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C14–M–304

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BOARD DIPLOMA EXAMINATION, (C–14)

MARCH/APRIL—2017

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.

(4) Assume data wherever necessary.

1. Define the properties *(a)* internal energy and *(b)* specific volume, and specify their units.

2. Write the statement for Zenoth law of thermodynamics.

3. State Kelvin-Planck statement for second law. What is PPM2?

4. State *(a)* Avagadro's law and *(b)* Joule's law.

5. Determine the volume occupied by 2·2 kg of CO_2 at NTP.

6. What is the difference between throttling process and free expansion?

7. A gas is compressed from initial state pressure of 140 kN/m^2 and volume of 0·1 m^3 to a final state of 2·8 MN/m^2 and 0·01 m^3. Find the index of compression.

8. What are the desired characteristics of fuel?

9. Write the Dulong's formula to find HCV of the fuel.

10. Why is only HCV obtained with bomb calorimeter?

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.

(4) Assume data wherever necessary. For air R 0 287 kJ/kg K, 1 4, if not specified.

11. The pressure of a gas in a system is a linear function of volume and is given by the relation p a bV where a, b are constants and p is in kN/m^2, V is in m^3. If the system changes from initial condition of 200 kN/m^2 and 0·1 m^3, to final condition of 600 kN/m^2 and 0·5 m^3, find the work done.

12. *(a)* At inlet of a nozzle a fluid has enthalpy of 2800 kJ/kg and a velocity of 80 m/s. Find the velocity of fluid at exit, if the enthalpy at exit is 1650 kJ/kg and there is a heat loss of 50 kJ/kg.

(b) Air initially at STP, occupying a volume of 0·15 m^3 is compressed in a cylinder to final volume of 0·01 m^3. The final pressure is 30 bar. Calculate *(a)* mass of air and *(b)* final temperature.

13. *(a)* A tank of 0·5 m^3 capacity contains air at a pressure 100 kN/m^2 and temperature 303 K. What will be mass of air that must be pumped into the tank to increase the pressure to 1 MPa without changing the temperature?

(b) A gas at 305 K and 101·3 kPa has a density of 1·757 kg/m^3. Determine the molecular weight.

14. 2·5 kg of air at 12 bar and 327 °C expands adiabatically to a pressure of 1 bar. Determine *(a)* the final volume, *(b)* the final temperature, *(c)* work transfer and *(d)* change in enthalpy.

15. Derive the expression for work done polytropic process in non-flow system.

16. 0·24 m^3 of air at 101·3 kPa and 305 K is compressed to one tenth of its original volume according to the law $pV^{1\,3}$ = constant. Heat is then added at constant pressure until it becomes to initial volume. Calculate the total changes in entropy.

17. *(a)* Draw a neat sketch of bomb calorimeter and indicate the parts.

(b) Write the heat balance equation for determining the HCV of given fuel by using bomb calorimeter and explain the terms involved in that equation.

18. The percentage composition of a fuel on mass basis : C–85%, H_2–5%, S–0·5%, O_2–2%, and rest being ash. Calculate *(a)* the minimum air required for complete combustion of 1 kg of fuel and *(b)* the composition of dry flue gases on mass basis if 40% excess air is supplied.

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