Homework #5

MEMS 0051 - Introduction to Thermodynamics

Assigned February 17st, 2020
Due February 21st, 2020

Problem #1

Determine the final temperature of 15 [kg] of carbon dioxide, that while undergoing a constant-pressure process which starts at a temperature of 25 °C, receives 10.2 [MJ] of heat, by treating the constant-pressure specific heat as:

(a) A constant taken from Table A.5;
(b) A constant evaluated at the average temperature (i.e. average of the initial and final temperature) using the polynomial expression from Table A.6;
(c) A constant evaluated at the average constant-pressure specific heat (i.e. the average of specific heat evaluated at the initial and that at the final temperature) using the polynomial expression from Table A.6;
(d) As the integral-average evaluated between the initial and final temperature using the polynomial expression from Table A.6.

Note: items (b)-(d) require an iterative approach. You are to use Matlab to develop the iterative approach and to solve for items (a)-(d). Your Matlab code will be submitted through an assignment link on Courseweb. Your code should have your name and assignment number at the top, as well as comments explaining your code. You are to use the fprintf command to output out results for items (a)-(d).

Problem #2

A heat engine operates between a high-temperature reservoir T_{H1} and a low-temperature reservoir T_{ambient}. The work produced, $\dot{W}_1$, which is the difference of heat input $\dot{Q}_{H1}$ and heat rejected $\dot{Q}_{L1}$, powers a heat pump. Part of the work from the heat engine enters the heat pump $\dot{W}_2$, whereas the difference between $\dot{W}_1$ and $\dot{W}_2$ is designated as the net work, $\dot{W}_{\text{net}}$. The heat pump accepts heat $\dot{Q}_{L2}$ from the same low-temperature reservoir (T_{ambient}) and rejects heat $\dot{Q}_{H2}$ to a secondary high-temperature reservoir T_{H2}. Assuming T_{H1}=T_{H2}>T_{ambient}, determine, based upon the following cases (a-c), if this system satisfies the First Law and/or violates the Second Law. Then, assuming T_{H1}>T_{H2}>T_{ambient}, determine if this system satisfies the First Law and/or violates the Second Law.

	$\dot{Q}_{H1}$	$\dot{Q}_{L1}$	$\dot{W}_1$	$\dot{Q}_{H2}$	$\dot{Q}_{L2}$	$\dot{W}_2$
a	6	4	2	3	2	1
b	6	4	2	5	4	1
c	3	2	1	4	3	1