**ChBE/ME 4720**

**Pulp and Paper Manufacturing**

**Instructors:** Dr. Chris Luettgen (ChBE), Dr. Sandra Pettit (ChBE)

Other Professors: Dr. Norman Marsolan (ChBE), Dr. Yulin Deng, (ChBE)

**Course Objective:** To present in practical and technical terms the nomenclature, processes and technologies of pulping and chemical recovery and papermaking used in the forest products industry to manufacture ligno-cellulosic materials into value added products.

**Learning Outcomes:**

By the end of this course, a student should:

1. Be knowledgeable of the technologies deployed in the Forest Bioproducts Industry.
2. Be well versed in the processes, equipment and unit operations for pulping, chemical recovery, bleaching, recycled fiber / deinking, paper, board and tissue manufacturing, and converting.
3. Acquire an understanding of Wood Chemistry and Tree and Fiber Morphology in order to comprehend the impact of factors on paper product properties and end use performance.
4. Obtain a fundamental knowledge of Surface Chemistry as it applies to wet-forming processes and the supply-side of chemical applications prevalent in the forest products industry.
5. Understand the environmental and issues and safety considerations involved in the operation of a forest bioproducts facility.
6. Be well versed in case studies of mill operation and the economics of the Forest Bioproducts Industry.

Undergraduates will be assessed by the use of Quizzes, Midterm and Final Examinations as well as Homework Assignments and participation in class.

**Grading Expectations:**

25% Mid-term Examination (1)

30% Final Examination (1)

25% Monthly Quizzes (6)

20% Oral presentation of Discussion and Assignments and oral capabilities presented in class

**Reference Materials:**  Series of Books, “Papermaking Science and Technology” in the library at the reference desk.  Particularly for this course, Volumes 2, 3, 5, 6-1, 6-2, 7, 12 and 16.  
Also, “Handbook for Pulp and Paper Technologists”, by Smook, Gary A., 3rd Edition, 2015.  
There are various other P&P Technology references available.

# Learning Accommodations:

If needed, we will make accommodations for students with documented disabilities. These accommodations must be arranged in advance and in accordance with the Office of Disability Services (<http://disabilityservices.gatech.edu>).

**Academic Integrity**

Students in this course are expected to abide by the Georgia Tech Honor Code. As per the honor code, no unauthorized collaboration is permitted. While discussions within your lab group are strongly encouraged, **sharing of reports between groups is not allowed. *Any use of material, text, figures, calculations or analysis from any previous reports will be considered an Honor Code Violation and your case will be referred to the Dean of Students for disciplinary action.* Copying any part of these reports or effectively copying (i.e., paraphrasing) the content is an honor code violation.** To verify the originality of your work, you must turn in an electronic copy of all reports that you write. Consult the class T-square site for details on how to turn in the electronic copy of your lab report.

**Course Outline:**

**Week 1: Syllabus, Course Outline and History of Pulp and Paper Making and Wood Structure / Forestry  
History of Pulp and Papermaking***Overview  
Topic 1: History of Pulp and Papermaking  
Activities: Discussion*

**Week 2: Wood Structure, Fiber Morphology and Forestry Best Practices**

**Wood Structure**  
*Overview  
Topic 1:  Tree Morphology and Wood Species  
Topic 2:  Fiber Morphology*

**Forestry***Topic 1:  Forestry Harvesting Practices  
Topic 2:  Best Practices Today  
Activities: Discussion; Knowledge Check 1: History of Pulp and Papermaking, Wood and Forestry*

**Week 3: Introduction to Pulping – Woodyard to Pulp  
Woodyard***Overview  
Topic 1: Debarking  
Topic 2: Chipping  
Activities: Discussion*

**Pulping Part I**  
*Overview  
Topic 1: Mechanical Pulping  
Topic 2: Chemical Pulping – the Kraft Cycle Overview  
Topic 3: Chemical Pulping – Unit Operations  
Activities: Discussion; Knowledge Check 2: Woodyard and Pulping Intro*

**Week 4: Pulping Part II***Topic 1:  Continued Discussion on Unit Operations of the Kraft Pulping Cycle*

*Topic 2: Kinetics  
Topic 3:  Stock Prep and Brown Stock Washing  
Activities: Discussion***Week 5: Recycled Fiber Pulping Operations***Overview  
Topic 1: Waste Paper Sourcing  
Topic 2: Recycle Fiber Unit Operations  
Lab 1: Laboratory Testing – Pulp Testing Procedures  
Activities:  
Group Activity: Designing an RF Facility based upon the input material and the output specifications  
Knowledge Check 3: Pulping*

**Week 6: Bleaching**  
*Overview  
Topic 1: Mechanical Bleaching  
Topic 2: Chemical Pulp Bleaching  
Topic 3: Recycle Fiber Bleaching  
Lab 2: Laboratory Testing – Bleach Tests  
Activities: Discussion*

*Knowledge Check 4: Bleaching*

**Week 7: Midterm Exam and Chemical Recovery I***Activities:*

*Study Session*

*Midterm Exam*

**Chemical Recovery I**

*Overview  
Topic 1: Evaporators*

**Week 8: Chemical Recovery II**

*Topic 1: Recovery Furnace  
Topic 2: Lime Cycle  
Activities: Discussion*

**Week 9: Environmental Considerations***Overview  
Topic 1:  Water Treatment  
Topic 2:  Waste Water Treatment  
Topic 3:  Air  
Topic 4:  Other Regulatory Requirements  
Topic 5:  Mill White Water Closure  
Topic 6:  Sustainable Practices & Customer Expectations  
Lab 3:  Laboratory Testing – Environmental Testing Procedures  
Activities: Discussion; Knowledge Check 5: Environmental Considerations*

**Week 10: Papermaking Part I***Overview  
Topic 1:  Stock Prep  
Topic 2:  Refining  
Lab 4:  Laboratory Testing – Strength Curves  
Activities: Discussion*

**Week 11:  Papermaking Part II**  
*Overview  
Topic 1:  Stock Prep  
Topic 2:  Refining  
Topic 3:  Wet-end Operation/ Surface Chemistry  
Topic 4:  Unit Operations Overview*   
*Activities: Discussion,Term Paper Report Due, Knowledge Check 6:  Papermaking*

**Week 12: Papermaking Part III***Overview  
Topic 1:  Head box  
Topic 2:  Press Section  
Topic 3:  Drying  
Topic 4:  Specifications /end product  
Topic 5:  Fundamentals of paper physics  
Lab 5:  Laboratory Testing – Finished Product Testing Procedures*

**Week 13: Oral Presentations**

**Week 14: Review of Materials**

**Week 15: Final Exam**

*Activities: Final Exam*