Code No: 113AB

R13

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year I Semester Examinations, November - 2015
THERMODYNAMICS
(Common to ME, AE, AME, MSNT)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

PART- A (25 Marks)

1.a) Discuss the Macroscopic and Microscopic point of view of thermodynamics. [2M]
b) Explain the terms – state, path, process and cyclic process. [3M]
c) What are the limitations of first law? Explain. [2M]
d) Show the equivalence of Clausius and Kelvin statement of second law of thermodynamics. [3M]
e) What is the vader waals equation of state? What are the limitations? Discuss. [2M]
f) Discuss the various methods for determining the dryness fraction of steam with relative merits and demerits. [3M]
g) Discuss Daltons law of partial pressure. [2M]
h) Is it possible to have equal value of DBT and WBT? [3M]
i) What do you mean by air standard cycle and what are the assumptions in air standard cycles? [2M]
j) List the main elements of vapor compression refrigeration system. [3M]

PART-B (50 Marks)

2.a) Distinguish between closed system, open system and semi closed system.
b) If the temperature scale is graduated according to the equation $t = 100 + 3t_c$ where t is the temperature reading on the scale and t_c is the Celsius temperature, find the freezing as well as boiling point of thermodynamic substance.
c) Verify the first law of thermodynamics using Joule's experiments. [2+6+2]

OR

3.a) At a speed of 50 km/h, the resistance to motion of a car is 900 N. Neglecting losses, calculate the power of the engine of the car at this speed. Determine also the engine developing power.
b) A household refrigerator contains fresh food and it is closed. 1 kWh of electric energy is consumed in cooling the food and internal energy of the system decreases by 500 kJ as the temperature drops. Find the magnitude and sign of heat transfer for the process. Assume the entire refrigerator and its contents as system. [3+7]

4.a) A Carnot engine with an efficiency of 40 percent receives 400 kJ/h from a high temperature source and rejects heat to a sink at 26.7^{0}C. What is the power output of the engine and the temperature of the source in ^{0}C?

b) All spontaneous processes are reversible. Explain.

c) An inventor claims to have a device which receives 1000W of energy as heat puts out only 750W of electrical power. The rest of energy is put out as electrical work and dissipated outside his device by friction. Discuss the validity of his claims. [4+2+4]

OR

5.a) During a cyclic process, total interactions happen to be positive. Does it violate the Clausius inequality? Explain it.

b) The efficiency of a Carnot engine rejecting het to a cooling pond at 27^{0}C is 30 percent. The cooling pond receives 13.91 kW. Calculate the power of the engine and the source temperature. [4+6]

6.a) What is the physical significance of compressibility factor? Discuss its significance.

b) A methane cylinder of 0.5 m^3 contains gas at 10 MPa and 298 K. Determine the mass of methane gas in this cylinder by using Ideal gas law and compressibility chart. [3+7]

OR

7.a) What do you mean by superheated vapor? What is the difference between saturated vapor and superheated vapor? Discuss.

b) Calculate the external work of evaporation, internal latent heat and internal energy of one kg of steam at a pressure of 13 bar when the steam is (i) 0.8 dry (ii) dry saturated. [4+6]

8.a) What do you mean by mass fraction of a species in a mixture? How is it different from mole fraction? Discuss.

b) A rigid insulated tank of volume 50 litres containing 40% H_2 and 60% CH_4 gas by volume is connected to a high pressure h_2 gas pipeline at 3 MPa and 300 K. By opening the valve, the gas mixture is allowed to fill this tank until it attains a pressure of 3 MPa at 300 K. Then this tank was disconnected from the pipeline and isolated. Estimate the mass fraction of final mixture. [3+7]

OR

9.a) Does mixture of ideal gases behave like an ideal gas? Explain with the help of an example.

b) The DBT of atmospheric air is 26.7^{0}C and the relative humidity is 30%. Find the value of humidity ratio and the partial pressure of water vapor if the total pressure is 1.103 bar. What is the dew point? [3+7]

10.a) How many parameters do we need to describe an ideal simple Brayton cycle completely?

b) A simple ideal Brayton cycle uses air as working fluid and has a pressure ratio of 12. If the air temperature at the entrance of the compressor and turbine are at 300 K and 1300 K respectively, determine (i) the air temperature at the compressor exit and back work ratio and (ii) thermal efficiency. Assume constant specific heats at room temperature. [3+7]

OR

11.a) Why is higher air-fuel ratio by mass basis used in the case of a gas turbine engine?

b) In an ideal vapor compression refrigeration system, the refrigerant R-12 enters the compressor as saturated liquid at -16^0C with a volumetric flow rate of 1 m^3/min. The refrigerant leaves the condenser at 36^0C, 10 bar. Calculate (i) the compressor power, (ii) the refrigerating capacity in tons and (iii) the coefficient of performance. [3+7]

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