3249

C09-M-305

3249

BOARD DIPLOMA EXAMINATION, (C-09)
OCTOBER/NOVEMBER-2018
DME – THIRD SEMESTER EXAMINATION

THERMAL ENGINEERING – I

Time : 3 Hours] [Total Marks: 80

PART-A

3X10=30

Instructions :
1. Answer **All** questions.
2. Each question carries **three** marks.
3. Answer should be brief and straight to the point and shall not exceed five simple sentences.

1. A complete cycle of a system is subjected to the following heat transfers, 848 KJ supplied and 58 KJ rejected. At two points work is done by the system to an extent of 95 KJ and 205 KJ. At third point there is a further work transfer. Determine the amount of work transfer. State whether it is done by the system or on the system.
2. An ideal gas has a mass of 2kg and occupies $3m^3$ at a temperature of 30^0C and a pressure of $300kN/m^2$. Determine the gas constant.
3. A constant volume chamber of $0.4m^3$ capacity contains 2kg of gas at 10^oC. Heat is transferred to the gas until the temperature is 100^oC. Calculate the initial pressure of gas. Take C_p = 1.973 kJ/kg^{0}K and C_v = 0.1511 kJ/kg^{0}K
4. 3kg of air is heated at constant volume such that the temperature changes from 25^0C to 327^0C. Determine the change in internal energy. Take C_p=1.005 kJ/kg^{0}K and R=0.287 kJ/kg^{o}K
5. Prove that 1kg sulphur requires 1kg oxygen to form 2kg sulphur dioxide.
6. Prove that 1 kg methane needs 4kg oxygen for carbon to form 9/4 kg steam (H_2O)
7. Determine the efficiency of an engine working on the Carnot cycle. If heat is absorbed at 540^0C and rejected at 45^0C.

8. Determine the enthalpy and specific volume of wet steam at a pressure of 20bar and dryness fraction of 0.85.
9. A vessel of volume 0.03m^3 wet steam of quality 0.9 at pressure 15bar. Determine it's mass.
10. Determine the amount of heat must be removed from water at 25^{0}C to produce ice at -5^{o}C.

PART-B

10X5=50

Instructions : 1. Answer any **Five** questions.
2. Each question carries **ten** marks.

11. A gauge pressure reads 80cm of Mercury. Convert this pressure in
    (a) Pascals (b) KPa (c) Bar
12. 3kg of air at 1bar and 400^{0}K is compressed polytropically to a pressure of 12bar. Then the air temperature rises to 600^{0}K determine:
    (a) the polytropic index (b) the final volume (c) the work of compression and (d) the amount of heat rejection from the air. Assume R=0.287 kJ/kg^{0}K
13. The values of specific heats at constant volume and constant pressure of an ideal gas are 0.73 kJ/kg^{0}K and 0.98 kJ/kg^{0}K respectively. If one kg of this fuel is heated at constant pressure from 30^{0}C to 250^{0}C. Calculate
    (a) The heat added (b) Ideal work done (c) Change in internal energy.
14. A bomb calorimeter was used to determine the calorific value of a sample of coal and the following readings were recorded:

Mass of coal burnt	=	1.01gm
Mass of water	=	1100gm
Water equivalent of apparatus	=	650gm
Initial temperature of water	=	25^{o}C
Final temperature of water	=	28^{o}C
Cooling correction	=	+0.016^{o}C

    Determine the calorific value of coal sample. Also find LCV if the fuel contains 5% hydrogen
15. An ideal diesel cycle operates with 1kg of standard air at an initial pressure of 1.5bar and temperature of 40^{o}C. The pressure at the end of the compression is 35bar and the cutoff is 5% of the stroke. Determine
    (a) compression ratio (b) the heat supplied (c) the heat rejected
    Take γ=1.4 and C_p = 1KJ/Kg^{0}K

16. Steam initially at a pressure of 14bar and 250^0C expands isentropically to 2bar. Determine (a) the final condition (b) work transfer (c) change in internal energy.
17. (a) An ideal gas is expanded from 400kN/m^2 and 0.04m^3 to 120kN/m^2 and 0.1m^3. The temperature drop during this process is observed as 150^0C. Calculate the mass of the gas C_v = 0.726 kJ/kg^{0}K and C_p = 1.025 kJ/kg^{0}K

    (b) An engineer claims his engine to develop 3.5KW. On testing the engine consumes 0.5Kg of fuel/hour having a calorific value of 40000 KJ/Kg. The maximum temperature recorded in the cycle is 1200^0C and the minimum is 325^0C. Determine whether the engineer's claim is justified.
18. (a) A cold storage is supplied with 3000 Kg of fish at 26^0C. The fish has to be cooled to -9^0C. The freezing points of fish is -3^0C

    Specific heat of fish above freezing point = 3 KJ/Kg^{0}K

    Specific heat of fish below freezing point = 1.25 KJ/Kg^{0}K

    Latent heat of freezing of fish = 210 KJ/Kg^{0}K

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

    (b) The capacity of a refrigerator 150TR. Determine the quantity of ice produced at -3^0C within 24hrs when water is supplied at a temperature of 15^0C. Take specific heat of ice = 2.1 KJ/Kg^{0}K

****