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Roll No. | | | | | | | | | | |

B.E / B.Tech (FT) END SEMESTER EXAMINATIONS – APRIL / MAY 2019

(Common to Industrial and Manufacturing Engineering)

Fourth Semester

ME8453 Thermodynamics

(Regulation 2012)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART- A (10 x 2 = 20 Marks)

1. 14.5 Litres of gas at 172 KN/m^2 is expanded at constant pressure until its volume becomes 130.5 Litres. Determine the workdone by the gas
2. What do you mean by a pure substance?
3. A domestic refrigerator is loaded with food and the door closed. During a certain period the machine consumes 1 kWh of energy and the internal energy of the system drops by 5000 kJ. Find the net heat transferred in the system.
4. Define heat engine, refrigerator and heat pump.
5. Distinguish between four stroke and two stroke engines.
6. List the accessories used in boilers.
7. Write down the Vander waals equation
8. State Dalton's law.
9. Define the term thermal conductivity and convective heat transfer coefficient.
10. The inner surface of a plane brick wall is at 40°C and the outer surface is at 20°C. Calculate the rate of heat transfer per m^2 of surface area of the wall, which is 250 mm thick. The thermal conductivity of the brick is 0.52 W/m K.

Part – B (5 x 16 = 80 marks)
(Question No.11 is Compulsory)

11. Two vessels, A and B, both containing nitrogen, are connected by a valve which is opened to allow the contents to mix and achieve an equilibrium temperature of 30°C. Before mixing, the following information is known about the gases in the two vessels.

Calculate (a) the final equilibrium pressure, the amount of heat transferred to the surroundings

(b) If the vessel had been perfectly insulated, calculate the final temperature and pressure. Assume $\gamma = 1.4$.

Vessel	Pressure (P)	Temperature (T)	Contents
A	16 bar	55°C	0.6 kg mole
B	6.4 bar	25°C	3.6 kg mole

12. a) A cylinder contains 1 kg of a certain fluid at an initial pressure of 20 bar. The fluid is allowed to expand reversibly behind a piston according to a law $pV^2 = C$ until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position: heat is then supplied reversibly with the piston firmly locked in position until the pressure rises to the original value of 20 bar. Calculate the net work done by the fluid, for an initial volume of 0.05 m^3.

(OR)

b) Explain .by drawing the P-T and the P-V-T surface of a pure substance.

13. a) In a steam plant, 1 kg of water per second is supplied to the boiler. The enthalpy and velocity of water entering the boiler are 800 kJ/kg and 5 m/s. The water receives 220 kJ/kg of heat in the boiler at constant pressure. The steam after passing through the turbine comes out with a velocity of 50 m/s, and its enthalpy is 2520 kJ/kg. The inlet is 4 m above the turbine exit. Assuming the heat losses from the boiler and the turbine to the surroundings are 20 kJ/s, calculate the power developed by the turbine. Consider the boiler and turbine as single system.

(OR)

b) 1 kg of ice at -5°C is exposed to the atmosphere which is at 25°C. The ice melts and comes into thermal equilibrium. (i) Determine the entropy increase of the universe, (ii) What is the minimum amount of work necessary to convert the water back into ice at -5°C? Take Cp of ice = 2.093 kJ/kg°C, latent heat of fusion of ice = 333.33 kJ/kg.

14. a) Explain the working of vapour compression and vapour absorption refrigeration system with neat sketch.

(OR)

b) Explain the working of compression ignition and spark ignition engines with necessary sketches and write the difference between four stroke and two stroke engines

15. a) A furnace wall is made up of three layers of thickness 250 mm, 100 mm and 150 mm with thermal conductivities of 1.65 and 9.2 W/m°C respectively. The inside is exposed to gases at 1250°C with a convection coefficient of 25 W/m²°C and the inside surface is at 1100°C, the outside surface is exposed air at 25°C with convection coefficient of 12 W/m²°C. Determine (i) the unknown thermal conductivity, (ii) The overall heat transfer coefficient (iii) All surface temperatures.

(OR)

b) In a counter-flow double pipe heat exchanger, water is heated from 25°C to 65°C by an oil with a specific heat of 1.45 kJ/kg K and mass flow rate of 0.9 kg/s. The oil is cooled from 230°C to 160°C. If the overall heat transfer coefficient is 420 W/m²°C, calculate the following: (i) the rate of heat transfer, (ii) The mass flow rate of water and (iii) The surface area of heat exchanger.