4252

C14–M–304

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BOARD DIPLOMA EXAMINATION, (C–14)

JUNE—2019

DME—THIRD SEMESTER EXAMINATION

BASIC THERMODYNAMICS

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

PART—A 3×10 =30

Instructions : (1) Answer **all** questions.

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

(3) Answers should be brief and straight to the point and shall not exceed *five* simple sentences.

1. Write steady flow energy equation for an open system and state the meaning of each term.

2. Write the Kelvin-Planck statement of second law of thermodynamics.

3. Heat is supplied to heat engine at the rate of 30 kJ/s and the thermal efficiency of 32%. Determine the rate of heat rejection.

4. Derive characteristic gas equation from Boyle's and Charles' law.

5. For a certain ideal gas, R = 0·278 kJ/kg-K and $\gamma = 1 \cdot 25$. Determine C_p and C_v.

6. 0·1 m^3 of air at a pressure of 1·5 bar is expanded isothermally to 0·5 m^3. Calculate the work done during the process.

7. What is the difference between adiabatic process and polytropic process?

8. Define HCV and LCV of fuel.

9. List out any six advantages of liquid fuel over solid fuel.

10. What is combustion? Why is excess air used for combustion of fuels?

PART—B

10×5=50

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

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

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

11. A fluid is contained in a cylinder by a spring loaded frictionless piston so that the pressure in the fluid is a linear function of the volume ($p = a+bV$). The change in internal energy of the fluid is 82 kJ. If the fluid changes from an initial state of 190 kN/ m^2, 0·035 m^3 to a final state of 420 kN/ m^2, 0·07 m^3, with no work other than that done on the piston. Find the direction and magnitude of the work.

12. *(a)* 0·2 kg of gas is subjected to change of temperature from 288 K to 458 K at constant pressure. Find the heat transfer, change in internal energy and change of enthalpy. Assume C_p = 1·0 kJ/kg-K and adiabatic index = 1·4. 5

(b) The volume of a closed vessel containing air at temperature of 303 K is 5 m^3. A vacuum gauge fitted to it indicates a reading of 739 mm of Hg. The barometer reading is 760 mm of Hg. Calculate the mass of air in the vessel. Assume R = 0·287 kJ/kg-K. 5

13. *(a)* State Joule's law and give mathematical expression. 3

(b) An oxygen (M = 32) cylinder of 0·45 m^3 capacity contains oxygen at a pressure of 15 bar and temperature of 298 K. After releasing some oxygen the pressure in the cylinder is reduced to 5 bar without change of temperature. Find the mass of the oxygen released from the cylinder. 7

14. A cylinder contains 0·18 m^3 of gas at a pressure of 1 bar and temperature of 47 °C. If this gas is compressed polytropically to $\frac{1}{13}$ th of its volume and the pressure raised to 20 bar. Find, *(a)* mass of the gas, *(b)* temperature at the end of compression, *(c)* the index of compression, *(d)* the change of internal energy and *(e)* heat rejected during compression. Take, C_v = 0·84 kJ/kg-K and C_p = 1·09 kJ/kg-K.

15. 0·45 kg gas at 179 °C expands adiabatically to three times its original volume and during the process, the temperature falls to 15·5 °C. The work done during the process is 52 kJ. Calculate C_p and C_v.

16. *(a)* Derive the expression for the work done in isothermal process. 5

(b) Derive the expression for the change of entropy in constant pressure process. 5

17. *(a)* Determine the theoretical mass of air required for complete combustion of 1 kg of fuel containing 83% carbon, 15% hydrogen and 2% oxygen by mass. 4

(b) Explain briefly the working of a mechanical type of CO_2 recorder. 6

18. *(a)* What is fuel and how the fuels are classified? 3

(b) Find the HCV and LCV of a sample of coal from the following data observed from bomb calorimeter : 7

Mass of coal = 0·85 gm
Mass of fuse wire = 0·03 gm
CV of fuse wire = 6700 kJ/kg
Mass of water in calorimeter = 2 kg
Water equivalent of calorimeter = 0·4 kg
Temperature rise of water = 3·05 °C
Cooling correction = +0·017 °C
Hydrogen content in the coal = 4·8%

Assume specific heat of water as 4·2 kJ/kg °C.

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