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Third Semester B.E. Degree Examination, Aug./Sept. 2020 Engineering Thermodynamics

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of Thermodynamics Data Hand Book, Steam tables, Psychrometry chart are allowed.

Module-1

- 1 a. State and explain Zeroth law of thermodynamics. Thermocouple with a test junction at $t^\circ\text{C}$ on a gas thermometer and cold junction at 0°C gives output emf as per the following relation. $e = 0.20t - 5 \times 10^{-4}t^2$, mV.
Where 't' is the temperature. The millivoltmeter is calibrated at ice and steam points. What temperature would this thermometer shown when gas thermometer reads 70°C .? (10 Marks)
- b. Differentiate between :
- i) Macroscopic and Microscopic approach
 - ii) Open and closed system
 - iii) Path function and point function
 - iv) Intensive and Extensive properties
 - v) Thermal and Mechanical equilibrium. (10 Marks)

OR

- 2 a. Explain working of constant volume gas thermometer with neat sketch. (06 Marks)
b. Derive an expression for displacement work is a quasistatic process. (06 Marks)
c. Define work and heat. Write the similarities and dissimilarities between them. (08 Marks)

Module-2

- 3 a. Explain unsteady flow process namely tank filling and tank emptying process with relation. (10 Marks)
b. 50Kg/min enters the control volume of a steady flow system at 2 bars and 100°C and at elevation of 100m above the datum. The same mass leaves the control volume at 150m elevation with a pressure of 10 bars and temperature of 300°C . The entrance velocity is 2400m/min and exit velocity is 1200m/min. During the process 50000 kJ/hr of heat is transferred to the control volume and the rise in enthalpy is 8kJ/kg. Calculate the power developed. Also find the ratio of inlet to outlet diameter of pipe. (10 Marks)

OR

- 4 a. State Kelvin – Planck's and Clausius statement of second law of Thermodynamic and prove that they are equivalent. (08 Marks)
b. The minimum power required to drive a heat pump which maintains a house of 20°C is 3kW. If the outside temperature is 3°C , estimate the amount of heat which the house loses per minute. (08 Marks)
c. Briefly explain PMM II and PMM I. (04 Marks)

Module-3

- 5 a. Derive Clausius inequality and hence prove that entropy is a property. (14 Marks)
b. Explain briefly available and unavailable energies referred to a cyclic heat engine. (06 Marks)

OR

- 6 a. Explain with neat volume sketch, the method of determining the quality of steam by combined separating and throttling calorimeter. (10 Marks)
- b. A vessel of volume 0.04m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C . The mass of the liquid present is 9kg . Find the pressure, the mass, the specific volume, the enthalpy, the entropy and the internal energy. (10 Marks)

Module-4

- 7 a. Explain the working of ammonia vapours absorption refrigeration system with neat sketch. (10 Marks)
- b. Explain steam jet refrigeration with neat sketch. (10 Marks)

OR

- 8 a. With a neat sketch, explain the working of the air-conditioning system for hot and dry weather. (08 Marks)
- b. It is required to design an air conditioned hall for the following condition:
- | | | |
|----------------------------|---|-----------------------------------|
| Outdoor condition | = | 32°C DBT and 65% RH |
| Indoor condition | = | 25°C DBT and 60% RH |
| Amount of air circulated | = | $250\text{m}^3/\text{min}$ |
| Coil dew point temperature | = | 13°C |

If the required condition is achieved first by cooling and dehumidifying and then by heating calculate :

- i) Cooling coil capacity and its bypass factor
- ii) Heating coil capacity and its surface temperature if its bypass factor is 0.3
- iii) Mass of water vapour removed per hour. (12 Marks)

Module-5

- 9 a. Derive the expression for the isothermal work done by a single state reciprocating compressor with and without clearance volume. (12 Marks)
- b. Explain Multi-stage compression with sketch. Mention its advantages. (08 Marks)

OR

- 10 a. Explain with neat sketch, types of gas turbines. (10 Marks)
- b. Write short notes on :
- i) Turbojet engine
 - ii) Rocket propulsion. (10 Marks)
