CBCS Scheme

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15MA33

Third Semester B.E. Degree Examination, June/July 2018
Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer any FIVE full questions, choosing one full question from each module.***
2. ***Use of thermodynamic data hand book is permitted.***

Module-1

1 a. Distinguish the following:
i) Open system and closed system
ii) Intensive properties and extensive properties
iii) Point function and path function
iv) Diathermic wall and adiabatic wall. **(08 Marks)**

b. A constant volume gas thermometer containing a gas gives the reading of gas pressure of 1 bar and 1.5 bar at ice point and steam point respectively. Assuming $T = a + bp$, where p is in N/m^2, express the gas thermometer Celsius temperature T in terms of gas pressure. What is the temperature recorded by the thermometer when it registers a pressure of 1.2 bar? **(08 Marks)**

OR

2 a. Derive an expression for displacement work for polytropic process. **(08 Marks)**

b. A spherical balloon of diameter 0.5 m is initially having an inside pressure of 100 kPa. Due to heating the pressure inside the balloon increases to 400 kPa during which the inside pressure varies inversely proportional to the square of the diameter of the balloon, $\left(p \propto \frac{1}{D^2}\right)$. Determine the displacement work during this process. **(08 Marks)**

Module-2

3 a. State and explain the first law of thermodynamics. Give its equation with respect to cyclic and non-cyclic process. **(08 Marks)**

b. A vertical cylinder of cross sectional area 0.1 m^2 fitted with a leak proof, frictionless, freely floating piston contains some air at a pressure of 1.2 bar. The air is agitated by paddle wheel for 10 min. The shaft of the paddle wheel running at 250 rpm with a torque of 0.5 Nm is driven by external prime mover. During the same period an electrical resistor housed in the cylinder and connected to an external 24 V battery draws a current of 0.45 A to heat the air. In the same period, find the distance in CM. Through which piston rises given that heat transfer from the air is 5 kJ and the internal energy of air increases by 2 kJ. **(08 Marks)**

OR

4 a. State the following:
i) Kelvin-Planck statement
ii) Clausius statement **(08 Marks)**

b. A reversible heat engine operates between reservoirs at temperatures of 177°C and 27°C. Find the efficiency of the engine. Evaluate the heat transfer from 177°C and heat transfer to the 27°C reservoir if the work output from the engine is 27 kJ. If the above engine is operated as a heat pump between the same reservoir. Evaluate the COP of heat pump. **(08 Marks)**

Module-3

5 a. Derive the expression for air standard efficiency of an Otto cycle. **(08 Marks)**

b. The minimum pressure and temperature in an Otto cycle are 100 kPa and 27°C. The amount of heat added to the air per cycle is 1500 kJ/kg. Determine:
i) The pressure and temperature at all points.
ii) The specific work of the cycle for a compression ratio of 8:1.
Take for air : $C_V = 0.72$ kJ/kg.K and $\gamma = 1.4$. **(08 Marks)**

OR

6 a. Compare Carnot vapour power cycle with Rankine vapour cycle. **(08 Marks)**

b. In a steam power cycle, the steam supply is at 15 bar and dry saturated. The condenser pressure is 0.4 bar. Calculate:
i) Carnot cycle efficiency
ii) Rankine efficiency (neglect pump work) **(08 Marks)**

Module-4

7 a. State and prove Classius inequality. **(08 Marks)**

b. 3 kg of water at 80°C is mixed with 4 kg of water at 15°C in an isolated system. Calculate the change of entropy due to mixing process. **(08 Marks)**

OR

8 a. Define the following:
i) Triple point
ii) Latent heat of evaporation
iii) Quality of steam
iv) Enthalpy of super heated steam. **(08 Marks)**

b. Using the steam table. State the condition of steam in the following cases:
i) At a pressure of a 9 bar and temperature 178°C.
ii) At a pressure of 11 bar, total heat is 2772 kJ/kg.
iii) At a pressure of 19 bar, and temperature 228°C.
iv) At a pressure of 17 bar, specific volume 0.112 m^3/kg. **(08 Marks)**

Module-5

9 a. List the desirable properties of a good refrigerants. **(08 Marks)**

b. With neat figure explain the working principle of vapour absorption refrigeration system. **(08 Marks)**

OR

10 a. Define the following:
i) Atmospheric air
ii) Dry bulb temperature
iii) Wet bulb temperature
iv) Relative humidity **(08 Marks)**

b. Atmospheric air having DBT = 16°C and RH = 25% is passed through a furnace and then through humidifier to maintain a final DBT = 30°C and 50% RH. Find the heat and moisture added to air. Also calculate Sensible Heat Factor (SHF). **(08 Marks)**

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