C16-M–303

6244

BOARD DIPLOMA EXAMINATION, (C-16)

MAY/JUNE—2023

DME - THIRD SEMESTER EXAMINATION

THERMAL ENGINEERING—I

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. Define adiabatic index. Why its value is always greater than unity?

2. Define *(a)* state, *(b)* path and *(c)* process of a thermodynamic system.

3. Write steady flow energy equation and state the terms in it.

4. List six thermodynamic processes.

5. Write the mathematical expressions for change in internal energy and heat transfer and work done for a constant pressure process.

6. Define air standard efficiency. Write mathematical expression for it.

7. Write the classification of IC engines.

8. State the functions of a governor in internal combustion engines.

9. List important parameters that affect the performance of an IC engine.

10. Write any six industrial applications of compressed air.

PART—B

10×5=50

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

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

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

11. A vessel of 2.5 m^3 capacity contains one kg-mole of nitrogen at 100 °C. If the gas is cooled to 30 °C, calculate *(a)* final pressure *(b)* change in specific internal energy and *(c)* change in specific enthalpy. Take $\gamma = 1.4$ and mass of one kg-mole nitrogen is 28 kg.

12. *(a)* What are reversible and irreversible processes? Give two examples each.

(b) State the conditions for reversibility of a process and a cycle.

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

(a) Complete the table

(b) Determine the rate of work in kW

(c) Show that for a cyclic process change in internal energy is zero.

Process	Heat Transfer (kJ/min)	Work Transfer (kJ/min)	Change in Internal Energy (kJ/min)
1-2	550	200	-
2-3	130	-	280
3-4	–400	-	-
4-1	0	90	-

14. A mass of air at 1.3 MN/m^2 pressure, 0.014 m^3 volume and 135 °C is expanded until its final pressure is 275 kN/m^2 and volume becomes 0.056 m^3. Calculate *(a)* mass of air, *(b)* the final temperature, *(c)* law of expansion, *(d)* work transfer and *(e)* the heat transfer. Assume C_p = 1.005 kJ/kg-K, C_v = 0.718 kJ/kg-K and γ = 1.4.

15. Calculate the air standard efficiency of constant volume cycle with the following data :

Compression ratio = 8 : 1;

Maximum pressure = 38 bar;

Suction conditions are 1 bar and 18 °C.

Also, find the maximum temperature and the temperature at the end of expansion. Assume $\gamma = 1.4$.

16. Explain, with the help of line sketches, the working principle of a 4-stroke petrol engine.

17. A single cylinder engine working on 4-stroke cycle has bore of 120 mm and stroke 135 mm runs at 650 r.p.m. The mean effective pressure is 6.5 bar. The engine consumes 0.000283 kg fuel in one second. The calorific value of diesel oil is 42000 kJ/kg. The brake wheel diameter is 920 mm. The net load on the brake is 0.11 kN. Calculate *(a)* indicated power, *(b)* brake power, *(c)* mechanical efficiency, *(d)* indicated thermal efficiency and *(e)* brake thermal efficiency.

18. Describe, with a neat sketch, the working of an axial flow compressor.

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