Total No. of Questions – [6] Total No. of Printed Pages: 2

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S. Y. B.TECH. (MECHANICAL) (SEMESTER – III)
COURSE NAME: THERMODYNAMICS
COURSE CODE: MEUA21184
(PATTERN 2018)

Time: [2 Hours] [Max. Marks: 50]

(*) Instructions to candidates:
1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of scientific calculator is allowed.
4) Assume suitable data where ever required.

Q.1) Attempt any **one**

a) Explain the following concepts of thermodynamics:
i. Flow work iii. P-dv work [4]

b) A mass of 0.8kg of air at 1 bar and 20°C is contained in a gas-tight frictionless piston cylinder device. The air is now compressed to a final pressure of 5 bar. During the process, the heat is transferred from air such that the temperature inside the cylinder remains constant. Calculate the heat transferred and work done during process and the direction of each in process. [4]

Q.2) Attempt any **one**

a) A house requires 2×10^5 kJ/h for heating in winter. Heat pump is used to absorb heat from cold air outside in winter and send heat to the house. Work required to operate the heat pump is 3×10^4 kJ/h. Determine:
(i) Heat abstracted from outside;
(ii) Coefficient of performance. [4]

b) State the reasons that Carnot cycle is impracticable. [4]

Q.3) Attempt any **one**

a) 1.5 kg of air at 1 bar, 300K is contained in a rigid insulated tank. During the process, 18kJ of work is done on the gas through a paddle wheel mechanism. Determine the final temperature, final pressure of air in the tank and change in entropy. Take Cv=0.716 kJ/kgK [6]

b) Derive the expression for the entropy change for constant volume heating process and plot the process on T-s diagram. [6]

Q.4) Attempt any **one**

a) A temperature of 2280K is attained in a furnace when hot products of combustion are produced by burning fuel in air at atmospheric pressure. Determine the availability of heat in the combustion products. It may be presumed that combustion products behave as a perfect gas and the heat withdrawal occurs at constant pressure. Take Cp = 1.00 kJ/kgK for the gas and ambient temperature 300 K. [6]
What is high grade and low-grade energy? Give important examples of each category [4]

b) A system at 450 K receives 225 kJ/s of heat energy from a source at 1500

K, and the temperature of both the system and source remains constant during heat transfer process. Determine:
i. Net change in entropy ii. Available energy of heat source iii. Available energy of system [6]
Take atmospheric temperature equal to 300K
Define: i. Dead state ii. Irreversibility [4]

Q.5) Attempt any **one**

a) State different methods to determine the dryness fraction of steam. Explain working of any one calorimeter with neat sketch for estimating the dryness fraction. [7]
1000 kg of steam at a pressure of 16 bar and 0.9 dry is generated by a boiler per hour. The steam passes through a superheater via boiler stop valve where its temperature is
raised to 380°C. If the temperature of feed water is 30°C, determine: (i) The total heat supplied to feed water per hour to produce wet steam. (ii) The total heat absorbed per hour in the superheater.
Take specific heat for superheated steam as 2.2 kJ/kg K. [6]

b) Explain the process of steam generation from water at constant pressure. Show the various stages on T-h diagram. [7]
In a laboratory experiment on wet steam by a barrel calorimeter, the following observations were recorded: Mass of copper calorimeter = 1 kg
Mass of calorimeter + water = 3.8 kg
Mass of calorimeter + water + steam = 4 kg
Initial temperature of water = 10°C
Final temperature of water = 50°C
Steam pressure = 5.5 bar
If the specific heat of copper is 0.406 KJ/KgK, determine the dryness fraction of steam. [6]

Q.6) Attempt any **one**

a) Discuss in brief with their function: i. Fusible plug ii. Safety valve [7]
A coal fired boiler plant consumes 400kg of coal per hour. The boiler evaporates 3200 kg of water at 44.5 °C into superheated steam at a pressure of 12 bar and 274.5 °C. If the calorific value of fuel is 32760 kJ/kg of coal, determine: 1. equivalent evaporation from and at 100°C 2. thermal efficiency of the boiler.
Assume specific heat of superheated steam as 2.1 kJ/kgK [6]

b) With neat sketch explain working of water level indicator. [7]
A 30 m high chimney is used to produce a natural draught of 15 mm of water. The temperature of hot gases in the chimney is 287 °C. If the temperature of outside air is 27°C; find the mass of air used per kg of fuel. Also calculate the draught produced in terms of hot gas column. [6]