ME 322 – Mechanical Engineering Thermodynamics
EES Exam 2
Spring 2024

This is a non-collaborative take-home exam. Submit your own work.

Please read the following statement:

Article II, Section 1 of the University of Idaho Student Code of Conduct states,

> *Cheating on classroom or outside assignments, examinations, or tests is a violation of this code. Plagiarism, falsification of academic records, and the acquisition or use of test materials without faculty authorization are considered forms of academic dishonesty and, as such, are violations of this code. Because academic honesty and integrity are core values at a university, the faculty finds that even one incident of academic dishonesty seriously and critically endangers the essential operation of the university and may merit expulsion.*

EXAM INSTRUCTIONS – PLEASE READ THIS CAREFULLY

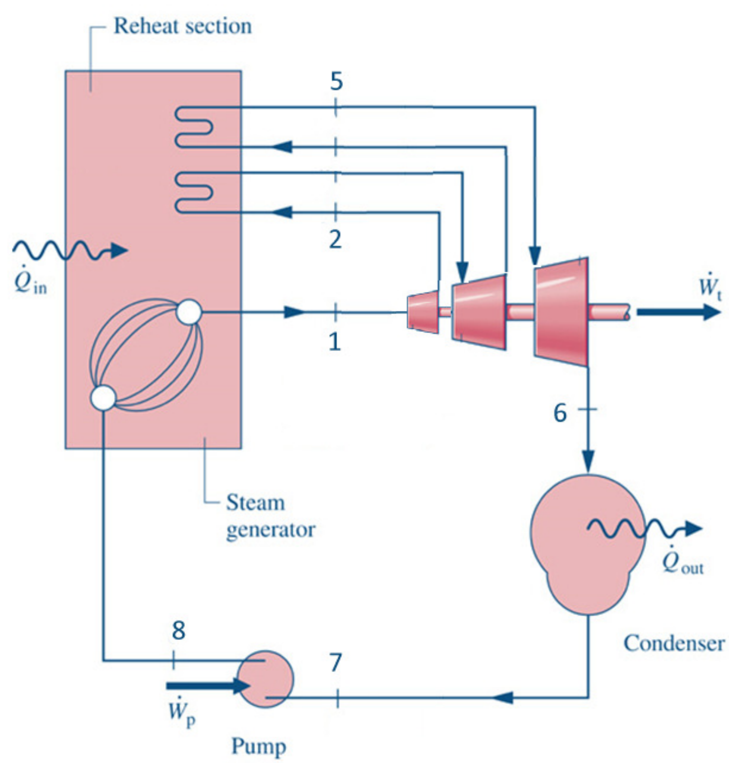
You will have several days to complete this exam. You may use your notes, the online course resources, your computer (EES, Google, etc.) and pretty much any non-human resource you can find. You are not allowed to collaborate with other students/engineers on the exam. However, if you have a strong need to collaborate with others on this exam, you may discuss the exam at great lengths with anyone currently pursuing a humanities degree at the UI.

There will be minimal partial credit for this exam. Either you get the answer (within reasonable rounding error), or you don't. Take your time. Validate your answers with some back-of-the-envelope calculations. Make sure your answers make sense.

You may want to compare your results from Homework 25 (a steam plant with nearly identical parameters, but only one reheat section). Should a steam plant (making the same net power output) with two reheat loops be more or less efficient than a plant with just one?

This is a 100 point exam

A steam power cycle that incorporates two reheat legs is shown in the figure above. Steam from the boiler enters the first turbine stage at 1600 psia and 1100 °F. The steam leaves the first turbine stage at P[2] and then enters the reheat section of the boiler where it is reheated back to 900 °F (assume no pressure drop). The steam then enters the second turbine stage, and leaves at P[4] to a second reheat where it increases temperature to 750 °F. It enters the third turbine stage where it expands to 1 psia. The working fluid is a saturated liquid at 1 psia when it leaves the condenser. Each stage of the turbine has an isentropic efficiency of 85% and the pump has an isentropic efficiency of 90%. The net power output of the cycle is 220 MW.



You will build a parametric table that explores ranges for **both** P[2] and P[4] as a means to maximize plant efficiency. These ranges should be:

- P[2] from 225 psia to 125 psia in increments of 25 psia (5 values)
- P[4] from 100 psi to 20 psia in increments of 20 psia (5 values).

To explore all possibilities, you will have a parametric table that has 25 runs in it. From this analysis, you should be able to determine values of P[2] and P[4] for optimal net cycle efficiency?

Turn In

Submit to Canvas a PDF made directly from EES. That PDF needs to have the following:

- Equations
- Solution
  - Once you've solved for the optimal P[2] and P[4], use those values as the inputs for your code and run it again (so that the solutions window and array table show values at the optimal P[2] and P[4].
  - Make sure you don't have any unit errors
  - Assign Key Variables to: P[2], P[4], and net thermal efficiency (showing at least 5 sig figs)
- Arrays (should show you state values at optimal P[2] and P[4])
- Parametric Table (showing all 25 combinations of P[2] and P[4])