1621

Code : 15ME42T

Register Number

IV Semester Diploma Examination, Oct./Nov.-2019

BASIC THERMAL ENGINEERING

Time : 3 Hours] **[Max. Marks : 100**

Note : (i) Answer any **six** questions from Part – A.
(ii) Answer any **seven** full questions from Part – B.

PART – A

1. Define the terms : **5**
   (i) System
   (ii) State of a system
   (iii) Cycle
   (iv) Enthalpy
   (v) Specific heat

2. State the characteristics of Throttling process. **5**

3. One kg of air is heated in a closed vessel at a constant volume from a pressure of 2 bar to 5 bar. If the initial temperature of the air is 300 °K. Determine the change in internal energy, work done. C_V = 0.712 kJ/kg K. **5**

4. List any five assumptions made in thermodynamic air standard cycles. **5**

5. Explain with the help of P – V and T – S diagram working of Carnot cycle. **5**

6. Define the following : **5**
   (i) Cylinder bore
   (ii) Swept volume
   (iii) Compression ratio
   (iv) Indicated power
   (v) Brake power

[Turn over

7. Explain with diagram, Rope Brake dynamometer. 5

8. Explain with line diagram radial heat transfer by conduction through thick cylinder. 5

9. Differentiate between the closed and open cycle gas turbine. 5

PART – B

10. (a) Differentiate between Intensive and Extensive properties of a system. Give examples for each. 5

(b) A domestic food freezer is to be maintained at a temperature of –15 °C. The ambient air temperature is 30 °C. If the heat leaks into the freezer at the continuous rate of 1.75 kJ/sec. Find the power required to pump this heat out continuously, if the actual COP is one-third of theoretical COP. 5

11. (a) Derive the characteristic gas equation PV = mRT. 5

(b) A gas having initial pressure, volume and temperature as 275 kN/m^2, 0.09 m^3 and 185 °C respectively, is compressed at constant pressure until its temperature is 15 °C. Calculate the amount of heat transferred during the process. Take R = 290 J/kg · K and C_p = 1.005 kJ/kg K. 5

12. (a) Draw P.V. & T.S. diagram for Iso-thermal process with indicate various process. 5

(b) One kg of air at a temperature of 40 °C is compressed isothermally from a pressure of 1.5 bar to 6 bar. Determine the heat rejected by the air during the process of compression.

For air C_p = 1.005 kJ/kg K and C_v = 0.712 kJ/kg K. 5

13. A gas has a molecular mass of 26.7. The gas is compressed through a ratio of 12, according to the law $PV^{1.25}$ = C from initial condition of 0.9 bar and 333 K. Assuming specific heat at constant volume Cv = 0.79 kJ/kg K, determine per kg of mass, work done, heat flow across the cylinder walls, gas constant and ratio of specific heat. Take Ru = 8314 J/kg K. 10

14. With the help of P – V and T – S diagram, derive an expression for air standard efficiency of Otto cycle. **10**

15. The compression ratio of an ideal air standard diesel cycle is 15. The heat transfer is 1465 kJ/kg of air. Determine the pressure and temperature at the end of each process and cycle efficiency, if the inlet conditions are 300 K and 1 bar. Take $\gamma = 1.4$ and $C_v = 0.712$ kJ/kg K and $C_p = 1$ kJ/kg K for air. **10**

16. Explain with neat diagram working of four stroke Diesel engine. **10**

17. A test on a single cylinder 4-stroke oil engine having bore 18 cm and stroke 36 cm yielded the following results : **10**

Brake torque = 0.44 kN-m

MEP = 7.2 bar

Fuel consumption = 3.5 kg/min

Cooling water flow = 4.5 kg/min

Water temperature rise = 36 °C

A/F ratio = 25 (Air fuel ratio)

Exhaust gas temperature = 415 °C

Room temperature = 21 °C

Specific heat of exhaust gases 1.05 kJ/kg K

Calorific value = 45200 kJ/kg K

Speed = 286 rpm

Draw up a heat balance sheet on kJ/min basis

18. (a) The following data refer to a test on a petrol engine :

Indicated power = 30 kW

Brake power = 26 kW

Engine speed = 1800 rpm

Fuel per brake power hour = 0.35 kg

Calorific value of the fuel used = 44100 kJ/kg

Calculate :

(i) Mechanical efficiency

(ii) Indicated thermal efficiency

(iii) Brake thermal efficiency

(b) Derive an expression for heat transfer through a composite slab. 5

19. (a) Heat is conducted through a wall of room made of composite plate with a conduction of 134 W/m K and 60 W/m K and thickness 36 mm and 42 mm respectively.

The temperature at the outer face 96 °C and at the inner face 8 °C. Determine the temperature at the interface of the two materials. 5

(b) Explain with neat diagram the working of turbojet engine. 5
