UC Davis

EMS 160 Homework 2

Enthalpy, Entropy and Gibbs

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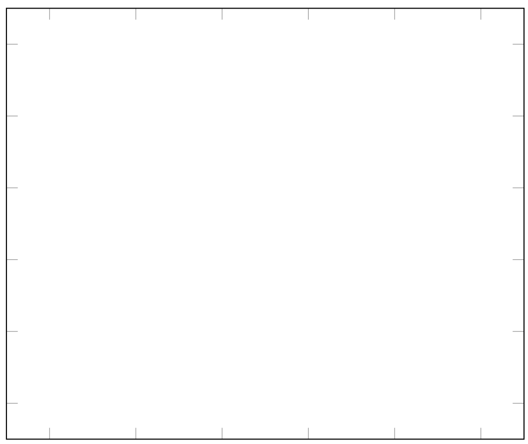
Question 4 (6pts)

i Rankine cycle

Rankine cycle



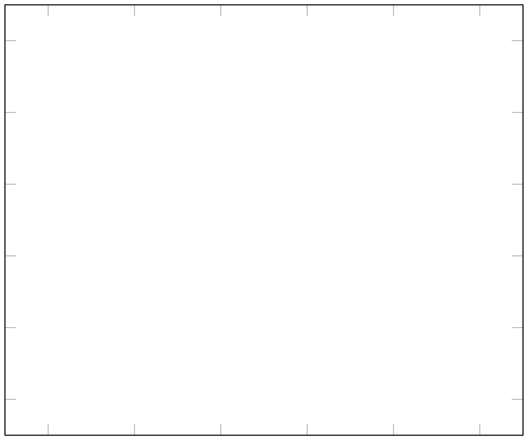
Entropy

1-2: Isothermal heat addition: $Q = \int_1^2 TdS, W = 0, Q$ is positive
2-3: Isentropic expansion: $Q = 0, W = V(P_3 - P_2), W$ is negative
3-4: Isothermal heat rejection: $Q = \int_3^4 TdS, W = 0, Q$ is negative
4-1: Isentropic compression: $Q = 0, W = V(P_1 - P_4), W$ is positive

Commonly used in power plants.

ii Stirling cycle

Stirling cycle

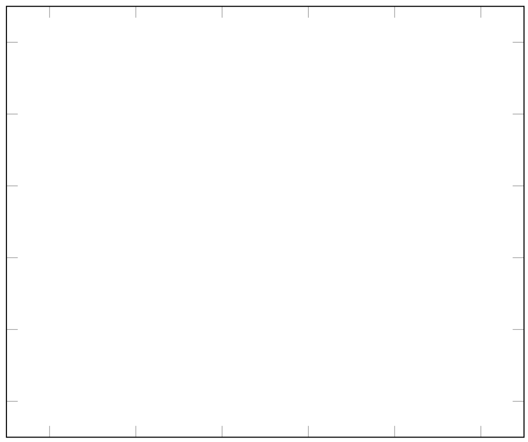


Entropy

1-2: Isothermal heat addition: $Q = \int_1^2 TdS$
2-3: Isochoric heat rejection: $Q = \int_2^3 TdS$
3-4: Isothermal heat rejection: $Q = \int_3^4 TdS$
4-1: Isochoric heat addition: $Q = \int_4^1 TdS$
net work in this cycle: $W_{net} = mR\ln{(\frac{V_2}{V_1})}\Delta T$

Invented in the early 1800. Aside from use in engines, it is also used as coolers iii Otto cycle

Otto cycle

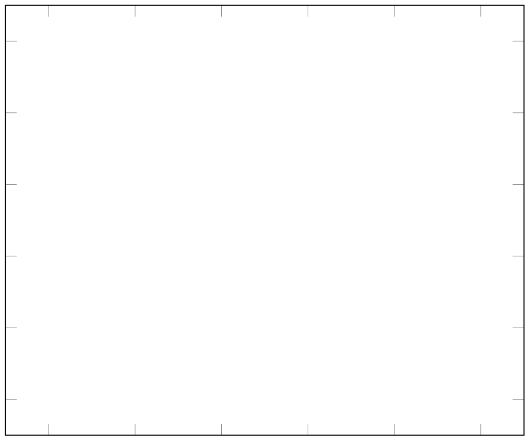


Entropy

Stroke 1
1-2: Isentropic and Adiabatic compression: $Q = 0, W = U_2 - U_1$
Stroke 2
2-3: Isochoric heat addition: $Q = \int_2^3 TdS$
Stroke 3
3-4: Isentropic and Adiabatic expansion: $Q = 0, W = U_4 - U_3$
Stroke 4
4-1: Isochoric heat rejection: $Q = \int_4^1 TdS$

Used in most piston driven engines in automobiles iv Brayton cycle

Brayton cycle



Entropy

1-2: Isentropic compression: $Q = 0, W = H_2 - H_1$
2-3: Isobaric heat addition: $Q = \int_2^3 TdS, W = 0$
3-4: Isentropic expansion: $Q = 0, W = H_2 - H_1$
4-1: Isobaric heat addition: $Q = \int_4^1 TdS, W = 0$

Applications in power grids as gas turbines. Also used in aircraft jet engines