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C09–M–305

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BOARD DIPLOMA EXAMINATION, (C–09)

MARCH/APRIL—2016

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) Answer should be brief and straight to the point and shall not exceed *five* simple sentences.

1. What do you mean by density of a substance?

2. Write the differences between a vapour and a perfect gas.

3. Air is expanded according to the law of $PV^{1.24}$ constant from a pressure of 1 bar and the expansion ratio is 10 : 1. Calculate the final pressure.

4. What is property? Show that the entropy is an extensive property.

5. Mention the desired characteristics of fuel.

6. Distinguish between HCV and LCV.

7. Define cutoff ratio. Draw *PV* diagram for diesel cycle and mark the cutoff point on the diagram.

8. Define dryness fraction.

9. State the principle of throttling calorimeter.

10. Differentiate clearly between open and closed systems of Bell-Coleman refrigerator.

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 any missing data.

11. *(a)* What is Clausius statement of the second law of thermodynamics? Is it different from Kelvin-Planck statement? Briefly explain it.

(b) Explain clearly the difference between a non-flow and a steady-flow processes.

12. *(a)* An automobile tyre is inflated to a gauge pressure of 200 kPa at a temperature of 20 °C. After a trip the temperature of the air in tyre increases to 50 °C, while the volume of the tyre increases by 2 percent due to stretching of the tyre material. Calculate the air pressure in the tyre after trip.

(b) Explain Carnot cycle with a *PV* diagram.

13. A cylinder contains 180 litres of gas at a pressure of 1 bar abs and temperature of 45 °C. If the gas is compressed polytropically to 1/10th of its volume and the pressure is then 20 bar, find the *(i)* mass of the gas, *(ii)* temperature at the end of compression, *(iii)* index of compression, *(iv)* change of internal energy and *(v)* heat transferred during the compression process.

Assume ratio of specific heats 1 4 and *R* 0 287 kJ/kg-K.

14. A 0·5 kg of gas at 3·5 bar abs and 30 °C is heated at constant volume until its pressure is 20 bar abs. The gas is then expanded isothermally until its volume is 1 m^3. Determine the change of entropy for the whole system.

Assume, C_p 1 05 kJ/kg-K and C_v 0 755 kJ/kg-K.

15. The ultimate analysis of a dry coal burnt in a boiler is C 84%, H_2 9% and incombustibles 7% by weight. Determine the weight of dry flue gases per kg of coal burnt, if volumetric combustion of the flue gas is CO_2 8 75%, CO 2 25%, O_2 80% and N_2 81%.

16. *(a)* Sketch the *PV* and *TS* diagrams for constant volume air cycle.

(b) Develop the formula for the ideal thermal efficiency.

17. A cylinder contains 150 litres of steam at 4 bar and 0·5 dry. The steam is compressed hyperbolically to 0 06 m^3. Find *(a)* the mass of the vapour, *(b)* the final dryness fraction and *(c)* the heat flow indicating the direction. Neglect the volume of water present.

18. *(a)* Explain the working of a Carnot refrigerator.

(b) Derive an expression for its COP in terms of maximum and minimum temperatures in the cycle.

(c) Why is this cycle not used in practice?

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