



PART B — (5 × 16 = 80 marks)

11. (a) An engine working on the Otto cycle has an air standard cycle efficiency of 56% and rejects 544 kJ/kg of air. The pressure and temperature of air at the beginning of compression are 0.1 MPa and 60°C respectively, Compute :
- (i) The compression ratio of the engine (4)
  - (ii) The work done per kg of air (4)
  - (iii) The pressure and temperature at the end of compression, and (4)
  - (iv) The maximum pressure in the cycle. (4)

Or

- (b) Draw the actual and theoretical p-v diagrams of a four stroke diesel engine and compare them.

12. (a) With a neat sketch explain the working principle of a simple carburettor.

Or

- (b) Explain the battery ignition system with a suitable diagram.

13. (a) The inlet condition to a steam nozzle are 10 bar and 250°C. The exit pressure is 2 bar. Assuming isentropic expansion and negligible inlet velocity determine:

- (i) The throat area (6)
- (ii) Exit velocity and (6)
- (iii) Exit area of the nozzle. (4)

Or

- (b) What is velocity compounding? List the advantages and limitations of velocity compounding.

14. (a) A single - stage single - acting compressor delivers 15 m<sup>3</sup> of free air per minute from 1 bar to 8 bar. The speed of compressor is 300 r.p.m. Assuming that compression and expansion follow the law  $pv^{1.3} = \text{constant}$  and clearance is 1/16<sup>th</sup> of swept volume, find the diameter and the stroke of the compressor. Take  $L/D = 1.5$ . The temperature and pressure of air at the suction are 20°C and 1 bar respectively.

Or

(b) A two-stage compressor delivers  $2 \text{ m}^3$  free air per minute. The temperature and pressure of air at the suction are  $27^\circ\text{C}$  and 1 bar. The pressure at the delivery is 50 bar. The clearance is 5% of the respective stroke in L.P. cylinder as well as in H.P. cylinder. Assuming perfect intercooling between the two stages, find the minimum power required to run the compressor at 200 rpm. Also find the diameters and strokes assuming the strokes of both cylinders are equal to the diameter of the L.P. Cylinder.

15. (a) A vapour compression machine is used to maintain a temperature of  $-23^\circ\text{C}$  in a refrigerated space. The ambient temperature is  $37^\circ\text{C}$ . The compressor takes in dry saturated vapour of F-12. A minimum  $10^\circ\text{C}$  temperature difference is required at the evaporator as well as at condenser for effective heat transfer. There is no sub-cooling of liquid. If the refrigerant flow rate is 1 kg/min, find

(i) Tonnage of refrigeration (6)

(ii) Power requirement (6)

(iii) Ratio of C.O.P. of this cycle to C.O.P. of Carnot cycle. (4)

Or

(b) One kg of air at  $35^\circ\text{C}$  DBT and 60% R.H is mixed with 2 kg of air at  $20^\circ\text{C}$  DBT and  $13^\circ\text{C}$  dew-point temperature. Calculate the specific humidity of the mixture.