C09-M-305

3249

BOARD DIPLOMA EXAMINATION, (C-09)

MARCH / APRIL - 2019

DME - III SEMESTER EXAMINATION

THERMAL ENGINEERING - I

Time : **3** Hours] [Total Marks : **80**

PART - A **3×10=30**

Instructions : *(1) Answer **ALL** questions.*
*(2) Each question carries **THREE** marks.*
(3) Answer should be brief and straight to the point.

1 From the equation $dH=mC_p (T_2-T_1)$, what do you mean $1\frac{1}{2}+1\frac{1}{2}$ by 'dH' and 'C_p' ?

2 An ideal gas has a mass of 2 kg and occupies $3m^3$ at a temperature of 30°C and a pressure of 300 kN/m^2. Determine the gas constant. **2+1**

3 1 kg of an ideal gas is contained in a rigid cylinder at 305°K. If 21.1 kJ of heat is added to the gas, determine the final temperature. Take R = 0.317 kJ/kg °K and $\gamma = 1.26$. **2+1**

4 A constant volume chamber of 0.4 m^3 capacity contains 2kg of a gas at 10°C. Heat is transferred to the gas until the temperature is 100°C. Determine the initial poressure of gas. Take C_p = 1.973 ikJ/kg °K and C_v = 0.1511 kJ/kg °K. **2+1**

5 Prove that 1 kg methane needs 4kg oxygen for carbon to form 9/4 kg steam. (H_2O). **3**

6 LCV = HCV – Ms 2466 KJ/Kg. Explain the significnce of '2466' in the above formula. **3**

7 Determine the efficiency of an engine working on the Carnot cycle. If heat is absorbed at 540°C and rejected at 45°C. **2+1**

8 Calculate the change in enthalpy from saturated liquid to dry saturated steam at a pressure of 6 bar. **2+1**

9 Determine the internal energy of superheated steam at 10bar and 300°C. **2+1**

10 Calculate the amount of heat must be removed from water at 20°C to produce 1 kg of ice at 0°C. **2+1**

PART - B **10×5=50**

Instructions : *(1) Answer any **FIVE** questions.*

*(2) Each question carries **TEN** marks.*

(3) Answer should be comprehensive and the criterion for valuation is the content but not the length of the answer.

11 A system executes a cyclic process as follows : **6+4**

At point 1, 20 KJ of heat is supplied and 3 KJ of work done by the system. At point 2, 2 KJ of heat is rejected and 5 KJ of work is done by the system. At point 3, 15 KJ of heat is supplied and 9 KJ of work is done by the system. At point 4, 5 KJ of heat is supplied to the system. Calculate the work done at the fourth point.

12 One kg of gas at 100 kN/m^2 and 15°C is compressed isothermally in a cylinder to a pressure of 2600 kN/m^2. The characteristic equation gas is given by PV = 292 T per kg where T is measured in degree Kelvin. Calculate (a) The final temperature (b) Final volume (c) Change in enthalpy (d) work done (e) State whether the work is done by the system or on the system. **2+2+2+2+2**

13 A quantity of gas has an initial pressure, volume and temperature of 150 kN/m^2, 0.14 m^3 and 25°C respectively. It is compressed to a pressure of 1.5 MN/m^2 according to the law $PV^{1.25}$ = constant. **4+4+2**

Determine :

(a) Work transfer to the gas

(b) Heat transfer from the gas

(c) The change of entropy.

Take C_p = 1.041 kJ/kg °K,

Cv = 0.743 kJ/kg°K.

14 The following readings were taken during a test on Junker's gas calorimeter. **7+3**

Water collected	=	1200 CC
Inlet water temperature	=	14°C
Outlet water temperature	=	25°C
Gas Burnt	=	0.0025 m^3
Gas temperature at inlet	=	15°C
Gas pressure	=	53.5 mm of water
Barometer reading	=	750mm of Hg.
Steam condensed	=	2.5CC

Calculate HCV and LCV of the gas at STP.

15 The stroke and cylinder diameter of a compression ignition engine are 250 mm and 150 mm respectively. If clearance volume is 0.0005 m^3 and heat supplied takes place at constant pressure for 5% of the stroke. Determine the efficiency of the engine. Assume that the engine is working on diesel cycle and take γ = 1.4. **6+4**

16 Calculate, using steam tables, the specific internal energy of steam in the following cases : **4+3+3**

(a) P = 40 bar; q = 0.9 dry

(b) P = 70 bar; dry and saturated

(c) P = 90 bar; t = 400°C

17 (a) The density of Nitrogen at NTP is 1.5 kg/m^3. Calculate the gas constant. **5**

(b) Find the percentage increase in the efficiency of an Otto cycle if the compression ratio increases from 6 to 8. **5**

18 (a) A cold storage is supplied with 5000 Kg fish at 25°C for preserving the fish, the temperature is to be maintained at –8°C in 10 hrs. **5**

Freezing point of fish = –3°C, specific heat above freezing point = 3KJ/kg °K

Specific heat below freezing point = 1.25 KJ/kg °K.

Latent heat of freezing of fish = 220 KJ/Kg

Determine the capacity of the plant.

(b) A cold storage is supplied with 3000 Kg of fish at 26°C. The fish has to be cooled to –9°C. The freezing points of fish is –3°C. **5**

Specific heat of fish above freezing point = 3 KJ/kg°K

Specific heat of fish below freezing point = 1.25 KJ/kg°K

Latent heat of freezing of fish = 210 KJ/kg°K.

If the capacity of the plant is 15 tons, how long it will take to cool the fish.
