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C14–M–304

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BOARD DIPLOMA EXAMINATION, (C–14)

OCT/NOV—2018

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 whereever necessary.

1. Define intensive properties and extensive properties. Give examples.

2. What are the limitations of the first law of thermodynamics?

3. *(a)* Write Kelvin-Plank statement for second law.

(b) Define COP of heat pump.

4. State *(a)* Avogadro's law, and *(b)* Regnault's law for ideal gases.

5. For certain gas the characteristic gas constant and adiabatic index are 0·26 kJ/kg K and 1·35 respectively. Find *(a)* the specific heats (C_P, C_V), and *(b)* molecular weight.

6. 2 kg of air at STP is compressed isothermally to 1/10th of its initial volume. Find the work done. *R* 0 287 kJ/kg K.

7. Write the expression for entropy change for isothermal process and explain the terms involved.

8. Classify the fuels and give examples for each.

9. Define HCV and LCV of the fuels.

10. Write the advantages and disadvantages of solid 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.

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

11. Steam enters a turbine at the rate of 5 kg/s. At inlet it has a pressure of 15 bar, a velocity of 450 m/s, internal energy 2750 kJ/kg and specific volume 0·5 m^3/kg. At the exit it has a pressure of 1·5 bar, a velocity of 120 m/s, internal energy 1650 m^3/kg, and specific volume 1·5 m^3/kg. During the passage through the turbine this fluid has a loss of heat of 50 kJ/kg to the surroundings. Determine the power output from the turbine. Assume the system as steady flow system and neglect potential energy change.

12. *(a)* Heat is supplied to heat engine at the rate of 30 kJ/s and gives an output of 9·5 kW. Determine the thermal efficiency and rate of heat rejection.

(b) Air-initially at pressure of 1·3 MN/m^2, a volume of 0·014 m^3 and temperature of 135 °C. It is expanded until final pressure is 275 kN/m^2 and its volume is 0·056 m^3. Determine *(i)* the mass of air, and *(ii)* the final temperature.

13. An ideal gas is expanded from initial state of 900 kN/m^2 and 0·12 m^3 to final state of 100 kN/m^2 and 0·48 m^3. The temperature change during this process was observed as 160 °C. The values of C_P and C_V are 1·025 kJ/kg K and 0·735 kJ/kg K respectively. Find *(a)* the change in internal energy, and *(b)* mass of the gas.

14. A certain quantity of air is initially at a pressure of 1·2 MPa and a volume of 0·01 m^3. It is expanded to a final pressure of 100 kPa and a volume of 0·06 m^3. If the expansion follows the law pV^n Constant. Find *(a)* polytropic index, *(b)* work done, and *(c)* heat transfer.

15. 2 kg of air initially at 120 kPa, and 27 °C is compressed adiabatically to a pressure of 1·5 MPa. During this the volume reduced to 1/5th of its original volume. Then heat is added at constant pressure to regain its original volume. Find *(a)* initial volume, *(b)* temperature at the end of compression, *(c)* work done in compression process, and *(d)* heat added during constant pressure process.

16. *(a)* Derive the expression for entropy change during isothermal process in nonflow system.

(b) 3 kg of air at a pressure of 10 bar and a temperature of 100 °C undergoes a reversible process which may be represented by $pV^{1\,1}$ Constant. The final pressure is 2 bar. Find the change in entropy.

17. Draw a neat sketch of Junker's gas calorimeter and explain the procedure.

18. From the volumetric analysis of a flue gas it is found that CO–6%, CO_2–10%, O_2–8%, H_2–6%, N_2–70%. Convert the volumetric analysis into mass analysis.

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