**1279** **Code : 15ME42T**

*Register Number* | | | | | | | |

**IV Semester Diploma Examination, Nov./Dec. 2017**

# BASIC THERMAL ENGINEERING-I

**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. Prove that the difference between two specific heats of a gas is equal to its gas constant. **5**

2. With neat sketch, explain free expansion process. **5**

3. 0.05 $m^3$ of air at 500 kPa and 200 °C is expanded adiabatically to 100 kPa. Calculate change in internal energy. Take R = 0.287 kJ/kg – °k, $C_p$ = 1.0045 kj/kg – °k and $\gamma = 1.4$. **5**

4. List the conditions for reversibility and main causes for the irreversibility of a cycle. **5**

5. Derive an expression for air standard efficiency of an Otto cycle with PV and TS diagrams. **5**

6. Explain the nomenclature associated with an IC-Engine. **5**

7. With neat sketch explain the rope brake dynamometer. **5**

8. Explain the following terms : **5**
   (a) Thermal radiation
   (b) Absorptivity
   (c) Reflectivity
   (d) Transmissivity
   (e) Emissivity

9. List any five comparisions of open cycle and closed cycle gas turbines. **5**

## PART – B

10. (a) Define the following properties of a Gas : 3
    (i) Enthalpy
    (ii) Entropy
    (iii) Internal energy

    (b) A chamber of volume 25 $m^3$, pressure of 1.026 bar and temperature of 25 °C is to be reduced to pressure of 0.32 bar and temperature of 5 °C. How many kg of air must be removed from the chamber ? Express this mass as volume measured at 1.026 bar and 25 °C. Take R = 287 J/kg - °k. 7

11. (a) State first and second law of thermodynamics. 5

    (b) A steel vessel of mass 1.75 kg contains 7.25 kg of water at a temperature of 23 °C. Find heat required to warm the vessel and water to 85 °C. Take specific heat of steel as 0.49 kJ/kg - °k and specific heat of water = 4.187 kJ/kg - °k. 5

12. (a) Explain the throttling 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 during the process. Take $C_p$ = 1.005 kJ/kg – °k and $C_V$ = 0.712 kJ/kg – °k. 5



13. (a) Derive an expression for work done during polytropic process. 4

    (b) A quantity of air has a volume of 60.5 lts and a pressure of 7.23 bar. IT is expanded in a cylinder to a pressure of 1.08 bar. Calculate the work done, if the expansion is : (i) Isothermal (ii) Adiabatic (iii) $PV^{1.2} = C$ 6
    Take $\gamma = 1.4$.



14. With the help of P-V and T-S diagrams, derive an expression for air standard efficiency of dual combustion cycle. 10

15. (a) State the assumptions ARA made in Air Standards Cycles. 5

    (b) In an ideal diesel cycle, the temperature at the beginning and end of compression are 57 °C and 603 °C respectively. While those at the beginning and end of expansion are 1950 °C and 870 °C respectively. Determine per kg of working fluid for which R = 0.287 kJ/kg – °k and $\gamma = 1.4$. 5
    (i) The heat received in kJ.
    (ii) The heat rejected in kJ
    (iii) The work done in kJ.
    (iv) Ideal thermal efficiency
    If the compression ratio is 14 : 1 and pressure at the beginning of compression is 100 kPa determine the maximum pressure in cycle.

16. With neat sketches, explain construction and working of four stroke petrol engine. **10**

17. The following observations were made during a test on two stroke cycle oil engine : **10**

Cylinder dimensions – 20 cm Bore, 25 cm stroke. Speed – 6 rps. Effective brake drum diameter = 1.2 mts. Net break load = 440 N. Imep = 280 kPa; Fuel oil consumption = 3.6 kg/hr. C.V. of fuel oil = 42,500 kJ/kg; mass of jacket cooling water per hour = 468 kg; Rise in temperature of jacket cooling water = 28 °C. Air used/kg of fuel oil = 34 kg. Temperature of air in test house = 30 °C. Temperature of exhaust gases = 400 °C. Mean specific heat of exhaust gases = 1 kJ/kg. – °k.

Draw up heat balance sheet in kJ/min as % of the heat supplied to the engine.

Also calculate : IP, $\eta_{mech}$ and BMEP.

18. (a) Write the comparisons of petrol and diesel engines. **5**

(b) Derive and expression for Heat Transfer by conduction through a composite wall. **5**

19. (a) A glass windows of a room have a total area of 10 $m^2$ and the glass is 4 mm thick. Calculate the quantity of heat that escapes from the room by conduction per second when the inside surfaces of windows are at 25 °C and the outside surfaces at 10 ° C. The value of 'k' is 0.84 w/mk. **5**

(b) With neat sketch explain the working of RAM-JET engine. **5**