CBCS SCHEME

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Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
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 T.D data hand book, steam tables, psychrometry chart allowed.

Module-1

1 a. Explain:
i) Thermodynamic equilibrium
ii) Quasistatic process
iii) Thermometric property
iv) Zeroth law of thermodynamics. **(08 Marks)**

b. The temperature 't' on a thermometric scale is defined in terms of a property 'p' by the relation $t = x \ln p + y$, where 'x' and 'y' are constants. The values of 'p' are found to be 1.83 and 6.78 at the ice and steam point, the temperatures of which are assigned the numbers 0 and 100 respectively. Determine the temperature corresponding to a reading of 'p' equal to 2.54 on the thermometer. **(08 Marks)**

OR

2 a. Show that the work and heat are path functions. **(06 Marks)**

b. Determine the total work done by a gas system following an expansion process as shown in Fig.Q.2(b). **(10 Marks)**

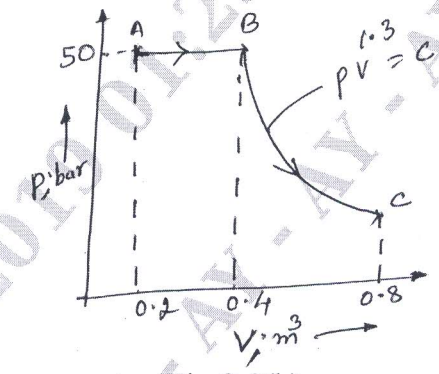

Fig.Q.2(b)

Module-2

3 a. State and explain the first law of thermodynamics. Give its equation with reference to a cyclic and non-cyclic process. **(05 Marks)**

b. What is perpetual motion of I-kind? Explain. **(03 Marks)**

c. Air enters an adiabatic horizontal nozzle at 400°C with a velocity of 50m/s. The inlet area is 240cm^2. The temperature of air at the exit is 80°C. Given that the specific volume of air at the inlet and exit are respectively 0.2m^3/kg and 1.02 m^3/kg, find the area of cross section of the nozzle at the exit. Assume that enthalpy of air is a function of temperature only and that $c_p = 1.005$ kJ/kg K. **(08 Marks)**

OR

4 a. Stat the limitations of first law of thermodynamics. **(04 Marks)**

b. Prove that entropy is a property of system. **(06 Marks)**

c. A cyclic heat engine operates between a source temperature of 800°C and a sink temperature of 30°C. What is the least rate of heat rejection per kW net output of the engine? **(06 Marks)**

Module-3

5 a. Define air-fuel ratio and relative air-fuel ratio. **(04 Marks)**

b. Derive an expression for mean effective pressure of Otto cycle. **(06 Marks)**

c. A diesel engine has a compression ratio of 14 and cutoff takes place at 6% of the stroke. Find the air standard efficiency. **(06 Marks)**

OR

6 a. Explain how the frictional power of a multi cylinder engine is carried out using Morse test. **(06 Marks)**

b. The following observations are recorded in a test of one hour duration on a single cylinder four stroke S.I. engine. Bore = 220mm, stroke = 300mm, fuel used = 4 kg, CV of fuel = 42000 kJ/kg, speed = 300 rpm, M.e.p. = 5 bar, load on brake = 60kg spring balance reading = 30N, diameter of brake drum = 1.4m, quantity of cooling water = 500kg temperature rise of cooling water = 20°C, A/F = 16, exhaust gas temperature = 410°C, c_p of gas = 1.1 kJ/kg K, ambient temperature = 30°C. Calculate the following : i) I.P ii) B.P iii) η_{bt} iv) B.S.F.C. Also draw a heat balance sheet in kJ/min and find the unaccounted losses. **(10 Marks)**

Module-4

7 a. What is refrigeration? Explain with the neat sketch the working principle of vapour compression refrigeration system. **(08 Marks)**

b. A refrigerator uses R – 134 a as the working fluid and operates on an ideal vapour compression cycle between 0.14MPa and 0.8MPa of the mass flow rate of the refrigerant is 0.06 kg/s, determine: i) The rate of heat removal from the refrigerated space; ii) the power input to the compressor , iii) the heat rejection in the condenser and iv) the cop. **(08 Marks)**

OR

8 a. Define relative humidity and specific humidity. **(04 Marks)**

b. With neat sketch, briefly describe winter air conditioning system. **(06 Marks)**

c. One kg of air at 50°C DBT and 50% RH is mixed with 2kg of air 20°C DBT and 20°C DPT. Calculate temperature and specific humidity of the mixture. **(06 Marks)**

Module-5

9 a. Define the following with respect to reciprocating air compressor: i) Isothermal efficiency ii) Isentropic efficiency and iii) Mechanical efficiency. **(06 Marks)**

b. Obtain an expression for volumetric efficiency of a single stage air compressor interms of clearance ratio, pressure ratio, and index of compression. **(10 Marks)**

OR

10 a. Explain, with neat sketch, the differences between open and closed cycle. **(06 Marks)**

b. In an ideal Brayton cycle, air from the atmosphere at one atm, 300K is compressed to 6 atm and the maximum cycle temperature is limited to 1100K by using a large air-fuel ratio. If the heat supply is 100MW. Find: i) The thermal efficiency of the cycle; ii) Work ratio and iii) Power output. **(10 Marks)**

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