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MET 350

Test 1 Reflection

1) The first question pertains to calculating the effectiveness of a regeneration heat exchanger (HX) for an engine operating under partial load conditions. It involves applying principles from Chapter 4c, specifically related to the Brayton Cycle with Intercooling-Reheating-Regeneration. By calculating the effectiveness of the regeneration HX, students are expected to understand its significance in improving the thermal efficiency of the cycle, as well as its implications for design considerations. Additionally, the question also asks you to consider how changes in engine operation, such as reducing heat addition in combustion chambers, affect power output and thermal efficiency. The second question involves calculating the propulsive efficiency of a jet propulsion cycle, incorporating concepts from Chapter 5. We were asked to solve a problem related to the jet propulsion cycle discussed in class, which covers topics such as ideal and actual cycles, efficiency calculations, and the effects of compressor and turbine efficiencies on cycle performance. By repeating the problem with different compressor and turbine efficiencies, we were expected to analyze how these factors influence the propulsive efficiency of the cycle and compare the results to understand their impact on overall cycle performance.

2) For the first question I computed the HX effectiveness correctly as well as realizing that the regeneration was hurting the cycle and calculating the new efficiency as well as the power for the cycle without regeneration. However, I did make some minor mistakes in labeling the states, as I had T_5 = to 729.609K when it should've been T_6 = 729.609K for the new reworked states of the cycle without regeneration. This can be avoided in future tests by paying closer attention to the PV and TS diagrams and to double check the values in order not to misrepresent a state. For the second problem I used the isentropic efficiencies of the compressor and turbines to get the states, however some of my values were off due errors in calculations which led to other values being off as they were dependent on each other. For example, when calculating P_5, I got the wrong value because I used the wrong value of T_5 in the following equation: $\frac{P_4}{P_5} = \left(\frac{T_4}{T_5}\right)^{\frac{k}{k-1}}$

   Regarding the calculations for the propulsion efficiency, I observed that the efficiency dropped, however, I got the wrong values because I used the wrong equation and did not first calculate the propulsion force/power. I should have used this equation:

$$n_p = \frac{W_p}{Q_{in}} = \frac{W_p}{\frac{1}{v_1} \times V_1 \times \frac{\pi}{4} D^2 \times \left(h_4 - h_{3a}\right)}$$

3)

WRITING RUBRIC:

Purpose	0.0/10.0
Drawings	1.0/10.0
Sources	0.0/10.0
Design considerations	0.0/10.0
Data and variables	0.5/10.0
Procedure	2.0/10.0
Calculations	1.0/10.0
Summary	0.0/10.0
Materials	0.0/10.0
Analysis	1.0/10.0
TOTAL	5.5/10.0

PROBLEM 1:

P-v and T-s diagrams	2/11
HX effectiveness for previous problem	1/11
State calculations (with regeneration)	2/11
Realize that regeneration hurts	2/11
State calculations (without regeneration)	1/11
Power	1/11
Final results	1/11
TOTAL	10/11

PROBLEM 2:

P-v and T-s diagrams	2/8
State calculations:	2/8

Use wc_act = wt_act

Use efficiencies to get states

Cp & Cv variable

P5

Propulsion efficiency (before and after)	0/8
Final results	0.5/8
TOTAL	4.5/8

<u>FINAL GRADE:</u>

5.5 + (80/2) *(10/11+4.5/8) = 64.36

4) Some issues that I encountered during the test was using the wrong data or equations for a specific state or calculation, as well as some difficulties in interpreting the problem statements. To troubleshoot this in the future, clarifying unclear points with the professor, and reviewing relevant concepts and equations can help to not make these mistakes again. The steps that I took to complete the test was to first analyze each problem, identify the appropriate equations and data needed, and then to solve step by step. The. new concepts that I learned related to regeneration heat exchangers, propulsive efficiency in jet propulsion cycles, and the efficiency of compressors and turbines. These concepts are used in designing thermal systems, engines, and propulsion systems in various engineering fields. Understanding regeneration heat exchangers is important for optimizing energy usage in various systems, particularly in power generation and thermal management applications. This knowledge allows me to design more efficient heat transfer systems that can recover waste heat and improve overall system efficiency. In the field of aerospace engineering or any industry involving propulsion systems, knowing about propulsive efficiency in jet propulsion cycles is essential. It helps in designing more fuel-efficient engines and optimizing thrust output for aircraft or other propulsion systems. Compressors and turbines are also ubiquitous in mechanical systems, including power plants, refrigeration systems, and aircraft engines. Understanding their efficiency characteristics is vital for designing and operating these systems optimally, minimizing energy consumption, and maximizing performance. I can apply this knowledge in the design and analysis of various mechanical systems, including power plants, HVAC systems, aerospace propulsion systems, and more. I can also use this during the design phase of projects to ensure optimal performance and efficiency because it's essential to ensure that the future systems I work on are energy-efficient, reliable, and cost-effective. Understanding these concepts helps achieve those goals. I organized time effectively but may adjust time allocation for each problem in the future based on difficulty.