Basic mechanical Engineering T1 Solution

Q1) a) Sketch of Rotameter …….. 3 marks

Working in detail ……. 3 marks

b) List various applications of Mechanical Engineering ……. 2 marks

Explanation of two applications of Mechanical Engineering .. 4 marks

c) Compare Vernier caliper and Micrometer screw gauge minimum four point ….. 4 marks

Q2) a) Sketch of LVDT . …. 3 marks

Working in detail …… 3 marks

b) List various process of thermodynamic system …… 2 marks

Explanation of two …….. 4 marks

c) Define the following terms

i. Thermodynamic System

ii. Surrounding

iii. Boundary

iv. Universe ….. for each definition …… 4 marks

Q3) a) Statement of Claussius statement and kelvin plank statement of second law of thermodynamics …… 4 marks

Explanation of PMM-I and PMM-II ….. 2 marks

b) solution: Given Data: u_1= 450 kJ/kg, u_2= 220 kJ/kg

W= 120 kJ/kg …. 1 marks

$Q= W+ \Delta u= W+ (u_2-u_1)$ … 1 marks

Q= 120+ (220-450)

Q= -110 kJ/kg ….. 1 marks

Comment : -ve sign indicates that heat is rejected by system…. 1 marks

c) case I- W= 100kw

Q_1 = 300 kw

$\eta_{HE} = W/Q1 = 100/300 = 0.3333 = 33.33\%$ .... 1 mark

$W = Q_1 - Q_2$, $100 = 300 - Q_2$

Q_2= 200 kw .... 1 mark

Case II- $COP_R = Q2/w = 200/100$ ..... 1 mark

$COP_R = 2$ .... 1 mark

Q4) a) Explanation of joules experiment ..... 2 marks

Sketch joules experiment ..... 2 marks

Definitions... Thermodynamic reservoir, heat engine, heat pump, refrigerator ..... 2 marks

b) $COP_R = 1.5$, Q_2= 80kJ/min ..... 1 mark

$COP_R = Q2/W$

W= 53.33 kJ/min = 0.88 kw ..... 1 mark

$Q_1 = W + Q_2 = 0.88 + 1.333 = 2.21$ kw ..... 2 marks

c) Given Data: T_1 827°c= 1100 K, T_2 = 303K, T_3= 260K, T_4= 303 K

Q1= 2500 kJ, W_{net} = 300 kJ

$\eta_{HE} = (T_1 - T_2)/T_1 = (1100-303)/1100 = 0.7745$ ..... 1 mark

$\eta_{HE} = W/Q_1$

$0.7045 = W_E/2500$, W_E= 1811.36 kJ ..... 1 mark

$W_{net} = W_E - W_R$, W_R= 1511.36 kJ ..... 1 mark

$COP_R = T3/(T4-T3)$ 260/(303-260) = 6.04, $COP_R = Q_3/W_R$

Q_3= 9138.45 kJ ..... 1 mark