

ME 4767 Pulp & Paper Lab Syllabus

COURSE PURPOSE/OBJECTIVE:

The purpose of this course is to acquaint students with practices and procedures in the paper industry field, specifically pulping, bleaching, and papermaking processes. Students will learn how to analyze and interpret experimental data and to communicate their results and analyses in written and spoken form.

LEARNING OUTCOMES:

1. Work effectively in teams to cooperatively conduct experiments which are representative of unit operations for pulping, bleaching, fiber deinking/ recycling, and paper manufacturing.
2. Be able to identify key process variables and gather and analysis data for typical processes in pulp and paper manufacturing.
3. Understand the theory and safe operation of analytical equipment used in the pulp and paper industry (i.e. – tensile testers, optical property measurement, and burst and tear resistance).
4. Analyze experimental data using standard statistical methods.
5. Write effective technical reports for the experiments.
6. Understand the environmental issues and safety considerations for unit operations in pulp and paper manufacturing.

INSTRUCTORS:

Dr. Sandy Pettit, P.E. sandra.pettit@chbe.gatech.edu ES&T 1230
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Office Hours: By appointment

TEXTBOOK:

No required text (materials are available in class or online in T-square.)

Recommended Reference: “*Handbook for Pulp and Paper Technologists*” by G.A. Smook

TOPICAL OUTLINE:

The lab work will physically occur in the Renewable Bioproducts Institute Building (otherwise called the Paper Tricentennial Building) on 10th and Hemphill. The labs assigned are Rooms 434 (Pulping and Bleaching Lab), 432 (Handsheet and Physical Testing Lab) and 427 (Kappa Number and Viscosity Overflow Lab)

1. Kraft Pulping

- a. White Liquor Preparation – lab batch preparation with a specific Equivalent Alkali and Sulfidity level; calculate and execute a white liquor and water balance for the digester cook.
 - b. Digester Operation – safe execution of laboratory procedures outlined in lecture; operation of the digester from automated controls (cooking time, temp, H-factor); physically charge the digester; discharge the digester.
 - c. Screening & Characterization – screen the wood fibers through a lab cut screen; collect the accept fibers and rejects; determine the screen yield and rejects content; Kappa Number and Viscosity Testing; thorough and approved lab clean-up.
2. Bleaching - Oxygen Delignification – lab prep; unit design configuration; charging and controls (manual and automated); Kappa Number and Viscosity Testing; general evaluation of the pulp.
 3. Papermaking
 - a. Handsheet formation – consistency and freeness testing; proper handsheet forming, pressing and drying
 - b. Physical Properties – handsheet conditioning; tensile, mullen burst, tear resistance; optical properties
 4. Recycling & De-inking – flotation deinking unit preparation; wastepaper physical evaluation; charging and operating; evaluation of physical pulp; handsheets and physical properties.

ChBE 4873 Pulp & Paper Lab				
Spring 2016 Schedule				
Date				Due
12-Jan	T	<i>Intro to Course, Discussion of MSDS</i>	<i>RBI 114</i>	
14-Jan	R	<i>No Class. On-line Safety Courses</i>		
19-Jan	T	<i>Lecture - White Liquor, H-factor, Kappa</i>	<i>EST L1122</i>	A1 - MSDS Review
21-Jan	R	White Liquor Prep	RBI Lab	Certificates for Safety Training
26-Jan	T	Cook 1	RBI Lab	
28-Jan	R	Kappa, Residual Alkali	RBI Lab	
2-Feb	T	Cook 2	RBI Lab	
4-Feb	R	Kappa, Residual Alkali	RBI Lab	
9-Feb	T	Cook 3	RBI Lab	
11-Feb	R	Kappa, Residual Alkali	RBI Lab	
16-Feb	T	Cook 4	RBI Lab	
18-Feb	R	Kappa, Residual Alkali	RBI Lab	
23-Feb	T	<i>Lecture - Oxygen Delign, Viscosity</i>	<i>RBI 372</i>	
24-Feb	W	<i>Georgia Tech Pulp & Paper Foundation Panel</i>	<i>EST L1205</i>	3-4 pm
25-Feb	R	<i>Data Analysis / Report Writing</i>	-	

1-Mar	T	Oxygen Delign	RBI Lab	Lab 1 - Kraft Cooking, A2 - Measurement & O2 Delign.
2-Mar	W	<i>International Paper with Brittany Robinson</i>	<i>EST L1205</i>	3-6 pm
3-Mar	R	Kappa, Viscosity	RBI Lab	
8-Mar	T	Kappa, Viscosity	RBI Lab	
10-Mar	R	<i>Data Analysis / Report Writing</i>	-	
15-Mar	T	<i>Lecture - Handsheet formation & Physical Prop, 3 pm</i>	<i>EST L1120</i>	Lab 2 - Oxygen Delign
17-Mar	R	Handsheets	RBI Lab	
22-Mar	T	Spring Break	-	
24-Mar	R	Spring Break	-	
29-Mar	T	Handsheets & Physical Prop	RBI Lab	A3 - Equipment Operation
31-Mar	R	Handsheets & Physical Prop	RBI Lab	
5-Apr	T	<i>Lecture - Deinking, Data Analysis / Report Writing</i>	<i>TBD</i>	
7-Apr	R	Flotation De-inking	RBI Lab	Lab 3 - Physical Properties
12-Apr	T	Flotation De-inking, Handsheets	RBI Lab	
14-Apr	R	Handsheets & Physical Prop	RBI Lab	
19-Apr	T	Handsheets & Physical Prop	RBI Lab	
21-Apr	R	<i>Lab Practicum, 3-5 pm</i>	<i>EST 1387</i>	
26-Apr	T			Lab 4 - De-inking

COURSE ASSESSMENT:

Course Element	Fraction	Note
Lab Preparation and Participation	20%	Includes attendance, pre-lab preparation, in-lab participation, safety, teamwork, quality of products, waste handling, and post-lab clean-up.
Lab reports	40%	<i>Group Grade. See separate guideline and rubric</i>
Other Assignments	20%	
Lab practicum	20%	Final test covering the experiments, safety, and technical elements.
TOTAL	100%	

CLASS WEB PAGE: T-Square, CHBE-4873

REQUIRED MATERIALS: A bound lab notebook, a pair of safety glasses with side shields, and a 100% cotton lab coat (as required by Georgia Tech).

LAB EXECUTION

Labs may be carried out in groups of up to 3 students. **Groups will be assigned during the first class period.** During the first week, no experiments will be performed. We will discuss general and lab specific safety, review key equipment utilized in the experiments, and review the chemistry and calculations necessary to perform experiments.

1. Safety Certification

Students will be required to complete safety training before performing any experiments. The training consists of two on-line courses:

- a. Right to Know (RTK)
- b. Lab Safety 101

Courses may be accessed at <http://www.ehs.gatech.edu/training>. To access the online tutorial, you must log-in (see “Login” on left column). If you are not directed to enter your GT account and password, please use another web browser (the login function may not work properly with certain versions of Explorer)

2. Pre-lab Preparation

Students should come prepared to spend sufficient time in the lab to fully complete the required steps of each experiment. Some experiments may span across multiple lab periods, especially if overnight drying is required. The time required to perform each experiment varies, so thorough preparation is necessary. Students should review each experiment and the supporting procedures. Before beginning each laboratory period, you should prepare an execution plan. **A copy of your written execution plan must be submitted at the beginning of each lab period.** This plan should summarize each of the major steps by:

- Identifying the required equipment and chemicals
- Identifying the supporting operational and testing procedures / protocols
- Estimating the time required for each major step. Note that not all steps for each experiment can be completed in one lab period. Appropriate break-points for the experiments should be identified. Further, time for clean-up should also be allotted.

3. In-lab participation, safety, teamwork, quality of products, waste handling, and post-lab clean-up

Personal safety and the safety of others is and always should be of primary importance. For this reason, it is imperative that you follow all lab safety procedures at all times. Safety glasses with side shields, closed-toe shoes, and a 100% cotton lab coat must be worn in the lab at all times. **Each violation of this safety policy will result in a grade deduction.** Additional safety protocols include:

- Familiarize yourself with all lab safety equipment before beginning any experiments. These include the safety eye wash, shower, medical kit, and fire extinguisher.
- Use of appropriate hand protection (latex gloves when handling chemicals and heat resistant gloves when handling hot equipment).
- Proper use and operation of equipment.

- Long hair must be pulled back and secured.

When working in teams, lab report grades are shared among the group members, so it is assumed that the team members contribute equally. Because you will be equally responsible for each lab, effective teamwork will not only reduce your workload, but also help produce better lab reports.

After completion of each major step in the experiment, due care should be exercised in the proper disposal of wastes and clean-up of equipment and work space. **Failure to properly dispose of waste or clean-up will result in a grade deduction.**

4. Lab Reports

Due dates will be posted on T-Square. The lab reports are due in paper (hardcopy) at the beginning of your scheduled lab period. A format guideline and grading rubric will be posted in T-square. To ensure adequate laboratory time, the final lab report may be due during Dead Week. The report may be submitted earlier, if all laboratory experimentation is complete.

5. Other Assignments

Other assignments may be given throughout the semester to assess individual comprehension of key concepts and calculations. Assignments may include chemical safety analysis, review of analytical equipment operation, calculation of experimental values (white liquor and deinking solution preparation) and calculation of physical properties (Kappa number, viscosity, and pulp consistencies). Analysis will be emphasized in that the data from physical and optical testing should describe explainable trends and an understanding of cellulosic and fibrous substrates.

6. Lab Practicum

The lab practicum will be given during the regular instructional period (not during Finals Week). It will be closed book and will cover material from the topical outline, experimental procedures, equipment operation, and safety. Formula sheets, if necessary, will be provided by the instructor.

COLLABORATION & HONOR CODE

Students in this course are expected to fully abide by the Georgia Tech Honor Code. For this laboratory course, special attention should be paid to the following aspects of the Honor Code:

- No unauthorized collaboration is permitted. While discussions within your lab group are strongly encouraged, **sharing of data and/or reports between lab groups is not allowed.**
- Use of material, text, figures, calculations, or analysis from any **previous reports** is not allowed; **copying any part of these reports or effectively copying (i.e., paraphrasing) the content is an Honor Code Violation.**
- **Plagiarizing content from the Web or other sources is not allowed.** Note that copying texts verbatim from a source is considered plagiarism **even if you give proper citation for the source.**

All violations of the Honor Code (without exception) will be reported to the Office of the Dean of Students with the following recommended **MINIMUM** repercussions:

- **First-time offenders: lowering course letter grade by one letter**
- **Repeat offenders: course letter grade “F” (failure of the course)**

MISCELLANEOUS ISSUES

You must purchase and bring a bound laboratory notebook to each lab session. Previously used laboratory notebooks are acceptable provided they contain sufficient blank pages to record the work in this course. After each lab period, you must get the work page(s) signed by the TA or instructor. **A Xerox or scanned copy of the original data sheets from your notebook must be included with the lab report as an appendix.**

Requests for a regrade of any report should start with a written e-mail appeal within one week of receiving the grade; the appeal should clearly and succinctly explain the basis for the regrade request (non-specific “fishing expeditions” will be rejected without consideration). After this one-week period, regrade requests will no longer be considered.

NOTE: The syllabus is subject to change based on the flow of the course. Any changes will be announced in class and posted to T-square.