CBCS SCHEME

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15AU33

Third Semester B.E. Degree Examination, Feb./Mar. 2022
Engineering 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 handbook is allowed.***

Module-1

1 a. 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. **(08 Marks)**

b. A certain thermometer is calibrated using ice and stream and fixed points and designating them as 0°C and 100°C respectively. The thermodynamic function chosen to establish the scale is $t = (a\ell nx + b)$ inside of the linear scale $t = (ax + b)$. Determine the constants 'a' and 'b' interms of X_{ice} and X_{steam} and show that the new scale is given by

$$t = 100 \frac{\ell n\left(\frac{x}{x_{ice}}\right)}{\ell n\left(\frac{x_{steam}}{x_{ice}}\right)}$$ **(08 Marks)**

OR

2 a. Define work and heat, write the similarities and dissimilarities between them. **(08 Marks)**

b. An elastic balloon has diameter of 0.5m and is filled with gas at a pressure of 200KPa. The gas is heated so that its diameter increase to 0.6m and pressure to 250KPa. During the process, the pressure is proportional to balloon's diameter. Evaluate the workdone by gas during the process. **(08 Marks)**

Module-2

3 a. Write the first law of thermodynamics for a closed system undergoing cyclic and non cyclic process and prove that internal energy is a property of system. **(08 Marks)**

b. During a steady flow process 5000kg/hr of fluid pass through a system in which the exit pipe is 2m below the level of the inlet pipe. Find the power developed by the system, if pressure decreases from 7 to 1.2KPa, velocity decreases from 400 to 60m/sec, internal energy decreases by 5kJ, specific volume increases from 0.03 to 0.2m^3/Kg and heat lost by the system is 12kJ. **(08 Marks)**

OR

4 a. Illustrate that entropy is properly of system. **(04 Marks)**

b. A perfect gas is heated from 60°C to 300°C at a constant pressure of 4 bars. The gas is then cooled to 60°C at constant volume. The mass of gas is 5kg. Calculate the change in entropy. Take $C_p = 1.0$kJ/Kg.K, $C_v = 0.72$ kJ/Kg.K. **(04 Marks)**

c. It is proposed to heat a house using a heat pump. The heat transfer to the house is 50000kJ/min and the house is maintained at 25°C. If the outside air temperature is −5°C, what is the minimum power required to drive the pump and its COP. **(08 Marks)**

Module-3

5 a. Define :
   i) Theoretical air and excess air
   ii) Air-fuel ration and theoretical air fuel ratio. **(08 Marks)**

b. Compression ratio of an air standard dual cycle is 8. Air is at 100KPa, 300K at the beginning of the compression process. The temperature of air at the end of constant pressure heat addition process is 1300K. The net heat transfer to the cycle is 480kJ/kg. Determine :
   i) Heat added during constant volume per Kg of air
   ii) Air standard cycle efficiency and
   iii) m.e.p **(08 Marks)**

OR

6 a. Explain the principle of conducting Morse test on IC engines for determining frictional power. **(08 Marks)**

b. A 4-cylinder 2-stroke petrol engine has a bore of 57mm and stroke of 90mm. Its rated speed is 2800rpm and is tested at this speed against a brake, which has a torque arm of 0.356m. The net brake load is 155N and fuel consumption is 6.74 ℓit/h. The specific gravity of the petrol is 0.735 and it has a calorific value of 44200kJ/kg. A Morse test is carried out and the cylinders are cut out in order 1, 2, 3, 4 with corresponding brake loads 111, 106.5, 104.2 and 111.3N respectively. Calculate for this speed.
i) The engine torque ii) Brake mean effective pressure iii) Brake thermal efficiency iv) BSFC v) Mechanical efficiency vi) Indicated thermal efficiency. **(08 Marks)**

Module-4

7 a. Explain stream jet refrigeration with neat sketch. **(08 Marks)**

b. A vapour compression plant uses R-12 and is to develop 5 tonnes of refrigeration. The condenser and evaporator temperatures are to be 40°C and −10°C respectively. Determine :
i) The refrigerant flow rate in Kg/s ii) Heat rejected in the condenser in kW iii) COP and iv) Power required to drive the compressor. **(08 Marks)**

OR

8 a. The atmospheric conditions are 20°C and specific humidity of 0.0095 Kg/Kg of dry air. Calculate the following : i) Partial pressure of water vapour ii) Relative humidity **(08 Marks)**

b. With a neat sketch, explain the working of air conditioning system for hot and dry weather. **(08 Marks)**

Module-5

9 a. Derive the expression for the isothermal workdone by a single stage reciprocating compressor with and without clearance volume. **(08 Marks)**

b. Explain multistage compression with neat sketch. **(08 Marks)**

OR

10 a. Classify gas turbines, sketch the gas turbine cycle on T-S diagram, showing all the processes consider both ideal and actual cases and explain. **(08 Marks)**

b. Write short notes on :
   i) Turbojet engine
   ii) Rocket Propulsion. **(08 Marks)**

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