* 4252 *

C14–M–304

4252

BOARD DIPLOMA EXAMINATION, (C–14)

OCT/NOV—2015

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. State the second law of thermodynamics.

2. In a cycle the heat transfers are +14·7 kJ, –25·2 kJ, –3·56 kJ and +31·5 kJ. Determine the network done for this cyclic process.

3. Define thermodynamic system and give the classification of thermodynamic system.

4. Define Boyle's and Charles' law.

5. 2 m^3 of air at 30 °C receives heat at constant pressure so that the final volume is 3·3 m^3. Find the final temperature.

6. Write the expression for change of entropy in isothermal process.

7. A quantity of air has a volume of 0·06 m^3 and pressure of 7 bar. It is expanded in a cylinder to a pressure of 1 bar. Compute the work done if the expansion is following the law $PV^{1\,25}$ C.

8. What are the various chemicals used in pipettes for absorbing CO_2, O_2 and CO in Orsat apparatus?

9. Write any three advantages and limitations of solid fuels.

10. Write the definition of 'combustion'.

PART—B

10×5=50

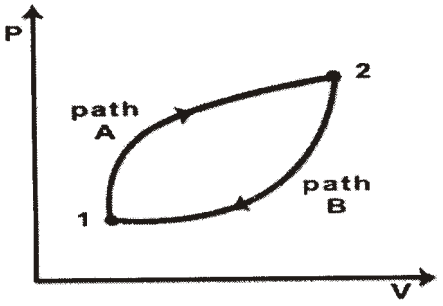
Instructions : (1) Answer *any* **five** questions.

(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. 1 kg of gas occupies a volume of 0·8 m^3 in a cylinder sealed with a piston subjected to a constant pressure of 101·3 kN/m^2. Heat is supplied so that gas expanded reversibly to double its volume. Determine the work done. Also determine the quantity of heat supplied when the internal energy of the gas increases by 100 kJ.

12. *(a)* A system changes from state (1) to state (2) along the path 1A2. During the process 250 kJ of heat is added to system and the system does 90 kJ of work. How much heat must be supplied to the system if the path followed is 1B2 with 50 kJ of work done by the system. 5



(b) The values of C_p and C_v for a gas are 1·02 kJ/kg-K and 0·72 kJ/kg-K respectively. Find the density of this gas at STP and NTP conditions. 5

13. 2·5 kg of an ideal gas is expanded from a pressure of 700 kPa and volume 1·5 m^3 to a pressure of 140 kPa and volume of 4·5 m^3. The change in internal energy is 500 kJ. Specific heat at constant volume for the gas is 0·719 kJ/kg K. Determine— *(a)* gas constant and *(b)* initial and final temperatures.

14. A cycle is constituted with three processes, constant pressure 1-2, constant volume 2-3 and isothermal 3-1. At state (1) the temperature and specific volume are 555 K and 0·1416 m^3/kg. At state (2) the specific volume is 0·2 m^3/kg and the working fluid is nitrogen. Calculate the change of entropy for each process and for the cycle. Assume R = 0·297 kJ/kg-K and C_p = 1·046 kJ/kg-K.

15. *(a)* Derive the expression for work done in adiabatic process. 5

(b) 0·12 m^3 of air at 1·5 MPa and 1500 °C expands adiabatically to 175 kPa. Find—

(i) the final temperature;

(ii) the work done. Take C_p = 1·0035 kJ/kg K and C_v = 0·7165 kJ/kg-K. 5

16. A perfect gas is compressed according to the law $PV^{1\,25}$ = constant from initial pressure of 1 bar and volume of 0·9 m^3 to a final volume of 0·6 m^3. Determine the final pressure and change of entropy per kg of gas during the process. Take = 1·4 and R = 0·287 kJ/kg-K.

17. Explain the working of Junkers gas calorimeter with a neat sketch.

18. *(a)* The gravimetric analysis of a solid fuel is as follows : 5

Carbon = 86%, hydrogen = 8%, oxygen = 4%, nitrogen = 1% and sulphur = 1%

Determine the minimum air required per kg of fuel for complete combustion.

(b) A flue gas consists of 15% CO_2, 2·3% CO, 1·7% O_2 and 81% of N_2 by volume. Convert this volumetric analysis to mass analysis. 5

★ ★ ★