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C09–M–305

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BOARD DIPLOMA EXAMINATION, (C–09)

OCT/NOV—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. Define pressure. What is the difference between absolute pressure and gauge pressure?

2. List out the characteristics of a perfect gas.

3. Briefly explain the following terms used in the context of a heat engine :

(a) Thermal reservoir

(b) Source

(c) Sink

4. State the characteristics of throttling process.

5. List any three merits of gaseous fuels over liquid fuels.

6. A fuel consists of 72% carbon, 20% hydrogen and 8% oxygen by mass. Determine the minimum quantity of air required for complete combustion of 1 kg of fuel.

7. Compare Otto cycle and diesel cycle in terms of—

(a) heat addition ;

(b) compression ratio ;

(c) applications.

8. Define the following terms :

(a) Saturation temperature

(b) Sensible heat

(c) Latent heat

9. List out different calorimeters used to find the quality of wet steam.

10. List out any six methods of refrigeration.

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.

11. *(a)* What is the perpetual motion machine of second kind (PMM2)? Why is it impossible to have such a device?

(b) During a complete cycle of operations, a system is subjected to the heat transfers 848 kJ supplied and 58 kJ rejected. At the points work is done by the system to the extent of 95 kJ and 205 kJ. At third point there is a further work transfer. Determine its amount. State whether it is done by the system or on the system.

12. *(a)* Define specific heat. Why gases have two specific heats? Derive the relationship between these two specific heats.

(b) An inventor claims to have developed a heat engine operating on reversible Carnot cycle which receives 950 kJ of heat from a source at 400 K and produces 300 kJ of net work while rejecting the waste heat to a sink at 293 K. Is this a reasonable claim? Why?

13. 3 Kg of air at 1·50 bar pressure and 87 °C temperature at condition I compressed polytropically to condition II at pressure 7·50 bar, index of compression being 1·2. It is then cooled at constant pressure to condition III and then finally heated at constant temperature to its original condition I. Find the net work done and heat transferred. Assume C_p 1 005 kJ/kg-K, C_v 0 718 kJ/kg-K and R= 0·287 kJ/kg-K.

14. 1 kg of air initially at 227 °C and 21 bar receives 420 kJ of heat. Determine the change in entropy if the heat is received *(a)* at constant volume, *(b)* at constant pressure, *(c)* at constant temperature and *(d)* when the air expands according to the law $PV^{1\,15}$ Constant.

Assume C_p 1 005 kJ/kg-K, C_v 0·718 kJ/kg-K and R 0 287 kJ/kg-K

15. Describe with a neat sketch the method of measuring calorific value of solid fuels by bomb calorimeter.

16. The stroke and cylinder diameter of a diesel engine are 250 mm and 150 mm respectively. If the clearance volume is 0·0004 m^3 and fuel injection takes place at constant pressure for 5% of the stroke, determine the air standard efficiency (ASE) of the engine.

17. *(a)* Draw a neat sketch of a combined separating and throttling calorimeter.

(b) Explain how it can be used to determine the dryness fraction of steam.

18. *(a)* Explain an air refrigerator working on a reversed Carnot cycle.

(b) Derive expression for its COP.

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