**MEC514 Design Project F2018**

**Design a Power Plant**

**Introduction**

In your lab/project group of 4 or 5 students, you will be responsible for an Applied Thermodynamics design project. Since you have only four labs in this course, it is encouraged that you hold meetings during your lab timeslots when labs do not occur. A significant amount of meeting outside of these lab hours is also expected.

**Project Components**

The design project has three components that are to be handed in on the dates and times specified below. This project is worth 25% of your final mark.

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| **Component** | **Item Due** | **Due** | **Weighting** |
| 1 | Planning Meeting Report | **3PM Friday, Oct 4, 2019** | 5% |
| 2 | Progress Report | **3PM Friday, Nov 8, 2019** | 20% |
| 3 | Final Report | **3PM Friday, Nov 29, 2019** | 75% |

The lab report should be submitted, in hard copy, in the professor’s dropbox in EPH. You must notify the professor of any late submissions; they will be penalized 10% per business day. (i.e., a component handed in after 3PM on the due date but before 3PM on the following business day will be penalized 10%.)

In addition to the three graded components, each group member must track and record a list of all tasks that they have performed and what their contributions to each report were. Include specific sections and be specific as to what your contribution was (drawing, drafting, editing, etc.). A group member may contribute less to one component and more to another as long as the overall work distribution is fair. Your list should be in point-form and should be 2 pages or less. It will be included as an appendix in the final report only. Each group member must prepare their own list, however, before the final report is handed in, the group should meet to make sure there is no overlap on the lists (i.e. two group members do not both claim *sole* responsibility for a task). At the instructor’s discretion, if work distribution is perceived to be unfair, the members of a group may not receive the same grade on the final report.

Component #1: Planning Meeting Report

The first component of the design project is the planning meeting report, to be submitted by 3PM on Friday, **October 4, 2019**. The report will be 4 pages or less and will be professional in its appearance. Based on your discussions, your planning meeting report should include the following information:

1. Background information and literature review: In the research and information gathering phase of the project, what areas of further background information are needed? who will perform what tasks in the gathering of that information? and what resources will be exploited?
2. Report Components and Goals: What information do you hope to convey to the reader of your final report? What recommendations do you hope to be able to make in the report? For the conveying of each of these pieces of information and recommendations, what formats (graphs, tables, etc.) will you utilize.
3. Table of Contents: Propose a table of contents for your final report. List the major sections of the report, and for each major section, include a description of what that section will contain and a list of any subsections that might be included. One of the sections must be titled “Background information and literature review”.
4. Tasks and Timeline: Describe which tasks each group member will perform individually throughout the duration of the project. Describe which tasks will be performed jointly with two or more group members throughout the project. Include a timeline for performing each of these tasks. Be sure to include a comprehensive list of tasks and duties including everything from scheduling meetings, to drawing schematics, to printing.

The grading criteria for the planning report will include completeness, clarity, language, how realistic the plan is, and style. Throughout the term, some deviations from your original plan are to be expected.

Component #2: Progress Report

The second component of the design project is the progress report, to be submitted by 3PM on Friday, **November 8, 2019**. The report will be 10 pages or less, plus an appendix for item #7, and will be professional in its appearance. Your progress report should include the following information:

1. A complete description of all project tasks and duties performed by each individual to date.
2. A draft of the “Background information and literature review” section.
3. An updated version of the “Report Components and Goals” from your planning meeting report. How have these components and goals changed in the course of your project so far?
4. An updated version of the Table of Contents, including indication of which sections have been partially or completely written already.
5. The tasks and timeline for the remainder of the project: Describe which tasks each group member will perform individually throughout the remainder of the project. Describe which tasks will be performed jointly with two or more group members throughout the remainder of the project. Include a timeline for performing each of these remaining tasks.
6. An explanation for any significant deviations from the planning meeting report. (Note that you will not be penalized for deviations from the planning meeting report. Some are expected. The purpose of the planning meeting report was not to set out an exact roadmap to complete the project, but rather to describe what you thought was a realistic roadmap.)
7. Any components of the final report that have already been drafted, such as written work, diagrams, graphs, tables, etc. (this section does not count in the 10-page limit).

Component #3: Final Report

The third and final component of the design project is the final report, to be submitted before 3PM on Friday, **November 29, 2019**. The report must be professional in its appearance. The final report should more or less follow your table of contents, with the following recommendations/requirements:

1. You must include a section on Background information and literature review.
2. Any significant deviations from what you proposed to do in your planning meeting report and progress report should be explained in a preface.
3. The last appendix of the final report must contain the point form lists of tasks completed by each group member.

**Evaluation**

Your evaluation will be based on design completeness, report quality, adherence to constraints, the making of realistic assumptions, ingenuity, written report quality (style, grammar, etc.), and the value of the information contained in the report from the point of view of an industry professional.

**Problem Description**

You are tasked with designing a power plant that will utilize a vapour power cycle with H2O as the working fluid. The cycle should be based loosely on the Rankine cycle and should contain the four principal components of at least one boiler, at least one turbine, at least one condenser, and at least one pump. Design modifications to the cycle are a key component of the task.

The system constraints and additional components are to be selected based on a set of design constraints established from initial research and literature review by the students. Critical thinking and engineering design principles must be used to develop a system which can adequately provide power to the assigned community. Reasoning and rationale behind the selection of parameters and components must be clearly communicated.

Two heating sources are available: Fuel (coal/wood pellets) and a geothermal source. There exists geothermal hot water, which is available at P2, and 180°C, and at a maximum flow rate of MDOT2. Heat exchangers are available in which the geothermal water enters the heat exchanger at 180°C and must exit it between 40°C and 175°C. The heat exchanger efficiency is a function of the exit temperature according to the graph below:

Values for population size, P2, MDOT2, are on the next page and are different for each group. The heat exchanger efficiency is defined as , where is the rate at which heat is absorbed by the cold water, and is the heat outputted by the geothermal water. The cost per unit of heat extracted from the geothermal source is roughly 1.5 that of the heat extracted from the fuel. Design a power plant that somehow utilizes the geothermal heat source in addition to the fuel.

In addition to completing and portraying a complete design of the power plant, including diagrams, lists of assumptions, and operating conditions calculations, you may wish to consider or address any of the following: environmental concerns, economic concerns, and/or optimization recommendations.