flow rate is 2.5 kg/sec. Determine.

i) Rate of heat transfer to air in the heat exchanger.
ii) Power output from the turbine, assuming no heat loss.
iii) The velocity at the exit from nozzle, assuming no heat loss. **8**

UNIT - III

3. a) Describe the concept of Entropy. Also explain the importance and significance of it. **8**

b) Prove that the kelvin plank and clausius statements of second law of thermodynamics are equivalent to each other. **8**

c) A household refrigerator maintains a space at temperature of 0°C. Every time the door is opened, warm material is placed inside, introducing an average 420 kJ of heat, but making only a small change in temperature of the refrigerator. The door is opened 20 times a day and refrigerator operates at 25% of ideal COP. The cost of work is Rs. 3.50 per kwh. What is monthly bill of this refrigerator ? The atmospheric temperature is at 30°C. **8**

UNIT - IV

4. a) What is an Isothermal process ? Indicate on P-V and T-S diagrams. Derive the equations for work done and heat supplied. **8**

b) A cylinder of 50 liters capacity contains oxygen at 18°C and at a pressure of 10 MPa. Calculate -

i) the mass of oxygen in the cylinder.
ii) the molar volume.
iii) the density of oxygen.

The molecular mass of oxygen is 32 kg/kmol. **8**

c) 0.5 kg of air is compressed reversibly and adiabatically form 80 kPa and 60°C to 0.4 mPa and is then expanded at constant pressure to the original volume. Sketch the process on P-V and T-S diagram. Compute work done heat transfer and change in entropy for whole path. Take R = 0.287 kJ/kg k and r = 1.4. **8**

UNIT - V

5. a) Write short note on : 8

i) Sensible neat and Latent heat.

ii) Dryness fraction.

iii) Triple point.

iv) Critical point.

b) Discuss construction and working of combined separating and throttling calorimeter. 8

c) Calculate the amount of heat to be supplied to produce 10 kg of steam at a pressure of 8 bar and temperature of 320°C from water at 30°C. Take specific heat of superheated steam as 2.2 kJ/kg k. 8

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