



Answer all the following Questions (allowable charts and tables)

assume any missing data for air take $c_p = 1.005 \text{ kJ/kg K}$ and $c_v = 0.718 \text{ kJ/kg K}$.

Question 1

- a) Air flows steadily at the rate of 0.4 kg/s through an air compressor, entering at 6 m/s with a pressure of 1 bar and a specific volume of $0.85 \text{ m}^3/\text{kg}$, and leaving at 4.5 m/s with a pressure of 6.9 bar and a specific volume of $0.16 \text{ m}^3/\text{kg}$. The internal energy of air leaving is 88 kJ/kg greater than that of the air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at the rate of 59 kJ/s . Calculate the power required to drive the compressor and the inlet and outlet pipe cross-sectional areas?
- b) An air-standard diesel cycle has a compression ratio of 20 , and the heat transferred to the working fluid per cycle is 1800 kJ/kg . At the beginning of the compression process, the pressure is 0.1 MPa and the temperature is 15°C . Determine
- a) The pressure and temperature at each point in the cycle.
b) The thermal efficiency. c) The mean effective pressure

Question 2

- a) A Brayton cycle with regeneration using air as the working fluid has a pressure ratio of 7 . The minimum and maximum temperatures in the cycle are 310 and 1150 K . Assuming the regenerator efficiency 65% , determine (a) the air temperature at the turbine exit, (b) the net-work output, and (c) the thermal efficiency?
- b) A Carnot cycle operates between source and sink temperatures of 290°C and 14°C . If the system rejected 80 kJ heat to the sink, find (i) efficiency of the system, (ii) the net-work transfer, (iii) heat receives from the source?

Question 3

A cascade system with one refrigeration cycle operating with R-410a has an evaporator at -40°C and a high pressure of 1400 kPa . The high temperature cycle uses R-134a with an evaporator at 0°C and a high pressure of 1600 kPa . Find the ratio of the two cycles' mass flow rates and the overall C.O.P?

Question 4

Consider a steam power plant operating on the ideal reheat Rankine cycle. Steam enters the high-pressure turbine at 150 bar and 600°C and is condensed in the condenser at a pressure of 0.1 bar . the steam is reheated to the inlet temperature of the high-pressure turbine (600°C). If the moisture content of the steam at the exit of the low-pressure

turbine is not to exceed 12 percent, determine (a) the pressure at which the steam should be reheated (b) the thermal efficiency of the cycle. (c) the steam flow rate if the net work for cycle equal 33.2 Mw.

Question 5

Choose the Correct Answer :

- 1- The maximum efficiency of an ideal Carnot engine occurs when.....
 (a) minimum temperature of the sink only (b) maximum temperature of the source only
 (c) absolute temperature (d) maxi. temperatures of the source and mini. of the sink
- 2- In a reversible cycle, the entropy of the system
 (a) increases (b) decreases
 (c) does not change (d) depends on the properties of working substance
- 3- During throttling process
 (a) internal energy does not change (b) pressure does not change
 (c) entropy does not change (d) enthalpy does not change
- 4- The latent heat of vaporization at critical point is.....
 (a) less than zero (b) greater than zero
 (c) equal to zero (d) none of the above.
- 5- An open system is one in which.....
 (a) heat and work cross the boundary of the system, but the mass of the working substance does not
 (b) mass of working substance crosses the boundary of the system but the heat and work do not
 (c) both the heat and work as well as mass of the working substances cross the boundary of the system
 (d) neither the heat and work nor the mass of the working substances cross the boundary of the system.
- 6- The thermal efficiency of theoretical Otto cycle.....
 (a) increases with increase in compression ratio (b) increases with increase in isentropic index
 (c) does not depend upon the pressure ratio (d) follows all the above
- 7- the effect of the Regenerative and reheat on thermal efficiency of the cycle are
 (a) decreases (b) increases
 (c) does not affect (d) may increase or decrease.
- 8- Rankine efficiency of a steam power plant
 (a) improves in summer as compared to that in winter
 (b) improves in winter as compared to that in summer
 (c) is unaffected by climatic conditions
 (d) none of the above.
- 9-..... cycle comprises of two isentropic processes, one constant pressure processes and one constant volume.
 (a) Rankine (b) Otto
 (c) Carnot (d) Diesel
- 10- The gas constant (R) is equal to the
 (a) sum of two specific heats (b) difference of two specific heats
 (c) product of two specific heats (d) ratio of two specific heats.

Good Luck...

