

Course Syllabus

FORS 340-- FOREST PRODUCTS AND WOOD SCIENCE

3 Credits

Instructor:	Ed Burke Office: Stone Hall 105 Phone: 243-5157
Course Schedule:	Lecture Wednesday, 14:00.to 15:20, Gallagher 122 Laboratory Wednesday, 15:30 to 18:30, Gallagher 122 or, sometimes, in Stone Hall 102 (Wood Lab)
Lecture Exams:	2 Lecture exams scheduled as seen below in the weekly schedule
Lecture Final:	Lecture final scheduled as seen below in the weekly schedule
Laboratory Final:	Laboratory final scheduled as seen below in the weekly schedule
Special Lab Tour:	Tours of area forest products plants, if possible, will be set up and announced once the semester is underway.
Required Text:	FORS 340 Course Pack- from Burke for \$40
Outcomes:	At the end of the semester, successful students will be able to: <ul style="list-style-type: none">• Verbally and diagrammatically describe the different layers of the cell walls of Gymnosperm and Angiosperm xylem.• Recognize the three anatomical directions and three anatomical planes of wood specimens in hand or under the microscope• Verbally and diagrammatically describe the microscopic and macroscopic a tree's above and below-ground body and appendages• Identify several commercial wood products and describe the raw materials and processes that produce them• Determine the green lumber target size required to produce lumber of standardized dimensions given species, sawing, planing and drying parameters and desired lumber grade• Using ASTM standards, prepare specimens for static bending evaluation, perform the standard static bending tests and determine the as-tested strength values as specified in the standards.• Determine the dry and wet-basis moisture contents of wood and wood products using gravimetric and electrical resistance methods, as outlined in the ASTM standards.• Determine the specific gravity and density of woods using ASTM standardized methods.• Explain the correlation between tree growth characteristics and the mechanical and physical properties of wood.• Be able to identify and explain the manufacturing process of several wood and wood-based products, including:<ul style="list-style-type: none">○ Factory and Yard lumber types and grades○ Laminated beams and other edge and face-glued products○ Sliced and rotary-cut hardwood and softwood veneer○ Hardwood and softwood plywood types and grades○ Composite beam and panel products including Parallel Strand Lumber, Oriented Strand Board, Laminated Veneer Lumber, I-joists and Cross-Laminated Timbers and Panels○ Wood fiber-based products such as hardboard, low density fiberboard, medium density hardboard, paperboard, linerboard, tissue and writing paper

Manufacturing Facility Tours during Laboratory:

Typically, field trips and exercises showing different forest product manufacturing are conducted during laboratory periods throughout the semester, along with one special all-day trip to some Flathead Valley mills. Some laboratory exercises will also be held in the classrooms and in the Wood Science Laboratory, Stone 102. Any changes in the specific details of timing and conduct of these laboratory sessions will be announced in class.

This semester, COVID protocols preclude using University vehicles for transportation to field exercises and our mill tours. We may be able to offer tours of local plants, as well as exercises at Lubrecht forest using student-operated vehicles so long as proper distancing and other protocols are followed. The number of persons allowed in a student-operated vehicle used to attend a lab or field exercise will be announced prior to the proposed trip. These trips would be voluntary, and no requirements for attendance will be made. They will be offered as an optional learning experience to aid in the understanding of products and processes, but attendance will not be required.

Requirements for Laboratory Safety

No sandals or shorts are permitted on field trips.

- **Hard hats, eye & hearing protection and safety vests will be furnished and WORN at all times when on plant grounds and buildings.**
- **Field boots and gloves, in addition to the other Personal Protective Equipment, are strongly advised, especially for the Lubrecht field trip and the mechanical testing exercises.**

Course grading will be as follows:

(2) 1.5-hr. lecture examination during Week #5	300 pts.
(1) 2-hr. lecture final examination in Week #9	200 pts.
(1) 2-hr laboratory final examination	200 pts.
Total for Course	700 pts.
A = 90.00+ %; B = 80.00 – 89.99 %; C = 70.00 – 79.99 %; D = 60.00 – 69.99 %; F < 60.00 %	

Student Conduct Code

All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University. All students need to be familiar with the [Student Conduct Code](http://life.umt.edu/ypsa/student_conduct.php). http://life.umt.edu/ypsa/student_conduct.php.

Important Dates Restricting Opportunities to Drop Course Autumn 2020:

Days into Semester	Opportunities	Drop Dates
To 7 th instructional day	Last day for students to add Autumn classes via CyberBear without consent of instructor	27 August
To 15 th instructional day	Last Day that students can: <ul style="list-style-type: none"> • drop classes on CyberBear with refund & no "W" on Transcript • withdraw from all classes with a partial refund • add Autumn classes with electronic override on CyberBear • change Autumn credits in variable credit courses • change grade mode in CyberBear • change grading option to or from Audit buy or reuse UM's student health insurance coverage	8 September = last day
16 th to 45 th instructional day	Drop requires form with instructor and advisor signature, a \$10 fee from registrar's office; student will receive a 'W' on transcript, no refund.	8 September through 20 October

Days into Semester	Opportunities	Drop Dates
Beginning 46th instructional day	<ul style="list-style-type: none"> • adds & drops require a Course Add/Change or Course Drop form with instructor's & advisor's signatures; \$10 fee applies • drops require a Course Drop form with instructor's, advisor's, & Dean's signatures; \$10 fee applies • A 'WP' or 'WF' will appear on the transcript for dropped classes; No refunds • Students can change variable credit amounts, or change grading options, (except audit) using a Course Add/Change form with instructor's & advisor's signatures 	21 October– 18 November

Class Attendance Policy

- Students who are registered for a course but do not attend the first two class meetings may be required to drop this course. This rule allows for early identification of class vacancies to permit other students to add classes. Students not allowed to remain must complete a drop form or drop the course on the Internet (<http://cyberbear.umn.edu>).
- Students are expected to attend all class meetings and complete all assignments for this course. Student may excused for brief and occasional absences for reasons of illness, injury, family emergency, religious observance or participation in a University sponsored activity. (University sponsored activities include for example, field trips, ASUM service, music or drama performances, and intercollegiate athletics.) Students shall be excused for military service or mandatory public service.
- Students incurring an excused absence will be allowed to make up missed work when done in a manner consistent with the educational goals of this course.

Students expecting to incur excused absences should consult with the instructor early in the term so that they understand the absence policies for this course.

1 Introduction; Plant Cell Membrane and Wall Chemistry and Structure 8/19-20

Lecture: Since the semester is beginning on a Wednesday, there is no lecture meeting this week.

Laboratory; We will begin with an explanation of how the course will be conducted, including testing, lab expectations, field trips and grading. Course Packs will be distributed. Don't forget your \$\$\$. We will then move into a discussion of the chemical constituents and the architecture of the plant cell membrane and wall. Wood cell types and their features in both angiosperms and gymnosperms will also be covered, as well as a discussion of wood morphology and the anatomy of angiosperms and gymnosperms and how they relate to wood properties and appearance of the wood from the two types of trees. **Reading Assignment for Week 2;** Chapters 3 and 4 of the Course Pack. **Suggested Study Activity:** Review and draw diagrams of wood cell walls in transverse and face view, being able to show the relative layer thicknesses (transverse) and the S₂-layer microfibril angle (face view).

2 Tree and Wood Structure 8/26

Reading assignment to have completed before Week #2's Lecture; Chapters 3 and 4 of the Course Pack. **Lecture/Laboratory:** Discussions of primary and secondary growth of the tree; differences between Monocots, Eudicots and Gymnosperm stems; discussion of the origin, structure and function of the apical meristem, protoderm, ground meristem, procambium, vascular cambium and cork cambium. Students will learn how to describe and draw the three anatomical directions and three anatomical planes of secondary xylem. Periodic growth increments will be examined as well as sections from whole trees showing several growth increments. The macroscopic structure of several commercial softwoods and hardwoods will be examined and explained. **Reading Assignment for Week 3;** Review Chapters 3 and 4 of the Course Pack. **Suggested Study Activity:** Practice drawing the three planes and directions in different types of softwood and hardwood xylem (abrupt and gradual transitions in SW; Resin canals in SW; Ring, Diffuse and Semi-ring porous vessel element arrangement in HW; Wide and narrow rays in HW).

3 Gymnosperm and Eudicot Xylem Structure 9/2

Reading assignment to have completed before Week #3's Lecture; Review Chapters 3 and 4 of the Course Pack. **Lecture:** Microscopic examination of hardwood and softwood xylem structure.

Laboratory; Students will perform gross and microscopic examination of various species. Recognition of blocks and slides to be able to identify the type of wood, its growth ring features and identify 6-8 woods with hand lens or microscope. **Reading Assignment for Week 4;** Read Chapters 5 and 6 of the Course Pack. **Suggested Study Activity;** Come into Forestry 301 to practice use of the microscope and hand lens in the identification of wood slides and wood blocks.

4 Wood-Water Relations; Wood Shrinking and Swelling; Wood Density and Specific Gravity 9/9

Reading assignment to have completed before Week #4's Lecture/Laboratory: Read Chapter 5 and 6.

Lecture/Laboratory: A discussion of the type and location of water in wood. Discussion of moisture content measurement techniques and wood's orthotropic shrinking and swelling. We will explain terms like Fiber Saturation Point, Bound Water, Free Water, adsorption and desorption, etc. We will also discuss and work problems in determining wood density, moisture content, shrinking and swelling. **Laboratory;** Continuation of lecture topics with emphasis on problem solving for moisture content and dimensional changes with changes in moisture content. Students will also determine wood moisture content, density, specific gravity and total volumetric shrinkage of wood specimens. **Reading Assignment for Week 5;** Read Chapter 6 of the Course Pack. **Suggested Study Activity;** Review all lecture and lab material from Week #1 through Week #4. Practice identification of gross and microscopic wood features

5 Lecture Exam #1 Weeks 1-4 9/16

Reading assignment to have completed before Week #5's Exam: Lecture/Lab: Review of material covered in weeks 1-4. **Examination #1:** 2-hour Exam covering material from Weeks 1 through 4. **Laboratory Exercise yet to be confirmed:** Lumber milling exercise at Wood Science Laboratory's sawmills at Lubrecht Forest. Meet outside the Wood Lab's roll-up door no later than 14:10. Students will be shown and operate both circular and band headsaw mills. **NO SHORTS OR SANDALS!!** Wear forestry field clothes, including work gloves, long pants, button shirts, boots. **Reading Assignment for Week 6:** Chapter 6 in the Course Pack (Lumber) **Suggested Study Activity;** Review math problems.

6 Lumber Production 9/23

Reading assignment to have completed before Week #6's Lecture: Chapter 8 **Lecture:** Log scaling, Actual and Nominal lumber sizes, Lumber manufacturing and recovery factor, between and within board variation, various growth and manufacturing characteristics and fundamental lumber grading will be covered. Lumber production flow charts and equipment. Lumber grading and marketing. Determination of log scale, green lumber target sizes and marketing **Laboratory;** Examination of sawing theory, types of saw blades, planers and Dry Kilns. Examination of models of lumber stacked for drying. **Reading Assignment for Week 7:** Review Chapter 8 and read "End-Jointed Lumber" and "Glue-laminated Timbers and Beams" from Chapter 9. **Suggested Study Activity;** Practice determining green lumber target size, actual lumber sizes, computing board-foot volume in a lumber purchase, etc., computing Lumber Recovery Factor given input log cubic volume and bd.-ft. volume output.

7 Lumber Drying and Composite Lumber Products (Part 1) 9/30

Reading assignment to have completed before Week #7's Lecture: Review Chapter 8 and read "End-Jointed Lumber" and "Glue-laminated Timbers and Beams" from Chapter 9. **Lecture:** Discussion of air- and kiln-drying of lumber. Discussion of end-joining wood and the manufacture and use of laminated beams. laminated veneer lumber (LVL), cross-laminated timbers and panels (CLT), houselogs for the log home industry. **Laboratory:** Production of a 1/4-scale laminated beam. Students will work in teams of 4-5 to select laminations and lay-up a laminated beam to be broken and analyzed later in the semester. **Reading Assignment for Week 8:** Finish Chapter 9. **Suggested Study Activity;** Draw diagrams of the different types of end joints in wood, and the end view of a laminated beam indicating the general location of high, moderate and lower strength laminations.

8 Composite Lumber Products (Part 2) 10/7

Reading assignment to have completed before Week #8's Lecture: Chapter 9. **Lecture:** Discussion of the remaining products and processes in Chapter 9. Discussion of the industry, including the types of adhesives used to bond these products. Veneer products, such as Laminated Veneer Lumber will be introduced. **Laboratory.** Teams of 3-4 students will select veneer plies, spread adhesive, layup a beam, press and trim their own LVL billet. Teams will be scheduled for lab instruction sessions and billet layup operations. **Reading assignment to have completed before Week #9 Exams:** Chapters 1- 9 of the Course Pack, and notes from all lab exercises

9 Review for and Execution of Lecture Exam #2 on Moodle 10/13-15

Lecture/Laboratory; Review of material from Weeks 5-7. Moodle Exam covering lab exercises and products covered in the first 8 weeks of the course. Photos and diagrams of different products, raw materials and tools/machinery will be identified, as well as calculations of bd. ft. volume, lumber weight and value, determination of moisture content and specific gravity. Time when test available to take will be announced during a prior class. **Reading assignment to have completed**

before Week #9's Lecture: Review of all lecture and lab materials covered so far in the semester.

Reading Assignment for Week 10: Chapter 10 of the Course Pack. **Study Suggestions for Week 10:** Take a much-needed break from review and concentrate on Chapter 10!!

10 Engineered Structural Panels and Beams 10/21

Reading assignment to have completed before Week #10's Lecture: Chapter 10 of the Course Pack

Lecture/Laboratory: Manufacturing processes and uses of Plywood, Oriented Strand Board (OSB), laminated veneer lumber (LVL), parallel strand lumber (PSL), structural composite lumber (SCL), cross-laminated timber (CLT) panels and I-joists. **Reading Assignment for Week 11:** Chapter 10 of the Course Pack. **Study Suggestions for Week 11:** Review notes from mill tours

~~**10 Flathead Valley All-Day Trip: Monday** (06:30—18:00) trip to Flathead Valley Wood Products mills. View manufacturing processes used in manufacture of cross-laminated timbers, plywood and lumber. Bring sack lunch, drinks and snacks, and wear field clothing. Hardhat and other PSE provided. Meet no later than 06:30 at Campus Security to load up in University Vehicles and return at 18:00 hrs. Full field gear including hardhat and other PSE required.~~

11 Non-structural Panels 10/28

Reading assignment to have completed before Week #11's Lecture: Chapter 10 of the Course Pack.

Lecture/Laboratory: Manufacturing processes and uses of particleboard, medium density fiberboard (MDF) and Hardboard. ; Optional Tour of Roseburg Forest Products particleboard plant in Missoula. NO SHORTS OR SANDALS!! Wear forestry field clothes, including long pants, button shirts and boots. Hardhats and other Personal Protective Equipment (PPE) will be provided. **Reading Assignment for Week 12:** Chapter 11 of the Course Pack. **Study Suggestions for Week 11:** Review notes from Field trips

12 Pulp and Paper 11/4

Reading assignment to have completed before Week #12's Lecture: Chapter 11 of the Course Pack.

Lecture/Laboratory: -mechanical, semi-chemical chemical pulping processes, recycled paper technology and Kraft paper production presented. **Reading Assignment for Week 14:** Review all chapters of the Course Pack. Review **Study Suggestions for Week 11:** Review notes from Field trips

13 Mechanical Properties of Wood 11/10-12

Reading assignment to have completed before Week #14's Lecture: Chapter 7 of the Course Pack.

Lecture/Laboratory: **NO WEDNESDAY LAB-VETERANS' DAY HOLIDAY. folks need to get to the Thursday lecture/lab. Thursday Lecture/Lab group:** A discussion of the mechanical properties of solid wood, as well as the physics and engineering used in their evaluation.

Introduction to standardized mechanical test methods, and explanation of static bending testing of dimension lumber tested as a simply-loaded joist. **Laboratory Exercise:** Mechanical Testing Exercise. Groups of 3-4 students will use the Tinius Olsen universal testing machine to conduct static bending testing of their scale model laminated beams made in Week 8, following the methods of ASTM Standard D-143. Calculation of moisture content, specific gravity, Modulus of Elasticity and Modulus of Rupture will be made by each group, with each student performing their own calculations and writing a full report of the exercise. **Reading Assignment for Week 15:** Review all chapters of the Course Pack. Review **Study Suggestions for Week 11:** Review notes from lecture and lab; practice math problems;

14 Lecture and Laboratory Finals—Held on Moodle 11/17

Lecture/Lab Final: A 1.5-hour lecture final covering entire course, but 75% of the questions will pertain to material covered since Examination #2.

The laboratory portion of the final will cover identification the gross and microscopic identification of selected species of wood as well as the identification of specimens of wood products and various raw materials, finished products, tools and equipment used in the manufacture of the products covered during the semester. Some simple mathematical computations (moisture content, specific gravity etc.) similar to those on the lecture final and Examinations #1 & 2 may also be present on the Lab Final.

15 Finals Week (cont.) 11/19, 20; 11/23-25

Lecture and Laboratory exams will be graded and final grades computed.