

MEEG346 Thermal Laboratory

Spring 2019

INSTRUCTOR

S. D. Harris

(sdharris@Udel.edu)

330 Spencer Lab

Office Hours: Monday 12-3

Graduate TA

Undergraduate TA's

Prescott Weishaar

Rachel Silverman

Caroline Kook

Jaclyn Ulvila

Olivia Powell

Objectives

- To illustrate physical concepts of Heat Transfer (MEEG342) and Thermodynamics developed in class.
- To learn basic experimental methods for thermal systems.
- To utilize experimental results as a basis for practical design.
- To develop the ability for teamwork.
- To develop effective communication of technical information.
- To develop computer skills for acquiring data, data reduction, error analysis, and plotting.

Experiments

Students working in teams of 3-5 will study a total of six experimental problems (once every other week for an individual) during the semester. Each team will acquire a common set of data for a particular experiment, and each team will submit a single report.

Students must study the lab handout thoroughly before arriving at the lab session. The TA's job is not to do the experiment for you. Instead, the TA will familiarize you with the

equipment and software. You will need to decide for yourself, how best to collect the data to answer the questions posed in the handout. Of course some hints will be provided to get you on your way. The TA will use his/her judgment to determine at what point a group is ready to proceed on its own.

Experiments will be performed in either Spencer 123 or the Campus Power House. Location will be announced.

List of experiments:

- X1 Heat transfer coefficients
- X2 Heat Exchangers
- X3 UDel Power House – HX / Boilers
- X4 Conduction Heat Transfer
- X5 Convection/Radiation
- X6 UDel Chiller Plant – Vapor Compression cycle

Instructions for each lab can be obtained on Course Canvas site

Students will be assigned to a team. Your team will meet approximately every other week at the lab time for which the student enrolled. The detailed schedule for team lab dates and corresponding experiment will be posted.

Lab Report

Each team will turn in a single report for each experiment, with all team members receiving the same grade. Assume the point of view that you are reporting experimental and analytical results to your employer or client, who will use the information to design a new product, or to more effectively operate a plant or business.

Reports must be printed hardcopy. Reports should be concise, but complete. More than about five pages (excluding cover page & appended data sheets) is getting long. Use your own words; verbatim copying of the instructions should be avoided, with exception of the Objectives. Do not pad the length of a report unnecessarily. We grade on merit and content, not weight.

NOTE: The Lab Instructions may modify this outline, omitting or modifying some items.

The following outline is general. While all items should be included, you may vary the order and details, always keeping in mind the goal of communicating important results simply and clearly. While not omitting, tedious details may be placed in appendices.

- Title Page
 - Title of Experiment
 - Group ID e.g., Section 20L Team A1

Names of group members and role in this experiment

Date experiment was performed

Date report submitted

- Objectives (will be provided in lab handout)
- Summary
 - Briefly summarize results, in the format of a business letter from engineering consultants to a client
- Theoretical background
 - What principle(s) underlie this experiment, e.g., Fluid statics, Bernoulli's law, conservation of momentum...
 - Relevant equations – usually the one used to reduce the data
 - You should not copy or paraphrase the lengthy Theory section of the lab instructions.
- Equipment
 - Include a neat schematic diagram with all parts labeled and dimensioned. **(Photographs are acceptable, provided they are captioned and key parts label).**
 - Show or describe measurement devices and instruments
 - Copying sections of another report or sharing sketches with other groups is **not** permitted.
 - .Define of all symbols used, including dimensional units.
- Procedure
 - For each objective in a given experiment:
 - Procedure
 - Parameters varied and range of variation
 - Again, do not copy lab instructions. Use your own words and shorten.
- Results
 - Key data should be rearranged in tabular form. A completely worked-out sample calculation is required for repetitive calculations.
 - Use MS Excel, MathCad (or any other spreadsheet program) for tabulation and plotting graphs.
 - All graphs must have a caption (what is it?), axes must be labeled, and symbols defined.
- Uncertainty analysis as specified in the lab instructions.
 - Suggest ways to reduce uncertainty in the final result.
- Discussion and Conclusions (Counts as one section)
 - For example:
 - Did the apparatus deliver the results intended.
 - What discrepancies did you see between theory and experiment?
 - If the apparatus malfunctioned or is suspect, say so.
 - Is the data reliable enough for a client to base new design or plant operations on it?
 - What could be done to improve or increase confidence in the results?
- Design Objective
- Appendices
 - At a minimum this should be your raw (handwritten) data sheets.

It could also be intermediate tables of calculations that would clutter your main report.

Ethical Behavior

Please read and understand the Office of Judicial Affairs Quick Reference Guide to Academic Integrity <http://www.udel.edu/judicialaffairs/ai.html>

In particular, please pay close attention to PROACTIVE STRATEGIES FOR STUDENTS <http://www.udel.edu/judicialaffairs/ai.html#stustrat> and ABOUT THE INTERNET <http://www.udel.edu/judicialaffairs/ai.html#internet> . These documents will help you to overcome any misunderstandings of what constitutes unethical behavior. The proper and ethical use of external resources such as the internet is also clearly defined.

Lab Strategy

Time in the lab is limited and will pass quickly. Before arriving at the lab session, students must study the lab handout and be familiar with the phenomena they will investigate and the procedure to do so. Such preparation will make for smoother and more fruitful lab experience.

At the beginning of the lab each team will be asked to sign up for responsibility for the lab work and report. This is a personal commitment to your fellow team members. Agreeing up front will make the whole process easier. Roles may be team leader, data recorder(s), analyst(s), sections of the report, etc. It is intended that roles be varied for each experiment, so that everyone tries every task.

IMPORTANT – Actual operation of the lab apparatus typically requires only three people, out of five or six. The people not actively operating the equipment must (1) pay attention to what data is being taken and double-check accuracy. (2) Begin work on the Design Objective. Although the Design problem of uses your data, you should set up the analysis in general form, and ask the TA any questions.

A key outcome of the pre-lab preparation is an experimental **data-sheet** listing all of the quantities that will be measured (and how many times) for each experiment objective. The row and column headings will prove that adequate thought has gone into planning the experimental procedure. Please obtain the **TA's signature** on this data-sheet as soon as you arrive at the lab. The TA may conduct a short quiz before the experiment to measure your level of preparedness.

Grading of Reports

Simply following and fulfilling basic requirements listed above (All sections included, neatness, professionalism, and on-time reporting are key) will fetch you an automatic 5 points on a scale on a scale of 10. The remaining points will be awarded on the basis of

merit including the organization of thoughts, good grammar, correct computations, excellence of analysis, and response to Design Objectives.

Lab reports are due no later than **two weeks** after performing the experiment, approximately on or before the next experiment for the particular team. Late reports will be penalized, 0.5 points for every late day. Lab attendance is absolutely necessary. An unexcused absence will cause a deduction of 0.5 points from the lab report (for the absent individual, not the team). Grading concerns should be addressed to the TA's.

Evaluation

Lab report grades for each team will be averaged. Course grade will be based on the average and adjusted for each individual by quiz score according the following schedule:

93+	A
90	A-
87	B+
83	B
80	B-
77	C+
73	C
70	C-
67	D+
63	D
60	D-
<60	F

Generally, all members of the team will receive the same grade on a report. Exceptions may occur because of an unexcused absence, attendance at Wed discussion lectures, etc.

.