CH #03. Air Cycle Refrigeration System

Q # 06

Bootstrap Refg Sys

$Q = 10\,TR$

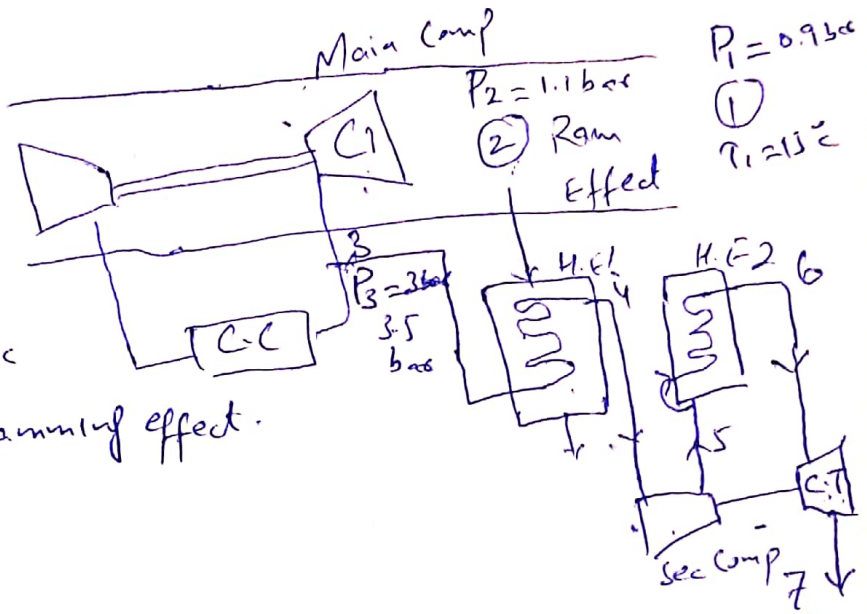
$P_1 = 0.9\,bar$

$T_1 = 15^\circ C$

Process

$P_2 = 1.1\,bar$ ↑ isentropic

↓ Ideal Ramming effect.



$P_3 = 3.5\,bar$

$P_3 = P_4$

$P_5 = 4.5\,bar$

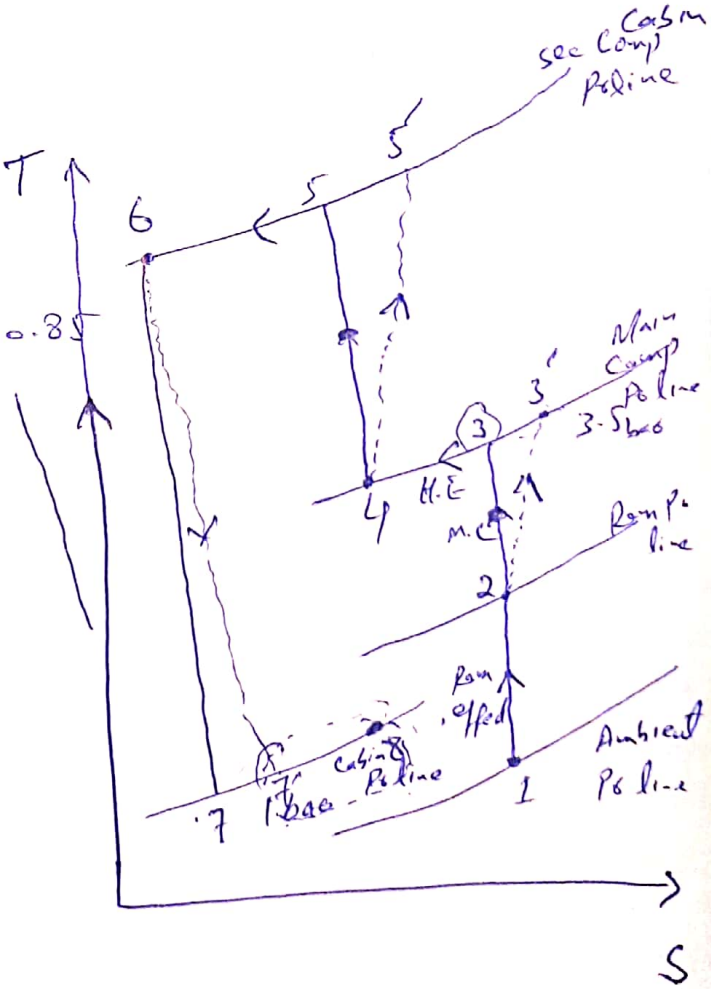
$\eta_{c_{1,2}} = 90\%$ or 0.9

$\eta_{Cooling\ turbine} = 85\%$ or 0.85

$\epsilon_{1,2} = 0.6$

$T_8 = 25^\circ C$

$P_7 = P_8 = 1\,bar$



To Finds:

$\dot{m}_a = ?$

$P = ?$

$COP = ?$

Ram Process 1-2 $T_2 =$

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{n-1}{n}} \Rightarrow$$

$T_2 = ---$

Comp Process 2-3

$$\frac{T_3}{T_2} = \left(\frac{P_3}{P_2}\right)^{\frac{n-1}{n}}$$

$T_3 =$

$$\eta_c = \frac{T_3 - T_2}{T_3' - T_2}$$

$T_3' = ---$

H-E process 3'-4. $T_4 =$

$$\epsilon = \frac{\text{Actual decrease in Temp}}{\text{Ideal decrease in Temp}}$$

$$= \frac{T_3' - T_4}{T_3' - T_2}$$ $T_4 =$

Comp process 4-5 T_5'

$$\frac{T_5}{T_4} = \left(\frac{P_5}{P_4}\right)^{\frac{n-1}{n}}$$

$T_5 =$

$$\eta_c = \frac{T_5 - T_4}{T_5' - T_4}$$

$T_5' =$

H-E 5-6.

$$\epsilon = \frac{T_5' - T_6}{T_5' - T_2}$$

$T_6 =$

Expansion process 6-7.

$$\frac{T_7}{T_6} = \left(\frac{P_7}{P_6}\right)^{\frac{n-1}{n}}$$

$T_7 = ---$

$$\eta_t = \frac{T_8 - T_7}{T_6 - T_7'}$$

$T_7' =$

$$m_a = \frac{210\,Q}{C_p(T_8 - T_7)}$$

$m_a =$ kg/min Ans.

$$P = \frac{m_a C_p (T_3' - T_2)}{60}$$

$P =$ kW.

Ans

$$COP = \frac{210 \times Q}{P \times 60}$$

$COP =$ Ans