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MET 350 Thermal Applications CRN 33464

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Test 1 Reflections

Question 1

1)

For Test 1 Question 1, I was successful in demonstrating my understanding of thermodynamics laws related to gas turbines, specifically one that utilizes a Brayton Cycle. This is exemplified in my correct P-V and T-S diagrams, as well as my strategy of finding the missing temperatures at each state using the given pressures. From there, I understood that the Thermal Efficiency can be derived from the heat added to the system and the work done by the system

From there, I was satisfied to see that my choice to derive the Thermal Effectiveness by dividing the found temperatures. I believe that this demonstrates knowledge of the Second Law of Thermodynamics as a result. Finally, it was encouraging to see that Dr. Ayala found the Thermal Efficiency if the Heat Exchanger Operates at 100% by dividing the power output by the found net work.

2)

However, my major failing within the question was that I stated that the Thermal Efficiency (η_{System}) can be found by " $\eta_{\text{system}} = Q_{\text{in}} / W$ ". I now see that this is obviously backwards, and that the correct application of the principle would be " $\eta_{\text{system}} = W / Q_{\text{in}}$ ". Unfortunately, this caused my answer in Part A to be 76.95% instead of 40.9%.

For Part B, it is now apparent to me that my calculation for the Work Done by the System was thrown off by my choice to utilize " $C_p * (T_6 - T_1)$ " instead of " $C_p * (T_{5a} - T_2)$ " which then caused my calculation comparing it to the Power Output to be incorrect.

In summary, I need to ensure that the formulas on my approved formula page are correct and accurate. I believe that it would have been ethically wrong to double check formulas during the test, so I'm at least satisfied in that regard. However, it would benefit my ability to demonstrate my understanding of the overall concepts if I reported the formulas from the module correctly.

3)

From Problem Solution Rubric and Email Rubric;

PROBLEM 1)

1. P-v and T-s diagrams

1/9 out of 1/9

Grade: 0.9 / 1

Explanation: The provided P-V and T-S Diagrams were accurate with the question. Next time, provide the Q_{in} and Q_{out} arrows as well as the dotted lines at the end of the cycle

2. State calculations (7 of them – including 5a)

4/9 out of 4/9

For 6 -> Balance HX using 5a

Grade: 3.5 / 4

Explanation: The overall strategy Meets Standard and demonstrates an understanding of the concepts from Chapter 9. However, errors with the state equations " $N_{system} = Q_{in} / W$ " vs " $N_{system} = W / Q_{in}$ " resulted in incorrect answers

3. Efficiency and mass flow rate calculation

2/9 out of 2/9

w_{out4-5} , w_{in1-2} (use isent eff or 5a), q_{in3-4}

Grade: 1.5 / 2

Explanation: The overall strategy Meets Standard and demonstrates an understanding of the concepts from Chapter 9. However, errors with the state equations " $C_p * (T_6 - T_1)$ " instead of " $C_p * (T_{5a} - T_2)$ " resulted in incorrect answers

4. New HX effectiveness

1/9 out of 1/9

Grade: 0.5 / 1

Explanation: Using the given Power Output and work done by the system Meets Standard, but the final answer was incorrect due to issues with Part (a) and Part (b)

5. Final results

1/9 out of 1/9

Grade: 0.5 / 1

Explanation: The diagrams and problem solving strategy demonstrate an understanding of the course objectives but were hindered by calculation errors

TOTAL

6.9 out of 9/9

4)

a). During the test, I initially encountered an issue when attempting to find the work done by the system. When I referenced by approved formula page, I was reminded that Specific heat constant pressure (C_p) needed to be factored in

b). To complete the test, I focused on understanding the problem requirements as a whole and then addressing each part individually without being burdened by the following parts. For next time, I would ensure that my approved formula page is accurate

c). In this portion, I reinforced my learning of gas turbines that utilizes a Brayton Cycle and an application of the Second Law of Thermodynamics

d). In my work as an Engineering Technician for the Mack Truck production plant in Salem, VA, I can imagine that these concepts are heavily utilized for planning the HVAC needs in the coming expanded portion of the production plant or within the truck's A/C system design.

e). When I assist the Cab Assembly Line, questions about the A/C component can arise. A background knowledge of the laws and applications of thermodynamics will be indispensable

f). Yes, I believe that all knowledge will be important for a professional career. Even if one does not work with these types of parts or systems directly, one will still need to know the principles behind them to avoid unanticipated concerns

g). I believe that I will utilize these concepts in the future if I choose to work as a design engineer as opposed to a manufacturing engineer. Currently, I support both departments

h). Yes, I can apply these concepts to other courses, specifically my current Industrial Materials course. In that course, we will build a Thermoforming machine to manipulate LDPE plastic and knowledge of heat interactions in a closed system will be beneficial

i). I believe that I was most successful in my problem solving strategy. This is an improvement from my previous Thermodynamics course as the material in this section highlights the applications of the previous concepts

j). I believe that this course's content will intersect with many facets of engineering like part design engineering, facility engineering, or manufacturing engineering

k). I spent roughly 90 minutes to two hours on this test. My time was organized based on the production shift that I needed to support for that week. In the future, I would utilize my preparation time differently to ensure that the approved formula sheet that I bring to the test is optimal. In this way, I would prevent silly calculation mistakes that cost points

Question 2

1)

For Test 1 Question 2, I was able to show my knowledge of thermodynamics principles related Ideal Jet-Propulsion Cycles. Here, we were asked to find the pressure and velocity of combustion gasses at the turbine exit which also required a base understanding gas-turbine relations. I was satisfied once again to see that my posted P-V and T-S diagrams matched Dr. Ayala's analysis of the problem and that my problem solving strategy was on the right path

I see that my application of " $V_{\text{Nozzle}} = \sqrt{2 * (h_{\text{In}} - h_{\text{Exit}})}$ " and " $\text{Thrust} = m * (V - V_{\text{Nozzle}})$ " were also correct which is encouraging. I also see that my analysis of Specific Enthalpy's relationship to temperature and work provided an appropriate strategy

This test overall made me feel confident that I have internalized the course material correctly. Specifically, Chapter 9's description of Gas Power Cycles and their relation to Enthalpy

2).

My major error in judgement was with Part (a). I see that attempting to calculate the air density was unnecessary. In hindsight, I should have assumed that air was acting in an ideal state as this has been the standard for both Thermodynamics and Thermal Applications so far

My other major mistake was not realizing that the pressure at the exit (P_5) was the requested value and that I did not need to compare it to the density and temperature at the nozzle exit.

3).

From Problem Solution Rubric and Email Rubric;

PROBLEM 2)

1. P-v and T-s diagrams

1/9 out of 1/9

Grade: 0.9 / 1

Explanation: The provided P-V and T-S Diagrams were accurate with the question. Next time, provide the Q_{in} and Q_{out} arrows as well as the dotted lines at the end of the cycle

2. State calculations (8 of them – including 3a and 5a)

4/9 out of 4/9

Use 500 kJ/kg -> Compressor & Turbine

C_p and C_v are variable

Grade: 3 / 4

Explanation: While the strategy does utilize the concepts taught in the module, the process was incorrect compared to Dr. Ayala's work

3. Pressure (P_5)

1/9 out of 1/9

Grade: 0.5 / 1

Explanation: The value was reported via a comprehensible strategy and the correct units were reported in the answer

4. Velocity (V6) Use h5a

1/9 out of 1/9

Grade: 0.9 / 1

Explanation: The correct formula was utilized the find the answer but one of the found values was incorrect

5. Thrust

1/9 out of 1/9

Grade: 0.9 / 1

Explanation: The correct formula was utilized the find the answer but one of the found values was incorrect

6. Final results

1/9 out of 1/9

Grade: 0.9 / 1

Explanation: The strategy was comprehensible from a thermodynamics approach but some of the found values were unnecessary. Also, there was a calculation mistake with h_{in} Specific Enthalpy

TOTAL

7.1 out of 9

4)

a). During the test, I initially encountered an issue when judging the conditions that the aircraft would be operating. Specifically, if air density needed to be factored in due to the aircraft's altitude. I had background knowledge of these kinds of calculations so I was able to overcome it, but it was ultimately erroneous

b). To complete the test, I imagined the conditions in the system that I was asked to analyse and I was able to have a frame of reference when finding values, in other words a "sanity check"

c). In this portion, I reinforced my learning of Ideal Jet-propulsion Cycles and the properties of air under ideal conditions

d). In my work as an Engineering Technician for an automotive manufacturer, the relationship between temperature, thrust, and velocity is an imperative concept to understand.

e). When I assist the Chassis and Final Assembly Line, cooling systems and Thrust Angle defects are commonly noted. These concepts will transfer to my professional problem solving in these areas

f). Yes, I believe that all knowledge will be important for a professional career. These concepts like heat, velocity, and thrust and important in almost all Mechanical Engineering fields

g). I believe that I will utilize these concepts in the future if I choose to work as a design engineer as opposed to a manufacturing engineer. Currently, I support both departments

h). Yes, I can apply these concepts to other courses, specifically, anything that concerns forces applied to objects like Dynamics or Strength of Materials

i). I believe that I was most successful in my problem solving strategy. This is an improvement from my homework answers and it reinforces important Gas Power Cycle concepts

j). I believe that this courses content will intersect with many facets of engineering like part design engineering, facility engineering, or manufacturing engineering

k). I spent roughly 90 minutes to two hours on this test. My time was organized based on the production shift that I needed to support for that week. In the future, I would utilize my preparation time differently to ensure that the approved formula sheet that I bring to the test is optimal. In this way, I would prevent silly calculation mistakes that cost points