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C16–M–303

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BOARD DIPLOMA EXAMINATION, (C–16)

MARCH/APRIL—2018

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.

(4) Assume data wherever necessary.

1. State Boyle's law and Charles' law.

2. Define thermodynamic system and state its classification.

3. Distinguish between heat and work.

4. Represent the following processes on T-S diagram :

(a) Constant pressure process

(b) Isentropic process

(c) Isothermal process

5. 2 kg of air expands isothermally from a volume of $1{\cdot}0\,m^3$ to a volume of $5\,m^3$. Find the change in entropy. Assume $R = 0{\cdot}287$ kJ/kg K.

6. An engine working on Carnot cycle has maximum and minimum temperatures are 1310°C and 320°C. Determine its efficiency.

7. Write the functions of carburettor in IC engine.

8. List out the different methods of governing systems in IC engines.

9. Define the following terms :

(a) Mechanical efficiency

(b) Brake thermal efficiency

(c) Relative efficiency

10. Mention any three advantages of multistage compression method.

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 wherever necessary for air R 0 287 kJ / kgK and 1 4, if not specified.

11. A mass of air has an initial pressure of 1·3 MN/m^2, volume 0 014 m^3 and temperature 135 °C. It is expanded until its final pressure is 275 kN/m^2 and its volume becomes 0·056 m^3. Determine—

(a) the mass of air;

(b) the final temperature of air.

Take R 0 287 kJ / kgK. 5=5=10

12. A mass of an ideal gas has initial temperature of 16 °C. If the temperature is raised to 280 °C, find the change of internal energy and enthalpy. Assume specific heat at constant pressure 1·005 kJ/kgK and specific heat at constant volume 0·718 kJ/kgK. 5+5=10

13. *(a)* State the limitations of first law of thermodynamics. 4

(b) Fluid with a specific enthalpy of 2800 kJ/kg enters a horizontal nozzle at the rate of 14 kg/sec. At the outlet from the nozzle, the specific enthalpy is 2250 kJ/kg. Neglecting initial velocity, determine the exit velocity of the fluid. 6

14. *(a)* Write a short note on throttling process.

(b) A perfect gas is compressed according to the law $PV^{1\ 25}$ constant from initial pressure of 1 bar and volume of $0\ 9\,\text{m}^3$ to a final volume of $0\ 6\,\text{m}^3$. 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.

15. 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 $\ 1\ 4$ 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.

16. Explain the working of 4-stroke diesel engine with neat sketch. 10

17. The percentage composition of a sample of fuel by mass is found to be C 76%, H_2 5 2%, O_2 12 8%, N_2 2 7%, S_2 1 2% and ash = 2·1% . Calculate the minimum amount of air necessary for complete combustion of one kg of fuel and percentage composition by mass of dry products of combustion. 10

18. Air from an initial conditions of 25 °C and 1 bar is compressed in two stages according to the law $PV^{1\ 25}$ constant and with complete intercooling to a pressure of 36 bar. Estimate the minimum work required and heat rejected in the intercooler per kg of air. Assume $C_p\ \ 1\ 05$ kJ / kgK and $R\ \ 0\ 29$ kJ / kgK. 10

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