CBCS SCHEME

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21AU34

Third Semester B.E. Degree Examination, June/July 2024
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 Thermodynamic Data Handbook is permitted

Module-1

1 a. Distinguish between :
i) Open system and closed system
ii) Intensive and extensive properties
iii) Microscopic and Macroscopic approaches
iv) Point and path function **(08 Marks)**

b. State Zeroth law of thermodynamics and explain any one kind of thermometer to measure the temperature. **(06 Marks)**

c. The temperature scale of a celcius thermometer is given by the relation t = a lnx + b. Where a and b are constants and 'x' is the thermometric property of the fluid in the thermometer. If the ice point and steam point of the thermometric property are found to be 1.5 and 7.5 respectively. What will be the temperature corresponding to the thermometric property 3.5. **(06 Marks)**

OR

2 a. Derive an expression for work done for reversible isothermal process taking place in a closed system containing an ideal gas. **(06 Marks)**

b. Bring out the similarities and dissimilarities between heat and work. **(08 Marks)**

c. A gas system confined by a piston and cylinder undergoes a change of state such that the product of pressure and volume remains constant. If the process begins at a pressure of 3 bar and a volume of 0.015m^3 and proceeds until the pressure falls to half of its initial value. Determine the magnitude and direction of the work flow. **(06 Marks)**

Module-2

3 a. With a neat sketch, explain joules experiments. **(06 Marks)**

b. Stating the assumptions derive steady flow energy equation for an open system. **(08 Marks)**

c. A centrifugal pump delivers 60kg of water per second. The inlet and outlet pressure are 10kPa and 400kPa respectively. The suction is 2m below and delivery is 8m about the centre line of the pump. The suction and delivery pipe diameter are 20cm and 10cm respectively. Determine the capacity of the electric motor to run the pump. **(06 Marks)**

OR

4 a. Define the two statements of II laws of thermodynamics. Further prove that violation of Clausius statement also violates Kelvin plank statement. **(10 Marks)**

b. Show that $(COP)_{HP} = 1 + (COP)_R$. **(05 Marks)**

c. A reversible heat engine operates with two environments. In the first it draws 12000kW from a source at 400°C and in the second it draws 25,000kW from a source at 100°C. In both the operations the engine rejects heat to a thermal sink at 20°C. Determine the operation in which engine delivers more power. **(05 Marks)**

Module-3

5 a. Show that entropy is a property of the system. **(08 Marks)**

b. Outline the principle of increase of entropy. **(06 Marks)**

c. A heat engine is supplied with 300kJ/S of heat at 290°C and heat rejection takes place at 8.5°C. The following results were collected:
i) 215kJ/S are rejected ii) 150kJ/S are rejected iii) 75kJ/S are rejected.
Specify which of the above data represents a reversible, irreversible or impossible results. **(06 Marks)**

OR

6 a. Sketch and explain P-T diagram of water. **(06 Marks)**

b. Define the following: i) Pure substance ii) Triple point iii) Critical point iv) Latent heat **(08 Marks)**

c. Find the enthalpy, specific volume and internal energy if the pressure of the steam is 50 bar and temperature is 443°C. **(06 Marks)**

Module-4

7 a. With the help of T-S and p-h diagram explain vapour compression refrigeration system. **(10 Marks)**

b. With a neat sketch, explain vapour absorption refrigeration system. **(10 Marks)**

OR

8 a. Define the following terms:
i) Specific humidity
ii) Wet bulb temperature
iii) Sensible cooling
iv) Degree of saturation
v) Dew point temperature. **(10 Marks)**

b. Atmospheric air at 750mm Hg has a DBT of 34°C and WBT of 24°C. Compute : i) Relative humidity ii) Humidity ratio iii) Dew point temperature iv) Enthalpy of atmospheric air v) Density of moist air. **(10 Marks)**

Module-5

9 a. Derive with usual notations an expression for air standard efficiency of an otto cycle. Represents the cycle on P-V and T-S diagrams. **(10 Marks)**

b. In an air-standard diesel cycle the compression ratio is 16. At the beginning of isentropic compression the temperature is 15°C and pressure is 0.1MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate: i) Cut-off ratio ii) Heat supplied per kg of air iii) Cycle efficiency. **(10 Marks)**

OR

10 a. Explain the following methods in detail
i) William's Line method
ii) Morse test **(10 Marks)**

b. The following observations were made during one hour test on a single cylinder 4-stroke oil engine. Bore = 300mm, stroke = 450mm, mass of the fuel used = 8.8kg, calorific value = 41800kJ/kg, average speed = 200rpm, mean effective pressure = 5.8 bar, brake load = 1860N, mass of cooling water circulated = 650kg, temperature rise = 22°C, diameter of brake drum = 1.22m. Calculate : i) Mechanical efficiency ii) Brake thermal efficiency iii) Draw the heat balance sheet. **(10 Marks)**

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