No. of Printed Pages : 4

ET-201(B)

B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) / B.Tech. (Aerospace Engineering)

Term-End Examination

00401

December, 2015

ET-201(B) : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

Note : *Answer any* ***seven*** *questions. All questions carry equal marks. Use of steam tables and calculator is permitted.*

1. (a) Explain Zeroth law of thermodynamics with a suitable diagram. *5*

(b) A mass of gas is compressed in a fully resisted process from 90 kPa and 0·12 m^3 to 0·45 MPa and 0·03 m^3. Assuming that pressure and volume are related to PV^n = constant, determine the work done by the gas system. *5*

2. (a) What are the devices to measure pressure ? Explain the Bourdon Pressure Gauge. *5*

(b) In a steam power plant, the work output of the turbine is 130 kJ, while heat supplied at the boiler is 350 kJ. Given that during the same period work input to the pump is 1·5 kJ. Find the heat rejected at the condenser and thermal efficiency of the plant. *5*

3. (a) Explain Kelvin – Planck Statement with a suitable example. *3*

(b) Two kg of a gas is passed through an insulated and opened valve such that its pressure falls from 20 bar abs. to 1·5 bar abs. In the process the internal energy falls by 0·16 kJ. If the initial volume of the gas is 0·44 m^3, find the final volume. *7*

4. (a) Describe the working of vapour compression refrigeration system, with a neat sketch. *5*

(b) Determine the specific volume of steam at a pressure of 20 MPa and temperature 600°C

(i) using ideal gas equation.

(ii) using Van der Waal's equation.

The constants in Van der Waal's equation are :

$a = 5{\cdot}538 \times 10^5\ Nm^4/(kg\text{-}mole)^2$

$b = 0{\cdot}0305\ m^3/mg\ mole.$ *5*

5. (a) When a system received 30×10^3 Nm of work, the energy of the system increases by 35 kJ. Determine the amount of heat transfer with direction. *5*

(b) When a system receives 70 kJ of work, the energy of the system decreases by 30 kJ. How much heat is transferred from the system ? 5

6. (a) A reciprocating air compressor operates between 200 kPa and 600 kPa with a polytropic exponent of 1·5. How much clearance would have to be provided in the ideal case, to make the volumetric efficiency 60 percent ? 5

(b) A can of soft drink at room temperature is put into the refrigerator so that it cools. Would you model this arrangement as a closed system or as an open system ? Explain. 5

7. (a) Explain briefly : 3

(i) Conduction

(ii) Convection

(iii) Radiation

(b) A refrigerator with a COP of 3·0 transfers heat at a rate of 0·6 kJ/s at a condenser. Find the rate of heat transfer at the evaporator and power input to the compressor. Also calculate the COP, if the refrigerator is to operate as a heat pump with same heat and work interactions. 7

8. (a) Briefly describe heat exchangers. Write their practical applications and specifications. *5*

(b) 10 kg of nitrogen is cooled in a rigid tank from 350°C to 37°C. The initial pressure is 35 bar. Calculate the change in entropy, internal energy and enthalpy. Assume nitrogen to be an ideal gas with

C_p = 1·042 kJ/kg K and C_v = 0·745 kJ/kg K. *5*

9. Briefly explain the following : *5×2=10*

(a) Entropy

(b) Internal Energy

(c) Equation of State

(d) Control Volume

(e) Intensive and Extensive Properties