1277

Code : 15ME-42T

Register Number | | | | | | | |

IV Semester Diploma Examination, April/May-2017

BASIC THERMAL ENGG.

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

Note : (i) Answer any **Six** from Part – **A** and any **Seven** from Part – **B**

(ii) Missing data may be suitably assumed.

PART – A

6 × 5 = 30

1. Define the terms : **5**
   (i) System
   (ii) Boundary
   (iii) Surroundings

2. Explain steady flow process and write steady flow energy equation with notations. **5**

3. A vessel contains 6.5 m^3 of nitrogen under a pressure of 12 bar and temperature of 40 °C.
   Find (i) Mass of gas (ii) Specific Volume (iii) Density of gas.
   Take molecular mass of nitrogen as 28. **5**

4. List the thermodynamic processes on gases. **5**

5. Derive an expression for work done during Isothermal process. **5**

6. List the assumptions made in air standard cycle. **5**

7. A Carnot engine working between 650 K and 300 K, produces 160 kJ of work. Determine thermal efficiency and heat added during the process. **5**

8. Define IC engine and give classification of IC engines. **5**

9. State and derive the Fourier law of heat conduction. **5**

PART – B **7 × 10 = 70**

10. (a) A piston cylinder containing air expands at a constant pressure of 150 kPa from a temperature of 285 K to a temperature of 550 K. The mass of air is 0.05 kg. Determine the heat transfer, work transfer and change in internal energy during the process. Take C_p = 1.01 kJ/kg K and C_v = 0.72 kJ/kg K. **6**

(b) Determine the co-efficient of performance and heat transfer rate in a condenser of a refrigerator in kJ/hr whose refrigeration capacity is 11000 kJ/hr, if the power input is 1.5 kW. **4**

11. (a) A quantity of gas occupies a space of 0.3 m^3 at a pressure of 2 bar and a temperature of 77 °C which is heated at constant volume, until the pressure is 7 bar. Determine :

(i) Temperature at the end of the process

(ii) Mass of gas

(iii) Change in internal energy

(iv) Change in enthalpy, during the process. Assume : C_p = 1.005 kJ/kg K

C_v = 0.714 kJ/kg K

R = 287 J/kg K **6**

(b) 0.1 m^3 of air at a pressure of 1.5 bar is expanded isothermally to 0.5 m^3. Determine the final pressure of the gas and heat supplied during the process. **4**

12. A certain quantity of air has a volume of 0.028 m^3 at a pressure of 1.25 bar and 25 °C. It is compressed to a volume of 0.0042 m^3 according to the law $PV^{1.3}$ = C. Determine the final temperature and work done during compression. Also determine the reduction in pressure at a constant volume required to bring the air back to its original temperature. **10**

13. (a) Explain with the help of P-V and T-S diagrams, the working of Otto cycle and derive an expression for the air standard efficiency of it. **6**

(b) An Otto cycle has a cylinder diameter of 150 mm and a stroke of 225 mm. The clearance volume is 1.25 × 10^{-3} m^3. Calculate the air standard efficiency of the cycle. Take γ = 1.4. **4**

14. (a) An ideal diesel engine working on diesel cycle having cylinder bore 210 mm, piston stroke 330 mm, clearance volume is 7 × 10^5 mm^3 and cut off takes place at 6% of stroke volume. Find the air standard efficiency. **7**

(b) A carnot engine operates with thermal efficiency of 70%. The minimum temperature of the cycle is 30 °C. Find the maximum temperature of the cycle. **3**

15. Explain with neat diagram the working of four stroke petrol engine. **10**

16. During a test on single cylinder diesel engine, working on four stroke cycle and fitted with rope brake, the following readings are taken :

Effective diameter of brake wheel	=	360 mm
Dead load on brake	=	200 N
Spring balance reading	=	30 N
Speed	=	450 rpm
Area of indicator diagram	=	420 mm^2
Length of indicator diagram	=	60 mm
Spring scale	=	1.1 bar per mm
Diameter of cylinder	=	100 mm
Stroke	=	150 mm
Quantity of oil used	=	0.815 kg/hr
Calorific value of oil	=	42000 kJ/kg

Determine :

(i) Brake power

(ii) Indicated power

(iii) Mechanical efficiency

(iv) Brake thermal efficiency

(v) Brake specific fuel consumption **10**

17. A test on a single cylinder four stroke oil engine having bore 180 mm and stroke 360 mm yielded the following results :

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
Air-fuel ratio	=	25
Exhaust gas temperature	=	415 °C
Room temperature	=	21 °C
Specific heat of exhaust gases	=	1.005 kJ/kg K
Calorific value	=	45200 kJ/kg
Speed	=	286 rpm

Draw up heat balance sheet on kJ/min basis. **10**

[Turn over

18. (a) A furnace wall is made up of bricks of 200 mm thick. The inner and outer surfaces of the wall have temperatures of 800 °C and 200 °C. Determine the heat loss, if the outside temperature becomes 25 °C, after the furnace wall is covered with insulator of 100 mm thick. Determine the reduction in heat loss.

Take K – brick = 4.5 W/m – k

K – Insulator = 0.5 W/m – k **7**

(b) A metal pipe of external diameter 150 mm carries the steam at 200 °C. The pipe is covered by a layer of 25 mm thick insulating material whose conductivity is 0.21 W/m – k. If the outer surface is at 100 °C, calculate the amount of heat loss per meter length per minute. **3**

19. (a) List the difference between closed cycle gas turbine and open cycle gas turbine. **5**

(b) Explain with neat diagram the working of turbo-jet engine. **5**