

Syllabus
MSE 307: Materials Laboratory-I
Fall 2021

Instructors: Jessica TerBush, 207 Ceramics, 217-300-9924, jterbush@illinois.edu

Lecture: 1:00 PM – 1:50 PM, Mondays & Wednesdays

119 MSEB for FIRST CLASS ONLY

122 Kiln House for ALL SUBSEQUENT CLASSES

Office Hours: 1:00 PM – 2:00 PM Tuesdays & Thursdays, or by appointment

Laboratory: 2:00 PM – 5:00 PM (M-F) – 105-108 Kiln House

Course Objectives:

- 1) To learn the basic skills required to properly use materials science instruments;
- 2) To learn the principles of materials science and engineering through lab investigation;
- 3) To learn to organize the lab results into logic, concise and accurate reports.
- 4) To develop writing and communications skills for effective presentation of technical materials.

Text: Handouts for individual experiments.

On reserve in Grainger: “A Guide to Writing as an Engineer”, Beer and McMurrey, 4th Edition. (Not required, but available for reference.)

Website for course materials: <https://canvas.illinois.edu> and CampusWire site for Q&A

Course Outline:

- | | |
|--|------|
| 1. Thermal Stresses and strains (TS) | 2 Wk |
| 2. Thermoelectric Energy Conversion (TEC) | 2 Wk |
| 3. Phase Equilibria: Optical Microscopy (OM) | 2 Wk |
| 4. Absorption and Humidity (AH) | 2 Wk |
| 5. Pyrometry (PY) | 2 Wk |
| 6. Differential Scanning Calorimetry (DSC) | 2 Wk |

Schedule: Fall 2021

Students will be divided into three groups (A, B, or C), and only need to attend the discussions for their group. Group assignments as of x/yy/21 are posted on Canvas.

Week	Group A	Group B	Group C	Week	Monday	Wednesday
1	TEC1	OM1	TS1	8/23 – 8/27	Intro	TEC-Disc-A
2	TEC2	OM2	TS2	8/30-9/3	OM -Disc-B	TS -Disc-C
3	TS1*	TEC1*	OM1*	9/6-9/10	Labor Day*	TEC-Disc-B
4	TS2	TEC2	OM2	9/13-9/17	OM-Disc-C	TS-Disc-A
5	OM1	TS1	TEC1	9/20-9/24	TEC- Disc-C	OM-Disc-A
6	OM2	TS2	TEC2	9/27-10/1	TS- Disc-B	Tech Writ-A
7	Break	Break	Break	10/4-10/8	Tech Writ-B	Tech Writ-C
8	PY1	AH1	DSC1	10/11-10/15	PY-Disc-A	AH-Disc-B
9	PY2	AH2	DSC2	10/18-10/22	DSC-Disc-C	Present-A
10	AH1	DSC1	PY1	10/25-10/29	DSC-Disc-B	PY-Disc-C
11	AH2	DSC2	PY2	11/1-11/5	AH- Disc-A	Present-C
12	DSC1	PY1	AH1	11/8-11/12	AH-Disc-C	DSC-Disc-A
13	DSC2	PY2	AH2	11/15-11/19	PY-Disc-B	Present-B
14	Fall Break	Fall Break	Fall Break	11/22-11/26	No Lecture	No Lecture
15	Presentation	Presentation	Presentation	11/29-12/3	Presentation	Presentation
16	Presentation	Presentation	Presentation	12/6-12/8	Presentation	Presentation

**Students in the Monday group need to join one of the other groups on T-F for the week of Labor Day*

Teaching Assistants:

Sushant Mahat (smahat2@illinois.edu)

Junehu Park (junehup2@illinois.edu)

Akash Rai (akashrai@illinois.edu)

Undergraduate Assistants

TBD

Lab Manager: Nicole Robards

nrobards@illinois.edu

212 Ceramics (4-7498)

Grading Policies and Procedures:

1. Each student will submit **five (5) individually written reports** during the course of the semester and also will make **an oral presentation** at the end of the semester.
 - **Two** of the reports are formal **Long** reports, **one** of which will have a rewrite opportunity.
 - **Three** are **Short** reports;
2. An **electronic version** of each lab report will be submitted in MSWord or PDF format to the Canvas course website.
3. The reports are due **exactly at 2:00 PM** in the lab, **one week after** the experiment is finished. Any excuses must be presented to the instructor in writing **before** the due date of the report, and only then will the excuse be considered.
4. **All unexcused late reports will be penalized.** Typical penalty is 10% deduction for reports submitted within 24 hours of deadline, but may be higher for reports submitted after this.
5. Each report will be graded using a standard checklist for a total of **100 points**.
 - 30% of which is allocated to the writing (organization, format, grammar, spelling, sentence construction, style and illustration).
 - 70% is allocated to the technical content (concepts, data analysis, interpretation and understanding).
6. Each student is required to maintain a **lab notebook**. The notebook must be **signed and dated** by the TA at the end of each lab to indicate that the student has completed the lab. The student then needs to scan the signed page and submit it to Compass to receive the credit for completing the lab. Completing all 6 labs will add **20%** toward the final grade; however, missing one lab will result in an **incomplete** grade until made up.
 - Students in the online section will not be submitting signatures; instead, they should submit a screenshot from their Zoom lab session (if applicable).
7. Everyone is required to make a **15-minute presentation** on the Pyrometry lab. The presentation will be followed by 5-minute questions and answers (Q&A). The presentation will be graded on completion of lab requirements (40%), data analysis (30%), clarity of presentation (15%) and Q&A (15%). The presentations will be held during the last two weeks of the semester. Signup sheets will be posted for scheduling individual presentations.
8. Each lab will have a **pre-lab quiz**, which must be completed online (on the Canvas course website) before the start of the lab. The quizzes will contribute 5% toward the final grade.
9. The final grade will be calculated as following: **60%** from the 5 lab reports (**10%** for each short lab report, **15%** for each long report), **20%** for completing all 6 labs (signatures), **15%** from the presentation, and **5%** from the 6 pre-lab quizzes.
10. Everyone will have the opportunity to **rewrite** the report for the **OM** lab. Rewrites will be due at **11:59 PM on 12/3**. The grade of the initial report will count 40%, while the grade of the rewritten report will add 60% toward the final grade for the OM lab report. A copy of the original report must be submitted with the rewrite.
11. **Final letter grades** will be awarded depending on the **class average** and the **relative performance** of the individuals. Overall, scores **less than 50%** are a **failing grade**.

Penalties:

- **Copying or Sharing:** 25 - 50% penalty for **copying** or **sharing** any part of the individual report
- **Plagiarism:** As per the University Code of Policies and Regulations, the instructor may impose one or more of the following penalties **depending on the severity** of the infraction:
 - A reduced grade for the lab report
 - A "0" for the lab report
 - A reduced grade for the course
 - A failing grade for the course
 - Recommend to the head of the department that the student be suspended or dismissed from the University

Laboratory Rules and Regulations:

A) Safety:

- 1) Always use appropriate **safety equipment** and follow proper **safety procedures**
- 2) Always bring your **own Safety Glasses** and wear them during the lab period (**Safety glasses will not be provided for you! No exceptions**)
- 3) Always **wear proper attire** (shirt, **long pants or ankle-length skirt** and **closed toe shoes**) and **face mask** (if not fully vaccinated). Face masks are optional for fully vaccinated individuals, per CDC guidelines.
- 4) **Long hair?** Properly **contain it** so that it will not be hazardous to you and to your fellow classmates and will not damage the very sensitive equipment in the labs
- 5) Inside the labs, **ABSOLUTELY NO:**
 - **Food or drink**
 - **Roller Skates/Blades**
 - **Game playing** (of any sort, particularly on the computers)
- 6) Anyone caught **violating** the above **laboratory rules:**
 - Will be **expelled** from the lab
 - **No compensating lab time** will be given to complete the experiment(s) and
 - Will **not be allowed** back into the labs without a letter from the Head of the Materials Science and Engineering department.
- 7) **Online Lab Safety Training:** Everyone is required to complete the online lab safety training at the DRS website before **finishing** the first lab. You can complete the training at the following website: <http://www.drs.illinois.edu> – select “Laboratory Safety” from the dropdown menu.
After you finish the training, submit a copy of your certificate to Canvas. Must be completed within the **first two weeks of class**.

B) **General:**

- Arrive at the lab (**105-108 Kiln House**) a few minutes before the start of each lab; TA has the discretion to deduct 2% from the completion grade (20% for all 6 labs) for anyone who is more than 15 minutes late for a lab. Anyone who is more than 30 minutes late for a lab will not receive the credit for the lab and will automatically receive an **incomplete** grade.
- You are responsible for the **clean up** of the common as well as the individual work areas at the end of your lab period
- After you are done with your experiment, you **should not leave** the lab premises **without checking with your TA**
- Pay particular attention to the proper use of equipment and experimental procedures. Use your down time wisely. **No loud and excessive conversations**
- You **should not leave** the area of your experimental set up in the middle of the experiment **without a proper cause and/or permission** from the **lab supervisor**
- Save your data on your own storage media immediately after the experiment is done.

University Policies to Note (the “fine print”):

Emergency Situations: Emergencies can happen anywhere and at any time, so it’s important that we take a minute to prepare for a situation in which our safety could depend on our ability to react quickly. Take a moment to learn the different ways to leave this building. If there’s ever a fire alarm or something like that, you’ll know how to get out and you’ll be able to help others get out. Next, figure out the best place to go in case of severe weather – we’ll need to go to a low- level in the middle of the building, away from windows. And finally, if there’s ever someone trying to hurt us, our best option is to run out of the building. If we cannot do that safely, we’ll want to hide somewhere we can’t be seen, and we’ll have to lock or barricade the door if possible and be as quiet as we can. We will not leave that safe area until we get an Illini-Alert confirming that it’s safe to do so. If we can’t run or hide, we’ll fight back with whatever we can get our hands on. If you want to better prepare yourself for any of these situations, visit police.illinois.edu/safe. Remember you can sign up for emergency text messages at emergency.illinois.edu. (*From the Division of Public Safety and Public Affairs*)

Ceramics Kiln House: <http://police.illinois.edu/dpsapp/wp-content/uploads/2016/02/u0011.pdf>

COVID: Following University policy, all students are required to engage in appropriate behavior to protect the health and safety of the community, including wearing a facial covering properly, maintaining social distance (at least 6 feet from others at all times), disinfecting the immediate seating area, and using hand sanitizer. Students are also required to follow the campus COVID-19 testing protocol.

Students who feel ill must not come to class. In addition, students who test positive for COVID-19 or have had an exposure that requires testing and/or quarantine must not attend class. The University will provide information to the instructor, in a manner that complies with privacy laws, about students in these latter categories. These students are judged to have excused absences for the class period and should contact the instructor via email about making up the work.

Students who fail to abide by these rules will first be asked to comply; if they refuse, they will be required to leave the classroom immediately. If a student is asked to leave the classroom, the non-compliant student will be judged to have an unexcused absence and reported to the Office for Student Conflict Resolution for disciplinary action. Accumulation of non-compliance complaints against a student may result in dismissal from the University.

Sexual Misconduct Reporting Obligation: The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University’s Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: wecare.illinois.edu/resources/students/#confidential.

Other information about resources and reporting is available here: wecare.illinois.edu.

Academic Integrity: The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>.

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <https://studentcode.illinois.edu/article1/part4/1-401/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Religious Observances: Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/> to request appropriate accommodations. This should be done in the first two weeks of classes.

Disability-Related Accommodations: To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to <https://www.disability.illinois.edu>. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

Family Educational Rights and Privacy Act (FERPA): Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

Anti-Racism and Inclusivity Statement: The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The College recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART) (<https://bart.illinois.edu/>). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

Guidelines to Preparing **Laboratory Reports**

Department of Materials Science and Engineering
University of Illinois at Urbana-Champaign

The following guidelines are for writing formal laboratory reports for the MatSE-307 and 308 laboratory courses taught in the Department of Materials Science and Engineering at the University of Illinois at Urbana-Champaign.

All laboratory reports should contain the following in order:

Title Page:

The following information should be centered on the front page: (with no page number)

Experiment Number

Title of the Experiment

Author

(Lab Partners)

Class _____, Section _____

Date Due _____

Date Received _____ (leave blank)

Abstract:

The abstract is to be placed on numbered Page 1, in block style with no paragraph indentation and in **bold** type. It should be no more than **150 to 200 words** in length.

The abstract should be a concise summary of the experiment, containing general statements of the investigation, the methods used, materials tested, and the main results. It should not include procedural details.

The following sections of the report should start at the top of Page 2:

Introduction and Background:

The Introduction and Background section should include: (1) statements that clearly define the purpose of the experiment; (2) its significance; (3) background information necessary to understand the concepts, methods, and procedures presented in the subsequent sections. This section should not contain the details of the laboratory procedures and the data analyses.

The purpose of this section is to identify the reasons for performing the experiment. What are you measuring or determining and why? What is the significance of your observations? Say this in your own words. Do not copy the "objectives" from the laboratory manual or any handout that might be given to you. The goal is to supply the minimum supplementary information necessary to understand the methodology employed and the theoretical background of the experiment. When this section is properly written, the logic behind the experimental approach will be clear.

Experimental Procedure:

The Experimental Procedure section should give an explicit and concise account of the methods and procedures followed during the experiment without getting into the operational details of the equipment used. Do not simply copy the laboratory manual or a handout. A person with technical background should be able to carry out the experiment without any difficulty by reading this section and the appropriate equipment manuals.

This section should include, when applicable, raw materials, compositions, batch formulas, and specific processing and analytical procedures used to make, test, and analyze the samples. Brief descriptions of equipment, diagrams of apparatus, sketches of circuits, etc., should be included when needed for clarity.

Results and Discussion:

This section should be the majority of your report. All pertinent observations and the refined data should be presented and discussed in logical order. Whenever possible, data should be presented in graphical form to show any relationships between variables. Raw data should be tabulated and placed in an appendix.

The interpretations and significance of the results should be discussed, including whether the purpose of the experiment had been fulfilled. The results should be compared with those found in the literature and if possible, with theory. Any specific experimental conditions that may have affected the results and any sources of error should also be discussed.

Conclusions:

This section should be a brief summary of the important findings, preferably in itemized form. The conclusions should not simply be a copy and paste of the abstract. Conclusions are a distinct element within a technical report.

References:

References acknowledge the sources of non-original information, data, and ideas (i.e., not those of the author), and are used to support the author's point of view or observations.

References should be numbered consecutively in the order they appear in the text and listed in this section with the following information. The references should be listed in IEEE format as indicated by the following examples:

Journal:

¹R.W. Vest, "Materials Science of Thick Film Technology," *Am. Ceram. Soc. Bull.*, vol. 65 [4], pp. 631-36, 1986.

Proceedings:

²R. A. Perecherla and R.C. Buchanan, "Copper Thick Film Adhesion on Glass Ceramic Substrates," in *Proceedings of the American Ceramic Society Symposium*, Indianapolis, IN, 1989, pp. 439-454.

Books:

³W. D. Kingery, H. K. Bowen, and D.R. Uhlmann, "Dielectric Properties" in *Introduction to Ceramics*, 2nd Ed., New York, NY, John Wiley and Sons, 1976, pp. 913-74.

Patents:

⁴M. J. Pryor and T. J. Gray, "Method of Preparing Molten Metal Filter," US Patent #4,056,586, Nov 1, 1977.

Appendices:

The Appendices are used for placing material that is pertinent, but would cause a disruption to the flow of the text in the main body of the report. Raw data, sample calculations, and extensive derivations are typically included. Appendices should be lettered consecutively (e.g., Appendix A, Appendix B, etc.) and given a descriptive title.

General Guidelines:

Format:

All reports must be *typewritten, single sided and double-spaced, with one-inch margins on all sides and the pages numbered*. Reports must be either stapled at the upper left-hand corner or bound in a report cover. Any handwritten annotations, equations, etc. must be neat and legible.

A good laboratory report should be concise and comprehensive, and need not be long. The *text* of a typical laboratory report usually ranges from *10 to 13 pages* in length (excluding tables and figures).

Writing:

- *Always save your report file on a backup disk*
- Use concise and economical wording of sentences and paragraphs without being choppy
- Particular attention should be given to proper word usage, correct spelling, proper punctuation, and the use of complete sentences
- Keep the tense consistent in a given section. Usually simple present tense is best. The main exception is the description of the experimental procedure where past tense is often more natural.
- Typically, sentences should be written in **third person**, but **first person** can be used where appropriate. Avoid a conversational style of writing.
- Avoid using gender-specific references.
- Avoid the use of absolute, unrestricted, or unqualified statements
- Reports should be written based on the premise that the reader may not be well informed on the subject. Reports should be concise, but they must be sufficiently complete to supply the necessary information.
- If you have general comments, which you care to make about the laboratory, this is not the place to make them. Such comments should be directed to the instructor or to a teaching assistant on a separate note.

Tables:

All tables should be numbered in the order they appear and placed successively in the text. Each table should have a descriptive caption *above* the table, and numbered as Table I, Table II, etc. as per the following example:

Table I. Mg and Fe Contents in the External Oxide Layer as a Function of Time and Temperature

Sample no.	Oxidation temperature (°C)	Oxidation time (h)	Fe content ($\times 10^{15}/\text{cm}^2$)	Mg Content ($\times 10^{15}/\text{cm}^2$)
4-1a	1000	0.5	120	160
4-1b	1000	1.0	210	190
4-1c	1000	4.0	320	340
4-1d	1000	10.0	480	550
4-1g	1000	40.0	960	1200
5-b1	700	10.0	33	29
5-b3	800	10.0	100	100
2-1a	900	10.0	330	460
5-b2	1000	10.0	470	480
5-b5	1100	10.0	1100	770
10-b3b	700	70.0	220	150
10-b4b	810	49.3	460	250
10-b5b	907	10.0	440	310
9-b5b	1100	1.0	350	160

Figures:

All figures should also be numbered in the order they appear and placed successively in the text. Each figure should have a descriptive caption *below* the figure, and numbered as Fig. 1, Fig. 2, etc. as per the following examples:

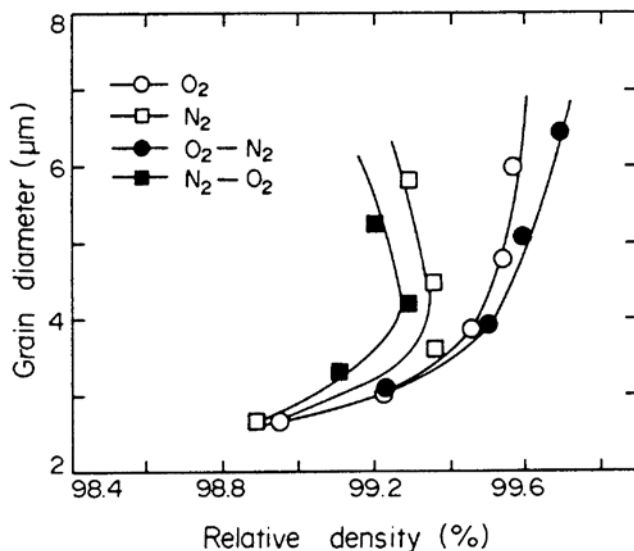


Fig. 1. Acceptable example of a graph.

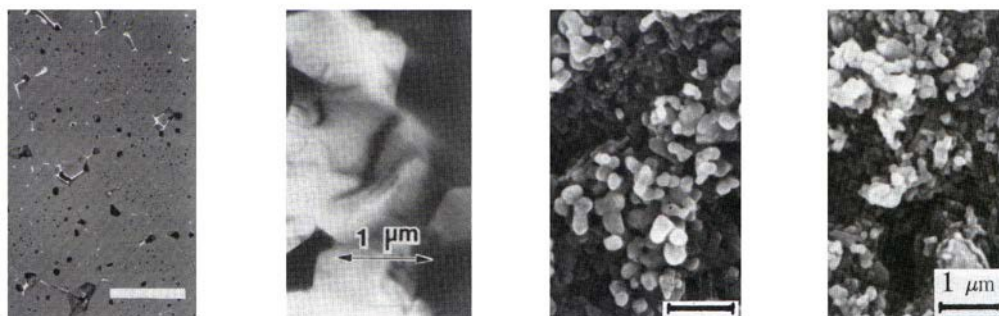


Fig. 2. Acceptable examples of scale bars.

When micrographs are to be included in the report, use scale bars as shown above and indicate the magnification in the caption, in parenthesis.

The axes of each graph must be labeled and their units clearly designated in parenthesis. Take error into account.

Mathematical Expressions:

Equations should be consecutively numbered and all variables identified. Decimal numbers less than one must have a leading zero such as 0.01, not .01. Every symbol must be defined, and avoid multiple meanings for the same symbol. In displaying equations with fractions (except superscripts), numerators should be stacked over denominators rather than placed on a single line and separated by a slash (/). Very large and very small numbers should be expressed in scientific notation, e.g., 4.53×10^8 and 2.98×10^{-8} .

Note:

If you choose to include tables and figures within the body of your report, always place them (along with the equations) after their point of reference. Otherwise, put your tables and figures at the end of the report (after References)

SI Units:

Use metric units of measurement, specifically SI units. English or non-metric units may appear in the report, but they should appear only in parenthesis following the SI units, e.g., 32 mm (1.25 in.).

Formal (Long) Reports

The long reports should contain the following sections in order:

- 1. Title Page**
- 2. Abstract**
- 3. Introduction and Background**
- 4. Experimental Procedure**
- 5. Results and Discussion**
- 6. Conclusions**
- 7. References**
- 8. Appendices**

Short Reports

The short reports should contain the following sections in order:

- 1. Title Page**
- 2. Abstract**
- 3. Objectives and Experimental Procedure (What? and How?)**
Maximum of **one page** in length
(This section should contain the main objectives of the experiment and a brief experimental procedure.)
- 4. Results and Discussion**
- 5. Conclusions**
- 6. References**
(**DO NOT** include any Appendices)

Type of Reports / MSE-307

<u>Experiment</u>	<u># of weeks</u>	<u>Report Type</u>
1. Thermoelectric Energy Conversion / (TEC)	2 Wks	Short
2. Thermal Stresses and Strains / (TS)	2 Wks	Short
3. Phase Equilibria: Optical Microscopy / (OM)	2 Wks	Long (rewrite)
4. Absorption and Humidity / (AH)	2 Wks	Short
5. Pyrometry / (PY)	2 Wks	Presentation
6. Differential Scanning Calorimetry / (DSC)	2 Wks	Long

Presentation Guidelines

Location: TBA, likely 122 KH
Format: Electronic presentation in Powerpoint format
Duration: 15 minutes + Q&A
Date: M-F afternoons during the last 1.5 weeks of class

Everyone should sign up for one 20-minute presentation slot. Sign-up will be done electronically through Google Docs (watch email for link).

Please upload a copy of your slides (.ppt or .pdf) to Compass.

A group of two instructors (TAs, UG assistants, and/or Dr. TerBush) will grade the presentations. The presentation grade will be determined by the following four components:

- 1) Completion of lab requirements (40%)
- 2) Data analysis (30%)
- 3) Clarity of presentation (15%)
- 4) Q&A (15%).