SYLLABUS
(Credit based)

FOR

MSc. Programme
In

"Wood Science &Technology"

AT

FOREST RESEARCH INSTITUTE
DEEMED UNIVERSITY

DEHRADUN- 248006

Programme Objective: The Master in Wood Science and Technology programme aims to provide opportunity to the students wishing to pursue professional careers in science and technology of wood as natural resource and to make themselves aware about the problems related to wood as basic material to manufacture various useful products. The structure of the curriculum is designed to synthesize multi-disciplinary knowledge in the biological and physical science of wood and its industrial application. The syllabus comprises of basics of wood anatomy, chemistry, physics, mechanics as well as processing knowledge and techniques to manufacture solid and composite wood products. The programme is designed to improve the qualitative, quantitative and futuristic aspects of students. Students are also expected to improve their capacities as leaders and managers through study tour, industrial attachment and excursions and other opportunities. Human Resource Management and Marketing and Enterprise Development are also the part of syllabus to build their entrepreneurial skills and aptitude.

Programme structure: The programme consists of courses and other requirements worth a total of 90 credits. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week. Each semester will consist of 18 to 20 weeks of academic work equivalent to 90 actual teaching days. The programme structure and respective credits are given below as:

Programme Structure		Credits
Core course	:	59
Foundation courses	:	7
Elective courses	:	5
Masterôs thesis	:	12
Master thesis seminar	:	2
Study tour	:	2
Industrial Attachment	:	3
Total	:	90

Allotment of credits to different courses

FIRST SEMESTER

Course Code	Course	Credit	
		Theory	Practical
Foundation Course			
WOC 101	Orientation Course (Wood Science, Basic Forestry, Basic Botany)	2	.-
WCA 102	Computer Application	-	1
Core Course			
WWC 111	Wood Chemistry	2	1
WWP 112	Wood Physics - I	2	1
WWP 113	Wood Physics - II	2	
WSM 114	Sawmilling and Saw Doctoring	2	1
WWA 115	Wood Anatomy- I	2	1
WWA 116	Wood Anatomy -II	2	
WEM 117	Timber Entomology and Microbiology	3	1
Total credits in first semester		**17^a +6^b =23**	

SECOND SEMESTER

Course Code	Course	Credit	
		Theory	Practical
Foundation Course			
WSM 201	Statistics and Research Methodology	1	1
Core Course			
WTM 211	Timber Mechanics -I	2	1
WTM 212	Timber Mechanics -II	2	
WWP 213	Wood Preservation -I	2	1
WAD 214	Composite Wood I - Adhesives	2	1
WPW 215	Composite Wood II - Plywood	2	
WWS 216	Wood Seasoning - I	2	1
WWW217	Wood Working	2	1
Total Credits		**15**	**6**
Total credits in second semester		**15^a +6^b =21**	

THIRD SEMESTER

Course Code	Course	Credit	
		Theory	Practical
Core Course			
WWS 311	Wood Seasoning -II	2	1
WWP 312	Wood Preservation II	2	1
WWF 313	Wood Finishing	2	1
WRW 314	Composite Wood III-Reconstituted Wood	2	1
WLW 315	Composite Wood IV- Laminated Wood	2	
WTE 316	Timber Engineering	2	1
WPD 317	Products Design and Fabrication	2	1
WST 318	Study Tour	2	
WIA 319	Industrial attachment and Report	3	
Total credits in third semester =		**14^a +6^b +2^c+3^d =25**	

FOURTH SEMESTER

Course Code	Course	Credit	
		Theory	Practical
Foundation Course			
WHR 401	Human Resource Management	1	-
WME 402	Marketing and Enterprise Development	1	-
Elective Courses		**5**	
WFC 421	Forest Certification and Nano-technology	5	-
WFJ 422	Finger Joints for Efficient Wood Utilization	3	2
WVS 423	Vaccum Seasoning Technology	3	2
WMT 441	**Master 's thesis**	12	
WMS 442	**Master thesis seminar**	2	
Total credits in fourth semester		**$2^a+5^b+12^f+2^g=21$**	

a- Theory, b- Practical, c- Study tour, d- Industrial attachment, e- Elective paper, f- master thesis report, g-seminar . One lecture credit comprises of one hour teaching of the course in a week, while one practical credit comprises of two hours of practical/assignment work in a week

Descriptions of Course Code

The courses of M. Sc. programme are divided into four series:

- 100-series courses pertain to first semester
- 200-series courses pertain to second semester
- 300-series courses pertain to third semester
- 400-series courses pertain to fourth semester
- Credit for Masterôs thesis and Master thesis seminar is designated by code no. 441 by 442 respectively.

Course code is formulated as:

- First alphabet shows programme
- Second and third alphabet shows course name
- First digit shows semester number
- Second digit shows course type (0= foundation, 1= core, 2= elective)
- Last digit shows course number

I[st] SEMESTER

FOUNDATION COURSE

WOC 101 **ORIENTATION COURSE**

LEARNING OBJECTIVES: The knowledge about basic botany, history of forestry in India and classification of wood based industries and their current status is important prior to give core subjects lectures. All these topics are covered in this course. The course also describes the scope and opportunities in wood science.

MODULE I BASIC BOTANY

- Importance of Forest Botany in Wood Science and Technology. Bendam and Hooker system of plant classifications. Name changes nomendacture of commercial tree species and its significance in judicious utilization of timber. Field characters morphology of 10 families. How to consult Forest Floras

MODULE II BASIC FORESTRY

- Status of Indian Forestry, forest types, changing trends in social agro and plantation forestry, National Forest Policy and its salient changing features. Historical background of forestry and forest product research. Status of wood utilization research and broadening horizons of research at various ICFRE, CSIR and other institutes

MODULE III INTRODUCTION TO WOOD SCIENCE

- Supply and demand status of wood, export and import of timber, its products and channels. Growth of wood based industry in India, effect of globalization. Role of skilled manpower in this sector. Brief status of solid wood, reconstituted and handicraft industry; such as wood carving, basketry, executive desk accessories, furniture, joinery, cabinets, sport goods, saw mills, wood seasoning, flooring and paneling, automobile body building, wood treatment, wood preservation, building construction, packaging and boats. Other areas like plywood, block boards, flush doors, MDF and fiber board, particle board, laminated wood, bamboo board, wood wool, wood adhesives, match wood, cooling towers, wooden houses/ bamboo huts and log cabins. Career in wood science and technology and scope of innovation changing trends from solid wood to functional panels and composite material

WCA 102 **COMPUTER APPLICATION**

LEARNING OBJECTIVES: The course is designed to teach students basic level computer programme like DOS, internet, Microsoft office and Statistical software like SPSS and Auto-cad are also covered in this course.

PRACTICAL

MODULE I INTRODUCTION

- Introduction to computers, block diagram of a computer system, Basic parts of a computer: Processor, RAM, Hard Disc, monitor, CD/DVD Writer. Types of monitors and printers. Introduction to operating systems: DOS, Windows, UNIX

MODULE II MS OFFICE

- Presentation: Introduction to MS PowerPoint, Creation of slides, slide layout, inserting graphs and photos in the slides, animation in slides, slide transition, use of slide sorter, slide show and printing of handouts. Electronic Spreadsheet: Introduction to MS Excel, worksheet, workbook, data entry, formula entry for calculations and creation of graphs. Word Processor: Introduction to MS Word, basic features like creation of a file, editing features, printing and saving of a file with password protection
- Data base system: Introduction to MS Access, creating a new database, editing a database table, searching and displaying of data, printing of data from an access database

MODULE III AUTO-CAD

- Introduction of AutoCAD
- Drawing Settings, Drawings Tools- Line, Polyline, Rectangle, Polygon, Arc, Circle, Ellipse, Spline,
- Modify Tools ï Copy, Mirror, Erase, Array, Offset, Move, Rotate, Scale, Stretch, Trim, Extend, Break, Join, Chamfer, Fillet, Boundary, Region
- Drawing and Modifying Objects
- Inserting Layers, Table, Text, Blocks
- Formatting Layers, Text Style, Table, Blocks
- Dimension, Inquiry, Block Editor, Commands

CORE COURSE

WWC 111 **WOOD CHEMISTRY**

LEARNING OBJECTIVES: The basic aim of the course is to explain the students about general chemistry of wood components, chemicals/ extractives present in wood, their utilization and spectroscopic techniques to analyse and characterize them.

MODULE I CHEMICAL CONSTITUENTS OF WOOD

- Chemical constituents of wood and bark, Cellulose: structure, chemical properties, effect of acids and bases. Hemi-cellulose: structure, chemical properties, effect of acids and bases. Lignin: structure and chemical properties
- Variation of major constituents in different morphological regions of wood. Extractives in some prominent timber species and their importance. Resins, oleo resins, gum oleo resins in some characteristic woods. Gums in some prominent timber species with special references to larch arabinogalactan, Gum Arabic, Gum Karaya, Gum Ghatti, Gum Tragacanth etc

MODULE II EXTRACTION OF CHEMICALS FROM WOOD

- Pyrolysis of wood. Eco-friendly dyes from bark and wood. Tannins: Introduction, structure and properties in characteristic wood and barks
- Isolation of extractives from wood and bark and separation of secondary metabolites using chromatographic techniques

MODULE III INDUSTRIAL UTILIZATION OF WOOD EXTRACTIVES

- Industrial utilization of wood and bark extractives such as natural rubber, resin and turpentine from pines, tannins, gums, resins, pharmacologically active metabolites and future directions for their utilization

MODULE IV SPECTROSCOPIC TECHNIQUES

- General account of spectroscopic techniques such as UV-Visible, IR, NMR and Mass spectroscopy with special reference to characterization of chemical constituents of wood and bark

PRACTICAL

- Estimation of extractives in a given wood-bark sample
- Isolation of pure chemical constituents using thin layer and column chromatography.
- Estimation of turpentine and resin in the given oleo-resin sample
- Isolation of polysaccharides and characterization of mono sugars
- Proximate analysis: estimation of holo-cellulose, cellulose, hemicelluloses, lignin and extractives
- TLC analysis of extractives
- Estimation of tannins, essential oils in sandal wood, dyes and dyeing trials on different fabrics

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WWP 112 **WOOD PHYSICS – I**

LEARNING OBJECTIVES: This course highlights and explains the physical properties and characteristics of wood and wood based components. It also develops understanding of students about practical knowledge of factors determining physical properties of wood.

MODULE I PHYSICAL PROPERTIES OF WOOD

- Density and specific gravity. Variation in density of early and late wood constituents. Effect of growth rings on density. Pith to peripheral density variations. Different modes of presentation in relation to moisture content. Physical properties of wood as influenced by moisture content and maximum moisture content of wood. Specific gravity of wood substance. Anisotropy in Wood

MODULE II THERMAL PROPERTIES OF WOOD

- Dimensional changes on heating green wood. Effect of dry and wet heat and heating in presence or absence of air on strength and dimensional stability
- Thermal expansion, specific heat, thermal conductivity and diffusivity. Change of temperature in wood under heating. Effect of moisture on thermal properties. Thermal properties of wood composites

MODULE III ELECTRICAL PROPERTIES OF WOOD

- Introduction, DC electrical conductivity-effect of moisture content, temperature and extractives. Activation energy associated with electrical conduction. Electro-osmosis in green wood. Voltage breakdown strength
- Dielectric properties of wood under alternating current and electro-magnetic field conditions, effect of specific gravity, moisture content, temperature and extractives.

- Principles of induction and dielectric heating. Piezo-electric properties of wood and its applications

MODULE IV ACOUSTICAL PROPERTIES OF WOOD

- Sound transmission and acoustics in buildings
- Response of defects to stress waves in timber

MODULE VI COMPARISON OF PROPERTIES OF SOLID WOOD WITH COMPOSITE WOOD

- Broad Comparison of Physical properties of wood, in relation to panel products, Plastic, steel and bamboo such as weight, density, specific gravity and effect of temperature

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WWP 113 WOOD PHYSICS – II

LEARNING OBJECTIVES: To impart knowledge on wood water relationship based on permeability and capillarity concepts, thermodynamic aspects of wood drying and flow of water in different forms through wood. This will help in understanding wood water relationship as an important processing step in product manufacturing.

MODULE I INTRODUCTION

- Equilibrium moisture content and hygroscopicity of wood. Crystalline and amorphous zones in cellulose and hydrogen bonding

MODULE II THERMODYNAMIC ASPECTS OF WOOD

- Thermodynamic aspects such as heat of wetting, sorption, sorption hysteresis, sorption under stress, theories of sorption and effect of extractives on sorption. Thermodynamic method of measurement of Fibre Saturation Point

MODULE III FLOW OF WATER IN WOOD

- Flow of water in liquid-vapour form through wood. Flow channels, mechanism
- Theories and equations of flow through a permeating medium and through timber section: slip, viscous and turbulent flow. Permeability measurement of wood to water and its applications, specific permeability. Capillarity in relation to wood capillary tension and liquid tension collapse. Forces involved in overcoming capillary tension

MODULE IV ULTRA STRUCTURE AND ANISOTROPY

- Effect of cell ultra-structure on anisotropy-radial pitting. Relationships with density and factors causing departures in their form. Relative anisotropic changes and effect on cell ultra structure by extractives and pre-treatment such as pre-freezing, polar and non polar liquid and cell wall bulking

PRACTICAL

- Sonic and ultrasonic methods of determination of strength properties
- Determination of specific gravity, F.S.P. from shrinkage and sorption
- Measurement of thermal conductivity, dielectric constant, permeability of wood to air
- Moisture content by oven-drying and distillation methods
- Use of electrical moisture meters
- Determination of linear and volumetric shrinkage
- Determination of moisture diffusion coefficient of wood under steady state condition
- Measurement of swelling of wood in liquor ammonia and water
- Hot water- steam bending and ammonia plasticization of 15-30mm thick strips

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WSM 114 SAWMILLING AND SAW DOCTORING

LEARNING OBJECTIVES: The objective of this course is to introduce sawmills and saw blade doctoring.

MODULE I INTRODUCTION

- Introduction to a wet mill: Layout of log yard, in-feed systems to log yard and to head rig. Measurement of log volume, dimension and inventories
- Saw mill layouts comprising horizontal- vertical band saws, chipper canters, frame saws, trim saws and surfacer. Computer control, head rig and reducer passes

MODULE II SAW MILLING EQUIPMENT

- Horizontal band saw, vertical band saw, frame saw and chipper canters. Cross cut saws, re-saws, head rig, log scanners and BOF systems. Gantry equipment, conveyer systems. Sawing of logs prone to growth stresses, line bar system and gang sawing

MODULE III ECONOMICS OF SAWN MATERIAL

- Economic conversion of logs, various interacting parameters and decision making. Timber scale
- Comparison of sawing for logs of forest and plantation origin. Various associated systems relating to sawn material including scribber deck and auto stacking

MODULE IV SAW BLADE DOCTORING

- Saw blade geometry, ripsaw, cross cut saws, tensioning, leveling, straightening, brazing, and setting of saw blades using saw doctoring equipment. High strain thin kerf saws. Threshold energy considerations in wood cutting

PRACTICAL

- Sketching of saw blade geometry and calculation of hook angle, clearance angle and sharpness angle
- Calculation of saw blade length for a given machine
- Calculation of peripheral-linear speed in a saw
- Measurement of log dimensions and calculation of volume using Hoppus true volume of logs
- Measurement of a diametric over lap of two ends of logs and calculation of relative off cut losses
- Measurement of girth at many points of a log and calculation of off cut losses per module length. Girth-output curve for 60mm x 60mm sawn sections
- Demonstration of setting of saw tooth and their pattern calculation of kerf losses. per cut or many cuts

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WWA 115 WOOD ANATOMY – I

LEARNING OBJECTIVES: This course equips students with the knowledge of the macro and micro-structure of softwoods and hardwoods and their relation with properties of wood. The course exposes students to wood identification skills and practices.

MODULE I INTRODUCTION TO WOOD ANATOMY

- The Importance of anatomical studies in areas of wood utilization- an overview

- Basic characteristics of important soft wood and hard wood species from various forest types and plantations of Indian origin. Formation of wood cambium and its derivatives: peripheral and epical growth components, heart wood initiation
- General features visible on logs, sleepers and converted material: sap wood, heartwood, growth rings, growth marks, colour, odor, taste, grain, texture, luster, figure and weight. Other components influencing wood quality such as knots, shakes, discoloration, deposition, gum, resins, calceration.
- Wood anatomy in relation to properties of wood. Scope of bamboo, canes, coconut, palm and other fibrous lignocelluloses materials in wood based industry

MODULE II MICROSCOPIC FEATURES OF IMPORTANT TIMBER SPECIES

- Identification of wood using a hand lens- characteristics features
- Microscopic features of soft wood and hard wood. Characteristics, diagnostic features used in wood identification of five soft wood species (*Pinus roxburghi, P. wallichiana, Abies pindrow, Pecia smithiana, Cedrus deodara*) and twenty hardwood species (*Acacia nilotica, Albizia lebeck, Adina cardifolia, Anogeissus latifolia, Bombax ceiba, Colophyllum* spp., *Dalbergia sissoo, Dalbergia latifolia, Diptocarpus* spp., *Lagerstromia lanceolata, Mangifera indica, Morus alba, Palaqcium elipticum, Pterocarpus marsupium, Shorea robusta, Tectona grandis, Terminalia tomentosa, Toona ciliata, Holoptelia integrifolia, Michilia champaca)* of forest origin and their economic importance and end uses

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WWA 116 WOOD ANATOMY – II

LEARNING OBJECTIVES: The objective of the course is to explain the effect of silivicultural practices on wood quality, anatomical aspects of plantation timber and application of ultra structure of wood.

MODULE I WOOD QUALITY IN PLANTATION GROWN TIMBER

- Assessment of wood quality in plantation grown timber. Juvenile wood and its tissue characteristics compared to mature wood. Effect of spacing and silvicultural practices on wood quality from anatomical stand point. Anatomical aspects of high density plantation timber. Production Forestry: Clones, Clonal forestry ï its merits and demerits

- Tree improvement. Importance of genetics, selection of superior phenotypes Merits and demerits of monoculture, exotics

MODULE II ANATOMICAL AND UTILIZATION ASPECTS OF FIBROUS MATERIAL

- Reaction wood and spiral grains
- Ultra structure of wood and its applications towards better understanding of anatomical and utilization aspects of plantation woods and other fibrous material Anatomical aids, different types of microscopes and photography attachments objectives and eyes pieces and magnification levels.
- Heartwood formation. Reaction wood and spiral grains. Wood structure in relation to properties and uses of wood.

PRACTICAL

- Hand lens features and identification of wood
- Hand lens features of soft wood and hardwood, sapwood and heartwood specimens.
- Microscopic features, slide inspection of twenty five characteristics species
- Maceration, staining, slide preparation and measurement of dimensions of woody tissues
- Ultra structures and their interpretation
- Measurement of fibril angle and tissue proportions
- Reaction wood
- Increment core based studies
- Microscopic features of bamboo, cane, coconut, lantana and assorted materials
- Morphological observations on important timber species of common occurrence for architectural patterns of habit, bole, buttress, blaze leaf, flower, fruit and seeds

WEM 117 TIMBER ENTOMOLOGY AND MICROBIOLOGY

LEARNING OBJECTIVES: The main objective of the course to explain the forest insects and their broad classification like Leaf defoliators, wood borers, termites etc it also comprises laws of quarantine and phyto-sanitary certification. Students will be introduced to biodegradation and biodeterioration by the microbes and physical, chemical and microscopic effects of decay, soft rot and discoloration in wood.

MODULE I INTRODUCTION TO TIMBER ENTOMOLOGY

- General introduction of insects and their body parts, head, thorax and abdomen, metamorphosis of adult larval mouth parts and caterpillars. Population dynamics, natality, mortality and endemic growth
- Forest insects and broad classification. Wood borers of standing trees, logs and converted materials for prominent species, Oak*, Juniper, Shoreas, Dipterocarpus, Toona cialiata, Dalbergia, Artocarpus* and *Ficus* species beside *Pines*. Leaf defoliators and their effect on forest and plantation species; regardless of durability of timber species

MODULE II TERMITES

- Termites, their identification, life history and distribution in forest lands, plantations and built structures. Termite resistance tests and termite control

MODULE III INSECT AND PEST CONTROL METHODS

- Biological control of insects and pests, pests control components, principles and practices. Integrated pest management, Economics of pest control. Insect fungi interaction, microbial control, insect behavior regulators and forest hygiene
- Laws of Quarantine and phyto-sanitary certification

PRACTICAL (TIMBER ENTOMOLOGY)

- Life cycle of some important insect pests of forest and plantation origin. Collection of insects from forest, plantation and infected sites, nurseries and log yard. Their up keep and dispatch techniques for expert advices
- Study of damage specimens mainly wood borers of felled and converted wood, bark and pinhole borers, beetles, sap wood borers, short-hole borers, heartwood borers and dry wood borers
- Observations of termite nests, castes, and infected material in various forms such as poles, beams and planks

- Insect control techniques: Field application methods on forest crops, plantations, constructed structures and log yards
- Precautions and application methods for insecticides, fungicides in liquid, vapor and dust form
- Museum studies: Diagnosis of insect attack, protection of valuable documents in book, sheet leather form beside timber

MODULE IV INTRODUCTION TO WOOD MICROBIOLOGY

- Biodegradation and biodeterioration and broad idea about microbes involved in wood deterioration. Biotic and abiotic factors involved in attacking timber products ranging from logs, planks, wood chips, exterior and interior furniture and joinery products, plywood, MDF, particle board and bamboo products

MODULE V WOOD DEGRADATION

- Taxonomy of wood decaying fungi. Essentials of fungal attack on lignocellulosic material like solid wood
- Types of fungal degradation of wood, bamboo and their products. Physical, chemical and microscopic effects of decay, soft rot and discoloration
- Fungal decay in wood in buildings
- Natural decay resistance of wood and its assessment using accelerated laboratory tests. Quarantine regulation of import of timber

PRACTICAL (WOOD MICROBIOLOGY)

- Laboratory testing for natural decay resistance of wood.
- Demonstration of loss appraisal due to decay.
- Examination and identification of wood-decaying fungi, section cutting and preparation of slides.
- Isolation of white-rot, brown-rot and sap stain fungi.
- To study the conditions favouring fungal stains on bamboo in laboratory.
- Treatments to check fungal staining of bamboo in laboratory

IInd SEMESTER

FOUNDATION COURSE

WSM 201 STATISTICS AND RESEARCH METHODS

LEARNING OBJECTIVES: This course is designed to help the students to learn the basics of statistics and its application in the field of Wood science and technology. The course will also expose the students to the use of statistical methods in wood based industries.

MODULE I

- Importance of statistics and statistical methods in the fields of wood science and technology and forest products research.
- Data collection, compilation, condensation of statistical data and graphical presentation.
- Type of variates- univariates, bivariate and multivariate. Physical significance and measures of central tendency, dispersion, skewness and kurtosis such as arithmetic mean, median, mode, standard deviation and coefficient of variation and other moment measures.
- Regression analysis- simple and multiple regression, correlation coefficient, coefficient of determination.

MODULE II

- Probability and probability function, expectation, parameters and sample statistic. Normal, binomial and poisonôs distribution.
- Statistical inference: estimation and testing of hypothesis- T-test, F-test, Chi-square test.

MODULE III

- Analysis of variance one way and two way classification. Analysis of covariance.
- Tests for homogeneity and linearity. Importance of transformations.
- Design of experiments. Principles of designs of experiments. Completely randomized design, randomized block design, latin square design, introduction of factorial experiments.
- Introduction to statistical softwares and their operations.

MODULE IV

- Statistical quality control- control charts and sampling inspection.

CORE COURSES

WTM 211 **TIMBER MECHANICS – I**

LEARNING OBJECTIVES: The course emphasis on theory of solid mechanics in timber and its application in structural purposes.

MODULE I BASIC SOLID MECHANICS

- Brief account of isotropic, anisotropic, orthotropic, coordinate systems. Stress-strain relationships. Different type of stresses and strain. Simple shear, principle stress and Mohr circle diagram. Hookôs law and modulus of elasticity, directional elastic constants. Non-linear behaviour of wood, hysteresis. Bulk modulus and Poissonôs ratio. Shear forces and bending moments, stresses in beams, beam deflections, column buckling and torsion forces. Role of moisture on elastic constants Shrinkage: directional shrinkage and fibre saturation point

MODULE II STANDARD TESTS ON TIMBER SPECIMEN

- Static bending, impact bending, compression parallel and perpendicular to the grain, hardness, shear, tension parallel and perpendicular to the grain, cleavage, torsion, nail and screw pulling, brittleness. Testing of specialized wood products, performance tests and method of evaluation for door shutters, joinery, furniture, packing cases, tool handles, agricultural implements and sports goods

MODULE III THEORY OF CREEP

- Kelvin, Maxwell and Burger models. Effect of level of loading, moisture content, temperature, dynamic humidity conditions and pre-freezing on creep. Fatigue and its characteristics, orthotropic elasticity of reconstituted wood based systems including creep in lignocelluloses panels. Fracture Mechanics

MODULE IV SUITABILITY COEFFICIENTS AND INDICES OF INDIAN TIMBERS

- Determination of suitability coefficients and indices of Indian timbers. Safe working stresses and end uses of timber species based on strength data. Classification of timber for various end uses. Specialized uses of timbers and BIS Standards

WTM 212 **TIMBER MECHANICS – II**

LEARNING OBJECTIVES: This course imparts the knowledge of timber grading system and its application like LQI, CPR, and TCCS.

MODULE I TIMBER DEFECTS

- Timber a biological material: Various defects and their manipulation in logs and sawn form. Importance of grading in primary and secondary processing. Quantification of defects in softwood, hardwood logs and swan timber

MODULE II TIMBER GRADING

- Introduction to grading and its importance in various wood utilization sectors. Introduction to grading in relation to plywood and surface veneers.
- Stage of grading and grading rules, commercial and structural grading, Grading for specific end uses such as railway sleepers, pallets and packing cases, cooling tower, and relevant standards.
- Visual grading: its merits and demerits
- Stress grading and its relationship to non-destructive testing and their importance
- Grading and its relevance for plantation and clonal material. Grading rules prevailing in various states
- Futuristic application of grading: Log Quality Index (LQ1), Comparative Price Relatives (CPR) and Timber Value Conversion Standard (TVCS). Growth stresses in timber and their measurement. Influence on grading

PRACTICAL

- Mechanical test on timber. Static bending, impact bending, compression parallel and perpendicular to grain, hardness, shear, torsion, nail and screw puling test, brittleness test and calculation of properties.
- Identification and measurement of defects in wood and their evaluation.
- Specialised tests on wood products

WWP 213 **WOOD PRESERVATION – I**

LEARNING OBJECTIVES: This course is designed to describe the importance of preservatives and their types. Students are expected to learn different treatment methods and testing of efficacy of preservatives in lab as well as field condition.

MODULE I WOOD DURABILTY

- Natural durability, durability of heartwood and sapwood. Causes for natural durability. Classification of timbers on the basis of natural durability. Nature and conditions of attack by various wood- bio degrading organisms on land and marine conditions. Estimates of losses of wood by bio-degradation in storage, processing and service. Importance of wood preservation

MODULE II MARINE WOOD BIODETERIORATION

- **Biodeteriogens-** Biofoulers. Microfoulers. Macrofoulers. Wood-/deteriogens, Bactreria, Fungi, Insects, Bivalves, Pests of Mangroves
- **Control Measures**- Indigenous approaches, Mechanical barriers, Bioresistant timbers, Chemical preservatives
- Methods of determination of durability, including accelerated tests methods

MODULE III WOOD PRESERVATIVES

- Preservative materials toxic to various bio-degrading agents- their toxicity levels. Bio-degradable preservatives. Eco-friendly preservatives
- Requirement of an ideal preservative. Types of wood preservatives. Merits-demerits of different preservative compositions in relation to end use
- Recommended preservatives and their penetrations and retentions for various end uses
- Testing of the efficacy of preservatives under laboratory and field conditions.
- Qualitative and quantitative analysis of preservatives in their free condition and in the treated timber
- Treatments for special end uses

PRACTICAL

- Spot tests for determination of penetration

- Chemical analysis of preservatives in free state and in treated wood. (Cu, Cr, As, B, Chlorinated compounds and Cu resonates)
- Examination of test specimens in timber yards and demonstration of accelerated test method against termites

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WAD 214 **COMPOSITE WOOD I- ADHESIVES**

LEARNING OBJECTIVES: The course deals with the chemistry and fundamentals of adhesion. It also emphasise on the application of adhesives in different wood composites.

MODULE I INTRODUCTION

- Introduction of linear and cross linking molecules, theory of adhesion, intermolecular, intra-molecular attraction, cohesion, adhesion and adherence. Application of adhesives: wood, plywood, laminated wood. Importance of colloidal state and rheological properties
- Application techniques of glues in relation to plywood, particle board, MDF, laminated woods
- Optimization of glue setting parameters: pressure, temperature, time

MODULE II ADHESIVE SCIENCE

- Influence of moisture content, pH interactions, surface preparation, pre-treatments. Fortifying, filling, extending, and spreading on glue bond strength. Chemistry, application, properties and classification of adhesives ï cold setting, thermo-setting and thermo-plastic adhesives, elastomeric adhesive, gap filling adhesives

MODULE III NATURAL AND SYNTHETIC GLUES

- Animal glue, casein glue, blood albumin, soya bean and starch, silicate of soda glues
- Synthetic glues: Phenolic and substituted Phenolic adhesives. Urea and melamine formaldehyde, epoxy and polyurethane adhesives. Polyvinyl adhesives
- Importance of viscosity and setting time of glues and adhesives. Precautionary measures in formulation of glues, application techniques, curing factors of safety and hygiene. Protective gadgets

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WPW 215 **COMPOSITE WOOD II PLYWOOD**

LEARNING OBJECTIVES: Students will be able to explore the plywood manufactures processing from veneers to final panels. It also explains the preservative treatment and test methods to assess product quality.

MODULE I INTRODUCTION

- Historical perspective of plywood making, merits and demerits of plywood over solid wood for diverse reasons and end users

MODULE II PLYWOOD MANUFACTURING

- Veneering: peeling of logs and peeling characteristics of diverse range of soft woods and hardwoods. Equipment for peeling and stressing: spindle lathes and slicer
- Modern developments including veneering of small diameter logs and core veneer. Geometry of knife for veneering in relation to wood species, optimum conditions of setting of peeling lathes and slicer
- Quality of veneer obtained by peeling and slicing, defects in peeled veneer
- Veneer drying, types of veneer dryers, their application and relative merits; recommended drying times, temperatures, jet-air speeds and venting. Steam consumption. Shrinkage in veneer drying. Collapse and warp and their control. High temperature veneer drying, tenderizing of veneer
- Plywood manufactures processing: Jointers, splicer. Veneer jointing, splicing, repairing, spreaders, glue spreading, assembly pre-pressing, hot pressing, sizing, trimming, thick nessing and finishing
- Pressing equipment: cold and hot pressing equipment. Manufacturing process, choice of material, species for Block Board and Flush Doors
- Test methods for plywood

MODULE III PLYWOOD TREATMENT

- Preservative treatment of plywood and allied products. Glue-line treatment and treatment of finished products
- Choice of glue compatible preservatives and fire retardant chemicals

PRACTICAL

- Preparation of UF and PF adhesives and fortified UF adhesive
- Viscosity, gelling time, water tolerance, pH, solid contents and shear strength tests on adhesive
- Preparation of various type of plywood
- Testing of plywood, including accelerated ageing tests

WWS 216 **WOOD SEASONING – I**

LEARNING OBJECTIVES: To impart knowledge of seasoning process of timber, drying rate of timber and its dependence on different factors like temperature, RH, air flow speed, permeability of species, thickness of timber and its initial moisture content, seasoning defects and their cause prevention. This course will be followed by second course in wood seasoning.

MODULE I INTRODUCTION

- Objects and importance of wood seasoning
- Recommended moisture content of seasoned timber for different end uses in different climatic zones and permissible tolerances. Basis of the recommendations
- Factors affecting drying rate of timber: thickness, moisture content, temperature, relative humidity and velocity of the drying air, diffusion and permeability characteristics of the species, moisture gradients in timber section
- Classification of Indian timbers according to refractoriness to seasoning

MODULE II SEASONING DEFECTS

- Surface and internal cracking, honey combing, end splitting, cupping, collapse, bow, spring, crookedness and diamonding. Their causes and prevention. Drying stress development: measurement of drying strains. Resultant plastic strains sets produced. Stress reversal and case hardening. Critical stages for surface and internal cracking
- Warp control: Top weighting, calculation of optimum loading, spring loading system, reduced crossers spacing
- Seasoning and warp control in short rotation plantation timber species
- Compression set, core strength, stress reversal and case hardening.

MODULE III SPECIEL DRYING TECHNIQUES

- Special seasoning methods and pre-treatment: Anti-shrink pre-treatment, their efficiencies, coldness shrinkage, chemical seasoning, pre-steaming, pre-freezing

PRACTICAL

- Casehardening tests
- Measurement of drying strains

WWW 217 **WOOD WORKING**

LEARNING OBJECTIVES: The course is structured to give knowledge of basic element of wood working design and theory used in industry. It also demonstrates the use of woodworking tools. Students will understand wood machining defects, their occurrence in Indian woods and evaluation of Working Quality Index (WQI) and Carving Quality Index (CQI) ease of working, overall performance and quality ratings of important basic operations.

MODULE I INTRODUCTION TO MILL OPERATIONS AND WOOD WORKING MACHINES

- Layout of wood workshop. Benefits of mechanization as against traditional carpentry tools; circular saw and range of jobs
- General features and designs of wood working machines such as planner, thicknessor, mortiser, tenonner, molders, routers, turning lathes and drill-boring machines. General features of universal wood working machines, copying lathes, four side planner-cum-molder and CNC router. Saws for panel products, radial arm saws, cross cut-trim saws. Disc and drum sanders. Portable power tools and dowel making machines

MODULE II BASIC JOINERY

- Elements of basic joinery, joints for furniture and joinery: tenon mortise, dovetail and mitre joints, their combinations. Knife geometry, cutter profiles, carbide tipped cutters

MODULE III WOOD MACHINING DEFECTS

- Various wood machining defects, their occurrence in Indian woods and evaluation of Working Quality Index (WQI) and Carving Quality Index (CQI) ease of working, overall performance and quality ratings of important basic operations
- Effect of machine parameters on quality of worked surface in basic wood working operations. Introduction to bamboo processing machines for downstream products

PRACTICAL

- Identification of wood machining defects from a given piece
- Measurement of cutter marks on a given piece subjected to plaining operation and verifications of feed speed
- Turning of a given sample using wood turning lathe and observations with regard to surface quality and reasons thereof for the outcome
- Effect of pre-moistening and drying on a given piece during sanding operation comparison with control samples
- Calculation and verification of cutter block speed in relation to RPM of motor mounted via V belt and pullies. Reasons of departure from calculated and observed values
- Fabrication of tenon-mortise joint

III[rd] SEMESTER

CORE COURSES

WWS 311 **WOOD SEASONING – II**

LEARNING OBJECTIVES: The main objective is to impart practical knowledge on stacking of timber for seasoning, kiln designs, their working principles, kiln during schedules, types of kilns and their energy efficiencies, kiln specifications, boiler and energy conserving drying techniques.

MODULE I AIR SEASONING

- Stacking, practice for poles, posts, railway sleepers and sawn timber. Orientation of stacks relative to wind direction. Fork lift trucks for stacking. Air seasoning sheds: Forced air drying

MODULE II SEASONING SCHDEULES

- General outline of kiln drying schedules. Optimum drying conditions, control at different stages of degrades development. Kiln drying times. Modification of schedule for higher thickness, lower initial moisture contents and special quality for end uses. Removal of casehardening. Reverse casehardening. Scope of accelerating a schedule. Equalization treatment

MODULE III KILN OPERATION

- Measuring instruments of different types for temperature, relative humidity and air velocity. Sample preparation. Seasoning kilns: General design features. steam, hot water, heated mineral oil, direct; indirect furnace, electric heated kilns. Steam and water spray humidification: Features of propeller and axial flow fans. Venting. Location of fans relative to timber stack. Baffles, uniformity of air circulation and structural insulation. Steam traps

MODULE IV KILN DESIGN AND SPECIFICATIONS

- Minimum requirement as per Indian Standard. Calculation of kiln capacity required for a given output, kiln automation, boiler capacity, evaporative capacity. Kiln heat losses and energy efficiency data. Consumption of different types of fuel

MODULE V ENERGY CONSERVING DRYING TECHNIQUES

- Energy conserving drying processes: solar kilns, dehumidification kilns, vacuum drying in vapor with heat recovery, vacuum drying in RF field etc. Comparative economics: air seasoning, steam heated and solar kilns

MODULE VI WOOD SEASONING PSYCHROMETRY

- Introduction to Psychrometry, understanding the psychrometric chart: scales of dry bulb temperature, wet bulb temperature, specific volume, specific humidity, dew point, vapour pressure, relative humidity and enthalpy
- Practical utility of psychrometrics in wood seasoning operations: dehumidification, venting, conditioning, increase/ decrease in relative humidity; temperature etc along with some practical calculations

PRACTICAL

- Practice on operating a kiln charge, preparation of kiln samples, calibration of instruments, final moisture content
- Determination of total evaporation and condensate discharge, inspection of material
- Measurement of air speeds in the timber stack and computation of total air volume discharged by fans
- Kiln control under abrupt RH and temperature fluctuations
- Measurement of solar energy
- Psychrometrics measurements in wood seasoning

WWP 312 WOOD PRESERVATION – II

LEARNING OBJECTIVES: The course describes fundamentals of preservative retention and penetration with penetration index. It also imparts the knowledge of preservative treatment procedure and fumigation techniques to enhance the natural life span of wood products.

MODULE I PERMEABILTY AND TREATABILTY OF TIMBER

- Dependence of penetration and retention of preservative on wood structure and permeability. Preparation of timber for treatment. Treatability classification of timbers
- Penetration indices. Percent voids filled

MODULE II TREATMENT PROCESSES

- Non-pressure: Brushing, spraying, dipping, steeping, cold soaking, hot and cold bath & diffusion methods. Their efficacy and suitability for selected end uses
- Pressure processes: Full cell, Rueping-Empty cell and Lowry treatments
- Special oscillatory pressure treatment for green timber with water soluble preservatives. Miscellaneous processes: Prophylactic treatment, Boucherie treatment and Osmosis treatment for green timber. Treatments for bamboo and thatch

MODULE III PRESERVATION PLANTS

- Design, specifications, layout, operation, inspection, maintenance and economic aspects. Pollution aspects
- Economics of preservative treatment

MODULE IV FLAME RETARDANTS AND FUMIGATION

- Fire protection of timber: General principles of combustibility; application of fire retardant chemicals; methods of testing fire resistance. Associated treatment to impart bio resistance. Appropriate eco friendly treatments for handicraft products
- Fumigants
- Chemical modification of wood

PRACTICAL

- Treatment of timbers of different treatability classes with representative
- Preservatives and evaluation of treatment parameters (time, temp. and pressure).
- Boucherie, sap displacement. Hot and cold bath and diffusion treatment.
- Calculation of voids for estimating maximum absorption.
- Determination of penetration indices.
- Treatment of problematic refractory heartwood like eucalyptus.
- Tests for fire retardancy

WWF-313 WOOD FINISHING

LEARNING OBJECTIVES: The course is designed to impart knowledge of theory and mechanism of wood finishing and equipments. Performance tests on wood finishes and test methods are also the integral part of this course.

MODULE I INTRODUCTION

- Wood finishing basics
- The role of moisture in liquid vapour state in each case
- Nature of woody tissue pre-finished surfaces and figure in wood. Infiltration of colouring material and its patterns

MODULE II FINISING OPERATIONS

- Filling, repeated sanding and staining operations using aniline based dye stains or other environment friendly techniques- use of bark saw dust extracts and ammonia fumigation. Finishing of Juvenile wood surface fibers, bamboo, cane grass and handicraft products. Priming and painting of wood and comparisons with polishing-lacquering ï varnishing, oiling-waxing and buffing. Refinishing

MODULE III WOOD FINISHING EQUIPMENT

- Brushing, spraying, electrostatic spraying, powder coating, UV curing. Precautions in the use of finishing materials with special reference to polyurethane finishes

MODULE IV PERFORMANCE TESTS ON WOOD FINISHES AND TEST METHODS

- Role of moisture on pre-finished, finished wood surfaces, relative, solubility and wash ability of wood coatings by rain water
- Photo oxidation effects. Electro kinetics of absorption and adsorption on surfaces
- Moisture Excluding Efficiencies (MEE) of wood coatings. Finishing qualities of Indian Woods. Test for surface smoothness and gloss

PRACTICAL

- Polishing of a given sample and observations on surface gloss
- Aqueous dip test and permeation of water through a coating. Calculation of MEE or water uptake
- Wet contact of a coated surface for a overnight and measurement of reduction on gloss of the film as compared to control
- Fuming of wood with ammonia and observations
- Comparison of gloss using diverse pore filling treatments

WRW 314 COMPOSITE WOOD IIII- RECONSTITUTED WOODS

LEARNING OBJECTIVES: The objective of the course is to impart into the students the knowledge of the manufacturing of various composite wood like particle Board, hardboard,

fibre board and MDF. The course also described the testing methods for wood composite panels and their comparative study.

MODULE I PARTICLE BOARD MANUFACTURING

- Homogenization and reorientation of woody mass, functional property improvement of ligno-cellulosic materials
- Manufacture of particle Board from various ligno-cellulosic materials. Particle generating machines; range of particle dimensions preferred. Particle dryers, drying times, temperatures and steam consumption. Size separating, sieving machines, adhesive selection
- Resin blending of face and core particles; resin quantities. Face-core composition in board. Mat laying. Pre pressing and hot pressing. Temperatures and curing times. Use of wax emulsion and hardeners in glue, pressing technique, sizing, sanding and thicknessing of board

MODULE II PROPERTIES OF PARTICLE BOARD & ITS TESTING

- Density, moisture content, modulus of elasticity and bending, internal bond strength in dry state and after accelerated ageing
- Testing methods. End uses

MODULE III PARTICLES BOARD PRODUCTS FOR SPECIALIZED USES

- Rice husk particle board, cement bonded board, bamboo mat board, OSB.Manufacture of fibre board and MDF
- Properties of hardboard and MDF. Testing methods and end uses. Manufacture of LVL Laminated Veneered Lumber
- Molded ligno products
- Test method for ligno panels as structural forms

MODULE IV PROPERTY COMPARISON

- Comparative account of properties of particle board, hard board, MDF, LVL as against solid wood products in the area of conservation of forest and growth of wood board industry
- Energy consideration and equipment costs of ligno-panels

WLW 315 COMPOSITE WOOD IV- LAMINATED WOOD

LEARNING OBJECTIVES: This course explores the Scope and merits of laminated wood and modified wood as a commercial construction material, provides an understanding of glues, assembly, cold pressing, HF gluing and curing. It also describes the tests methods such as block shear test for bonding strength and tensile test for finger joint strength.

MODULE I INTRODUCTION TO LAMINATED WOOD

- Scope and merits of laminated wood in comparison to solid wood as counter parts
- Energy consideration in laminated wood in comparison to solid wood as structural engineer grade material
- Dimensional stability considerations and in laminated wood. Density averaging and shrinkage averaging concepts

MODULE II PARAMETRS OF LVL MANUFACTURING

- Choice of species and improvement of aesthetic and strength properties for load bearing structures
- Roles of dynamic pre-compression and its benefits in subsequent processing and for multispecies laminates. Edge glued material and its scope in areas of wooden flooring, doors, cabinet inserts, cabinets and furniture
- Laminated wood from bamboo and bamboo laminates. Choice of glues, assembly, cold pressing, HF gluing and curing

MODULE III TEST METHODS

- Tests methods such as block shear test for bonding strength and tensile test for finger joint strength

MODULE IV MODIFIED WOODS

- Densified wood, Compreg, Impreg, Wood-Polymer Composites - their preparation, properties and uses. Pressing pressures and cooling cycle in press for stabilizing
- Acoustic panels from laminated wood and sandwich forms. Densified laminate panels. Laminated wood from plantation species. Poplar, Rubber wood, Mango and *Alanthus excelsa*

PRACTICAL

- Preparation of particle board and hardboard
- Testing of particle board and hardboard including accelerated ageing tests, glue shear and internal bond strength tests

- Preparation of densified wood and Compreg
- Testing of densified wood and Compreg

WTE 316 **TIMBER ENGINEERING**

LEARNING OBJECTIVES: The course is intended to expose the students to theory of engineering and basic engineering tools. The course will also in a comprehensive way help the students to know codal requirements for building material, scope of plantation grown material in engineered structures and Wooden Houses for hilly areas.

MODULE I INTRODUCTION

- Broader definitions of timber mechanics and timber Engineering and their inter relationships
- Introduction to basic engineering tools free hand sketching, different types of lines, materials breaks, principle orthographic projections and dimensioning. Method of representing a section for various materials, Isometeric view and detail of assembly drawing
- Scope of Timber, bamboos, laminated wood and panel products in relation to concrete, steel, stone and plastics in Engineered constructions such as floors, walls, roofs, and grain silos

MODULE II TIMBER COMPONENTS FOR STRUCTURAL PURPOSES

- Design of linear timber components beams, tiles, purlins, columns and chords.
- Trusses and Arches, their configuration. Analysis of simply supported, 2-hinged, 3-hinged types
- Codal requirements for building material (wood, laminated wood, laminates) grading, proof loading, strength properties, moisture content, size effect - length, width, thickness, depth and presence of knots effecting tension, compression, shear stress systems
- Glue laminated linear and curved structural members; shear strength, analysis and design

MODULE III MECHANICAL PROPERTIES AND NATIONAL BUILDING CODES

- Strength Properties and classification of structural timber. Dimensional optimization for beams columns and associated structural dimensions in a product. Minimum dimensions of sawn timber essential for timber engineering design

- Strength Properties and design of structural timber joints. Changing trends and role of fastenerôs metal rings, connector plates, newer technologies in effect of defect of design and performance
- National building code and its application with special reference to wood houses
- Statistical aspects in relation to engineered structures and fastener systems
- Prefabrication, do it yourself ï knock down concepts in relation to engineered structures
- Scope of plantation grown material, silvicultural thinning, small dimensions timber beside poles in engineered structures
- Wooden Houses for hilly areas, log cabins, ecotourism
- Retaining walls for hilly areas and slopes and their beneficial effects
- Wooden culverts in forest areas and villages and canals

PRACTICAL

- Inspection and suitability of wooden structural members, engineered grade material
- Isometric sketching of engineered house ï building
- Ratio, proportion and projection
- Preparation of a structural joint and its testing
- Demonstration of finger joint
- Demonstration of glue lamination technique for a small beam
- Elementary working drawings for a wooden sports floor
- Testing of beams, columns, trusses
- Fabrication of a beam from small dimensions timber
- Nailing patters on a joint and their importance
- Testing of Almirah, wooden-panel shelve under static load and recording of load deflection curve over an interval

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WPD 317 PRODUCT DESIGN AND FABRICATION

LEARNING OBJECTIVES: **T**he emphasis of the course is on introducing the concept of wood products design and anthopometric aspects. The aim is also to impart knowledge of wood behavior in warm and humid climates that arise during service and changing trends in material use in wood industries.

MODULE I PRODUCT DESIGN AND CARVING

- Design, ratios and proportions, projections and anthopometric aspects

- Manipulation of colour, figure, texture, and grain direction and visual grading, colour grading in fabrication of a product
- Wood carving and decorative wood working such as inlay work, parquetry and use of multiple species and wood waste in diaper and utility works
- Use of twigs, branches, roots, knots, and feature grade material including worm wood in making of ñnew waveò products
- The range and relevance of ñWindsor chairò as a classic example of time tested multiple utility and dynamic trendsetter

MODULE II PRODUCT BEHAVIOUR IN APPLICATION

- Behaviour of Furniture, cabinets, wall panels, wooden floors, table tops, wooden doors in warm and humid climates and weather-climate related fluctuations. Movement or working in wood
- Method of estimating movement of different timber species and panel products.
- ñSystem or product movementò and measures to contain them in a joint, solid wood door and a table top

MODULE III FASTNERS

- Role of various nails, serews, and fastners corrugated pins, and dowel pins along a design, with or without association of a joint
- The net gain or benefits of these aspects. Forces operating on a upright Timber chair calculation of bending moment on back to side rail connecting joints
- Possible design improvements, material selection and production aspects
- Changing trends in material use in wood based industry

PRACTICAL

- Fabrication of photo frame through mitre joint
- Estimation of finger geometry
- Fabrication of different joints
- Scratch hardness test for paints on metal surface

WST 318 **STUDY TOUR** **2 Credits**

LEARNING OBJECTIVES: A study tour is organised every year for the students of M.Sc. Wood Science and Technolgy to acquaint themselves with the knowledge in the relevant fields. The study tours are intended for giving actual field exposures to students. It helps in providing a real opportunity to students to visualize the professional efforts and measures taken by different industries, institution in tackling the problems related to wood processing.

WIA 319 INDUSTRIAL ATTACHMENT 3 credits

LEARNING OBJECTIVES: The aim of one month industrial attachment is to provide insight of actual problems related to wood science and technology and their solutions Students are expected to do problem based study and learn the gap between ideal and actual practices followed by industries in commercial wood products manufacturing and study/ suggest the remedial measures to the problems

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IVth SEMESTER
FOUNDATION COURSE

WHR 401 HUMAN RESOURCE MANAGEMENT

LEARNING OBJECTIVES: The course is structured to develop and understand human behavior in an around and in industries. The objective of this course is to prepare students for competitive world by developing their personal and professional skills.

MODULE I INTRODUCTION

- Human Resource Management ï Introduction and Importance ï Evolution- different between personnel Management and HRM Strategic HRM of a HR Manager
- Human Resources panting, Objectives, importance-HR Process Manpower Examination Lab Analysis lab description ï Job Specification Recruitment ï Sources of Recruitment selection Process Placement and Induction ï Retention of Employees

MODULE II TRAINING AND DEVELOPMENT

- Objectives and Needs ï Training Process- Methods of Training ï Tools and Aids Evaluation of Training Programs. Career Planning ï secession Planning

MODULE III PERFORMANCE MANAGEMENT SYSTEM

- Definition Concepts and Ethics-Different Methods of performance Appraisai- Rating Errors-competency management. Compensation Management ï Concepts and Components ï job Evaluation ï Incentives and Benefits. Productivity Management concepts ï TQM-Kaizen-Quality Circles
- Industrial relegations-Grievance procedure collective Bargaining Settlement of Disputes
- Retirement / Separation ï Superannuation- Voluntary Retirement Schemes-Resignation-Discharge- Dismissal- Suspension-Layoff

WME 402 MARKETING AND ENTERPRISE DEVELOPMENT

LEARNING OBJECTIVES: This course is designed to develop knowledge of marketing network of wood products and challenges faced in market competitiveness. It also includes the understanding of process and characteristics of entrepreneurship development.

MODULE I INTRODUCTION TO MARKETING

- Role of marketing in open market economy. Marketing functions, market segmentation, competition, regulation. cases studies of forest products, capital and credit management
- Fundamental principles, cost-benefit analysis; estimation of demand and supply
- Analysis of trends in the national and international market and changes in production and consumption patterns,

MODULE II ENTREPRENEURSHIP DEVELOPMENT

- Role of private sector and co-operatives, Socio-economic analysis of forest productivity and attitudes
- Entrepreneurship development. Formulation schemes, productions, sales and marketing strategies
- Overseas employment specialized training opportunities including research and development

ELECTIVE COURSE

WFC 421 FOREST CERTIFICATION AND NANO TECHNOLOGY

LEARNING OBJECTIVES: The basic objective of this course is 0to introduce role of nano science in wood as material and to study the life cycle analysis of wood and wood based products.

MODULE I FOREST CERTIFICATION

- Forest certification: concept, definition, origin, evolution, relevance and benefits, Emerging issues, trends and schemes, certification and labelling
- Certification programme: Standards, certification process, accreditation, auditing, organizational process, national and international schemes
- Forest and forest products certification ï basics and importance
- Framework for forest certification in India, Government policies and their objectives, Indian forest certification agencies, Standards of certification for sustainable utilization, and management of forest resources, progress of certification in India, stakeholder expectation and economics of forest certification
- Bhopal India process

MODULE II NANO TECHNOLOGY

- Basics of nano-science and its utility for forest and forest products sector

MODULE III CLIMATE CHANGE

Climate change: Carbon sequestration and climate change ï introduction. Carbon credits and possibilities in timber, timber products and processes

WFJ 422 FINGER JOINTS FOR EFFICIENT WOOD UTILIZATION

LEARNING OBJECTIVES: One of the ways to meet the growing demand of solid wood is to use up the short pieces that go waste in the mills and workshops for different end uses. Finger jointing is a technique through which small pieces can be used in applications ranging from panels to furniture parts and even in very high end structural members

MODULE I FINER JOINTING TECHNOLOGOY

- The Finger jointing technique, Need and uses
- Design and Adhesive aspects
- Machinery, Structural and non-structural usages
- Introduction to glulams, Strength and Finishing aspects

PRACTICAL

- Finger shaping
- Adhesive application
- Finger pressing
- Calculating finger geometry

WVS 423 VACCUM SEASONING TECHNOLOGIES

LEARNING OBJECTIVES: To impart knowledge on vacuum technology for timber seasoning

MODULE I VACCUM SEASONING

Theory/ Practical

- Concept of vacuum and pressure, Measurement of vacuum, pressure gauge
- Role of vacuum in boiling of water
- Types of vacuum pumps, types of Vacuum kilns and their working, concept of drying cycles including heating of timber
- Application and sustenance of vacuum

WMT 441 **Master's thesis** **12 Credits**

LEARNING OBJECTIVES: The students are expected to do their master thesis work under guidance of a capable expert/guide in the last semester of the programme. The thesis work includes comprehensive literature review, experimentation and data analysis on a particular relevant problem of wood Science and Technology. The thesis work is reported by student in form of written document in prescribed format provided by university. This provides an opportunity to students to learn to identify the research problems, scientific methodologies to address the problems and scientific communications.

WMS 442 **Master thesis seminar** **2 Credits**