Project 1:
Group Project

Date Assigned:	Thursday, September 1, 2022
Presentation in Class:	Thursday, September 15, 2002 – Preliminary Design
	Thursday, September 29, 2022 – Final Design
Due Date:	Thursday, September 29, 2022, 11:59 pm Abu Dhabi Time (upload to BrightSpace)

Design of a Heat Exchanger

Problem Statement:

- Consider Ethylene Glycol 50:50 (50% diluted with deionized water) used as a coolant for an automobile engine. It exits the engine at 90 ^{o}C and has to be cooled to 60 ^{o}C. The mass flow of the coolant is 1.2 kg/s.
- The cooling fluid is ambient air. For the design conditions take ambient air temperature to be 30 ^{o}C. Any mass flow rate of the air can be considered by selecting a proper fan.
- In the design consider typical fouling on the Glycol side only.
- Justify all assumptions you make for the thermal design.
- In your design you do not have to consider the design of the flow inlet and outlet headers of the heat exchanger.

Procedure:

- Select an appropriate geometry and configuration. Select key sizes (for pipes, etc., select standard available dimensions as appropriate).
- Find the heat transfer coefficients using appropriate correlations and find overall heat transfer coefficient.
- Find the remainder of the parameters for the heat exchanger.
- Write the specification sheet of the heat exchanger you have designed.
- Analyze off-design performance. For the same mass flow and inlet temperature of the Ethylene Glycol, what will the outlet temperature be if the air is available at 40 ^{o}C, 50 ^{o}C, 20 ^{o}C, and 10 ^{o}C? How will the effectiveness change?

Project Report:

Prepare a professional report that presents the following.

- The problem statement.
- The selection and justification of the preliminary design and flow parameters.

- The computation of heat transfer properties and parameters.
- The computation of the size and operating parameters of the heat exchanger.
- The final design.
- The final specifications of the heat exchanger (Manufacturer's spec sheet).
- The schematic drawing of the heat exchanger.
- Discussion of off-design performance of the designed heat exchanger if ambient air is available in the range of 10 ^{o}C and 50 ^{o}C.
- Qualitative discussion of pressure drops and pumping power.
- Identify the appropriate codes and standards related to your application and design, and discuss how your design complies with those.
- The report must be professionally prepared and presented, with proper sections, high quality graphics and illustrations, citations of sources consulted, etc.

Presentations:

Thursday, September 15: Prepare a short professional presentation for the class (max 10 minutes per group):

- Preliminary design concept: the type of heat exchanger, the layout, justification why you chose this particular configuration over other choices (e.g., cost, simplicity, compact form, robust, rugged, ease of operation and maintenance, minimal maintenance, effectiveness, comparatively better off-design performance, etc.; single criterion or multiple criteria – your informed decision)
- Preliminary calculations of mass flow rates, inlet and outlet temperatures, heat transfer coefficients, heat transfer area, LMTD, effectiveness.
- Off-design performance.

Thursday, September 29: Prepare a short professional presentation for the class (max 10 minutes per group):

- Final design. Justify your choices, and indicate how and why the design changed from the preliminary concept to the final design.
- Final specs in terms of mass flow rates, inlet and outlet temperatures, overall heat transfer coefficient, heat transfer area, LMTD, NTU, effectiveness.
- Applicable codes and standards, and their relationship to your final design.
- Off-design performance.

Select References:

https://ahtt.mit.edu/wp-content/uploads/2019/08/AHTTv500.pdf Textbook by Prof. Lienhard of MIT and his father Prof. Lienhard of University of Houston.

https://windyhm.files.wordpress.com/2008/11/fundamentals-of-heat-exchanger-design-0471321710.pdf Textbook by Prof. Ramesh Shah of General Motors, a leading authority on heat exchanger design.

Air Cooled Heat Exchangers (PTC 30) ASME Codes and Standards (available in library).

Single Phase Heat Exchangers (PTC 12.5) ASME Codes and Standards (available in library).

ASTM Codes and Standards for Ethylene Glycol (posted on BrightSpace).