C 6063 (Pages : 2) Name....................................

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FOURTH SEMESTER B. TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2010

ME 04 403 – THERMODYNAMICS

Time : Three Hours Maximum : 100 Marks

Part A

I. (a) What is Quasi-Static process? What is its characteristics feature?

(b) What is the system techniques in bottle-filling process?

(c) Show that is a property of a system.

(d) What do you understand by exergy and anergy?

(e) What do you understand by the degree of superheat and the degree of sub-cooling?

(f) What is Joule-Thomson co-efficient? Why is it zero for an ideal gas?

(g) What does the dew-point temperature of the product gases represent? How is it determined?

(h) What do you understand by the enthalpy of formation?

($8 \times 5 = 40$ marks)

Part B

II. (a) The air speed of a turbojet engine in flight is 270 m/s. Ambient air temperature is –15° C. Gas thermometer at outlet of nozzle is 600° C. Corresponding enthalpy value for air and gas are 260 and 912 respectively. Fuel-air ratio is 0.0190. Chemical energy of the fuel is 44.5 MJ/kg. Owing to incomplete combustion 5% of the chemical energy is not released in the reaction. Heat loss from the engine is 21 KJ/kg of air. Calculate the velocity of the exhaust jet.

Or

(b) A gas of 1.5 kg undergoes a quasi static expansion which follows a relationship $p = a + bV$, where a and b are constants. The initial and final pressures are 100 kPa and 200 kPa respectively and the corresponding volumes are 0.20 m^3 and 1.20 m^3. The specific internal energy of the gas is given by the relation $U = 1.5\ PV - 85$ KJ/kg where p is in kPa and V is in m^3/kg. Calculate the net heat transfer and maximum internal energy of the gas.

(15 marks)

III. (a) Which is the more effective way to increase the efficiency of a carnot engine to increase T_1 keeping T_2 constant ; or to decrease T_2, keeping T_1 constant?

Or

(b) (i) An inventor claims that 2 kg of air is supplied to a magic tube at 4 bar and 20° C produced two equal mass streams at 1 bar, one at – 20° C and the other at 80° C.

(ii) Another inventor claims that it is also possible to produce equal mass streams at – 40° C and other at 40° C. Take C_p (air) = 1kJ/kgk.

Whose claim is correct and why? Consider it as an diabatic system.

(15 marks)

IV. (a) Steam at 0.8 MPa, 250° C and flowing at the rate of 1 kg/s passes into a pipe carrying wet steam at 0.8 MPa 0.95 day. After adiabatic mixing the flow rate is 2.3 kg/s. Determine the condition of steam after mixing.

The mixture is now expanded in frictionless nozzle isentropically to a pressure of 0.4 MPa. Determine the velocity of the steam leaving the nozzle. Neglect the velocity of steam in the pipe.

Or

(b) Derive Clausis-Clapeyron's equation. What is its use and limitations?

(15 marks)

V. (a) A gasoline engine delivers 150 kW. The fuel used is C_8H_{18}(l) and it enters the engine at 25° C. 150% theoretical air is used and it enters at 45° C. The products of combustion leave the engine at 750 K, and the heat transfer from the engine is 205 kW. Determine the fuel consumption per hour, if complete combustion is achieved.

Or

(b) (i) Explain how the constant pressure heating value of a fuel can be computed using first law applied to combustion systems.

(ii) Briefly explain how the adiabatic flame temperature for a given fuel-air mixture could be calculated.

(8 + 7 = 15 marks)

(4 × 15 = 60 marks)