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ET-201(B)

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

Term-End Examination

June, 2010

ET-201(B) : ENGINEERING THERMODYNAMICS

Time : 3 hours *Maximum Marks : 70*

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

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1. (a) A turbine is supplied with steam at a gauge pressure of 1.4 MPa. After expansion in the turbine the steam flows into a condenser which is maintained at a vaccum of 710 mm Hg. The barometric pressure is 772 mm Hg. Express the inlet and exhaust steam pressures in pascals (absolute). Take the density of mercury as 13.6×10^3 kg/m^3. **5+5**

   (b) An engine cylinder has a piston of area 0.12 m^2 and contains gas at a pressure of 1.5 MPa. The gas expands according to a process which is represented by a straight line on a pressure - volume diagram. The final pressure is 0.15 MPa. Calculate the work done by the gas on the piston if the stroke is 0.30 m.

2. (a) What is a thermodynamic system ? What is the difference between a closed system and an open system ? Give examples. **5+5**

(b) Determine the total work done by a gas system following an expansion process as shown in figure - 1.

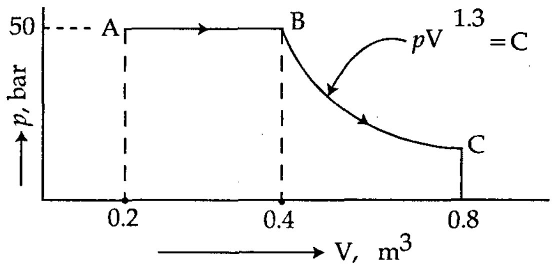

Figure - 1

3. (a) What is the zeroth law of thermodynamics ? Define thermometric property. **5+5**

(b) If a gas of volume 6000 cm^3 at a pressure of 100 kPa is compressed quasistatically according to $pV^2 = $ constant until the volume becomes 2000 cm^3, determine the final pressure and the work transfer.

4. (a) What is an ideal gas ? What is the difference between the universal gas constant and a characteristic gas constant ? **5+5**

(b) Which property is introduced by the first law of thermodynamics ? State the first law for a closed system undergoing a change of state.

5. (a) The following data refer to a 12 - cylinder, single - acting, two - stroke marine diesel engine : **5+2+3**

Speed : 150 rpm

Cylinder Diameter : 0.8 m

Stroke of piston : 1.2 m

Area of indicator diagram : 5.5×10^{-4} m^2

Length of diagram : 0.06 m

Spring value : 147 MPa per m

Compute the net rate of work transfer from the gas to the piston in kW.

(b) (i) Which property of a system increases when heat is transferred

(A) at constant volume, and

(B) at constant pressure.

(ii) What is a PMMI ? Why is it impossible ?

6. (a) Define enthalpy. Why does the enthalpy of an ideal gas depend only on temperature ? Define the specific heat at constant volume and constant pressure. **5+5**

(b) The properties of a certain fluid are related as follows :

$$u = 196 + 0.718\ t$$

$$pv = 0.287\ (t + 273)$$

Where u is the specific internal energy (kJ/kg), t is in °C, p is pressure (kN/m^2) and v is specific volume (m^3/kg).

For this fluid, find C_v and C_p.

7. (a) A mixture of gasses expands at constant pressure from 1 Mpa, 0.03 m^3 to 0.06 m^3 with 84 kJ positive heat transfer. There is no work done other then heat, on a piston. Find ΔE for the gaseous mixture. 5+5

(b) Give the Kelvin - Planck statement of the second law of thermodynamics.

8. (a) Show that the COP of a heat pump is greater than the COP of a refrigerator by unity. 5+5

(b) A cyclic heat engine operates between a source temperature of 800 °C and a sink temperature of 30 °C, what is the least rate of heat rejection per kW net output of the engine ?

9. (a) Explain the operation of a vapour compression refrigeration cycle with the help of a block diagram. 5+5

(b) What is a carnot cycle ? What are the processes which constitute the cycle ? What is a reversed heat engine ?

10. A reversible engine works between three thermal reservoirs A, B and C. The engine absorbs an equal amount of heat from the thermal reservoirs A and B kept at temperatures T_A and T_B respectively, and rejects heat to the thermal reservoir C kept at temperature T_C. The efficiency of the engine is α times the efficiency of the reversible engine, which works between the two reservoirs A and C. 10

Prove that $\frac{T_A}{T_B} = (2\alpha - 1) + 2(1-\alpha)\frac{T_A}{T_C}$
