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MET 350

Professor Ayala

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Test 1 Reflection

This test demonstrated my work toward developing my understanding of the first and second laws of thermodynamics. It showcased my ability to apply these laws to gas turbine engines using ideal cycles, reheating, regeneration, and inter-cooling cycles. Lastly, it showed that I can effectively apply the thermodynamics laws to jet propulsion engines using the ideal cycle.

After reviewing the first question I noticed some mistakes I made. First with the graphs, I never added the 6th stage in the cycle which accounts for the energy regenerated. Another thing I noticed I did differently was converted pressure as 1 bar = 100 kPa, while the appropriate conversion would be 1 bar = 101.3 kPa. This could have been the reason why my some of my solutions are slightly off. Going through each of the states, I solved for pressure and temperature correctly for all. Now for solving the questions, my answer for thermal efficiency and effectiveness of the heat exchanger was correct. The answer I gave for the mass air flow rate was also all correct. For thermal efficiency if the heat exchanger were operating at 100%, it looks like I went about solving the question a little differently. I first found the max q regen, subtracted the actual from that value which gave me an additional 44.85 kJ/kg. I then took the additional energy that would've been regenerated and subtracted it from how much energy would have been needed to be pulled from the solar storage. Resolving for thermal efficiency I got 45.5 percent, which is a little under 2 percent error from the solution of 46.3 percent.

For the second problem, all the graph I created for the system were correct. I noticed in my calculations for properties of air at state 3 I made an error. I divided the efficiency of the compressor by the real work of the compressor when I should've multiplied it. This then made my value for enthalpy at state 3 higher than it was supposed to be. I also made a mistake in solving for the enthalpy at state 5. When the problem gave 500 kJ/kg produced, I assumed that would've been the amount of work after the efficiency. Therefore my enthalpy calculated at the turbine exit was higher. For the pressure at the turbine exit, I made a blatant mistake and listed pressure at the turbine inlet. For velocity at the nozzle exit, I used the correct formula and came close but due to my enthalpy values being off my velocity was also off. Surprisingly it was still

only off by less than one percent. And lastly, my answer for the thrust of the engine was close and I used the correct formula, but since my exit velocity slightly differed I was off by 2 kN.

As far as the grade I think I got on the test for the formatting portion. I seemed to clearly state the purpose of each problem correctly. For drawings, I drew everything correctly but didn't label work in or out on either graph which I should include next time. For this, I subtracted 0.25 from the total. Sources was pretty straightforward because for these problems only one source, the textbook, is needed. Design considerations were all outlined clearly for the problems receiving full credit. Procedure and calculations I feel were clearly illustrated for each state. I added tacks for each new state and how I achieved each value including unit conversions and all formulas. Summary and analysis for both I feel could use some work. I struggled to understand what was being asked of these sections and after reading the professor's answers I feel I didn't do it correctly. For this, I only gave a quarter credit for each.

WRITING RUBRIC (Applied to the whole test, not to particular problems)

1. Purpose	0.5/10.0 out of 0.5/10.0
2. Drawings	0.75/10.0 out of 1.0/10.0
3. Sources	1.0/10.0 out of 1.0/10.0
4. Design considerations	1.0/10.0 out of 1.0/10.0
5. Data and variables	0.5/10.0 out of 0.5/10.0
6. Procedure	2.0/10.0 out of 2.0/10.0
7. Calculations	2.0/10.0 out of 2.0/10.0
8. Summary	0.125/10.0 out of 0.5/10.0
9. Materials	0.5/10.0 out of 0.5/10.0
10. Analysis	0.25/10.0 out of 1.0/10.0
TOTAL	8.625/10.0 out of 10.0/10.0

PROBLEM 1)

1. P-v and T-s diagrams	0.8/9 out of 1/9
2. State calculations (7 of them – including 5a) For 6 -> Balance HX using 5a	3.42/9 out of 4/9
(Missing State 6, 6 out of 7 states correct)	
3. Efficiency and mass flow rate calculation w_out4-5, w_in1-2 (use isent eff or 5a), qin3-4	2/9 out of 2/9
4. New HX effectiveness	1/9 out of 1/9
5. Final results	1/9 out of 1/9
TOTAL	8.22/9 out of 9/9

PROBLEM 2)

1. P-v and T-s diagrams 1/9 out of 1/9
2. State calculations (8 of them – including 3a and 5a) 2/9 out of 4/9
Use 500 kJ/kg -> Compressor & Turbine
Cp and Cv are variable

(Missing states 3s and 5s, and state 3 and 5 are incorrect. 4 out of 8 correct)

3. Pressure (P5) 0/9 out of 1/9

(used inlet pressure instead of exit, incorrect)

4. Velocity (V6) Use h5a 1/9 out of 1/9
5. Thrust 1/9 out of 1/9
6. Final results 1/9 out of 1/9

TOTAL 6/9 out of 9/9

HW Grades)

1. HW 1.1 10/10
2. HW 1.2 9.5/10
3. HW 1.3 10/10
4. HW 1.4 9/10
5. HW 1.5 10/10

TOTAL 48.5/50

Total for the test

$$\left(\frac{48.5}{50} * 0.1\right) + \left(\frac{8.625}{10} * 0.1\right) + \left(\frac{8.22}{9} * 0.4\right) + \left(\frac{6}{9} * 0.4\right) = 0.8152 * 100 = 81.52$$

Reflecting on this test, I think I was prepared considering the complexity of the material. The problems were a test of knowledge and understanding of the concepts rather than just repeating the same formulas. There were a few things that I had to think about because I hadn't come across the situations in the homework of the lectures. A couple examples are the use of solar energy in problem one, and applying efficiencies to jet turbine compressor and turbine. This made me have to think about what was really happening since there was nothing I could look to in my notes or even the textbook. This sort of troubleshooting is great practice for the numerous challenges I may experience in the field one day. On the first page of the test, it says to try and think about what happening in the problem first rather than jumping straight to notes and practice problems for examples. I see now this is the most important advice to being successful when completing the test.