

MECE3260U-INTRODUCTION TO ENERGY SYSTEMS
COURSE PROJECT 2
ENERGY SYSTEM ANALYSIS AND ASSESSMENT

Assignment Date: Saturday, 31 October 2020
Due Date: Monday, 30 November 2020 by 5pm.

Project Description

As an energy engineer, you are requested to design a hybrid energy system, based on your midterm energy system, as shown in the figure to serve your community to cover the needs for electricity, heat and hot water. You are flexible to identify the loads/capacities in this regard. The renewable heat (Q_R) should come from either a solar subsystem or a geothermal subsystem. You are free to size these subsystems accordingly. For the combustion chamber each of you need to consider a different fuel (note that H_2 , NH_3 and CH_4 are not acceptable). For combustion, the reactants come in at $25^\circ C$ while the products leave at $995^\circ C$ which can also be treated as the source temperature. The fuel selected is burned in the combustion chamber with 70% excess air. A 15% of the mass flowrate is extracted from high-pressure turbine into the process heater. The turbine and pumps have an isentropic efficiency of 85%.

You are expected to do the following:

- Draw a complete layout of your designed system
- Draw a T-s diagram of the entire system to show all data points/states
- Write all mass, energy, entropy and exergy balance equations for each component of the system
- Calculate all exergy destructions for all components (including combustion chamber) and explain how to reduce these
- Calculate both overall energy and exergy efficiencies
- Discuss the results
- Link efficiency to environmental and sustainability development and discuss in brief

The report should be organized as follows:

- 1) Summary (present the content of project and its brief results)
- 2) Introduction (highlight the importance of the topic, present some background about the system, and state the specific objectives)
- 3) System Description (describe the design developed/selected, and system(s) and system(s) components, with the flow diagrams and/or sketches, etc.)
- 4) Analysis (present the theory, concepts, balance equations, assumptions, models, etc.)
- 5) Results and Discussion (present your results in graphs and tables and their discussion in detail)
- 6) Conclusions (state main findings of your project)
- 7) Acknowledgement (if applicable)
- 8) Nomenclature (list all symbols used in your report, with the corresponding SI units)
- 9) References (list all references used correctly and completely)

Remarks:

- Use the following overall efficiency relations: $\eta_{en} = \frac{W_{turb} + \dot{Q}_{heat} + \dot{Q}_{con}}{\dot{E}_{in}}$ and $\eta_{ex} = \frac{W_{turb} + Ex_{heat} + Ex_{con}}{Ex_{in}}$
- For the state points and properties, you are free to make conceptually correct assumptions.
- No tolerance will be given to any kind of misconduct/cheating.
- The final report will be submitted through Turnitin via Canvas.
- There is no page limit.

