CBCS SCHEME

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18AE/AS32

Third Semester B.E. Degree Examination, June/July 2024
Aero Thermodynamics

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 Book and Steam table are permitted.

Module-1

1 a. Distinguish between :
(i) Microscopic and Macroscopic approach
(ii) Point function and Path function. **(10 Marks)**

b. A temperature scale of certain thermometer is given by the relation T = a *ln* p + 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 points. The thermometric properties are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property of 3.5 on Celsius scale. **(10 Marks)**

OR

2 a. Derive an expression for Pdv – work for the following Quasi-static process,
(i) Isothermal process.
(ii) Polytropic process. **(10 Marks)**

b. When the value of the evaluated bottle is opened. Atmospheric air rushes into it. If the atmospheric pressure is 101.325 KPa and 0.6 m^3 of air (measured at atmospheric condition) enters into the bottle. Calculate the work done by air. **(10 Marks)**

Module-2

3 a. With the help of a neat schematic diagram, explain Joule's experiment. **(10 Marks)**

b. Air enters a compressor at 10^5 Pa and 25 °C having volume of 1.8 m^3/kg and is compressed to 5×10^5 Pa isothermally. Determine
(i) Work done (ii) Change in internal energy (iii) Heat transferred. **(10 Marks)**

OR

4 a. Illustrate the application of the steady flow energy equations in the following engineering systems:
(i) Nozzle and Diffuser
(ii) Throttling Device **(10 Marks)**

b. During flight the air speed of a turbojet engine is 250 m/s. Ambient air temperature is −14°C. Gas temperature at outlet of nozzle is 610 °C corresponding enthalpy values for air and gas are 250 and 900 kJ/kg respectively. Fuel air ratio is 0.0180 chemical energy of the fuel is 45 MJ/kg. Owing to incomplete combustion 6% of chemical energy is not released in the reaction. Heat loss from the engine is 21 KJ/kg of air. Calculate the velocity of the exhaust jet. **(10 Marks)**

Module-3

5 a. State second law of thermodynamics and prove the equivalence of Clausius statement to the Kelvin statement. **(10 Marks)**

b. Two Carnot engines work in series between the source and sink temperatures of 550 K and 350 K. If both engines develop equal power determine the intermediate temperature. **(10 Marks)**

OR

6 a. With the help of a P-V diagram, prove that entropy is a property of the system. **(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 and $C_{P_0} = 2.5$ kJ/kgK, assume no heat losses. Calculate change is entropy for a system consisting of oil and casing. **(10 Marks)**

Module-4

7 a. Define pure substance. Describe the phase change of a pure substance with the help of a T-V diagram. **(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 the liquid present is 10 kg. Find the following: (i) The pressure (ii) The mass (iii) The Specific volume (iv) The specific enthalpy (v) The specific entropy **(10 Marks)**

OR

8 a. Derive an expression for Maxwell relations with usual notations. **(10 Marks)**

b. Describe the coefficient of Expansion and compressibility from P-V-T data. **(10 Marks)**

Module-5

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

b. The volume ratio of adiabatic expansion and compression of an ideal diesel cycle are 8 : 1 and 16 : 1 respectively. The intake pressure and temperature are 1 bar and 35°C. The pressure at the end of compression is 40 bar. Determine

(i) The maximum cycle temperatures.
(ii) The cut off ratio and percentage of cut off.
(iii) The thermal efficiency of the cycle.

Assume $\gamma = 1.4$, $C_p = 1.005$ KJ/kgK. **(10 Marks)**

OR

10 a. With the help of a neat schematic diagram, explain the working of a Rankine cycle. Draw the P-V and T-S diagram and derive Rankine efficiency. **(10 Marks)**

b. In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine

(i) The pump work
(ii) The turbine work
(iii) The Rankine efficiency
(iv) The condenser heat flow.
(v) The dryness at the end of expansion.

Assume flow rate of 9.5 kg/s. **(10 Marks)**

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