CERAMIC ENGINEERING 122
CHARACTERIZATION OF MATERIALS LAB II

Instructor: Prof. Richard Brow
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	Tuesday, Section A	Wednesday, Section B
Meeting Time and Place:	1:00-3:00 PM 245 McNutt	1:00-3:00 PM 243 McNutt
Graduate Lab Assistants:	Jaime George 140 McNutt Hall 341-6131 ; jgcc3@mst.edu	Xiaoming Cheng 140 McNutt Hall 341-6131 ; xcpn2@mst.edu

Introduction: The purpose of CerEng 122 is to introduce students to processing and characterization techniques commonly used in the field of ceramic engineering. In this course, students learn fabrication techniques that apply to glasses and other oxide-based ceramics, and will be introduced to a variety of characterization techniques related to thermal and optical properties. The results from each experiment will be reported in a concise, coherent manner as would be expected of any engineer in industry, using both written reports and oral presentations. At the same time, students are encouraged to have fun, to ask plenty of questions and to consider going beyond the required activities.

Attendance: This is a lecture/lab course. In a typical week, we will first meet in the classroom for lab presentations, if scheduled, and then for a review of that week's lab activities. Brief demonstrations related to laboratory assignments will then be done, usually in 142 McNutt. It is your responsibility to attend these classes and participate in the labs. Since many of the experiments will be performed outside of the scheduled lab time, it is the responsibility of each team to ensure that all lab members are actively involved in every assignment.

Lab Reports: For each laboratory exercise, a report and/or presentation is required. Samples prepared by students in the lab may also be evaluated. Samples, reports, and presentations will be graded either as an individual exercise or a group exercise, as detailed in this syllabus. *No late assignments will be accepted.* The report and presentation styles will be similar to those used in Cer111 (see outline below), although elements of style summarized in the monograph by Prof. David Van Aken (*Technical Communications*) will also be used.

Grades: A≥90, 80≥B≤89, 70≥C≤79, 60≥D≤69, F≤59

Texts: J.S. Reed, *Principles of Ceramics Processing*, 2nd Ed., Wiley, New York (1995); M.N. Rahaman, *Ceramic Processing and Sintering*, Marcel Dekker, Inc., (1995); J. E. Shelby, *Introduction to Glass Science & Technology*, 2nd

ed., RSC, London (2005); David C. Van Aken and William F. Hosford, *Reporting Results*, Cambridge Press, 2008.

Lab Notebooks Students are required to keep a proper laboratory notebook. The same notebooks that were used in Cer111 will be used in this course. For students who do not yet have their own Lab Notebook, you may pick up a copy from Amy in the MSE Office. Notebooks will be reviewed and graded twice during the semester. Notebooks are intended to record detailed descriptions and results of experiments and to summarize those outcomes. Information about the use of notebooks is provided elsewhere in the syllabus.

Lab Safety: Students must wear the appropriate personal protective equipment for all laboratory activities, including safety glasses whenever a student is in a laboratory. Students must review all appropriate MSDS information before using any chemicals.

Students who have not passed the Lab Safety Exam in Cer111 must review the department's lab safety manual (on Blackboard), then pass the Lab Safety Exam, also posted on Blackboard. You will not be allowed to work in the labs until you have passed this exam!

Cheating: The Missouri S&T policy on academic dishonesty (e.g. cheating, plagiarism) allows the instructor to make a judgment about the student's grade on the work in question and requires that alleged cases of academic dishonesty be reported to the Primary Administrative Officer.

SP 2012 SCHEDULE

The following schedule represents the dates for specific lectures, as well as those due dates for presentations, quizzes or reports.

Date	Laboratory Exercise	Presentation (in Class)	Report/Quiz Due in Class
1/10,11	Introduction/Data Presentation Melt Demonstrations- glass batching, forming, annealing		
1/17,18	Data Presentation Review Glass Preparation-1		Data presentation slides (individual) Batch calc./MSDS HW (individ.)
1/24,25	Glass Preparation-2		Data present. slides (individ. makeup)
1/31,2/1	Dilatometry Lab	Glass quality judging (group)	Glass formation report (individual)
2/7,8	Glass crystallization-1 DTA exercise		Dilatometry HW (individual) Notebook Review (individual)
2/14,15	Glass crystallization-2 x-ray diffraction	Glass properties group presentation	DTA HW (individual)
2/21,22	Comminution/Sieve Analysis Lab		Crystallization report (group)
2/28,29	Comminution/Ball Milling Lab		Comminution/sieve HW (individual) Peer Evaluation Sheet Due (by 3/2)
3/6,7	Color-1; Beer-Lambert Analysis	Comminution- group presentation	
3/13,14	Color-2		DTA/dilatometry quiz (individ)
3/20,21	Screen Printing Lab I- Inks: Demonstration	Color report- group presentation	Color Report (Group)
3/27,28	**No Class, Spring Break**		
4/5,6	Design Problem-described		
4/12,13	Design Problem-continued		
4/19,20	Design Problem-inks and screens		
4/26,27	Design Problem-completed	Design problem presentation (group)	Peer Evaluation Sheet Due (by 4/27)
4/30-5/4	**FINALS WEEK**		Notebook Review Due (4/30) Individ. Design Report Due (4/30)

GRADING

You can track your grade by filling in this table as the semester progresses. For presentations, your grade will be based on the score assigned to you by your peers and the score assigned by the TA's and professors. **Note that some assignments (reports and presentations) will receive 'group' scores and assignments will receive 'individual' scores.** This will be specified in each lab handout. Each student will receive up to 200 points for participating in lab activities and working on assignments. These points will be based on teammate evaluations (see attached form) during two confidential individual meetings with Prof. Brow, as scheduled. Attendance at the weekly Ceramic Engineering seminars constitutes 5% of your lab grade; a minimum attendance of nine seminars will give you the full 5% credit (100 points). **Attending less than 9 seminars will give you 0% credit.**

Exercise	Component (Due)	Possible Points	Your Score
Data presentation	Individual Report (1/17,18)	50	
Batch Calculations	Individual HW (1/17,18)	50	
Glass Melting	Glass Quality/Group (1/31,2/1) Individual Report (1/31,2/1)	100 100	
Glass Properties	Dilatometry HW (2/7,8) Group Presentation (2/14,15)	25 100	
	Notebook Review (2/7,8)	50	
Glass Crystallization	DTA HW (2/14,15) Group Report (2/21,22)	25 100	
Comminution, sieve analysis	Comminution HW (2/28,29) Group Presentation (3/6,7)	25 100	
Thermal analysis	DTA/dilatometer Quiz (3/13,14)	25	
Glass Color	Group Written Report (3/20,21) Group Presentation (3/20,21)	100 100	
	Notebook Review (4/30)	150	
Course Design Project	Group Final Present. (4/24,25) Individual Final Report (4/30)	200 300	
Individual Presentation	Periodic	100	
Individual Meeting-1	Due by 3/2	100	
Individual Meeting-2	Due by 4/27	100	
Seminar Attendance	Minimum of 9	100	
Total		2000	

PRESENTATIONS

Each student will give at least one presentation during the Spring semester. These will be individual presentations that summarize certain group activities. Your presentation should be from 6 to 8 minutes and should be PowerPoint compatible. Grades will be assigned using the following grading sheet. Note that for each presentation, the group will receive one score (100 points max) based on the content, and the speaker will receive an individual score (100 points max) based on the presentation.

Group Number:
Presenter:

Criterion	Possible Points	Points Awarded
Visual Aids (effective or distracting?)	10	
Organization and flow	20	
Time – appropriate for material	5	
Voice (spoke with clarity, enthusiasm)	10	
Mannerisms (fidgeting, pointer use, etc.)	5	
Content (was the topic covered thoroughly)	40	
Merit relative to class (assign after all talks)	10	
Total	**100**	

LAB REPORTS

Lab reports are due on the dates identified in the schedule. The reports may vary in length, but will be similar to those you prepared for Cer. Eng. 111. For the lab reports worth 100 points, the grades are broken down as follows:

General attributes (33 points)

Overall format and neatness ---------- 15 points
Length (too long or too short) ---------- 5 points
Spelling and grammar ---------- 13 points

Content-specific (67 points)

Abstract ---------- 5 points
Introduction/Background/Objectives --------- 10 points
Procedures/Equipment ---------- 10 points
Results (Tables and Graphs) ---------- 15 points
Discussion ---------- 15 points
Conclusions/summary ---------- 7 points
References ---------- 5 points

We will use the same lab report structure that you used in Cer111. Some of the elements that should be included in the various parts of your report are included in the following outline:

Title Page:

- Course, Lab Title, Author, Group #, Affiliation, Date

Abstract:

- Concise summary; should be the last section written; should include most important quantitative results (important numbers); 100-250 words. Consider the following for an effective abstract:
    - What you did
    - How you did it
    - What it means

Introduction:

- Review relevant background information, define the problem, and succinctly state the objectives of the work
    - Objective: the purpose, the big picture- should be the last few sentences in this section
    - Review of the literature- What background information supplements your study, helps explain why the work is important and helps interpret your results?
    - Relevant Equations: be sure to define all terms

Experimental Procedures

- Provide a description of what you did that is sufficient for someone to reproduce your work. This description should include:
    - What you did in the lab
    - How you analyzed your results
    - What equipment (make and model) and materials (source, purity) you used
    - What Standards you followed, like ASTM C-329

Results

- Record of findings
- Raw Data Tables, included here or refer to in Appendices
- Analyze data, Figures & Tables
- Statistical analysis, averages, standard deviations
- Refer to Figures & Tables in your narrative (text)!
- Figures & Tables: Captions- Figure, below; Table, above
  Labels must include units

Discussion

- Explanation or interpretation of the data in your Figures & Tables; consider the following:
    - Quantification of results
    - Interpretation; why, outcome- relate to what you know from classroom discussions and from reading textbooks, etc.
    - Discuss sources of error
    - Accuracy vs. reproducibility
    - Random vs. systematic error- "Human Error" is not a valid source of error
    - Keep track of your significant digits

Summary

- Confirm if your stated objective was met
- Emphasize main findings, be quantitative
- Draw conclusions
- Make Recommendations

References

- Endnotes; superscript
- Format according to the *Journal of the American Ceramic Society*; example:

  J.S. Reed, *The Principles of Ceramics Processing*, John Wiley & Sons, New York (1995) pp. 200-210.
    - Note: Lab handouts are never acceptable as reference materials; find the source documents

Appendices

- Assigned questions, pertinent calculations, relevant data not included in the body of the report

Lab Teams

Each of you has been assigned to a laboratory team for this semester. You will work in this team for the entire semester. The performance of each group member will be evaluated for each written lab using the confidential individual evaluation sheet. Individuals not meeting the expectations for the class will be asked to meet with the instructors and/or their academic advisor to improve their performance.

Group 1/Tues.	Group 2/Tues.	Group 3/Tues.	Group 4/Tues.
Ashley Hilmas	Sean Kennedy	Coti Bova	Michaela Kuzara
Jialun Li	Vicki McKinney	Brett Osmonson	Elizabeth Nolte
Shannon Loyet	William Schroeder	Markayla Pepper	Alex Reichert
Kenneth Moore	Mark Winseck	Nicholas Santoro	Cora Weidhas

Group 5/Wed.	Group 6/Wed.	Group 7/Wed.	Group 8/Wed.
Brittany Davis	Paul Brune	Rachel Ederle	Julia Valles
Peter Fehner	Kaitlin Ford	Jacob Ivy	Susan Verity
Robert Miller	Derek Guenther	Destinee Rea	Jodi Wurm
John Tomaszewski	Caroline Murphy		

Notebook Evaluations

Keeping careful and complete records of your work is an important aspect of the engineering practice. You are encouraged to keep a detailed record of all laboratory work you do for this course. These records should be sufficient to allow you (or someone reviewing your notes) to reproduce your work and to accurately convey all relevant details in subsequent written and oral reports.

Guidelines for the Laboratory Notebook

The Purpose of the Notebook

The technical notebook is one of the basic tools for any experimental work. It is primarily for the experimenter's own use, but another person with similar technical background should be able to understand and duplicate any experiment, data, and conclusion, or to prepare a technical report by following only the lab notebook details. The nature of the work and the purpose of the experimenter will influence the content and format of the laboratory notebook.

There are many reasons to keep an accurate and complete record of experimental work. Among these are:

1.To establish the authenticity of the work.

2.To act as a basis for technical reports and articles.

3.To avoid duplication of effort.

4.To avoid repetition of erroneous procedures.

5.To defend patents.

In General:

The notebook should be bound, never loose-leaf, and the pages numbers consecutively, preferably by the printer.

A neat, organized, and complete lab notebook record is as important as the investigation itself. The lab notebook is the record of what was done. You should use ink and write directly in the notebook as the experiment is done. Neatness is a basic requirement but if a mistake is made, you simply "X" it out and start over. Each person will keep his or her own notebook even though you might have lab partners. Remember the purpose of the lab notebook is to pass information on to another person and is a permanent record of all your work. Therefore complete details of what was done and what happened must be included.

General Format:

Use all pages. Avoid leaving any of them blank and avoid leaving blank spaces on any of them. Date and initial each page at the bottom as it is used. Where possible use the left-hand, blank pages for attaching diagrams, sketches, graphs and calculations (placed opposite your text). In industry it is very important to sign and date all work and ultimately leave no spaces where additions might be added later in order to preserve the legal integrity of the notebook.

Content Requirements:

What was done?

- Information for the Experimental Procedure-
- What equipment? What conditions or parameters?
- What information would I need to supply so that another person could repeat the experiment?

Who did it?

- List members of the group present for the experiment during each entry.
- Members present and conducting the experiment should sign the bottom of the page(s).

When was it done?

- Date all entries in the notebook and include times where appropriate for the experiment.
- Never back date notebook entries.
- Some experiments may have multiple dates because they take days to complete.

What were the results?

- Distinguish data from calculated values.
- Show the equations used for calculation.
- Make sure you graphs have titles, labels and scales.
- Tables should include units for the numerical data.
- What were concerns or problems encountered during the experiment?

What does it mean?

- Make observations and draw conclusions.
- Note errors relative to the accuracy of the measuring equipment or issues with precision.
- Taking notes here will make your formal report writing easier later.

Your notebook will be reviewed and graded twice this semester (50 points maximum for *the first* review, 150 points for the second). Among the things that will be evaluated are the level of detail you provide for specific experiments (67%) and the neatness and organization of your records (33%).

Individual Evaluations

Each person in this class is required to complete two individual evaluation sessions with Prof. Brow during the semester, the first by 3/2 and the second by 4/27. This will be a short meeting in which you will be asked to comment on the class in general, your contribution to your lab team, and the contributions of your team members. These evaluations will be similar to those you performed in Cer111. You will fill out the "individual evaluation sheet" on the next page before your meeting with Prof. Brow.

INDIVIDUAL EVALUATION SHEET

CONFIDENTIAL

Due Date: March 2, 2012
April 27, 2012

Name: _____

Part of your grade is based on your performance as a team member. To that end, each of you is asked to rate the other members of your team. Please complete this form prior to meeting with Prof. Brow. You should complete this form individually and not share your ratings with your other team members. Your ratings will be kept confidential, although a composite grade will be reported to each student along with feedback related to their individual performance.

Some factors that you should consider when assigning your rating include:

- Attendance during laboratory exercises
- Meets group deadlines
- Actively participates in group discussions
- Willingness to help
- Carries his/her share of responsibilities

Rating System

Rating	Criteria
Excellent	Consistently went above and beyond the call of duty, tutored teammates, carried more than his/her share of the load
Very Good	Consistently did what he/she was supposed to do, was well prepared, was cooperative, communicated well with team members
Satisfactory	Usually did what he/she was supposed to do, was acceptably prepared for class or meetings, was usually cooperative, communicated adequately with team members
Ordinary	Did what he/she was supposed to do about half the time, was minimally prepared for meetings or class, occasionally communicated with team members
Marginal	Occasionally failed to show up for lab or team meetings, was rarely prepared for meetings or class, did not communicate
Deficient	Often failed to show up for lab or team meetings, was never prepared for meetings or class, did not communicate
Unsatisfactory	Consistently failed to show up and participate
Superficial	Had practically no participation
No Show	Had no participation at all

Name	Rating