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C16-M–303

6244

BOARD DIPLOMA EXAMINATION, (C-16)

JUNE/JULY—2022

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. State Avogadro's law. What is Avogadro's number?

2. State three conditions for reversibility of a thermodynamic cycle.

3. Write three differences between Heat and Work.

4. Represent the following processes on *P-V* diagram :

(a) Isobaric process

(b) Isochoric process

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5. What is a polytropic process? How does it differ from an adiabatic process?

6. Mention three reasons for higher efficiency of Carnot cycle over other cycles.

7. State the functions of the following parts of an IC engine :

(a) Carburettor

(b) Spark plug

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8. Write three differences between rotary and reciprocating IC engines.

9. Define the following terms :

(a) Indicated power

(b) Brake power

10. Write three differences between centrifugal compressor and axial flow compressor.

PART—B

10×5=50

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

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

11. Two kg of ideal gas is heated from 20 °C to 95 °C. Assuming $R = 0{\cdot}265$ kJ/kg-K and $\gamma = 1{\cdot}3$ for the gas, find *(a)* specific heats, *(b)* change in internal energy and *(c)* change in enthalpy.

12. Determine the absolute pressure in "kPa" for the readings *(a)* 70 cm of Hg gauge, *(b)* 40 cm Hg vacuum and *(c)* 3·1 bar. Take that the barometer reads 760 mm of Hg.

13. In steady flow open system, a fluid substance flows at the rate of 4 kg/s. It enters the system at a pressure of 600 kN/m^2, a velocity of 220 m/s, internal energy 2200 kJ/kg and specific volume 0·42 m^3/kg. It leaves the system at a pressure of 150 kN/m^2, a velocity of 145 m/s, internal energy 1650 kJ/kg and specific volume 1·5 m^3/kg. During its passage through the system, the fluid has a loss of heat transfer of 40 kJ/kg to the surroundings. Determine the power of the system stating whether it is from or to the system. Neglect any change of gravitational potential energy.

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14. 0·24 m^3 of air at 101·3 kPa and 305 K is compressed to one tenth of its original volume according to the law $pV^{1{\cdot}3}$ = constant. Heat is then added at constant pressure until it becomes to initial volume. Calculate the total changes in entropy.

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15. An air standard Otto cycle with compression ratio 8 compresses air at 1 bar and 303 K. The maximum temperature of the cycle is 1273 K. Determine *(a)* heat supplied per kg of air, *(b)* heat rejected per kg of air, *(c)* net work done and *(d)* cycle efficiency. Assume $\gamma = 1{\cdot}4$ and $C_v = 0{\cdot}718$ kJ/kg-K.

16. Explain the working of 4-stroke spark ignition internal combustion engine with neat sketches.

17. The percentage composition of a sample of coal by mass is found to be $C = 90\%$, $H_2 = 4\%$, $O_2 = 1{\cdot}5\%$, $N_2 = 2{\cdot}5\%$; $S = 0{\cdot}5\%$ and remaining is ash. Calculate the minimum amount of air necessary for complete combustion of one kg of fuel and percentage composition by mass of products of dry combustion.

18. A two-stage air compressor is used to compress 1 kg of free air from 1 bar and 28 °C to 30 bar. The value of $n = 1{\cdot}25$ and $R = 0{\cdot}29$ kJ/kg-K. Determine *(a)* the intermediate pressure, *(b)* work required for the best performance, *(c)* work for a corresponding single-stage compressor and *(d)* percentage saving in work in two-stage compressor.

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