

12. (a) (i) Two Carnot engines A and B are operated in series. The first one receives heat at 870°K and rejects to a reservoir at T . B receives heat rejected by the first engine and in turn rejects to a sink at 300°K . Find the temperature T for
- (1) Equal work outputs of both engines (6)
 - (2) Same Efficiencies (6)
- (ii) Mention the Clausius inequality for open, closed and isolated systems. (4)

Or

- (b) (i) 3kg of air at 500kPa, 90°C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of the surroundings at 100kPa and 10°C . Find maximum work, change in availability and the irreversibility. (12)
- (ii) Briefly discuss about the concept of entropy. (4)
13. (a) Steam at 480°C , 90 bar is supplied to a Rankine cycle. It is reheated to 12 bar and 480°C . The minimum pressure is 0.07 bar. Find the work output and cycle efficiency using steam tables with and without considering pump work.

Or

- (b) (i) Steam initially at 0.3 MPa, 250°C is cooled at constant volume. At what temperature will the steam become saturated vapour? What is the steam quality at 80°C . Also find what is the heat transferred per kg of steam in cooling from 250°C to 80°C . (12)
- (ii) When will you call a vapour superheated? Give example. Also when will you call a liquid as compressed liquid? Give example. (4)
14. (a) (i) Derive the Clausius- Clapeyron equation and discuss its significance. (12)
- (ii) Write down two Tds relations. (4)

Or

- (b) (i) Derive any two Maxwell's relation. (10)
- (ii) Draw a neat schematic of a compressibility chart and indicate its salient features. (6)
15. (a) (i) Air at 20°C , 40% R.H is mixed with air at 40°C , 40% R.H in the ratio of (former) 1 :2(later) on dry basis. Determine the final condition of air. (10)
- (ii) Briefly discuss about evaporative cooling process. (6)

Or

- (b) (i) Define the terms — Relative humidity and Specific humidity. (2 + 2)
- (ii) Explain the adiabatic saturation process with a schematic. (8)
- (iii) Represent — heating and humidification, cooling and dehumidification processes on a psychrometric chart. (4)