

MEMS 412 – DESIGN OF THERMAL SYSTEMS
Washington University in St. Louis

GROUP DESIGN PROJECT

Overview: This class involves a final group design project. The goal is to design a thermal system, or a sub-component of a thermal system. The project will be carried out in groups of 3-4 students. Student teams will be able to choose their own topics.

Possible Topics: These topics are meant to be a guideline for possible topics. Please feel free to choose different ones! Please note that if you choose a topic that is similar to one of our regular design homework assignments, I expect significantly more effort and complexity for this group project!

- Ground-coupled heat pump for residential or commercial buildings
- Large-scale refrigeration for supermarkets (e.g. open shelves)
- Domestic refrigerator design
- Ice skating rink
- Personal ice maker
- Domestic waste heat recovery
- Wind-powered residential heating system
- Solar thermal power plant
- Ocean thermal energy conversion power plant
- School building space-conditioning system with air-to-air heat recovery
- Waste-to-energy power plant design
- Jet engine for commercial airplane
- Jet engine for military airplanes
- Propulsion system for a ship
- IC engine for a car
- IC engine for an off-road, heavy duty vehicle (dust!)
- ...

Content and grading: The design project should include (at a minimum) the items below. Grading will be based on the completeness of these items (similar to the grading rubrics from the design homework problems), but will additionally take into account content and its correctness, as well as language, grammar, style, etc.

- **Introduction**, why the topic was chosen, and why it is important
- Short **literature review** of existing cycles, approaches, state of the art, etc. (can combine with introduction)
- Clear statement of **boundary conditions** (e.g., which applications, size restrictions, environmental conditions, cost, legal restrictions, etc.) **and assumptions**
- Original **layout**, T-S and p-v **diagrams**, where applicable, combustion analysis and formulas (i.e., no one-to-one copying from literature)

- Analysis and optimization (choose few parameters to optimize, for example: mass flow, heat input, temperatures and pressure levels, working fluid/fuel, etc);
- show at least **2-3 diagrams** for your optimization, and discuss them (what did you optimize for? Efficiency, cost, environmental impact, size, etc, and what was the best solution and why?)
- please include the Matlab script (or the computer language of your choice) in the Appendix, i.e. in addition to the number of pages you need to write for the report
- Conclusion, **including short financial and environmental impact analysis**
- **References**

Note: If you are familiar with heat transfer or fluid dynamic calculations, please feel free to include those to estimate heat transfer rates, pressure losses, pumping power, etc., as applicable!

Schedule: **03/03:** One (1) page abstract, explaining the topic and what you intend to do
 by 03/08: I will read the abstracts and send feedback
 03/17: Revised abstract due (if requested)
 04/16, 04/21, 04/23: In-class poster presentations (bring hard copy to class)
 04/24: Final project report due

Report: The final project report will be **15-16 pages for groups of 4 students**, and **11-12 pages for groups of 3 students**, Times New Roman font 12, 1.5 space. I will deduct points for reports that are longer than these 15-16 (11-12) pages (except for the appendix with the script; figures, plots, etc., are part of the regular page limit).

Poster: Every team will prepare and present a **poster during the last 3 lectures of the semester**. Poster sizes should not exceed 2' x 3' (orientation doesn't matter). Please make sure to have your **group-# and your names** on the poster (there will be point deduction if you do not have this or don't adhere to the size requirement). You should upload your poster to canvas for grading, and also **bring a hard copy of the poster** the day of your presentation (the schedule will be posted on canvas 1-2 weeks prior to the poster sessions). Posters should include the most important references/sources. Also, pay attention to the amount of text vs. figures & images (less text is usually better), the font size, etc. (these are all things you will be graded on). The internet is a good resource if you are unsure on how to best prepare and present a poster.

The team with the best poster/day (as voted for by your peers) will receive **2% extra credit** on the overall final grade (and yes: you can vote for yourself. In case of a tie, I will make the final decision)!

Note: If you are not presenting on a particular day, you are nonetheless expected to attend the poster session, support your peers, learn and ask questions, and vote for "best poster".