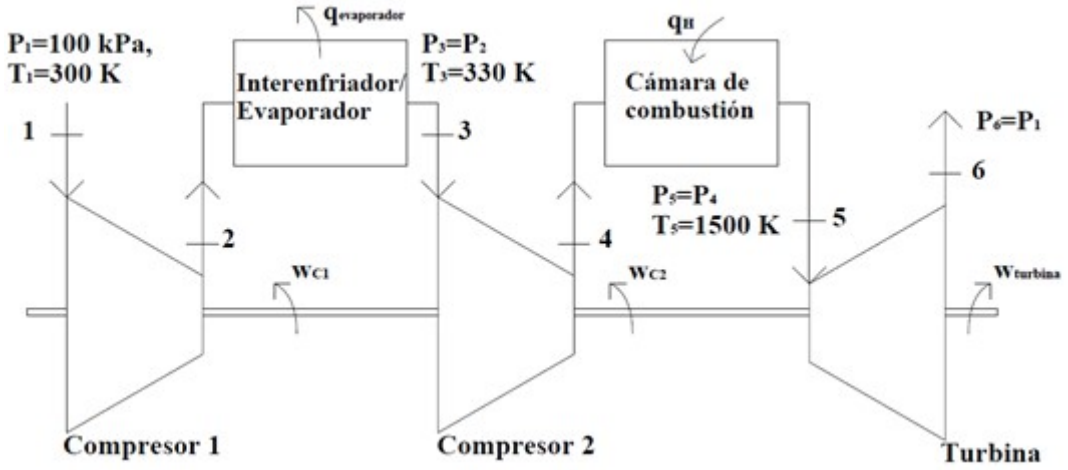


Problema # 1 (60 puntos)

Calores específicos c_v , y c_p

$c_v = 0.718$ [kJ/(kg*K)]

$c_p = 1.005$ [kJ/(kg*K)]

$R = c_p - c_v$

$$k = \frac{c_p}{c_v}$$

Definición de propiedades conocidas en los diferentes estados

Estado 1

$P_1 = 100$ [kPa]

$T_1 = 300$ [K]

Estado 2

$P_2 = 5 \cdot P_1$

$$T_{2s} = T_1 \cdot \left[\frac{P_2}{P_1}\right]^{\left[\frac{k-1}{k}\right]}$$ *T_{2s} : 5 puntos*

Estado 3

$P_3 = P_2$

$T_3 = 330$ [K]

Estado 4

$P_4 = 5 \cdot P_3$

$$T_{4s} = T_3 \cdot \left[\frac{P_4}{P_3}\right]^{\left[\frac{k-1}{k}\right]}$$ *T_{4s} : 5 puntos*

Estado 5

$P_5 = P_4$

$T_5 = 1500$ [K]

Estado 6

$P_6 = P_1$

$$T_{6s} = T_5 \cdot \left[\frac{P_6}{P_5}\right]^{\left[\frac{k-1}{k}\right]}$$ *T_{6s} : 5 puntos*

Parte a: T_2 y T_4

Recordando que la eficiencia isoentrópica del compresor, eff_{comp}, puede ser definida como: $eff_{comp} = w_{cideal} / w_{creal}$

$eff_{comp} = 0.82$

$$eff_{comp} = \frac{T_{2s} - T_1}{T_2 - T_1}$$ *T_2 : 5 puntos*

$$eff_{comp} = \frac{T_{4s} - T_3}{T_4 - T_3}$$ *T_4 : 5 puntos*

Parte b: $s_{genturb}$

Recordando que la eficiencia isoentrópica de la turbina, eff_{turb}, puede ser definida como: $eff_{turb} = w_{treal} / w_{tideal}$

$eff_{turb} = 0.86$

$$eff_{turb} = \frac{T_5 - T_6}{T_5 - T_{6s}}$$ *T_4 : 5 puntos*

$s_{gen} = s_6 - s_5$

$$s_{gen} = c_p \cdot \ln\left[\frac{T_6}{T_5}\right] - R \cdot \ln\left[\frac{P_6}{P_5}\right]$$ *s_{gen} : 10 puntos*

Parte c: n_{term}

$e_e = e_s$

$w_{c1} = c_p \cdot [T_2 - T_1]$

$w_{c2} = c_p \cdot [T_4 - T_3]$

$w_{turb} = c_p \cdot [T_5 - T_6]$

$w_{turb} = w_{gen} + w_{c1} + w_{c2}$ *w_{gen} : 10 puntos*

$q_h = c_p \cdot [T_5 - T_4]$

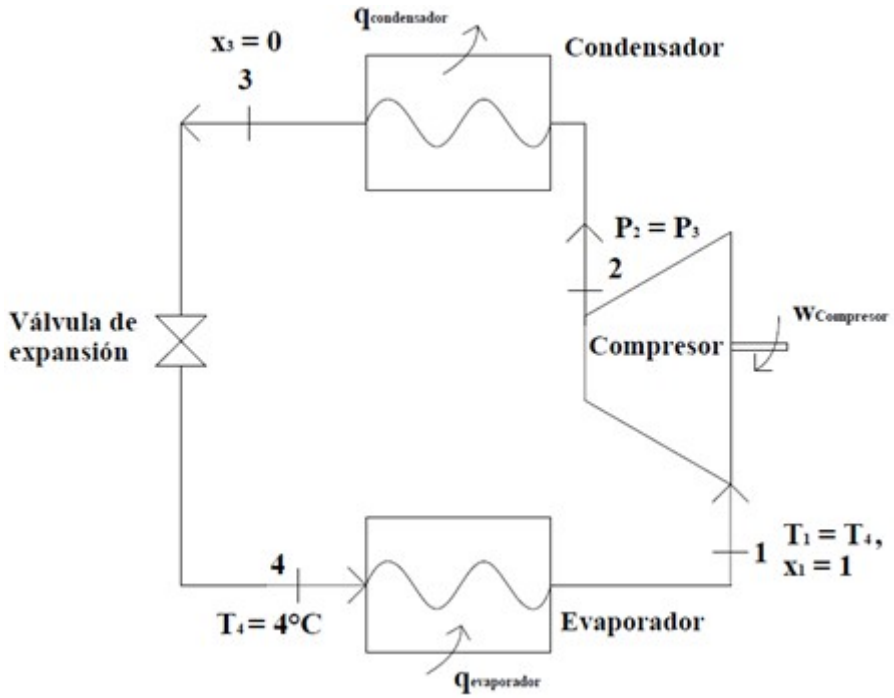
$n_{term} = \frac{w_{gen}}{q_h}$ *n_{term} : 10 puntos*

SOLUTION

Unit Settings: SI K kPa kJ mass deg

c_p = 1.005 [kJ/(kg*K)]
c_v = 0.718 [kJ/(kg*K)]
eff_{comp} = 0.82
eff_{turb} = 0.86
k = 1.4
n_{term} = 0.3499
P_1 = 100 [kPa]
P_2 = 500 [kPa]
P_3 = 500 [kPa]
P_4 = 2500 [kPa]
P_5 = 2500 [kPa]
P_6 = 100 [kPa]
q_h = 939.9 [kJ/kg]
R = 0.287 [kJ/(kg*K)]
s_{gen} = 0.1924 [kJ/(kg*K)]
T_1 = 300 [K]
T_2 = 513.5 [K]
T_{2s} = 475 [K]
T_3 = 330 [K]
T_4 = 564.8 [K]
T_{4s} = 522.5 [K]
T_5 = 1500 [K]
T_6 = 724.5 [K]
T_{6s} = 598.2 [K]
w_{c1} = 214.5 [kJ/kg]
w_{c2} = 236 [kJ/kg]
w_{gen} = 328.9 [kJ/kg]
w_{turb} = 779.4 [kJ/kg]

No unit problems were detected.



Problema # 2 (40 puntos)

$c_{paire} = 1.005$ [kJ/(kg*K)]

$T_{2aire} = 513.5$ [K]

$T_{3aire} = 330$ [K]

$q_{evaporador} = c_{paire} \cdot [T_{2aire} - T_{3aire}]$ *$q_{evaporador}$: 5 puntos*

Estado 1

$T_1 = 4$ [°C]

$x_1 = 1$

$h_1 = \mathbf{h}[R134a, T = T_1, x = x_1]$ *h_1 : 5 puntos*

$s_1 = \mathbf{s}[R134a, T = T_1, x = x_1]$

Estado 4

$T_4 = T_1$

1era ley en el evaporador

$h_4 + q_{evaporador} = h_1$ *h_4 : 5 puntos*

$x_4 = \mathbf{x}[R134a, T = T_4, h = h_4]$

Estado 3

$h_3 = h_4$

$x_3 = 0$

$T_3 = \mathbf{T}[\text{R134a}, x = x_3, h = h_3]$ *T_3 : 10 puntos*

$P_3 = \mathbf{P}[\text{R134a}, x = x_3, h = h_3]$

Estado 2

$P_2 = P_3$

$s_2 = s_1$

$h_{2s} = \mathbf{h}[\text{R134a}, P = P_2, s = s_2]$

$\text{eff}_{comp} = 0.12$

$$\text{eff}_{comp} = \frac{h_{2s} - h_1}{h_2 - h_1}$$ *h_2 : 5 puntos*

$T_2 = \mathbf{T}[\text{R134a}, P = P_2, h = h_2]$

Parte a: T_3, ya fue determinado

Parte b: $w_{compreal}$

$w_{compreal} = h_2 - h_1$ *$w_{compreal}$: 5 puntos*

Parte c: COP_{real}

$$COP_{real} = \frac{q_{evaporador}}{w_{compreal}}$$ *COP_{real} : 5 puntos*

$q_{condensador} = h_2 - h_3$

Alternativamente pudo buscar $q_{condensador}=h_2-h_3$ y con este el COP_{real}

SOLUTION

Unit Settings: SI C kPa kJ mass deg

$COP_{real} = 3.914$
$\text{eff}_{comp} = 0.12$
$h_2 = 299.9$ [kJ/(kg)]
$h_3 = 68.35$ [kJ/(kg)]
$P_2 = 445.1$ [kPa]
$q_{condensador} = 231.5$ [kJ/(kg)]
$s_1 = 0.9293$ [kJ/(kg*°C)]
$T_1 = 4$ [°C]
$T_{2aire} = 513.5$ [K]
$T_{3aire} = 330$ [K]
$w_{compreal} = 47.12$ [kJ/(kg)]
$x_3 = 0$

$c_{paire} = 1.005$ [kJ/(kg*K)]
$h_1 = 252.8$ [kJ/(kg)]
$h_{2s} = 258.4$ [kJ/(kg)]
$h_4 = 68.35$ [kJ/(kg)]
$P_3 = 445.1$ [kPa]
$q_{evaporador} = 184.4$ [kJ/(kg)]
$s_2 = 0.9293$ [kJ/(kg*°C)]
$T_2 = 57.44$ [°C]
$T_3 = 12.12$ [°C]
$T_4 = 4$ [°C]
$x_1 = 1$
$x_4 = 0.05676$

No unit problems were detected.