7259

BOARD DIPLOMA EXAMINATION, (C-20)

MAY—2023

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. Distinguish between heal and work.

2. State Clausius statement of second law of thermodynamics.

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

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

5. Represent isentropic process on *P*-*v* and *T*-*s* diagram.

6. What is free expansion process?

7. What are the assumptions made in analysis of air standard cycle?

8. Differentiate between Otto and Diesel cycles in terms of heat addition.

9. Find the higher calorific value of the fuel whose composition by mass is as follows :

Carbon = 75%, Hydrogen = 5%, Sulphur = 3%, Oxygen = 9%, Nitrogen = 4% and the remainder being ash.

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

PART—B

8×5=40

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

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

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

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 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.

(OR)

A fluid is confined in a cylinder by a spring loaded, frictionless piston so that the pressure in the fluid is a linear function of the volume as per the equation $P = a + bV$. If the fluid changes from initial state of 170 kPa, 0·03 m^3 to final state of 400 kPa, 0·06 m^3 with no work other than that done by the piston, find the direction and magnitude of the work.

12. One kg of an ideal gas is heated from 20 °C to 100 °C. Assume R = 285 J/kg-K and γ = 1·39 for the gas, find *(a)* both the specific heats, *(b)* change in internal energy and *(c)* change in enthalpy.

(OR)

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

13. 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. Assume γ = 1·4.

(OR)

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 come to initial volume. Calculate the total changes in entropy.

14. The high temperature of a Carnot cycle is 400 °C and the cycle has a thermal efficiency of 55%. The volume ratio of the isothermal processes is 2·8 : 1. Determine for the cycle *(a)* the low temperature, *(b)* the volume ratio of the adiabatic processes and *(c)* the overall volume ratio. Take γ = 1·4.

(OR)

In an ideal Otto cycle, the air at the beginning of isentropic compression is 1 bar and 15 °C. The ratio of compression is 8. The heat added is 1008 kJ/kg during constant volume process. Take γ = 1·4 and C_v = 0·714 kJ/kg-K. Determine —

(a) the maximum temperature in the cycle;

(b) the air standard, efficiency;

(c) the work done per kg of air;

(d) the heat rejected per kg of air.

15. How is the calorific value of solid fuel measured using bomb calorimeter? Explain it with line diagram and expressions.

(OR)

Explain the working of Junkers gas calorimeter with a line diagram and write an expression to find the Higher Calorific Value.

PART—C

10×1=10

Instructions : (1) Answer the following question.

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

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

16. The engines operates on diesel cycles with the following data :

Maximum temperature = 1400 K

Exhaust temperature = 700 K

Air is taken at 1 bar and 300 K

Find the expansion ratio, compression ratio and ASE of the cycle.

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