CBCS SCHEME

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18AE/AS32

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

Time: 3 hrs. Max. Marks: 100

Note: *1. Answer any FIVE full questions, choosing ONE full question from each module.*
2. Use of Thermodynamic data handbook is permitted.

Module-1

1 a. Distinguish the following:
(i) Microscopic and Macroscopic approach.
(ii) Intensive and Extensive properties. **(06 Marks)**

b. With the help of relevant sketches, explain Quasi-static process. **(06 Marks)**

c. A temperature scale of certain thermometer is given by the relation, t = alnp + b. where a and b are constants and P is the thermometric property of the fluid in the thermometer. If at the ice point and steam point the thermometer properties are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometer property of 3.5 on Celsius scale. **(08 Marks)**

OR

2 a. Derive an expression for work done during the following processes:
(i) Constant temperature process.
(ii) Polytropic process. **(06 Marks)**

b. Describe the similarities and dissimilarities between heat and work. **(06 Marks)**

c. 200 KJ of work is supplied to a closed system. The pressure and volume relation is P = 8 – 5 V. P is in bar and V in m^3. The initial volume is 0.5 m^3. Calculate the final volume and pressure. **(08 Marks)**

Module-2

3 a. State I law of thermodynamics. Explain classic paddle experiment with relevant sketches. **(06 Marks)**

b. Derive an expression for change in internal energy during adiabatic a Isentropic process with P-V diagram and prove that $PV^{\gamma} = C$ forth process. **(06 Marks)**

c. 90 KJ of heat is supplied to a system at constant volume. The system rejects heat of 95 KJ at constant pressure and 18 KJ of work is done on it. The system is brought to original state by adiabatic process. Determine (i) Adiabatic work (ii) The values of internal energy at all and state of initial value is 105 KJ. **(08 Marks)**

OR

4 a. Define steady flow process and derive an expression for steady flow energy equation with usual notations. **(08 Marks)**

b. Illustrate the application of steady flow energy equation for the following engineering system : (i) Nozzle and diffuser (ii) Turbine and compression. **(04 Marks)**

c. 10 kg of fluid per minute goes through a reversible steady flow process. The properties of fluid at the inlet are P_1 = 1.5 bar, $\rho_1 = 26 kg/m^3$, C_1 = 110 m/S and u_1 = 910 kJ/kg and the fluid rejects 55 KJ/s of heat and rises through 55 meters.
At the exit the properties of fluid are $P_2 = 5.5$ bar, $\rho_2 = 5.5 kg/m^3$, C_2 = 190 m/s and $u_2 = 710$ KJ/kg. Determine (i) The change in enthalpy (ii) Work done during the process. **(08 Marks)**

Module-3

5 a. Write Kelvin-Plank and Clausius statements of second law of thermodynamics. Show that violation of Clausius statement leads to the possibility of a perpetual motion machine of second type. **(10 Marks)**

b. Series combination of three Carnot engines A, B and C operates between temperatures of 1500 K and 300 K. If the amount of heat addition to each engine is in the ratio of 6 : 3 : 2. Calculate the intermediate temperature. **(10 Marks)**

OR

6 a. Obtain an expression for entropy change of a closed system when it undergoes a polytropic process. **(10 Marks)**

b. A 50 kg metal block at a temperature of 500°C is quenched in 140 kg of oil at 30°C. C_p of metal = 0.5 KJ/kg°K, C_p of oil = 2.5 KJ/kg°K. Assuming number of heat losses. Calculate change in entropy for a system consisting of oil and casing. **(10 Marks)**

Module-4

7 a. With the help of a neat diagram, explain P-V-T surface and also describe the property diagrams in common use. **(10 Marks)**

b. A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of liquid present is 10 kg. Find the following (i) Processor (ii) Mass (iii) Specific volume (iv) Specific enthalpy (v) Specific entropy (vi) Specific internal energy. **(10 Marks)**

OR

8 a. With the help of a relevant sketch explain the process of determination of dryness fraction of steam using Throttling calorimeter. **(10 Marks)**

b. With usual notations derive the following :

(i) Entropy equations (Tds equation)
(ii) Equation for internal energy.
(iii) Equation for enthalpy. **(10 Marks)**

Module-5

9 a. With the help of P-V and T-S diagram derive an expression for air-standard efficiency of Otto cycle with usual notation. **(10 Marks)**

b. An engine operating an the ideal diesel cycle has a compression ratio of 16:1. Heat is added during constant pressure process upto 8% of the stroke. If the engine inhales 0.04 m^3/s at 101 KPa and 25°C, determine

(i) The maximum pressure and temperature in the cycle.
(ii) The thermal efficiency of the engine.
(iii) The power developed. **(10 Marks)**

OR

10 a. With the help of a neat schematic P-V, T-S and h-S diagram, derive an expression for efficiency of Rankine cycle. **(10 Marks)**

b. In a steam power cycle, the steam supply is at 15 bar and dray and saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work. **(10 Marks)**

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