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C14–M–304

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BOARD DIPLOMA EXAMINATION, (C–14)

OCT/NOV—2016

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. Define zeroth law of thermodynamics.

2. In a non-flow reversible process, the pressure is given by $P \quad (V^2 \quad 8/V)$ bar. Determine the work done if volume changes from 1 m^3 to 3 m^3.

3. Calculate the quantity of heat required to raise the temperature of a steel forging of mass 200 kg from 300 K to 1265 K. The specific heat of steel is 0·49 kJ/kg K.

4. State the following laws :

(a) Joule's law

(b) Regnault's law

5. The density of air at NTP is 1·29 kg/m^3; calculate the gas constant for air.

6. Represent and compare the following processes on single *P-V* diagram :

(a) Isothermal process

(b) Adiabatic process

(c) Polytropic process

7. 2·5 kg of air at 27 °C and 0·21 m^3 is expanded to 1·05 m^3. The law of expansion being $PV^{1\,3}$ C. Find the change in entropy.

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

9. Define HCV of fuel and give Dulong's formula for it.

10. List out any six desired characteristics of fuel.

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. In a steady flow system, a fluid flows at the rate of 4 kg/s. It enters at a velocity of 300 m/s and enthalpy of 2330 kJ/kg at inlet. It leaves the system at a velocity of 150 m/s and its enthalpy at outlet is 1656 kJ/kg. During its passage through the system, fluid has a loss of heat transfer by 30 kJ/kg to the surroundings. Determine the power of the system in kW. Neglect any changes in the potential energy. 10

12. *(a)* During a complete cycle of operation, a systems subjected to the heat transfers—848 kJ supplied and 58 kJ rejected. At the two points, work is done by the system to the extent of 95 kJ and 205 kJ. At third point, there is a further work transfer. Determine the amount of work transfer at the third point. 5

(b) Prove that C_p C_v R. 5

13. *(a)* Define the specific heat at constant pressure and give its mathematical expression. 3

(b) A tank of 0·525 m^3 capacity contains air at a pressure of 35 kN/m^2 absolute and a temperature of 90 °C. What will be the mass of air that must be pumped into the tank without changing the temperature to increase the pressure to 1 bar absolute? Assume, R 0 287 kJ/kg K. 7

14. 1 kg of air at a pressure of 10 bar and a temperature of 373 K undergoes a reversible process which may be represented by $PV^{1\,1}$ C, the final pressure is 2 bar. Assume, R 0 287 kJ / kg K and 1 4. Find—

(a) the final volume;

(b) the final temperature;

(c) the change in entropy. 10

15. 1 kg of CO_2 (M 44) is contained in a frictionless piston cylinder system and during a reversible isothermal process 26·5 kJ of energy is transferred out of the system. If the initial condition of CO_2 are 1·4 bar and 32 °C, calculate—

(a) the work;

(b) the final pressure;

(c) the change in entropy. 10

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

(b) 0·5 kg of gas having volume of 0·28 m^3 and a pressure of 1·5 bar is compressed to a pressure of 15 bar according to a law $PV^{1\,25}$ C, find the amount of heat transfer during a process. Take, C_p 1 04 kJ/kg K and C_v 0 74 kJ/kg K. 5

17. Explain the working and construction of bomb calorimeter with a neat sketch. 10

18. *(a)* Explain briefly the working of Orsat's apparatus with a sketch. 6

(b) Find the HCV of the fuel whose compositions by mass is as follows :

Carbon 91%
Hydrogen 3%
Sulphur = 0·8%

and the remainder being ash. 4

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