NREM 1213, INTRODUCTION TO WOOD PROPERTIES AND WOOD PRODUCTS

Spring 2015

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CLASS : Tuesdays-Thursdays 12:30-1:20 am, Room 019, Agricultural Hall
LAB : Thursdays 2:00-3:50 pm, Room 019, Agricultural Hall

OBJECTIVE :

The objective of this course is to develop basic understanding of anatomical, physical, and mechanical properties of solid wood and wood products. Principles of lumber manufacturing, veneer and plywood production, biological deterioration of wood and preservation techniques will be covered. Some of the basic concepts of manufacturing of wood composites including particleboard, fiberboard, oriented strandboard, and engineered wood composite panels as well as pulp and paper manufacture will also be reviewed.

CLASS NOTES :

This is not a textbook, it is a collection of drawing, graphs, and copies from various sources which illustrate important principles of the subject that will be discussed within the course. The student is suggested to take additional notes directly on these pages during the lecture. Also additional reading assignments from various resources will be given during the class.

GRADING :

1- Exam 1..............................215 points
2- Exam 2..............................215 points
3- Homework and lab. reports.......180 points
4- Class attendance......................20 points
5- Final Exam............................370 points

Total .....................................1000 points

LABORATORY REPORTS :
Each student should prepare a brief report describing laboratory including sample preparation, test procedure etc. Reports should be typed. A total of 9 laboratory reports should be submitted throughout the course.

**Laboratory Report Subjects:**

1. Wood Physics - Moisture content
2. Wood Physics - Shrinkage, swelling
3. Wood Mechanics
4. Plywood manufacture
5. Field trip
6. Field trip
7. Field trip
8. Wood composites

**FIELD TRIPS:**

Field trips to three wood products manufacturers located in South Eastern Oklahoma will be arranged. Tentatively we will be leaving on April 9 (Thursday) morning and returning on April 10 (Friday) late afternoon. Field trips are mandatory and the students will prepare reports about each plant visited.
Spring 2015 CLASS OUTLINE:

WEEK 1…JAN.12- JAN. 16…………WOOD ANATOMY
1- Introduction to wood structure
2- Plant taxonomy
3- Porous structure of wood, xylem, phloem, and bark
4- Growth rings, springwood (earlywood), summerwood (latewood)
5- Heartwood versus sapwood
6- Juvenile wood and mature wood
7- Tangential, radial, and longitudinal directions
8- Structure of cellwall
9- Primary cellwall, secondary cellwall, middle lamella

LAB. 1 : 1- Introduction to macroscopic and microscopic wood identification
2- Macroscopic feature of softwood and hardwoods, using 10X hand lens
3- Key for macroscopic wood identification
4- Microscopic identification
5- Elements of a microscope
6- Preparing hand cut sections
7- Microtome and principles of sectioning
8- Identifying hardwood and softwood sections

WEEK 2……JAN.19- JAN.23…………WOOD PHYSICS.
1- Structure of cellwall
2- Chemical structure of cellwall
3- Hardwood cell types
4- Pit structure and pit aspiration
5- Density and specific gravity of wood
6- Determination of density and specific gravity
7- Cell wall and porosity
8- Effect of specific gravity on wood properties
9- Wood and moisture relationship
10- Moisture content in wood
11- Bound water and free water
12- Adsorption and absorption
13- Relative humidity and its measurement

LAB. 2 : 1- Determination of moisture content of wood and wood composites
2- Ovendry method
3- Electrical resistance moisture meters

WEEK 3……JAN.26- JAN.30……WOOD PHYSICS
1- Hygroscopicity of wood
2- Shrinkage and swelling of wood
3- Fiber saturation point (FSP) and its effect on shrinkage and swelling of wood
4- Equilibrium moisture content (EMC)
5- Shrinkage coefficient
6- Absolute humidity and relative humidity
7- Measurement of relative humidity

LAB. 3 : 1- Measurement of shrinkage and swelling
         2- Shrinkage and swelling calculations
         3- Determination of shrinkage and swelling of various species

WEEK 4........FEB. 2. -FEB. 6...... WOOD DRYING

1-Objectives of wood drying
2-Effect of wood drying on wood properties.
3-Basics principles of air drying and kiln drying
4- Developing dying stresses
5- Drying schedule
6-Drying defects

LAB. 4: Drying stresses and dry kiln operation
       (Training video)

WEEK 5.........FEB.9- FEB.13........LUMBER MANUFACTURING

EXAM – 1. FEB. 7 (Thursday)

1- Introduction to lumber manufacturing
2- Timber conversion chart
3- Log yard and log pond
4- Debarking process
5- Primary breakdown-Headrig
6- Secondary breakdown
7- Lumber classification

LAB. 5 : Exam -1 (Feb. 12 Thursday)

WEEK 6.........FEB.16– FEB.20...... WOOD MECHANICS

1- Definitions of stress and strain
2- Stress-strain relationship
3- Modulus of elasticity (MOE) and modulus of rupture (MOR)
4- Development of compression and tension stresses in bending of wood.
5- Shear stresses in wood
6- Basic mechanical tests of wood
7- Dynamic MOE, orthogonal planes of wood
8- Creep and its effect on wood utilization

LAB. 6 : No lab. for Field trip

WEEK 7.........FEB.23-FEB. 27........ WOOD MECHANICS
1- Factors affecting the strength of wood.  
    (Moisture content, temperature, and fatigue)
2- MOE and MOR calculations

LAB. 7:  1-Static bending test  
          2-Compression parallel to the grain of wood test  
          3-Calculation of MOE and MOR

WEEK 8.....MARCH 2 - MARCH 6 ............ VENEER AND PLYWOOD MANUFACTURING

1-Definition of plywood  
2-Basics of plywood construction  
3-Heating and steaming of veneer logs  
4-Rotary cutting veneer manufacturing  
5-Slicing veneer manufacturing  
6-Plywood manufacturing process  
7- Softwood and hardwood veneer  
8- Veneer drying  
9- Application of glue in plywood manufacture  
10- Pressing operation

LAB. 8 : Plywood manufacture in the lab.

WEEK 9....MARCH 9- MARCH 13  BIODETERIORATION OF WOOD

1-Fungi, bacteria, insects, marine borers and physical degradation.  
2-Protection of wood against biodeterioration  
3-General characteristics of fungi  
4-Requirements of fungi growth  
5-Decay fungi, sapstain, and mold  
6-White rot, brown rot, and soft rot  
7-Wood staining fungi  
8-Prevention of sapstain  
9-Deterioration of wood by termites, carpenter ants, powder post beetle.

LAB. 9 : Powerpoint presentation and discussion of biodeterioration of wood

WEEK 10 ........MARCH 16 - MARCH 20 ............ SPRING BREAK
WEEK 11........MARCH 23 - MARCH 27....... WOOD PRESERVATION

1- Objective of wood preservation
2- Wood preservation in the USA
3- Tar oil preservatives
4- Organic solvents preservatives
5- Waterborne preservatives
6- Fire retardants
7- Preparation of wood for preservation
8- Non-pressure preservation process
9- Pressurized preservation processes
   (Full cell and empty cell methods)
10- Retention and penetration
11- Properties of treated wood affecting end use
12- Testing of preservative treated wood
13- Preparation of wood for preservation
14- Non-pressure preservation process

LAB. 11 : Exam -2 (March 26 - Thursday)

WEEK 12.......MARCH 30 – APRIL 3..... WOOD PRESERVATION AND FINISHING

1- Properties of treated wood affecting end use
2- Testing of preservative treated wood
3- Basics of wood finishing and sanding
4- Stains, bleaches, application of topcoats

LAB. 12:  No lab for field trip

WEEK 13.......APRIL 6- APRIL 10........WOOD COMPOSITES

1- Classification of wood composites
2- Raw material characteristics
3- Particle and fiber manufacture
4- Furnish drying (rotary dryers)
5- Resin and wax application
6- Resin classification
7- Mat forming and board density
8- Hot pressing
9- Sanding and finishing and surface lamination

LAB. 13 : Material calculation for wood composites
Manufacture of particleboard and fiberboard panels in laboratory conditions.

WEEK 14.........APRIL 13- APRIL 17.......WOOD COMPOSITES

1- Fiberboard manufacture
2- Wet and dry process fiberboard
3- Medium density fiberboard
4- Hardboard
5- Raw material preparation for structural composites
6- Oriented strandboard (OSB),
7- Properties of structural wood composites
8- Composite lumber products, LVL, PSL
8- Testing of wood composites

LAB. 14: Overlaying of particleboard and fiberboard panels and evaluation of their surface quality.

WEEK 15.....APRIL 20 - APRIL 24.....PULP AND PAPER MANUFACTURE

1- Classification of paper manufacture
1- Preparation of pulpwood
2- Beating and refining
3- Paper making machines, fourdrinier
4- Drying, calendaring, reeling, and wrapping.
5- Testing of properties of paper.

LAB. 15: Pulp and paper manufacture video and discussion.

WEEK 16..........APRIL 27 – MAY 1   GENERAL REVIEW

(PRE-FINALS WEEK)

FINAL EXAMS: MAY 4 - MAY 8, 2015