Approved by
111th Meeting of the Academic Council
held on 16-7-09

M.Sc. (Wood Science)

College of Forestry
KERALA AGRICULTURAL UNIVERSITY
KAU (PO), Thrissur- 680 656

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DEPARTMENT OF WOOD SCIENCE
MSc Courses

Code	Course Title	Credits
WST 501*	Forest Products – Chemistry and Industries	1+1
WST 502*	Wood Variation	2+1
WST 503*	Identification of Wood	0+2
WST 504	Chemistry of Wood	1+1
WST 505*	Developmental Anatomy of Woody Plants	1+1
WST 506*	General Properties of Wood	2+1
WST 507	Seasoning and Preservation of Wood	2+1
WST 508	Paper and Pulp Technology	2+1
WST 591	Master's Seminar	0+1
WST 599	Master's Research	0+20

* Compulsory for Masters programme

The advisory committee at its discretion may decide on additional courses from other departments of the college as "major courses" depending on the research needs of the student concerned and the availability of such courses.

1. WST 501 FOREST PRODUCTS – CHEMISTRY AND INDUSTRIES 2+1

Objective

This course will provide the students the basic information about important wood based industries of our country such as plywood, fibre board, particle board, improved wood and paper and pulp. It will also impart information on how this industry influences the economy of the country. Practicals are designed to make the students understand the basics of the manufacturing procedures of pulp, paper, plywood, laminated wood and particle board etc.

Theory

Unit I

Wood as an industrial raw material. Demand and supply of wood in national and international markets. Utilization of lesser used species.

Unit II

Pulp and paper manufacturing. Pulping - mechanical, chemical, semi-chemical and semi-mechanical, beating, bleaching, sizing, sheet formation. Types of paper and requirement of raw materials.

Unit III

Manufacture of rayon and other cellulose derived products. Composite wood - plywood, laminated wood, core board, sandwich board, fibre board, particle board, their manufacturing process,

Unit IV

Improved wood – compressed wood, Improved wood-Compressed wood, Impregnated wood, Compregnated wood, Heat stabilized wood, Chemically modified wood, densified wood. Uses and scope.

Unit V

Principles of destructive distillation of hard and soft woods. Production of wood molasses, alcohol, yeast and other byproducts from wood hydrolysis.

Practical:

Estimation of cell wall contents – Cellulose and lignin. Visit to wood based industries to understand the manufacturing procedures of pulp, paper, plywood, laminated wood and particle board.

Suggested Readings

Forest Research Institute. *Indian Forest Utilization*. Vol I and II. FRI, Dehra Dun

Mehta T. 1981. *A Handbook of Forest Utilization*. Periodical Expert Book Agency.

Trotter H. 1982. *Manual of Indian Forest Utilization*. FRI & College, Dehra Dun.

Wadoo MS. 1992. *Utilization of Forest Resources*. IDRIS Publ.

2. WST 502 WOOD VARIATION 2+1

Objective

This course is designed to provide information about variation in wood properties of timbers at the species, provenance, stand, between trees and within tree levels. The course will also expose the students to the effect of accelerated rate of growth on wood quality and also to the genetics of wood properties. Practicals are designed to equip the students with determination of various wood properties.

Theory

Unit I

Wood properties - specific gravity, cell length, and other wood characteristics. Factors controlling wood properties, relationships among wood properties.

Unit II

Wood variation related to species and provenance. Wood properties of trees grown as exotics. Variation within and among trees.

Unit III

Wood property variation as related to tree form and reaction wood. Effect of growth rate on wood properties - growth rate and specific gravity in conifers and hard woods. wood properties affected by environmental, biological and other external agencies - effect of site, soil, climate, and pests and diseases.

Unit IV

Effect of silvicultural practices on wood properties - nutrient deficiency, fertilization, spacing, pruning on wood properties.

Unit V

Genetics of wood properties. Control of wood properties by breeding. Future importance of knowing and manipulating wood quality.

Practical:

Determination of wood properties such as density, moisture content, cell length, wall thickness etc. of wood samples.

Suggested Readings

Panshin, A. J. and de Zeeuw, C. 1980. *Textbook of Wood Technology*. New York: McGraw Hill Book Company.

Zobel, B.J. and van Buijtenen, J.P. 1989. *Wood Variation: Its Causes and Control*. Springer-verlag, New York.

3. WST 503 IDENTIFICATION OF WOOD 0+2

Objective:

The course deals with the use of physical and anatomical features of wood for timber identification. Usage of keys for timber identification are also dealt with.

Practical:

Timber identification and its importance. Procedures for field identification of timbers. Study of physical features of wood. Study of gross features of wood. Study of anatomical features of wood. Pores or vessels, different types. Study of soft tissue in timbers and their different types and distributions. Study of wood rays, and their different types. Study of the non porous woods, their physical and anatomical description. Study of infiltration and inclusions in wood. Anatomical keys and methods to use them. Dichotomous keys, punched card keys and computer aided identification. Field identification of important timbers of Kerala. Anatomical studies of reaction wood. Modern timber identification techniques.

Suggested Readings:

Brown, H.P. 1985. *Manual of Indian Wood Technology*. International Books and periodicals supply service, New Delhi.

Luxmi Chauhan and Vijendra Rao. 2003. *Wood Anatomy of Legumes of India*. Bishen Singh Mahendrapal Singh. Dehra Dun. p. 220

Pearson, R.G. and Wheeler, E. A. 1981. *Computer Aided Identification of Hardwood Species*. IAWA Bull. n.s., Vol. 2 (1). Pp 37-40.

Rao KR and Juneja KBS. 1992. *Field Identification of 50 Important Timbers of India*. ICFRE, Dehra Dun. 52 p

4. WST 504 CHEMISTRY OF WOOD 1+1

Objective

To impart knowledge about the chemical properties of wood, cell wall constituents and wood extractives.

Theory

Unit I

Chemical constituents of wood and their determination

Unit II

Occurrence of cellulose, hemicellulose and lignin in different morphological regions of cell wall and their effect on physicochemical properties of wood.

Unit III

Effect of heat, light, acids, bases and microbes on wood constituents. Wood extractives - formation, isolation and characterization of various extractives namely - tannins, polyphenols, resins, gums and waxes.

Practical:

Estimation of cellulose, lignin and extraneous components of wood volatile oils, gums, resins and tannins.

Suggested readings

David N-S Hon and Nobuo Shiraishi. 2000. *Wood and Cellulosic Chemistry* (second edition). Marcel Dekker.

Higuchi, T. 1997. *Biochemistry and Molecular Biology of Wood*. Springer. 362 p.

5. WST 505 DEVELOPMENTAL ANATOMY OF WOODY PLANTS 1+1

Objective

This course equips the student with the knowledge of developmental anatomy of woody plants with particular emphasis on processes of wood formation. The gross as well as fine structural features of major Indian timbers as well as bamboos and canes are also dealt with.

Theory

Unit I

Types of plants producing wood, characteristics of woody plants. Soft wood and hard wood.

Unit II

Developmental anatomy of wood - processes of wood formation. Tissue types and functions, organization of cell wall, reaction wood. The tree - parts of the tree and how a tree grows.

Unit III

Extent of secondary thickening and development of a tree trunk, cambial zone and cambium, kinds and arrangement of cambial initials, shape and size of cambial initials in hard woods and soft woods, enlargement of xylary cells and increase in cambium.

Unit III

The gross features of wood of value in identification. Wood rays, increment, sapwood and heart wood, wood parenchyma, resin and gum canals. Detailed anatomical structure of a few Indian hard woods, bamboos and canes.

Unit IV

Comparative wood anatomy of Angiosperms and Gymnosperms. Anomalous secondary growth. Wood formation in monocotyledons. Minute structure of compression wood and tension wood.

Practical:

Field identification of a few timber species. Microtomy of a few selected hard woods - staining techniques, preparation of slides. Maceration techniques and determination of the sizes of cellular components of wood.

Suggested readings

Wilson, K and White, D.J.B.1986. *The Anatomy of Wood: Its Diversity and Variability*. Stobart and son Ltd.

Brown, H.P. 1985. *Manual of Indian Wood Technology*. International Books and periodicals supply service, New Delhi.

Zobel, B.J. and van Buijtenen, J.P. 1989. *Wood Variation: Its Causes and Control.* Springer-Verlag, New York.

Panshin, A. J. and de Zeeuw, C. 1980. *Textbook of Wood Technology*. McGraw-Hill Book Company, New York

6. WST 506 GENERAL PROPERTIES OF WOOD 2+1

Objective

To acquaint the students with the physical characteristics and strength properties of wood.

Theory

UNIT I

Gross and fine structure of wood. Physical properties of wood- colour, weight, odour, lustre, wood density, specific gravity and methods of determination.

UNIT II

Moisture content and its measurement. Wood-water relationship. Fibre saturation point v/s shrinkage.

UNIT III

Thermal properties -conductivity and diffusivity. Extractives and its effect on various wood properties. Electrical properties - conductivity, dielectric constant and current resistivity.

UNIT IV

Mechanical properties - stress-strain relation in wood, elastic properties, plasticity. Vibration properties. Standard tests for timbers - compression, tensile strength, abrasion, brittleness and hardness. Rheological behavior of wood – creep in wood. Suitability coefficients and indices of different wood species. Defects in wood, wood seasoning and preservation.

Practical:

Determination of wood density, study of thermal, electrical and acoustic properties of wood. Determination of tensile and bending properties of wood.

Suggested readings

Mehta T. 1981. *A Handbook of Forest Utilization*. Periodical Expert Book Agency.

Trotter H. 1982. *Manual of Indian Forest Utilization*. FRI & College, Dehra Dun.

Wadoo MS. 1992. *Utilization of Forest Resources*. IDRIS Publ.

7. WST 507 SEASONING AND PRESERVATION OF WOOD 2+1

Objective

To understand the important techniques of wood seasoning and preservation for better utilization of secondary and lesser used timbers for varied end uses.

Theory

UNIT I

General principles of wood seasoning - objects of seasoning, forms of moisture, diffusion of bound water. Effect of temperature, relative humidity, air circulation, species, initial moisture content, grain direction and thickness of timber on rate of drying.

UNIT II

Classification of timbers according to their seasoning characteristics. Storage of logs in water and on land. Stacking of timber for air seasoning including methods of stacking of railway sleepers, poles and posts. Seasoning sheds.

UNIT III

Wood seasoning procedures - air seasoning, kiln seasoning - design and testing of seasoning kilns. Behaviour of seasoned timber in use. Moisture content of timber for different uses in different localities.

UNIT IV

Wood chemistry. Agents responsible for wood deterioration. Fungi, bacteria, insects, marine borers. Chemistry, biochemistry and biology of fungal decay. Micro-structural changes in wood due to fungal attack- Brown rot, white rot, dry rot and soft rot of timber-decay of standing trees and stored logs.

UNIT V

Wood boring insects. Natural durability of timber. Wood preservation: basic principles, preservative chemicals. Different wood preservation techniques. International Research Group on Wood Preservation.

Practical:

Determination of moisture content and swelling coefficients of different woods. Comparative studies on air and kiln dried woods. Analysis of decayed wood for physical and chemical parameters. Treatment of wood with different types of preservatives.

Suggested Readings:

Brown H P. *A Manual of Indian Wood Technology*.
Eaton RA and Hale MDC *Wood: Decay, Pests & Protection*
Findlay WPK. *Preservation of Timber in the Tropics*
FAO. *Wood Preservation Manual* by (FAO Forestry Paper No. 76)
A Handbook of Indian Woods and Wood Panels (Indian Academy of Science)

8. WST 508 PAPER AND PULP TECHNOLOGY 2+1

Objective:

To acquaint the students with the various stages of pulping and paper making. The course will also familiarize the students with chemistry of pulping as well as the types, properties and testing of paper, the knowledge that is essential for careers in this industry.

Theory

UNIT I

Stages in pulping and paper manufacture. Pulping; mechanical, chemical, semi-chemical and semi-mechanical. Mechanical pulping. Chemical pulping – alkali and

acid process. Soda process. Sulphate process. Kraft process. Semi-chemical process.

UNIT II

Pulp cleaning. Pulp bleaching. Stock preparation and sheet formation. Paper machine - wet end additives. Wet end operations. Dry end operations. Paper machine - principles of forming paper, steam drying and its effects. Coating and finishing - different coating principles, blade, rod metering etc. and supercalendering. Surface treatments. Finishing operations.

UNIT III

Classification, properties and testing of paper. Types and categories of paper and paper boards. properties of paper. and testing of pulp and paper. basis weight or grammage, bulk, curl, dimensional stability, moisture, smoothness. Optical properties. Brightness, whiteness and color. Strength properties. Bursting strength, tearing resistance, tensile strength, wet strength.

UNIT III

Pollution control. Water pollution control. Air pollution control. Effluent treatment. How the different waste water streams from each of these operations are treated.

Practical:

Various tests carried out to know the strength of paper and pulp.

Suggested Readings:

Christopher J. Bierman, 1993. *Handbook of Pulping and Paper Making*. Academic Press, California, 2nd Edition.

David N-S Hon and Nobuo Shiraishi. 2000. *Wood and Cellulosic Chemistry* 2nd ed.

Gary A. Smook. 2003. *Handbook for Pulp & Paper Technologists* (3rd Edition).

WST 591	**SEMINAR**	**0+1**
WST 599	**MASTER'S RESEARCH**	**0+20**