C20-M-304

7259

BOARD DIPLOMA EXAMINATION, (C-20)

NOVEMBER/DECEMBER—2022

DME – THIRD SEMESTER EXAMINATION

BASIC THERMODYNAMICS

Time : 3 hours] [*Total Marks* : 80

PART—A 3×10=30

Instruction : (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 refrigerator and heat pump.

2. A vacuum gauge in the condenser reads 630 mm of Hg and the barometer stands at 762 mm of Hg. What is the absolute pressure in the condenser tank in kPa?

3. Why is specific heat at constant pressure greater than specific heat at constant volume?

4. Define the terms *(a)* Dalton's law and *(b)* Avogadro's law.

5. Explain with *P-V* diagram why isothermal process is often referred as hyperbolic process.

6. Derive an expression for change of entropy for a constant pressure process.

7. Find the percentage increase in efficiency of ideal Otto cycle if compression ratio is raised from 5 to 6.

8. Draw *P-V* diagram for diesel cycle and mark the main points on the diagram.

9. Define the terms *(a)* calorific value and *(b)* calorimeter.

10. List any three needs of analysis of fuel.

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. *(a)* A system undergoes a cycle composed of four processes and the energy transfers are tabulated below :

Process	Q(kJ/min)	W (kJ/min)	dU (kJ/min)
1-2	550	230	-
2-3	230	-	380
3-4	–500	-	-
4-1	0	70	-

Complete the table and calculate the network output.

(OR)

(b) A closed system undergoes a frictionless process from initial volume of 4·5 m^2 to a final volume of 1·5 m^3. The pressure (bar) is related to the volume (m^3) by the equation

$$p = \{(10/v) + 5\}$$

The heat rejected during the process is 420 kJ. Determine the change in internal energy.

12. *(a)* Derive the relation between specific heat and gas constant.

(OR)

(b) 0·2 kg of gas is subjected to change of temperature from 15 °C to 180 °C at constant pressure. Find the heat transfer, change of internal energy and change of enthalpy, if specific heat at constant pressure is 1·0 kJ/kgK, adiabatic index is 1·4.

13. *(a)* During a constant pressure process, the internal energy of one kg system increases 28·5 kJ and enthalpy increases 44·3 kJ. The pressure is 620 $kN.m^2$.

(i) What is the work which accompanies this process?

(ii) If the initial volume is 0·793 m^3, what is the final volume?

(OR)

(b) A gas initially at 603 K expands until its volume is 5·2 times the initial volume, according to $pv^n = C$. If the initial and final pressures are observed to be 8·5 bar and 1 bar, determine the—

(i) index of expansion;

(ii) work done per kg of gas;

(iii) heat exchange per kg of gas.

Assume C_v = 0·412 kJ/kgK and γ = 1·4.

14. *(a)* An engine operating on the ideal Otto cycle has a bore of 0·1 m, a stroke 0·127 m and compression ratio 7. At the beginning of the compression stroke the cylinder contains air at 288·6 K and 100 kPa. If the maximum temperature of the cycle is 1923 K, determine the—

(i) pressure, volume and temperature at the main points;

(ii) heat supplied per kg of air;

(iii) heat rejected per kg of air;

(iv) net work done;

(v) air standard efficiency.

Assume γ = 1·4 and C_v = 0·718 kJ/kg-K.

(OR)

(b) In an ideal diesel cycle, the pressure and temperature are 1·03 bar and 27 °C respectively. The maximum pressure in the cycle is 47 bar and heat supplied during the cycle is 545 kJ/kg. Determine—

(i) The compression ratio;

(ii) The temperature at the end of compression;

(iii) Temperature at the end of constant pressure combustion;

(iv) The air standard efficiency.

Assume γ = 1·4 and C_p = 1·004 kJ/kg-K for air.

15. *(a)* Explain the working of bomb calorimeter with line diagram and write an expression to find the higher calorific value.

(OR)

(b) Explain the working of Junker's gas calorimeter with line diagram.

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. 0·5 kg of air at a pressure of 1 bar abs. and 30 °C is heated at constant volume until its pressure is 5 bar abs. It is then expanded adiabatically to the original pressure and finally cooled at constant pressure to the original volume. Find the change of entropy of each stage and the whole system.

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