KANNUR UNIVERSITY

(Abstract)

M.Sc. Wood Science and Technology(Industry -linked) Programme in the Department of Wood Science and Technology, Mangattuparamba Campus - Revised Scheme and Syllabus - Approved-Implemented w.e.f. 2023 admission--Orders issued

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ACADEMIC C SECTION

ACAD C/ACAD C1/25022/2023 Dated: 15.12.2023

Read:-1. U. O. No. ACAD C/ACAD C3/22373/2019 dtd.12.09.2023

2. Circular No. dated ACAD C/ACAD C3/22373/2019 dated 12/09/2023

3. Email dated 28.11.2023 from the Head, Department of Wood Science and Technology, Mangattuparamba Campus.

4.Minutes of the meeting of the Department Council held on 14.09.2023

ORDER

1.The revised Regulations for Post Graduate Programmes under Choice Based Credit and Semester System in the University Teaching Departments/Schools were implemented w.e.f. 2023 admissions vide paper read(1) above.

2. As per paper read (2) above, Heads of all Teaching Departments were requested to submit the revised Syllabus in accordance with the approved Regulations along with a copy of the Department Council Minutes

3. As per paper read (3) above, the Head, Department of Wood Science and Technology, Mangattuparamba Campus submitted the Scheme & Syllabus of M.Sc. Wood Science and Technology (Industry -linked) Programme to be implemented in the University Teaching Department w. e. f. 2023 admissions.

4. Department Council vide the paper read (4) above approved the aforementioned Scheme & Syllabus of M.Sc. Wood Science and Technology (Industry -linked) Programme to be implemented in the Dept. of Wood Science and Technology of the University w. e. f. 2023 admission.

5.The Vice Chancellor after considering the matter in detail, and in exercise of the powers of the Academic Council conferred under section 11(1), Chapter III of Kannur University Act 1996, approved the **Scheme & Syllabus of M.Sc. Wood Science and Technology (Industry -linked) Programme and accorded sanction to implement the same in the Department of Wood Science and Technology, Mangattuparamba Campus of the University w.e.f. 2023 admissions, subject to report to the Academic Council.**

6.The Scheme & Syllabus of M. Sc. Wood Science and Technology Programme (Industry-linked), under Choice Based Credit Semester System implemented in the Department of Wood Science and Technology, Mangattuparamba Campus w. e. f. 2023 admission, is appended and uploaded in the University Web Site.(www.kannuruniversity.ac.in)

7.Orders are issued accordingly.

Sd/-

Narayanadas K

DEPUTY REGISTRAR (ACAD)

For REGISTRAR

To: 1.The Head, Department of Wood Science and Technology, Mangattuparamba Campus.

2. Convener, Curriculum Committee.

Copy To: 1. The Examination branch (through PA to CE)
2. PS to VC/ PA to PVC/PA to R
3. DR/AR1/AR II (Acad), EXCI, EP IV
4. Web Manager (for uploading in the website)
5. Computer Programmer
6.SF/DF/FC

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY
CIVIL STATION P.O.
KANNUR
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THAVAKKARA

KANNUR UNIVERSITY

SCHOOL OF WOOD SCIENCE AND TECHNOLOGY
DEPARTMENT OF WOOD SCIENCE ANDTECHNOLOGY

M.Sc. Wood Science and Technology

(Industry-Linked) Programme

Choice based Credit Semester System (CBCSS)

Curriculum and Syllabus
(2023 Admission onwards)

Scheme and syllabus for

M.Sc. Wood Science and Technology (Industry-Linked) Programme

Choice based Credit Semester System (CBCSS)

(2023 admission onwards)

About the Department

The Kannur University established the Department of Wood Science and Technology under the School of Wood Technology in the year 2007 offering M. Sc. Wood Science and Technology Course. M.Sc. Wood Science & Technology course was converted into M.Sc. Wood Science and Technology (Industry-Linked) Programme in the year 2015. The Programme was launched with the support from the internationally reputed industry partner, The Western India Plywoods Ltd., Valapattanam, Kannur.

The aim of the department is to strengthen the process of sustainable and environment-friendly utilization of timber resource of the region through conduction of post-graduate programme relevant to the field of wood science and technology. The department with the support of University takes all efforts to link with the wood based industries, government agencies and local communitiesfor consultancy and extension services in the sustainable utilization of wood and other lignocellulose resources.

M.sc. Wood science and Technology (industry-linked) programme

The MSc Wood Science & Technology (industry linked course) offered by Department of Wood Science & technology is a unique programme due to its innovative approach to curriculum which is connected to industry. This initiative promotes the regional process of sustainable and environmentally responsible exploitation of timber resources by providing post-graduate studies applicable to the field of wood science and technology.

This unique Programme combines the conventional University level academic system with industry industry-level apprenticeship programme. As per the course structure, the Department of Wood Science and Technology, Kannur University will be providing theory and practical classes similar to any of the University Departments while the students will also be provided with a work-based training session at Western India Plywoods Ltd (WIP).

The syllabus offered by Wood Science and Technology Department at Kannur University covers major areas such as Forestry, Wood Identification, Logging, Wood Variation, Physical and Chemical Properties of Wood, Wood Bio-degradation, Wood Preservation, Wood Seasoning, Wood-Based Composites, Paper Technology, Wood Technology, related practical schedules, workshops, seminars, etc. along with individual research works.

Eligibility for admission

Any Science Degree with a minimum of 50% marks or equivalent grade in the core course.

Programme Structure

The programme will include Discipline Specific Core Courses (DSC), Discipline Specific Elective courses (DSE), Interdisciplinary Elective courses (IDC), Multidisciplinary Elective Courses (MDC), Ability Enhancement courses (AEC), Skill Enhancement courses (SEC) and Value Added Courses (VAC). The Discipline specific courses (DSC and DSE) offered by the department will be taken by the students of the respective departments. Other courses offered by a department can be taken by students of any department.

Every Course offered by the University Department is identified by a unique course code.Where, first two letters denote Programme name. Next threeletters denote subject. This is followed by semester numbers such as 01,02,03,04. Aftersemester number next three letters stand for category of the course such as Discipline Specific Core (DSC), Discipline Specific Elective (DSE), etc.. The last two digits denote the serial number of the course in that category in that programme.

Illustration:

MSWST02DSC01: A Discipline Specific ElectivecourseofferedasapartofM.Sc.Wood Science & Technology

MS = Master of Science

WST = Wood Science & Technology

02= 2nd Semester

DSC= Discipline Specific Core

01 = Serial number of the DSC course in the programme.

In addition to the course specified as part of the programme, all students should complete a Value Added Course or MOOC Course of at least 2 credits to complete the requirement of getting the degree. Marks/grades secured for VAC/MOOC course will not be considered for the computation of CGPA. However the marks will be shown in the consolidated grade card.

PROGRAMME OUTCOMES

PO1: **Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2: **Problem Solving**: Identify, formulate, conduct investigations, and find solutions to problems based on in-depth knowledge of relevant domains.

PO3: **Communication**: Speak, read, write and listen clearly in person and through electronic media in English/language of the discipline, and make meaning of the world by connecting

PO4: **Responsible Citizenship**: Demonstrate empathetic social concern, and the ability to act with an informed awareness of issues.

PO5: **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6: **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio- technological changes.

PO7: **Environmental Sustainability and Global Perspective** - Develop an understanding of global standards to foster legal environment. Learn and practice to critically analyze the legal issues from local, national and international concerns.

PROGRAMME SPECIFIC OUTCOMES

PSO 1: Gain in-depth knowledge in theoretical and practical aspects of Wood Science & Technology

PSO 2: Handle and manage the various operating and processing systems in wood based industry

PSO 3: Get exposure to a wide range of job opportunities in national and international levels as well as in research organization

PSO 4: Apply knowledge of the basic properties of wood in the areas of timber identification, raw material selection and product development with longer life span

PSO 5: Contribute to Research and innovation in sustainable wood utilization and processing technique

PSO 6: Familiarize with national and international testing standards and understand their role in sustainable product manufacturing

PSO 7: Use the strong leadership and communication skills to effectively execute quality management systems, efficient production plans and convey marketing and sales messages to multiple stakeholders

PO-PSO Mapping							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PSO1	✔	✔	✔	✔	✔	✔	✔
PSO2	✔	✔	✔	✔	✔	✔	✔
PSO3	✔	✔	✔	✔	✔	✔	✔
PSO4	✔	✔	✔	✔	✔	✔	✔
PSO5	✔	✔	✔	✔	✔	✔	✔
PSO6	✔	✔	✔	✔	✔	✔	✔
PSO7	✔	✔	✔	✔	✔	✔	✔

FIRST SEMESTER								
Course Code	**Course Name**	**Contact hours /Week**			**Marks**			**Credits**
		L	**T/S**	**P**	**ESE**	**CE**	**Total**	
Discipline Specific Core Courses (DSC)								
MSWST 01DSC01	Forestry and Dendrology	4	1		60	40	100	4
MSWST 01DSC02	Wood Structure and Identification	4	1		60	40	100	4
MSWST 01DSC03	Physical, mechanical and chemical properties of wood	4	1		60	40	100	4
MSWST 01DSC04	Logging and sawmilling practices	4	1		60	40	100	4
MSWST 01DSC05	Wood science laboratory Practical			8	60	40	100	4
Total							**500**	**20**
SECOND SEMESTER								
Discipline Specific Core Courses (DSC)								
MSWST02DSC06	Wood Biodegradation and Preservation	4			60	40	100	**4**
MSWST02DSC07	Wood seasoning	4			60	40	100	**4**
MSWST02DSC08	Industrial wood technology workshop		1	8	60	40	100	**4**
Discipline Specific Elective Courses (DSE)								
MSWST02DSE01 **OR** MSWST02DSE02	Plywood and Composites / Wood Mechanics	3	1		60	40	100	**3**
MSWST02DSE03 **OR** MSWST02DSE04	Reconstituted wood panels / Wood variation	3	1		60	40	100	**3**
Interdisciplinary Elective Course (IDC)								
MSWST02 IDC01	Wood Chemistry (**Offered to other department students**)	2			60	40	100	**2**
……..	**(To be obtained from other Departments)**	2			60	40	100	**2**
Multidisciplinary Elective Course (MDC)								
MSWST02MDC01	Advanced Coating for wood panels (**Offered to other department students**)	2			60	40	100	**2**
……..	**(To be obtained from other Departments)**	2			60	40	100	**2**
Total							**700**	**22**

THIRD SEMESTER								
Discipline Specific Core Courses (DSC)								
MSWST03DSC09	Adhesives for plywood and panel products	4	1		60	40	100	**4**
MSWST03DSC10	Wood Working Practical – 1	4	1		60	40	100	**4**
MSWST03DSC11	Wood Adhesive Technology Practical	4	1		60	40	100	**4**
MSWST03DSC12	Institutional / industrial internship and report submission		1	2	60	40	100	**2**
Discipline Specific Elective Courses (DSE)								
MSWST03DSE05 **OR** MSWST03DSE06	Pulp and Paper / Statistical methods and computer application	3	1		60	40	100	**3**
Interdisciplinary Elective Course (IDC)								
MSWST03IDC02	Wood and Climate change mitigation (**Offered to other department students**)	4			60	40	100	**4**
……..	**(To be obtained from other Departments)**	4			60	40	100	**4**
Total							**600**	**21**
VALUE ADDED COURSE (VAC)								
MSWST03VAC01	Vermicomposting Technology	2			60	40	**100**	**2**
FOURTH SEMESTER								
MSWST04DSC13	Production and Marketing Management	4	1		60	40	100	**4**
MSWST04DSC14	Dissertation and Viva	4	1		60	40	100	**8**
MSWST04DSC15	Wood Working Practical – 2		1	8	60	40	100	**4**
Discipline Specific Elective Courses (DSE)								
MSWST04DSE07 **OR** MSWST04DSE08	Timber Engineering / Forest management and planning	3	1		60	40	100	**3**
Total							**400**	**19**

Pattern of Credit Distribution

Discipline Specific Core Courses: 60
Discipline Specific Elective Courses: 12
Interdisciplinary elective course: 2+4=6
Multidisciplinary Elective Course: 2
Internship: 2
Total Credits: 82

FIRST SEMESTER

CORE COURSE

MSWST01DSC01: FORESTRY AND DENDROLOGY (64 hrs./Semester)

Course Objectives

To study the basic principles of sustainable forest management
To acquire knowledge on the basic identification methods used in tree identification
To explore the possibilities of people participation in forestry
To understand about the characteristics of important timber producing families
To give an overview about the importance of plantation forestry and various silvicultural operations

Course Outcome

On completion of this course the student will be able to:

C01	Explain the different types of forest and various branches of forestry
C02	Describe the importance of forest plantation, social forestry, and trees outside forest
C03	Apply the silviculture techniques for the production of suitable timbers for various industrial purposes
C04	Identify the common timber species using morphological characteristics
C05	Explain various forest certifications involved in sustainable forest management

Module 1

Forests – definition, classification and brief description of forest types. Forestry – its scope and branches. Forest health and its management.Sustainable forest management.Social forestry and its role in timber production.Participatory forest management. Agroforestry Systems

Suggested reading specific to module:

Manikandan, K and Prabhu S IFS (2018) Indian forestry A breakthrough approach to Forest service, Jain Brothers Publishers
Negi S.S., Agroforestry Handbook. International Book distributors, Dehradun
Ramachandran P.K., Mohan Kumar B., and Vimala D (2021).An Introduction to Agroforestry-Four Decades of Scientific Developments. Springer Publishers
Negi S.S. A Handbook of Social Forestry. International Book Distributors

Module 2

Silviculture - definition, scope and objects. Forest plantations - different types. Rotation - definition and types. Site and species selection, planting, maintenance and other silvicultural operations.High density short rotation plantations, pulpwood plantations and energy plantations.Trees outside forests (TOF).Forest plantations and CDM.Forest certification.

Suggested reading specific to module:

Sagwal, S.S. (2006): A Text book of Silviculture, Kalyani Publishers, India
Negi, S.S. (2000): Indian Trees and their Silviculture - Legumes,BishensinghMahendrapal Singh (pubication),Dehradun,India.
Khanna, L.S.1989. Principles and Practice of Silviculture.KhannaBandhu, Dehra Dun. 473 p Negi,
John G. Robles and Charlotte A. Savage (2012). Forest Certification and Sustainable Management: Programs, Standards and Techniques. Nova Science Publishers

Module 3

Taxonomy and its relevance to wood science. Taxonomic identification tools: bark, stem, leaf, flower, fruit, seed. Plant nomenclature: International Code of Botanical Nomenclature and its rules. Systems of classification (Natural, artificial and phylogenetic, brief description of Bentham and Hooker system of classification).

Suggested reading specific to module:

George H.M Lawrence, (1951): Taxonomy of Vascular Plants, Scientific Publishers, India.
Bhattacharyya *et.al.* (2007): A Text Book of Botany, New Central Book Agency Private Ltd., Kolkata, India

Module 4

Systematic positions and diagnostic features of important trees of 10 major timber producing families (Leguminosae, Dipterocarpaceae, Lythraceae, Meliaceae, Combretaceae, Pinaceae, Guttiferea, Myrtaceae, Santalaceae, Moraceae)

Suggested reading specific to module:

K.C. Sahini (1998) The Book of Indian Trees, Bombay Natural History Society
N. Sasidharan (2010) Forest Trees of Kerala. Kerala Forest Research Institute

Suggested Reading:

Tim Peck (2001): The International Timber Trade, Woodhead Publishing Limited, England.
Bhattacharyya *et.al.* (2007): A Text Book Of Botany, New Central Book Agency Private Ltd., Kolkata, India
Shukla, R.S. &Chandel, P.S.(2008): Ecology and Utility of Plants, S.Chand& Company Ltd, New Delhi
Nautiyal, S.&Kaul, K. (2003): Non Timber Forest Products of India (Ed.), Jyothi Publishers and Distributers, Dehradun, India.
SopheHigman.*et.al.* (2006): The Sustainable Forestry Hand Book(2nd edition), Earthscan Publications Ltd, London.
George H.M Lawrence, (1951): Taxonomy of Vascular Plants, Scientific Publishers, India.
Garfitt, J.E. (1995): Natural Management of Wood Continuous Cover Forestry, Research Studies Press Ltd, England.
Yadav, Manmohan. (2016). Handbook on Forest Certification. TERI Press

Sample questions to test outcome

1. Differentiate between linear strip plantation and shelter belts
2. Discuss the major aim of Clean development Mechanism
3. Using the information you have learned explains the role of social forestry in meeting timber requirements of rural people?
4. Examine the characteristics of the family Pinaceae and Combretaceae?

CO- PSO MAPPING						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	✔					
CO2	✔					
CO3	✔			✔	✔	
CO4	✔			✔		
CO5	✔					✔

MSWST 01DSC02: WOOD STRUCTURE AND IDENTIFICATION (64 hrs. /Semester)

Course Objectives

To identify different types of wood tissues their location and functions
To emphasizes the character of the cells and variability of wood within the tree.
To Identify timber species based on their macro and micro features
To know about the affect of various silvicultural practices on wood quality in plantation timber.

Course outcome

On completion of this course the student will be able to:

C01	Evaluate formation of wood and secondary growth
C02	Discuss general physical features of wood
C03	Critically evaluate microscopic features of softwood and hardwood
C04	Learn defects in wood
C05	Acquire skills in assessment of wood quality

Module 1

Wood anatomy – an introduction.Softwoods and hardwoods .Tissues- Meristems, Classification of Meristems. Permanent tissues-Simple permanent and complex permanent tissues .Primary structure of Dicot stem and Monocot stem. Formation of wood – cambium & its derivatives: secondary growth.

Suggested readings specific to module

Shukla R.S. &Chandel, P.S. (2008): Ecology and Utility of Plants, S.Chand& Company Ltd,New- Delhi,India.
Jeffryed,E.C.,(1985): Anatomy of Woody Plants, International Books & Periodicals Supply Services, New Delhi,India.
Hillis W.E. (1987): Heartwood and Tree exudates, Springer-Verlage Publications, New York.

Module 2

General features of wood. Important characteristics employed for wood identification – hand lens features of wood – softwood – hardwood; Anatomical structure of wood: Gross anatomical and minute anatomical structures – sapwood and heartwood, growth rings and growth marks, rays, vessels or pores – ring porous and diffuse porous wood, fibres, etc. Microscopic features of softwood and hardwood.

Suggested readings specific to module

Hillis W.E. (1987): Heartwood and Tree exudates, Springer-Verlage Publications, New York.
Jeffrey,E.C.,(1985),The Anatomy Of Woody Plants, NewDelhi,International Books & Periodicals Supply Service.

Module 3

Defects in wood – Natural defects – knots, shakes, cross grain and other defects due to stress. Defects other than natural. Variability of anatomical structure: reaction wood, abnormal rings - false rings and discontinuous rings. Juvenile wood and its characteristics and importance.

Suggested readings specific to module

Schmidt,O.,(2006),Wood And Tree Fungi Biology Damage Protection And Use,Germany, Springer-Verlag Berlin Heidelberg
Zobel,B.J.,Sprague,J.R.,(1998),Juvenile Wood In Forest Trees,Newyork, Springer- VerlagBerlin Heidelberg

Module 4

Anatomical features of some important timber species. Wood structure in relation to silviculture, agri-silvi practices, genetics and properties.Criteria and methods of assessment of wood quality in plantation timbers.

Suggested readings specific to module

Bamber,R.K.,Burley,J.,(1983),TheWoodPropertiesofRadiataPine,England,CommonWealth Agricultural Bureax
W. E. HILLIS (1962), Wood Extractives and Their Significance to the Pulp and Paper Industries, Academic press

***Suggested Reading*:**

Pijush Roy (2006): Plant Anatomy, New Central Book Agency(P) ltd, Kolkata-India.
Dinwoodie, J.M. (2000): Timber: Its Nature and Behaviour (2nd edition),E&FN Spon(Publication),London.
Aidan Walker,(1989): The Encyclopedia of Wood, New Burlington Books, London.
Hon, N.S.D &Shirashi, N.(ed.) (2001): Wood and Cellulosic Chemistry (2nd edition), Marcel DekkarInc, New York.
Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications(2nd edition),(Xerox copy),Academic Press inc. California
Smith,I et.al.,(2003): Fracture and Fatigue in Wood, John Wilog&Sons Ltd, England 8. Unger A. et.al., (2001): Conservation of Wood Artifacts- a handbook, Springer Publication ,Germany
Kollmann,(1968): Priciples of Wood Science & Technology Volume I – Solid Wood, Springer Verlage Publications, New York
Hon,D.N.S.,ShiraishiN.,(2001).Wood And Cellulosic Chemistry, NewYork, MarcelLDekker,Inc.
Panshim,A.J,Zeeauw,C.D.,(1980),Text Book Of Wood Technology, USA, Mcgraw Hill Book.
Tillman,D.A.,Rossi,A.J.,Kitto,W.D.,(1981),WoodCombustionPrinciplesProcessesand Economics,NewYork,Acadamic press inc.
PAULA J. RUDALL.,(2020), Anatomy of Flowering Plants-An Introduction to Plant Structure and Development Fourth Edition, Cambridge University Press.
Philip R. Larson(1994), The Vascular Cambium Development and Structure, Springer-Verlag.
Barry Gardiner , John Barnett , PekkaSaranpa.a, Joseph Gri.,(2014), The Biology of Reaction Wood, Springer Heidelberg New York Dordrecht London
Roger.M.Rowel,(2012).,Handbook of Wood Chemistry and Wood Composites SECOND EDITION, CRC Press
JOHN C.F. WALKER Primary Wood Processing Principles and Practice- 2nd edition

Sample questions to test outcome

1. Describe the anatomical difference between monocot and dicot stem (explain with diagrams)?
2. Give a comparative account between intrastelar secondary growth and extra 11tellar secondary growth.?
3. Discuss in detail about the various defects in wood.
4. Bring out the effects of silvicultural practices in wood properties ?

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔						
CO4	✔						
CO5	✔						

MSWST 01DSC03: PHYSICAL, MECHANICAL AND CHEMICAL PROPERTIES OF WOOD (64 Hrs. /Semester)

Course Objectives

To Understand the important physical and chemical properties of wood
To Get an idea about relationship between wood and moisture and effects of moisture on the properties of wood
To Explore the mechanical properties of wood like tensile, compressive, shear strength and modulus of elasticity
To identify the wood species using the basic physical properties like colour, texture, density etc.

Course outcome

On completion of this course the student will be able to:

C01	To bring out various physical properties of wood and their practical significance.
C02	Critically examine electrical properties, acoustic properties, optical properties and thermal properties of wood.
C03	To acquire skills in determination of wood mechanical strength, moisture content, swelling and shrinkage.
C04	Analyse wood cell wall and their impact on strength properties on wood.

Module 1

Physical properties of wood: colour, odour, lustre, fluorescence, weight and density, specific gravity, moisture content variations and their practical significance. Dimensional Stability of wood. Timber classification based on density and Specific gravity. Identification of common timbers using their physical properties.

Suggested readings specific to module

George Tsoumis., (1968),Wood as raw material,Pergamon Press Inc.
Kollmann,(1968): Principles of Wood Science & Technology- Volume I –Solid Wood, Springer-Verlage publications, NewYork

Module 2

Electrical, piezo-electrical, optical, acoustical and thermal properties of wood.Woodwater relationship, hygroscopic nature of wood, free and bound water, fibre saturation point, equilibrium moisture content in wood.Movement of moisture in wood, differential shrinkage.Effect of moisture loss in the dimensional stability of wood.

Suggested readings specific to module

Bucur,V.,(2006),Acoustic Of Wood, France: Springer
Kollmann,(1968): Principles of Wood Science & Technology- Volume I –Solid Wood, Springer-Verlage publications, NewYork

Module 3

Basic important mechanical properties of wood. Young's modulus, stress vs strain in wood, modulus of elasticity, anisotropy and various elasto-plastic nature of wood, strength of wood; Various stresses acting upon wood: Tensile, Compressive, Bending, Shearing Stress and torsion; Non Destructive testing Techniques; Important factors affecting the strength of wood-inherent characteristics-growth conditions, tree age etc.

Suggested readings specific to module

Smith,I., LANDISE, Gongm.,(2003),Fracture and fatigue in wood, England, Wiley.
Panshim,A.J,Zeeauw,C.D.,(1980),TextBookOfWoodTechnology,USA,McgrawHillBook.

Module 4

Structure and ultrastructure of wood –Chemical composition and analysis of wood. Chemistry of wood-cell wall components, cellulose-molecular structure,hydrogen bonds. Hemi-cellulose-softwood hemicellulose, hardwood hemicellulose.pectin and lignin; extractives, organic and inorganic materials.Their impact on the various strength properties. Chemistry of wood and bark extractives. Extractive of hardwood and softwood.Resin-fats and waxes-Tall oil.

Suggested readings specific to module

Hon, N.S.D &Shirashi, N.(ed.) (2001): Wood and Cellulosic Chemistry (2nd edition), Marcel DekkarInc, New York.
Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications(2nd edition),(Xerox copy),Academic Press inc. California

Suggested Reading:

Hakkila.P,(1989),Utilization of residual forest biomass, Germany: Springer Verlay Berlin Heidelberg
Hon,D.N.S.,ShiraishiN.,(2001).Wood And Cellulosic Chemistry, New York, MarcelL Dekker, Inc.
Koshijima,T.,Watanabe.,(2003),Association Between Lignin and Carbohydrate in Wood and Other Plant tissue, Berlin, Springer
Bhat,S.V.,Nagasampagi,B.A.,Sivakumar,M.,(2005),Chemistry of Natural Product, Mumbai, Narosa
Rowell,R.M.,(2005),Hand Book Of Wood Chemistry And Composites, Newyork, Taylor And FrancisGroup.
Kollmann,F.P.,Kuenzi,E.W.,Stamn,A.J.,(1975)Principles Of WoodScience Volume2 Wood Based Materials, Newyork, Springer-Verlag Berlin Heidelberg.
Kennedy,J.F.,Philips,G.O.,Williams,P.A.,(1996)The Chemistry And Processing Of Wood And Plant Fibrous Materials, England, Wood Head PublishingLtd.
Hilis,W.E.,(1987),Heart Wood And Tree Exudates,Newyork,Springer-Verlag Berlin Heidelberg.
Rowe,J.W.,(1989),Natural Products of Woody Plants I & II, NewYork, Springer-Verlag Berlin Heidelberg
Sjostrom,E.,(1993),Wood Chemistry Fundamentals and Application, NewYork, Academic Press, inc.

Sample questions

1. Elaborate on various stresses acting upon wood?
2. Briefly explain the thermal properties of wood?
3. Describe the movement of water within the wood?
4. Differentiate hard wood extractives and softwood extractives?

CO- PSO MAPPING

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔	✔		✔	✔		
CO4	✔						

MSWST01DSC04: LOGGING AND SAWMILLING PRACTICES (64 Hrs. /Semester)

Course Objectives

To emphasize the importance of responsible timber resource management.
To provide insights into the business aspects of timber logging.
To promote environmentally responsible logging practices.
To make aware about the latest technologies and trends in the sawmilling industry.
To provide knowledge and skills for maintaining and repairing sawmill equipment's.

Course outcomes:

On completion of this course the student will be able to:

C01	Prioritize the felling and logging operations in a sustainable manner.
C02	Plan the proper conversion and transportation of timber.
C03	Manage the depot and the storage of timber.
C04	Summarize the different sawmilling equipment.
C05	Outline the different saw doctoring practices

Module 1

Stem form –stem form theories. Form factor. Tree height measurement methods: instrumental and non-instrumental methods. Standardized terms used for stem volume and tree height measurement. Tree volume determination. Implements used in felling and logging operation; traditional and improved tools. Brief overview of tree felling operations: rules and methods. Logging: definition and scope. Reduced impact logging (RIL).

Suggested readings specific to module

SIST, P. (2000*). Reduced-impact logging in the tropics: objectives, principles and impacts*. *The International Forestry Review*, *2*(1), 3–10.

West, P.W. (2009): *Tree & Forest Measurements* (2nd Edition), Springer Publications, New York.

Avery,T.E&Burkhart,H.E,(1994*): Forest Measurements* (4th edition), McGraw-Hill,Inc Publications, Singapore.

Troup, R.S. (2007). Manual of Indian forest utilization.Asiatic publishing house.

Module 2

Central and State rules relating to timber transit. Methods of extraction and transportation. Timber grading. Storage of timber: timber depots – depot management. Marketing of timber. Conversion – steps. Economic conversion. Sawmills – types, requirements and layout. Saw mill improvement programme. Timber log yard and its management. Measures for yard hygiene

Suggested readings specific to module

The Indian forest act 1927. C.7.
The Kerala forest produce transit rules, 1975.
Suleski, C.J. (1985). The sawmill improvement program instant forestry at work. Forest products journal.35(1).6-7.
John C.F. Walker, (2006): Primary Wood Processing- Principles and Practices (2nd Edition), Springer Publication, The Netherland
Hopewell, G. (2015). Sawmilling – a best practice manual for small log processing in Lao PDR. Australian centre for international agricultural research.
Telford, J.C. (1952). Small sawmill operator's manual. U.S. department of agriculture.61-73.

Module 3

Sawing methods. Conversion terms for sawn timber. Sawmilling equipment's: log handling and preparation equipment's, saws and other miscellaneous equipment's used in sawmilling process. Gantry equipment: purpose and types. Head saws and re-saws. Types and parts of: chain saws, band saws and circular saws. Tungsten carbide tipped sawblades.

Suggested readings specific to module

Telford, J.C. (1952). Small sawmill operator's manual. U.S. department of agriculture.2-49.
Bureau of Indian Standards (1980). Guide for mill sawing of timber, (IS 9576).Knopf, A.A. (2011).
The complete manual of woodworking.The evergreen state college.172-177.

Module 4

Log scanners and computerized BOF system. Sawing equipment for small girth- logs. Modern developments and innovations in saw milling. Scope and importance of saw mill automation. Saw mill safety. Problems in the saw milling industry. Saw doctoring: Saw blade geometry and maintenance: Clearance, sharpness and hook angles, Pitch, Gullet capacity, peripheral/linear saw speed, Feed speed, Bite etc. Quality and choice of metal in saw blades. Tensioning, levelling, straightening, brazing, setting and tempering of saw blades. Automatic/Semi-automatic saw doctoring equipment.

Suggested readings specific to module

Pandey, C.N. (2008): *Training Courses on Saw Doctoring*, IPIRTI, Bangalore, India.
Bureau of Indian standards (1980). Guide for mill sawing of timber, (IS 9576).
Food and Agriculture Organization of the United States. (1985). Saw doctoring manual.63- 202.

Suggested Reading:

Mehta.(2008). *A Hand book of forest utilization*.International book distributors.
Bostrand, L., Frykman, B., Strehlke, B., Staudt, F., Apud, E., &Harstela, P. (1992). *Introduction to ergonomics in forestry in developing countries The Indian forest act 1927. C.7.*
Bureau of Indian standards (1980). Guide for mill sawing of timber, (IS 9576).
Troup, R.S. (2007). Manual of Indian forest utilization.Asiatic publishing house.
The Kerala forest produce transit rules, 1975.
SIST, P. (2000*). Reduced-impact logging in the tropics: objectives, principles and impacts*. *The International Forestry Review, 2*(1), 3–10.
Putz, F.E., Sist, P., Fredericksen, T.S., & Dykstra, D.P. (2008*). Reduced-impact logging: Challenges and opportunities*. *Forest Ecology and Management, 256*, 1427-1433.
Chhabra T.N. & R.K. Suri, R.K. (2007*).Industrial Relations- Concepts and Issues*.DhanpatRai&Co (P) Ltd, New Delhi.
Timpeck, (2001).*Infestations; diseases and their management*. The International Timber Trade, Woodhead Publishing Limited, England.

Kumar, A. N. A., Joshi, G., & Ram, H. Y. M. (2012).*Sandalwood: history, uses, present status and the future. Current Science, 103*(12), 1408–1416.
John C.F. Walker, (2006): *Primary Wood Processing- Principles and Practices* (2nd Edition), Springer Publication, The Netherland.
Pandey, C.N. (2008): *Training Courses on Saw Doctoring*, IPIRTI, Banglore, India.
Pandey, C.N. (2008): *Training Courses on Saw Milling*, IPIRTI, Banglore, India
West, P.W. (2009): *Tree & Forest Measurements* (2nd Edition), Springer Publications, New York.
Bucur,V.,(2003): *Non Destructive Characterization and Imaging of Wood*, Springer-Verlag Publications, Berlin.
Hopewell, G. (2015). Sawmilling – a best practice manual for small log processing in Lao PDR. Australian centre for international agricultural research.
Telford, J.C. (1952). Small sawmill operator's manual. U.S. department of agriculture.61-73.
Food and Agriculture Organization of the United States. (1985). Saw doctoring manual.63- 202.

Sample Questions to test outcomes

1. Elaborate different tree felling methods with suitable diagrammatic illustrations?
2. Formulate a set of tree felling rules based on your inferences to conduct felling operations in a most effective way?
3. Evaluate the importance and consequences of water transportation?

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔				✔		
CO4	✔						
CO5	✔						

MSWST 01DSC05: WOOD SCIENCE LABORATORY I (128 hrs. /Semester)

Course Objectives

To test the basic physical and mechanical properties of wood

To study the anatomical features of different wood species under microscope

To identify the important timber producing tree species

To analyse the chemical constituents present in wood

Course outcomes:

On completion of this course the student will be able to:

C01	Identify economically important timber species using morphological and anatomical characteristics
C02	Test the physical and mechanical properties of wood
C03	Analyze the important chemical constituents present in wood
C04	Identify the important equipment and operations used for logging and sawmilling
C05	Prepare the Herbarium of important tree species

1. Herbarium collection of important timber-yielding species for the understanding of its features of identification
2. Field identification of important timber trees and their importance- Hand lens features and identification of wood.
3. Anatomical keys and methods to use them. Dichotomous keys, punched card keys and computer aided identification
4. Microscopic features, slide inspection of important characteristics species
5. Traditional and modern equipment/tools used in logging operations and their uses.
6. Visit forest and timber depots and submit the reports.
7. Instructions regarding maintenance of various records and registers in logging operations.
8. Determination of density of wood.
9. Determination of moisture content
10. Determination of Shrinkage and Swelling in wood
11. Determination of Ash content in wood
12. Determination of Chemical constituents in wood
13. Marking and conversion of wood into small clear specimens for testing
14. Test for mechanical properties of wood – Static bending, impact bending, compression parallel and perpendicular to grain, hardness, shear, torsion, nail and screw puling test, brittleness test, and calculation of properties.

Sample Questions to test outcomes

1. Identify the given tree species using the characteristic features
2. Measure the density and Moisture content of the given wood samples
3. Write the procedure for testing the static bending strength of wood
4. Calculate the ash content of the given sample and write the procedure

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔			✔			
CO2	✔						
CO3	✔			✔	✔		
CO4	✔						
CO5	✔						

SECOND SEMESTER

CORE COURSE

MSWST02DSC06: WOOD BIODEGRADATION AND PRESERVATION (64hrs./ Semester)

Course Objectives

To identify different wood degrading agents
To effective utilization of preservatives in wood
To learn about different preservation methods and its significances
To test the effectiveness of different types of preservatives

Course Outcome:

On Completion of this course the student will be able to:

C01	Classify different wood degrading agents and its mode of degradation
C02	Understand the significance of quarantine and phytosanitary certifications
C03	Describe the importance and types of wood preservatives
C04	Analyse the requirements for wood preservation process
C05	Explain Environment friendly Preservatives

Module 1

Insect pests of natural forests and plantations, standing and felled trees, timber in storage. Biology, life history and extent of damage caused due to Wood boring insects: Coleoptera, Hymenoptera and Isoptera. Control measures against wood boring insects. Marine Borers.Galls, cankers etc. Wood attacking termites- life history and distribution wood destroying termites and its control measures.

Suggested readings specific to module

Kollmann,(1968): Priciples of Wood Science & Technology, Volume I – Solid Wood, Springer-Verlage
Martin R Speight & Ross F Wylie (2001): Insect Pest in Tropical Forestry – CABI Publishing,United Kingdom.
IssacIshawya, et.al.,(2012) : Advanced Technologies for Managing Insect Pests, Springer-VerlagePublications,New York, London.
Rose F. et.al.,(2011): Insect Pest in Tropical Forestry (2nd edition),CABI Publishing, United Kingdom.

Module 2

Fungal degradation of wood. Wood decay types: White rot, brown rot, soft rot, sap stain, moulds, discolouration and blemishes. Essentials of fungal attack on wood.Bacterial decay of wood; symptoms and causes. Decay in buildings. Heart rot in standing timber, management of timber with heart rot.Natural decay resistance of timbers and its evaluation.

Suggested readings specific to module

Olaf Schmidt, (2006): Wood and Tree Fung- Damage, Protection &Uses, Springer Publication ,Germany.
Dennis Allsopp et.al.,(2004): Introduction to Biodeterioration(2nd edition),Cambridge University Press, New York.
Nair, K.S.S. et al. (1996). Impact of Diseases and pests in Tropical Forests. Kerala Forest research Institute, Forestry research Support programme for Asia and the Pacific.

Module 3

Principles of pest control. Integrated Pest Management with respect to forest management: Natural, nutritional, biotic, silvicultural, mechanical, physical and chemical methods of insect control. Quarantine: principles and practices in plant protection. Phytosanitary certification.Classification of timbers on the basis of natural durability, methods of determination of natural durability.Wood preservation and importance, Types of wood preservatives- Requirements of an ideal preservative.Testing of the efficacy of preservatives under laboratory and field conditions.–their toxicity levels.

Suggested readings specific to module

Goodell,B.et.al.(ed.),(2003): Deterioration Wood and Preservation – Advanced in Our Changing World, American Chemical Society, Washington.Publication, Netherland
Thompson R (ed.),(1991): The Chemistry of Wood Preservation, Royal Society of Chemistry (publication) ,Cambridge

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Module 4

Non-pressure treatment processes: brushing, spraying, dipping, steeping, cold soaking, hot and cold bath, sap displacement and diffusion methods. Pressure treatment processes: Full cell, rueping (empty cell) and lowry treatments. Miscellaneous processes: prophylactic treatment, Preservation of Bamboo Boucherie treatment and Osmose treatment for green timber. New generation-eco-friendly and Biodegradable preservatives.Advanced methods of wood preservation.

Suggested readings specific to module

John C.F. Walker,(2006): Primary Wood Processing- Priciples and Practices (2nd edition), Springer
Gerorge M Hunt & George A Garratt, (1967): Wood Preservation (3rd edition) MC Graw Hill Book ,Companies, United State of America.
Baechler, R.H.; Roth, H.G. 1964. The double-diffusion method of treating wood: a review of studies. Forest Products Journal. 14(4): 171–178.

Suggested reading

AWPA.[Current edition].Annual proceedings. (Reports of preservations and treatment committees containing information on new wood preservatives considered in the development of standards). Birmingham, AL: American Wood Protection Association.
AWPA. 2008. Book of standards. (Includes standards on preservatives, treatments, methods of analysis, and inspection.) Birmingham, AL: American Wood Protection Association
Barnes, M.H., ed. 2007. Wood protection 2006.Publication No. 7229. Madison, WI: Forest Products Society. 388 p

Sample Questions

1. Compose the informations about types of wood decay with examples
2. Construct hierarchical classification of Phylum arthropoda
3. Predict the methods for evaluating efficiency of preservatives

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔					✔	
CO3	✔			✔	✔		
CO4	✔						
CO5	✔					✔	

MSWST 02DSC07: WOOD SEASONING (64 hrs. /Semester)

Course Objectives

To develop problem solving skills to address common issues related to wood seasoning
To learn various wood drying techniques
To assess the quality of seasoned wood
To familiarize with safety protocols and equipment's used in wood seasoning
To gain hands on experience in wood seasoning.

Course outcomes:

On completion of this course the student will be able to:

C01	Interpret the wood- water relationships.
C02	Evaluate the different factors affecting the drying rate of wood.
C03	Characterize the seasoning defects with their controlling measures.
C04	Differentiate between natural seasoning and artificial seasoning practices.
C05	Manage the kiln seasoning process.
C06	Summarize the kiln design and operations.

Module 1

Objectives and importance of wood seasoning. Fundamentals of wood water relationships – Forms of water present in wood, Fibre saturation point, Equilibrium moisture content, shrinkage and swelling and water movement in wood. Recommended moisture content of seasoned timber for different end uses in different climatic zones. Seasoning methods: Natural and artificial seasoning practices. Factors affecting drying rate of wood – thickness, moisture content, temperature, relative humidity, and velocity of drying air, diffusion and permeability characteristics of the species (form of moisture gradients in the timber section), sapwood and heartwood. Different pre-treatments methods and their significance in seasoning.

Suggested readings specific to module

Kape, W.J. (2013). *An introduction to Seasoning of Timber*.Pergaman Series Monographs on Furniture and Timber.

Brown, W.H. (1965). *An Introduction to seasoning of Timber*. Macmillan

Kollmann, (1968): *Priciples of Wood Science & Technology- Volume* I - solid Wood, Springer-Verlag Publications, New York

Mishra, K.R. (2017). Significance of wood seasoning.Tropical forest research institute.4(11).25 -30.

Bureau of Indian standards (1993).Permissible moisture content for timber used for different purposes, (IS 287).

Bureau of Indian standards (1993).*Seasoning of timber – code of practice,* (IS 1141).

Module 2

Seasoning defects- Surface & internal cracking, end splitting, cupping, warping etc.; their causes and prevention. Warp control – Top weighting, calculation of optimum loading (spring loading system); Drying stress development, measurement of drying strains. Resultant plastic strains (sets) produced. Stress reversal and case hardening. Critical stages for surface and internal cracking, drying conditions control, Partial pre- air drying; SDR procedure.

Suggested readings specific to module

McMillen, M.J. (1958). Stresses in wood drying.United States department of agriculture and forest service.

Bureau of Indian standards (1993).*Seasoning of timber – code of practice*, (IS 1141).

Yin, Q., & Liu, H. H. (2021, May 29). Drying Stress and Strain of Wood: A Review.*Applied Sciences*, *11*(11), 5023. https://doi.org/10.3390/app11115023

Module 3

Classification of Indian timbers according to refractoriness to seasoning. Storage and treatment of logs.Stacking: methods and importance. Air Seasoning – air seasoning sheds. Fan – air drying. Kiln Seasoning. Kiln schedules. Kiln operation: crossers selection and considerations, Kiln sample selection and preparation, Moisture determination methods, Measuring instruments for temperature., relative humidity and air velocity. Maintenance of steam traps. Kiln classification. Seasoning kilns: General design features and specifications. Heating (steam, hot water, heated mineral oil, direct/ indirect heating by wood or gas – fired furnace and electricity). 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 & structural insulation.Possibilities of kiln automation. Kiln heat losses and energy efficiency data. Consumption of different types of fuel.

Suggested readings specific to module

Bureau of Indian standards (1993).*Seasoning of timber – code of practice*, (IS 1141).

Bureau of Indian standards (1974). Guidelines for design, installation and testing of timber seasoning kilns (Compartment type with cross- forced air circulation), (IS 7315).

Module 4

Energy in kiln drying: energy consumption in drying systems. Heat transfer concepts, energy demands of various wood drying systems. Energy conserving drying processes: Solar kilns, dehumidification kilns, vacuum seasoning – Radio frequency, conductive, cyclic, superheated and microwave vacuum drying. Wood properties changes by vacuum drying.Special seasoning methods. High temperature, drying, solvent seasoning, chemical seasoning, vapour drying.)

Suggested readings specific to module

Espinoza, O., & Bond, B.H. (2016).*Vacuum Drying of Wood—State of the Art. Current Forestry Reports, 2*, 223-235.

Bureau of Indian standards (2010). Design, installation and testing of solar timber seasoning kiln, (IS 15890).

https://home.engineering.iastate.edu/~shermanp/STAT447/STAT%20Articles/Wood%20 Drying.pdf

Suggested Reading:

1. Kape, W.J. (2013). *An introduction to Seasoning of Timber*.Pergaman Series Monographs on Furniture and Timber.

2. Brown, W.H. (1965). *An Introduction to Seasoning of Timber*. Macmillan

3. Kollmann, (1968): *Principles of Wood Science & Technology- Volume* I - solid Wood, Springer-Verlage Publications, New York

4. Betts, H.S. (1970). *Timber its Strength, Seasoning and Grading*. McGraw-Hillbook
5. Keey, R.B. et.al., (2000): *Kiln- Drying of Lumber*, Springer-Verlage Publications, Germany.
6. Espinoza, O., & Bond, B.H. (2016). *Vacuum Drying of Wood—State of the Art*. *Current Forestry Reports, 2*, 223-235.
7. Bureau of Indian standards (1993). *Seasoning of timber – code of practice*, (IS 1141).
8. Bureau of Indian standards (1974). Guidelines for design, installation and testing of timber seasoning kilns (Compartment type with cross- forced air circulation), (IS 7315).
9. Bureau of Indian standards (1993). Permissible moisture content for timber used for different purposes, (IS 287).
10. Bureau of Indian standards (2010). Design, installation and testing of solar timber seasoning kiln, (IS 15890).
11. Yin, Q., & Liu, H. H. (2021, May 29). Drying Stress and Strain of Wood: A Review.*Applied Sciences*, *11*(11), 5023. https://doi.org/10.3390/app11115023
13. .https://home.engineering.iastate.edu/~shermanp/STAT447/STAT%20Articles/Wood%20 Drying.pdf
14. McMillen, M.J. (1958). Stresses in wood drying.United States department of agriculture and forest service.

Sample Questions to test outcomes

1. Formulate a short note on wood- water relationships
2. Discuss the importance of wood seasoning in India based on the alternating climatic conditions
3. Predict the possibilities and scope for popularizing the solar kilns in India

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔			✔			
CO2	✔						
CO3	✔	✔					
CO4	✔						
CO5	✔	✔					
CO6	✔	✔					

MSWST 02DSC08: INDUSTRIAL WOOD TECHNOLOGY WORKSHOP (128 hrs. /Semester)

Course Objectives

To explore the industrial operations for manufacturing wood panel products
To get hands on training in the various operations involved in manufacturing of plywood, hardboard, furniture and quality testing
To identify the root cause of various industrial problems and find solution
To supervise employees to ensure quality production with minimal resource waste.

Course outcomes:

On completion of this course the student will be able to:

C01	Manage the operations involved in manufacturing plywood and reconstituted boards
C02	Test the quality of manufacture product as per Indian Standards
C03	Plan the seasoning schedule for drying the timber without defect
C04	Manage the operations involved in the vaccum pressure treatment
C05	Prepare the combinations of chemical preservatives for treatment

PLYWOOD TECHNOLOGY

I. Storage Yard

Wood species used for production of plywood and other wood based materials

At the Log storage – need for storage, dry storage, wet storage, precautions in storage, measurement of log volume, Identify defects in wood, identify the wood destroying organisms such as insects and termites present in stored log

II. Plywood Processing (Green end)

The students should study the following processes with the help of the factory staff:

Steaming and boiling - determination of heating schedules- calculation and comparison with actual practice , effect of heating on properties of wood, advantages and disadvantages of heating. Preparation of logs for peeling - cross cutting, debarking and cleaning. Log centering - purpose and economic importance of centering, centering errors and their influence on veneer yield, methods of centering. Veneer peeling lathe - machine parts, cutting action, undesirable movement of wood on lathe, play in lathe machine parts, spindle overhanging, dynamic equilibrium and slackness. Peeling lathe settings- setting of knife, setting of pressure bar, and setting of the gap.

Rotary cutting of veneer - lathe settings and veneer quality, mechanism of veneer formation, type A and B veneer, effect of pressure bar compression and temperature on veneer yield. Peeling defects, their cause and control - thickness variation-application of SQC -, roughness, identification of loose and tight side, loose veneer corrugation, raised grain, torn grain, bump

formation, wooliness, knife and pressure bar marks. Measurement of veneer recovery, Yield calculation, Quality evaluation.

Maintenance of peeling lathe - general procedures, lubricants and lubrication, storage of spare parts for replacement

Veneer Clipping - functions, types, clipping efficiency, clipping allowance, veneer yield, dry clipping,

Preparation of flitches for slicing - sawing patterns, cutting plan, tangential cutting, radial cutting, box flitches, half sawn flitches, quarter sawn flitches. Veneer slicer - machine parts, cutting action, advantages of slicing, undesirable movement of wood on slicer, play in slicer machine parts. Slicer settings and veneer quality - setting of knife, selling of pressure bar, effect of knife and pressure bar settings on veneer quality. Matching of sliced decorative veneers - side matching or drawn across, book matching or tuned over or cathedral matching, quartered matching, half quartered matching.Slicing defects, their causes and control.Maintenance of slicer-general maintenance procedure, lubrication.

III. Plywood Processing (Dry End)

Drying of veneers

Veneer drying - purpose, drying variables, moisture movement in veneers during drying, special measures for controlling final moisture content, drying defects and their control, types of dryers, internal design details, air velocity measurement, drying time, dryer productivity, dryer capacity. Splicers and splicing veneers

Glue spreading

Glue spreaders – Examine the components, operation and maintenance of the machine

Hydraulic presses

Hydraulic presses - cold and hot.Hydraulic system, Pascal's law, calculation of specific pressure, Pneumatic system. Heating modes, steam generation boilers, high pressure hot water boilers, thermic fluid. Identify the number of Plate and Column presses in the factory and report their construction.

<u>Identify the following important parts of Single-day light and multi-opening presses</u>

1. Rams (chilled hardened steel), 2. Cylinders (forged steel), 3.Cooling platens, 4.Heat balancing platens, 5. Press table, 6.Insulation, 7.Hot platens, 8.Insulation, 9.Upper beam, 10. Heat balancing plates, 11. Bearing plate, 12. Press frame

Study the heating mediums employed in hydraulic hot presses and individually identify them and report. Discuss the advantages and disadvantages of each of them. Ascertain different types of forces to which the structural load-bearing parts of a press are subjected and report. Learn about

press deflection and also causes of press damage and report Study the time of pressing for different thicknesses. Calculation of time of pressing from theory

Trimming and sanding

Trimming - machines and operation. Drum and belt sanders - machines and operation. Abrasives, types of abrasives, grain size, grade, structure, bond, wheel selection, grinding head, grinding bed,

Workshop practice

Knife grinding machine and grinding wheels - knives, grinding machines, composition, coolant, grinding procedures, maintenance. Jointing and splicing of veneers

BLOCK BOARDS AND FLUSH DOORS

Batten preparation and core composing for flush door and block board. Block boards and flush doors - core preparation, veneers, adhesives, construction, hot press schedules.

BOILERS AND BRIQUETTING PLANT

Study the working of boilers using steam, high-pressure hot water, oil heating, and briquettes. Students should also study the working of briquetting machine

RECONSTITUTED PANEL PRODUCTS

Fibreboards

I Raw Materials

Raw materials - fibre characteristics, fibre strength, fibre morphology, cell wall thickness and density of wood, Wet process and dry process hardboard, S1S and S2S types , wood chips, saw mill chips, wastes from lumber and plywood mill such as planer shavings, sawdust, sanderdust, plywood trims, whole-wood- tree chips, non-wood raw materials- lignocellulosic fibres Mill yard, type of logs and how they are delivered at the storage sites, Measurement of quantity, standard methods solid contents,

II Size Reduction and Screening

Manufacture of pulp chips, slashing, debarking, chipping, type of chippers, gravity feed and horizontal feed, examining the geometry of rotating knives, screening-overs, accepts and fines, type of movement of the screen, blinding(plugging of the finer screens) and how the plugging is prevented by bouncing rubber balls, size openings of various screens, screen analysis to be carried out, dulling of knives, wearing of bed plate, Chip moisture content determination, chip handling, silos storage,

III Defibration and refining

Pulping process- freeness of pulp, disk refining, types of disk refiners, single disk and double disk, profiled cutting plates, material of construction, classification of plates based on the profile

IV Pressurized disk refining

Pressurized disk refining- complete interior details of the machines to be studied and reported, Asplunds (Sundsdefibrator) ,its operation, the process sequence, chip chute, conical horizontal feed screw, compression ratio, splines in the plug pipe and for preventing the plug from rotating.Pre-heater, internal design and functioning, conveyor screws to the defibrator, the design of the conveyor screw, grinding disks stationary and rotating mounted on main shaft rotors, closely examining the steel alloy grinding segments profiled for shearing action to defibrize .

V. Level Control in Pre-heater

The pre-heater control such as speed of the conveyor controlling the amount of chips going into the pre-heater to keep the level in the pre-heater constant based on gamma gauge measurement Pressure in the pre-heater and the adjustment of fresh steam flow into the pre-heater. Observing and recording the temperature in the pre-heater (Observation and report). Observe refiner motor power, Flow of dilution water to the screw conveyor feeding the refiner (Report). Observe the refiner housing pressure to give the pulp free flow through the refiner (Report)

VI Chemical Additives

The additives are added to the pulp in the 'stock chests'

1. Discussion on the acidity control , Improvement of water resistance (sizing) defoamers, and release agent
2. Discussion on specific sizing agents , rosin size, wax size, asphalt size
3. "Report on the appropriate information gathered from library for this seminar

VII Pulp consistency

Effect of pulp consistency on the uniformity fibre distribution and the hence board properties Experimental : Determination of freeness of pulp

VIII Fourdrinier machine

Study the functioning of the Fourdrinier machine for the formation of the wet mat. Identify the following: head box, overflow, breast roll, deckles, table rolls, Rota-belt suction unit, wire guide, wet press, wire guide, wire. Identify the 'wet line'.' Identify the location of 'Puddler'. Observe

the functioning of the trimming of the fibre mat and study how the mat is trimmed by the steel disk while the mat is travelling

IX Hot Pressing

To study the construction of the press, heating medium (high pressure hot water), fast closing and pressure build up, hydraulic pressure fluid at very high rate of flow. Identify 'jack rams' and accumulators. Study the press cycle and the different (3) phases such as high pressure-sqeeze, low pressure drying and consolidation phase

X. **Tempering of hardboard**

Tempering hardboard with linseed oil. Study the temperature, time duration for the polymerisation. Water treatment for boiler infeed, hydrazine treatment

Experimental: (1)Determination of freeness of hardboard pulp, 2) Determine the MOR of both normal and oil tempered hardboard

WOOD SEASONING

Factors affecting the rate of drying, effect of thickness, moisture content, temperature, relative humidity, and velocity of air , diffusion and permeability characteristics of species of timber, stacking of sawn timber for air drying, mill maintenance, seasoning kilns, construction, classification of timbers according to ease of seasoning, refractory timbers, seasoning schedules, seasoning defects Seasoning defects –surface and internal cracking, end splitting, cupping, collapse, bow, crookedness. Find out the causes and prevention. Classification of Indian timbers according to refracteriness in seasoning.

WOOD PRESERVATION

Treating wood by Pressure and non-pressure methods and Chemical analysis of preservatives in treated timber. Spot test for determination of preservation. Testing of Efficacy of wood preservatives against bio-degradation.

Sample Questions to test outcome

1. Identify the type of wood defect of given sample and list out the major cause of the defect
2. Write down the drying procedure of the given timber species
3. Identify the presence of copper in the given sample using the spot test method.
4. Calculate the retention of preservative in the given treated sample using the given values
5. Identify the presence of Boron in the given sample using the spot test method.

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔					✔	
CO3	✔	✔		✔	✔		
CO4	✔						
CO5	✔					✔	

ELECTIVE COURSES

MSWST 02DSE01: PLYWOOD AND COMPOSITES (48 hrs. /Semester)

Course Objectives

To understand product quality standard of various wood composites
To learn the manufacturing problems in wood industry
To evaluate raw materials in used in various industry
To familiarize with the various testing equipment used in quality control laboratories

Course Outcomes:

On Completion of this course the student will be able to:

C01	Evaluate the importance wood Composite instead of solid wood
C02	Interpret the modern machineries and technologies based production of wood Composite
C03	Summarise the characteristics and application of Plywood
C04	Understand the quality parameters and quality testings methods of Plywood
C05	Analyse the environmental issues and benefits by wood based industries

Module 1

Introduction to Plywood Manufacturing. Pre-treatment of logs:Steaming, boiling, and cooking of round logs, debarking and cleaning, Methods of veneer production: Peeling and Slicing . Peeling Lathes and Types Clipping, Veneer drying, Types of veneer dryers - Veneer matching.- Veneer jointing – splicing.Defects in peeled and dried veneers and their control and repair.

Suggested readings specific to module

Roger M Roswell (ed.) (2005) : Hand Book of Wood Chemistry and Wood Composites, Taylor & Francis Group Publications, Florida.

Baodong C, Weiming S, Minghua T (2006) Import analysis of China's major timber products in 2004. Front For China 1(2):238–242

Feng Sun, Youngdong Zhou "The effect of peeling equipment and drying on veneer quality of small diameter Eucalyptus" Biobase Material Science and Engineering IEEE (2021).

Module 2

Adhesive applications: Glue spreaders,Assembly. Pre-pressing and Hot pressing - Hydraulic multi daylight presses, Compression in hot pressing.Defects in pressed plywood and their control and repair. sizing, trimming, Sanding and finishing. Properties of plywood-Use and application.Resistance against destruction - Preservative treatments of plywood.

Suggested readings specific to module

Panshin, A.J. (1980): Textbook of Wood Technology (4th edition), McGraw-Hill Books, United State of America.
Bekhta P, Marutzky R (2007) Reduction of glue consumption in the plywood production by using previously compressed veneer. HolzRoh- Werkst 65:87–
Ismail Aydin ``Effect of Veneer Drying at High Temperature and Chemical Treatment on Equilibrium of Moisture Content of Plywood" ISSM (2014) Ciencia y tecnologia 16(4):445- 452.

Module 3

Laminated wood arrangements. Laminated Veneer Lumber(LVL). Glued laminated products-applications as structural composites.General information on production and properties of reconstituted wood.Improved Wood. Sandwich Composites:properties and applications. Compreg- production and properties -Reduction of global warming potential of wood products.

Suggested readings specific to module

ParvizNavi&Sandberg,D. (2012)P: Thermo Hydro- Mechanical Processing of Wood, EPFL Press,Boca Raton, Florida.
Cankal, D. and Sakar, G. (2021). Evaluation of Reinforcement of Timber and Laminated
Timber with Fibrous Polymer (FRP) Materials for Sustainable Structures. City Health Journal, 2(2): 99-109.
Hoyle, A. and Woste, B. (1989). Handbook of Wood And Wood Based Materials, USDA Forest Service, Forest Products Laboratory, Madison, USA.

Module 4

Quality Evaluation as per Indian standard (IS)- Elasticity and rigidity-tensile strength-compressive strength-bending strength-shear strength- hardness- adhesion- chemical analysis in treated plywood. Laboratory record Maintenance. CARB Certification: Importance-Requirements- Benefits. Formaldehyde emission tests.

Suggested readings specific to module

Aydin I, Colakoglu G (2005) Formaldehyde emission, surface roughness, and some properties of plywood as function of veneer drying temperature. Dry Technol 23(5):1107–1117
Alberto Regattieri, GiacomoBellomi "Innovation lay -up system in plywood manufacturing process" European Journal of Wood and Wood Product (2009)76(1):55-62.
Canadian Plywood Association (CANPLY): Plywood Design Fundamentals, Canada, 2005

Suggested readings

1. Nath, S.K. Plywood Manufacturing Practices in India (Xerox)
2. Baldwin RF (1981) Plywood Manufacturing Practices, 2 edn. Miller and Freeman Publication Inc., San Francisco, USA

Sample Questions

1. Predict the green wood Operation in Plywood manufacturing?
2. Invent the parameters that you will use to purchase a good Plywood from the market?
3. Create note on sandwich board, Explain its advantages and disadvantages?

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔				✔		
CO2	✔		✔				
CO3	✔						
CO4	✔					✔	
CO5	✔						

MSWST 02DSE02: WOOD MECHANICS (48 hrs. /Semester)

Course Objectives

To provide the students with a solid understanding of the mechanical properties of wood
To teach participants how to analyze the behaviour of wood under different types of loads
To explore the various ways in wood can fail
To introduce participants to the laboratory and field testing methods for evaluating wood properties and performance
To provide knowledge on designing wooden structures

Course Outcomes:

On Completion of this course the student will be able to:

C01	Explain the various mechanical properties of wood.
C02	Summarize about the creep in wood
C03	Conclude the impacts of defects on the mechanical properties of wood.
C04	Explain the mechanics of structural timber units
C05	Manage the standard tests for timber specimens

Module 1

Hooke 's law, modulus of elasticity, anisotropy, various elastic constants in wood. Poisson' s ratio. Compressibility (Bulk modulus).Determination of elastic constants by dynamic and static tests.Non-linear behaviour of wood. Hysteresis

Suggested readings specific to module

Corpuz, Onofre. (2012). Wood Physics and Timber Mechanics. Lap lambert academic publishing
Britannica, T. Editors of Encyclopaedia (2023, July 7). Hooke's law.Encyclopedia Britannica.
Libralato, M., De Angelis, A., Saro, O., Qin, M., & Rode, C. (2021). Effects of considering moisture hysteresis on wood decay risk simulations of building envelopes. *Journal of Building Engineering*, *42*, 102444. https://doi.org/10.1016/j.jobe.2021.102444

Module 2

Creep deformation, plasticity and creep recovery. Theory of creep.Effects of level of loading, moisture content, temperature, dynamic humidity conditions and pre-freezing on creep. Creep in reconstituted wood panels. Fatigue and its characteristics. Influence of defects on wood strength properties.

Suggested readings specific to module

Dourado, N., De Moura, M., & De Jesus, A. (2019). Fatigue-fracture characterization of wood under mode I loading. *International Journal of Fatigue*, *121*, 265-271. https://doi.org/10.1016/j.ijfatigue.2018.12.012

Schönbauer, B. M., Killinger, M., Karr, U., Fitzka, M., Müller, U., Teischinger, A., & Mayer, H. (2022). Fatigue properties of wood at different load ratios tested at 50 Hz and 20 kHz. *Materialwissenschaft und Werkstofftechnik*, *53*(3), 344-354. https://doi.org/10.1002/mawe.202100280

Kyanka, G.H, (1980). Fatigue properties of wood and wood composites. *Int J Fract* **.** 609–616 https://doi.org/10.1007/BF02265220

Module 3

Mechanics of wood columns and beams. Standard tests on timber specimen; static bending, impact bending, compression parallel & perpendicular to grain, hardness, shear, tension perpendicular and parallel to grain, cleavage, torsion, nail and screw pulling, brittleness tests, effects of specimen size and its standardization

Suggested readings specific to module

Bureau of Indian standards (1986).*Methods of testing of small clear specimens of timber [CED 09: Timber and timber stores],* (IS 1708)

Module 4

Testing of specialized finished wood products - different types of performance test and methods of evaluation for products like door shutters, joinery, furniture, packing cases, tool handles, agricultural implements and sports goods. Determination of suitability coefficients and indices of Indian timbers, Classification of timbers for different end uses based on suitability indices and safe working stresses. Non-destructive testing methods for timber strength

Suggested readings specific to module

Bucur, V., (2003). Non Destructive Characterization and Imaging of Wood, Springer-Verlag Publications, Berlin https://iaeme.com/MasterAdmin/Journal_uploads/IJCIET/VOLUME_10_ISSUE_10/IJCIET_10_10_032.pdf

Bureau of Indian standards (1986).*Methods of testing of small clear specimens of timber [CED 09: Timber and timber stores],* (IS 1708)

Suggested Reading:

*1. Corpuz, Onofre. (201*2). Wood Physics and Timber Mechanics. Lap lambert academic publishing

2. Britannica, T. Editors of Encyclopaedia (2023, July 7). Hooke's law.Encyclopedia Britannica.

3. Libralato, M., De Angelis, A., Saro, O., Qin, M., & Rode, C. (2021). Effects of considering moisture hysteresis on wood decay risk simulations of building envelopes. *Journal of Building Engineering*, *42*, 102444.

4. Schönbauer, B. M., Killinger, M., Karr, U., Fitzka, M., Müller, U., Teischinger, A., & Mayer, H. (2022). Fatigue properties of wood at different load ratios tested at 50 Hz and 20 kHz. *Materialwissenschaft und Werkstofftechnik*, *53*(3), 344-354.https://doi.org/10.1002/mawe.202100280

6.Kyanka, G.H, (1980). Fatigue properties of wood and wood composites. *Int J Fract* **.** 609–

7. Bureau of Indian standards (1986). *Methods of testing of small clear specimens of timber [CED 09: Timber and timber stores],* (IS 1708)

9. Bucur, V., (2003). Non Destructive Characterization and Imaging of Wood, Springer-Verlag Publications, Berlin

Sample Questions to test outcomes

1. Explain the various non-destructive tests for timber strength determination.
2. Formulate a note on classification of timbers for different end uses based on suitability indices
3. Summarize the mechanics of timber beams and column

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔			✔			
CO2	✔						
CO3	✔			✔			
CO4	✔						
CO5	✔					✔	

MSWST 02DSE03: RECONSTITUTED WOOD PANELS (48 hrs. /Semester)

Course Objectives

To know about the different reconstituted wood panels.
To familiarize the participants with relevant industry regulations and standards related to reconstituted wood panels.
To emphasize the industrial safety practices.
To promote the sustainable of utilization raw materials.
To provide the participants with the comprehensive understanding of industrial machineries and their safe management.

Course outcomes:

On completion of this course the student will be able to:

C01	Differentiate between different reconstituted wood panels.
C02	Explain the manufacturing steps of particleboard, fibreboard, flush doors, and block board
C03	Inspect the properties of particleboard, fibreboard flush doors, and block board.
C04	Plan the sustainable utilisation of raw materials in reconstituted panel production.
C05	Explain the different Indian standards related to different reconstituted wood panels.

Module 1

Reconstituted wood – definition and types.Comparison of reconstituted wood panel properties with solid wood. Particleboard - definition- types – raw materials - wood and other lingo-cellulosic materials - adhesives- additives. Storage of raw materials. Particle preparation – debarking. chipping – chipper types and primary and secondary reduction. Chip drying – dryer types. Size separation.Conveyor systems. Chip storage - methods and chances for the chip deterioration during storage.

Suggested readings specific to module

Mehta.(2008). *A Hand book of forest utilization*.International book distributors.
Kollmann, F.P., Kuenzi, E.W., Stamn, A.J. (1975). Principles of Wood Science Volume2 Wood Based Materials, New York, Springer-Verlag Berlin Heidelberg. 339 -538.

Pędzik, M., Janiszewska, D., &Rogoziński, T. (2021, December). Alternative lignocellulosic raw materials in particleboard production: A review. *Industrial Crops and Products, 174,* 114162. https://doi.org/10.1016/j.indcrop.2021.114162

Module 2

Chip blending – Mat laying – Prepressing – hot pressing. Board finishing. Extruded and Molded particle board - production and applications. Properties of particle board.Factors affecting properties of particle board.Comparison of particle board properties with solid wood.Testing of particle boards.

Suggested readings specific to module

Kollmann, F.P., Kuenzi, E.W., Stamn, A.J. (1975). Principles of Wood Science Volume2 Wood Based Materials, New York, Springer-Verlag Berlin Heidelberg. 339 -538.

Bureau of Indian standards (2005).*Particle boards of wood and other lignocellulosic materials (medium density) for general purposes - Specification [CED 20: Wood and other Lignocellulosic products],* (IS 3087).

Bureau of Indian standards (1977).*Methods of test for wood particle boards from other lignocellulosic materials [CED 20: Wood and other Lignocellulosic products],* (IS 2380).

Module 3

Fiberboard- definition -History and development, types- raw materials and their preparation - Chipping screening and storing.wet and dry process - Pulping- chemical and mechanical pulping- Thermo-mechanical pulping. Masonite pulping.The freeness of pulp.The sizing of the fiberboard.Asplunddefibrator method- wet process of manufacture of hardboard - mat formation. The Fourdrinier forming machine - hot pressing – press cycles.Oil tempering.Dry process of hardboard.S1S and S2S board. MDF and Insulation board- Raw materials- wood & lingo-cellulosic agricultural residues. Special fibreboards Testing methods and end uses.

Suggested readings specific to module

ParvizNavi& Dick Sandberg, (2012).Thermohydro-Mechanical Processing of Wood, EPFL Press, BocaRaton, Florida,

Hakkila.P,(1989).Utilization of residual forest biomass, Germany:SpringerVerlay Berlin Heidelberg

Kollmann, F.P., Kuenzi, E.W., Stamn,A.J.,(1975).Principles Of Wood Science Volume2 Wood Based Materials, Newyork, Springer-Verlag Berlin Heidelberg.

Otto Suchsland, George E. Woodson (1987).Fiberboard Manufacturing Practices in the United states, U.S. Department of Agriculture

Module 4

Manufacturing process of block board and flush door: Raw materials, Assembling, Pressing and Finishing. Basic terminology related to flush door and block board. Types of flush doors. Testing Practices for flush door and block board.

Suggested readings specific to module

Bureau of Indian standards (2004).*Block boards- specification [CED 20: Wood and other Lignocellulosic products],* (IS 1659).

Bureau of Indian standards (1999).*Wooden flush door shutters (solid core type): Part 1 Plywood face panels [CED 11: Doors, Windows and Shutter],* (IS 2202 -1).

Bureau of Indian standards (1983).*Wooden flush door shutters (solid core type): Part 2 Particle board and hardboard face panels [CED 11: Doors, windows and shutter,* (IS 2202-2).

Suggested Reading:

1. ParvizNavi& Dick Sandberg, (2012).Thermohydro-Mechanical Processing of Wood, EPFL Press, BocaRaton, Florida,
2. Hakkila.P,(1989).Utilization of residual forest biomass, Germany:SpringerVerlay Berlin Heidelberg
3. Kollmann, F.P., Kuenzi, E.W., Stamn,A.J.,(1975).Principles Of Wood Science Volume2 Wood Based Materials, Newyork, Springer-Verlag Berlin Heidelberg
4. Bureau of Indian standards (2004). *Block boards- specification [CED 20: Wood and other Lignocellulosic products]*, (IS 1659).
5. Bureau of Indian standards (1999). *Wooden flush door shutters (solid core type): Part 1 Plywood face panels [CED 11: Doors, Windows and Shutter]*, (IS 2202 -1).
6. Bureau of Indian standards (1983). *Wooden flush door shutters (solid core type): Part 2 Particle board and hardboard face panels [CED 11: Doors, windows and shutter*, (IS 2202-2).
7. https://gharpedia.com/blog/types-of-flush-doors/
8. Mehta. (2008). *A Hand book of forest utilization*.International book distributors.
9. Kollmann, F.P., Kuenzi, E.W., Stamn, A.J. (1975). Principles of Wood Science Volume2 Wood Based Materials, New York, Springer-Verlag Berlin Heidelberg. 339 -538.
10. Pędzik, M., Janiszewska, D., &Rogoziński, T. (2021, December). Alternative lignocellulosic raw materials in particleboard production: A review. *Industrial Crops and Products, 174*, 114162. https://doi.org/10.1016/j.indcrop.2021.114162
11.Kollmann, F.P., Kuenzi, E.W., Stamn, A.J. (1975). Principles of Wood Science Volume2 Wood Based Materials, New York, Springer-Verlag Berlin Heidelberg. 339 -538.
12. Bureau of Indian standards (2005). *Particle boards of wood and other lignocellulosic materials (medium density) for general purposes - Specification [CED 20: Wood and other Lignocellulosic products]*, (IS 3087).
13. Bureau of Indian standards (1977). *Methods of test for wood particle boards from other lignocellulosic materials [CED 20: Wood and other Lignocellulosic products]*, (IS 2380).

Sample Questions to test outcomes

1. Discuss the possibilities and importance of utilizing recovered wood in particle board preparation.
2. Elaborate on the different raw materials utilized for particleboard production.
3. Analyze the properties of particle board.

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔					✔	
CO3	✔						
CO4	✔						
CO5	✔					✔	

MSWST 02DSE04: WOOD VARIATION (48 hrs. /Semester)

Course Objevtives

To get an overview about tree improvement programmes in forestry.
To learn the assessment of genetic performance of tree population and strategies for maintaining genetic reservoirs
To know about the improvement of wood properties like specific gravity and density
To understand the use of genomic tools and technologies in identifying the desirable genes

Course Outcome:

On Completion of this course the student will be able to:

C01	Summarize the importance of tree Improvement and variation
C02	Explain the different types of selection hybridization and breeding
C03	Understand the seed production in genetic level
C04	Understand the Quantitative aspects of tree improvement

Module 1

General concepts of tree improvement.Definition, objectives, advantages and disadvantages.Variation and its use. Provenance variation, site to site variation, variation among stands within sites, between tree and within tree variation. Importance of exotic trees.

Suggested readings specific to module

Faulkner, R., 1975. Seed Orchards. Forestry CommisSion Bulletin No. 54. London, U.K. 1975.

Module 2

Selection- types of selection. In self-pollinated trees- Mass selection, pure-line selection, hybridization, pedigree breeding, bulk population method; In cross pollinated trees- Mass selection, hybridization, Synthetic varieties, mutation breeding.

Suggested readings specific to module

Kartikaningtyas D, Nirsatmanto A, Sunarti S, Setyaji T, Surip, Mangkuwibowo F. 2019. Produktivitastegakan Acacia mangiumunggulpadaberbagaipolatanamanhutanrakyat di Pacitan.JurnalPemuliaanTanamanHutan (in press)

Module 3

Seed production.Seedling seed orchard, clonal seed orchard.Mass multiplication, clonal propagation, Evaluation and screening, genetic testing program-experimental designs. Tree improvement trial, advanced generations and continued improvement. Gene transfer, genetic markers, DNA fingerprinting. Quantitative aspects of tree improvement; Testing and estimating population mean, Variance-phenotypic, genotypic and environmental variance. Breeding value, dominance, modes of gene action, genetic values, heritability, genetic gain, genetic advance

Suggested readings specific to module

Greaves, A., 1978.Pinuscaribaea.PaPers No. 12.Descriptions of seed sources and collection for provenances of Commonwealth Forestry Institute, Oxford.Tropical Forestry Oxford, U.K.
Lucas, G. & Synge, H., 1978.(Editores).The IUCN Plant Red Data Book; IUCN/WWF, Morges, Switzerland.

Module 4

Wood and tree improvement; Improvement in wood properties like specific gravity and wood density, importance of specific gravity variation for different end uses, Juvenile and mature wood variation. Tree form, fibre and tracheid length, cellulose and lignin content. High yield

Suggested readings specific to module

Nirsatmanto A. 2012 Genetic variation observed in composite seedling seed orchard of A. mangium Wild. At Central Java, Indonesia: Implication for increasing genetic gain and seed production. Journal of Forestry Research, 9(2): 91-100.
Kartikaningtyas D, Nirsatmanto A, Sunarti S, Setyaji T, Surip, Mangkuwibowo F. 2019. Produktivitastegakan Acacia mangiumunggulpadaberbagaipolatanamanhutanrakyat di Pacitan.JurnalPemuliaanTanamanHutan (in press)

Suggested Reading:

1. Zobel B, Talbert J. 1984. Applied Forest Tree Improvement. New York, Brisbane, Toronto, Singapore: John Willey and Sons.
2. Hubert J, Lee A. 2005. A review of the relative roles of silviculture and tree breeding in tree improvement: the example of Sitka spruce in Britain and possible lessons for hardwood breeding. Forestry,78(2): 109-120. doi:10.1093/forestry/cpi011

Sample Questions to test outcomes

1. Discuss about DNA fingerprinting and its Importance
2. Elaborate about Tree Improvement
3. Find out the importance of Exotic trees

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔				✔		
CO4	✔						

MSWST02IDC01 WOOD CHEMISTRY (32 hrs. /Semester)

Course Objectives

To provide participants with an understanding of the chemical composition of wood.
To explore the microstructure and macrostructure of wood
To teach the participants about the chemical modifications of timber
To highlight the recent developments and on-going research in wood chemistry
To illustrate the practical applications of wood chemistry in various industries

Course outcomes:

On completion of this course the student will be able to:

C01	Understand the anatomical aspects of wood
C02	Explain the importance of cellulose and Hemicellulose in wood
C03	Discuss about the structure and chemical properties of lignin
C04	Compare softwood and hardwood based on Chemical composition
C05	Understand the Cell wall chemical composition and distribution.

Module 1

Structure and ultrastructure of wood –anatomical aspects-ultrastructure of cell walls.Cell wall chemical composition and distribution.

Suggested readings specific to module

Kollmann, F. P., Kuenz i, E. W., Stamn, A. J., (1975). Principles of Wood Science Volume 2 Wood Based Materials, New York, Springer Verlag Berlin Heidelber.

Roger M Roswell (ed.), (2005): Hand Book of Wood Chemistry and Wood Composites, Taylor & Francis Group Publications, Florida.

Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications (2nd edition), Academic Press inc., California

Fengel,D. &Wegener,G.,(1984): Wood Chemistry, Ultrastructure, Reaction, Walter de Gruvter& Co., New York

Burton, R., Gidley, M. & Fincher, G, (2010).Heterogeneity in the chemistry, structure and function of plant cell walls. *Nat ChemBiol* **6**, 724–732. https://doi.org/10.1038/nchembio.439

Zhang, B., Gao, Y., Zhang, L., & Zhou, Y. (2020). The plant cell wall: Biosynthesis, construction, and functions. *Journal of Integrative Plant Biology*, *63*(1), 251-272. https://doi.org/10.1111/jipb.13055

Module 2

Cellulose constitution and configuration, (elementary)B14glyosidic linkages—Repeating cellulose units reducing and non-reducing ends conformation of cellulose. Molecular weight, Degree of polymerization, Inter and intra molecular hydrogen bonds.Polymorphism in cellulose.

Suggested readings specific to module

Kollmann, F. P., Kuenzi, E. W., Stamn, A. J., (1975). Principles of Wood Science Volume 2 Wood Based Materials, New York, Springer Verlag Berlin Heidelber.

Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications (2nd edition), Academic Press inc., California

Fengel,D. & Wegener, G.,(1984): Wood Chemistry, Ultrastructure, Reaction, Walter de Gruvter& Co., New York

Module 3

Hemi-cellulose: structure, chemical properties, effects of acids and bases. Lignin: structure and chemical properties. Changes in wood chemical constituents due to several modifications.

Suggested readings specific to module

Kollmann, F. P., Kuenz i, E. W., Stamn, A. J., (1975). Principles of Wood Science Volume 2 Wood Based Materials, New York, Springer Verlag Berlin Heidelber.

Roger M Roswell (ed.), (2005): Hand Book of Wood Chemistry and Wood Composites, Taylor & Francis Group Publications, Florida.

Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications (2nd edition), Academic Press inc., California

Module 4

Chemical composition of softwood and hardwood. Chemistry of wood and bark extractives. Extractives of hardwood and softwood.resin-fats and waxes-tall oil.

Suggested readings specific to module

Roger M Roswell (ed.), (2005): Hand Book of Wood Chemistry and Wood Composites, Taylor & Francis Group Publications, Florida.

Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications (2nd edition), Academic Press inc., California

Fengel, D. & Wegener, G., (1984): Wood Chemistry, Ultrastructure, Reaction, Walter de Gruvter& Co., New York

Sládková, Alexandra &Dubinyová, Lenka&Haz, Ales &Jablonsky, Michal &Sekretár, Stanislav&ButorSkulcova, Andrea &Vrška, Milan &Surina, Igor. (2015). Extractives from wood bark- source of chemicals and biofuels.

Suggested Reading:

Kollmann, F. P., Kuenz i, E. W., Stamn, A. J., (1975). Principles of Wood Science Volume 2 Wood Based Materials, New York, Springer Verlag Berlin Heidelber.

Roger M Roswell (ed.), (2005): Hand Book of Wood Chemistry and Wood Composites, Taylor & Francis Group Publications, Florida.

Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications (2nd edition), Academic Press inc., California

Fengel, D. & Wegener, G., (1984): Wood Chemistry, Ultrastructure, Reaction, Walter de Gruvter& Co., New York

Sládková, Alexandra &Dubinyová, Lenka&Haz, Ales &Jablonsky, Michal &Sekretár, Stanislav&ButorSkulcova, Andrea &Vrška, Milan &Surina, Igor. (2015). Extractives from wood bark- source of chemicals and biofuels.

Burton, R., Gidley, M. & Fincher, G, (2010).Heterogeneity in the chemistry, structure and function of plant cell walls. *Nat ChemBiol* **6**, 724–732. https://doi.org/10.1038/nchembio.439

Zhang, B., Gao, Y., Zhang, L., & Zhou, Y. (2020). The plant cell wall: Biosynthesis, construction, and functions. *Journal of Integrative Plant Biology*, *63*(1), 251-272. https://doi.org/10.1111/jipb.13055

Rowell, Roger M.; Pettersen, Roger; Tshabalala, Mandla A. (2013).Cell wall chemistry. In: Rowell, Roger. ed. Handbook of wood chemistry and wood composites, Second edition. Boca Raton, FL: CRC Press: 33-72.

Sample Questions to test outcomes

1. Distinguish between Heartwood and softwood Hemicellulose
2. Discuss on Bark extractives
3. Explain Wood Cell wall chemical Composition

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						

CO2	✔						
CO3	✔						
CO4	✔				✔		
CO5	✔				✔		

MSWST02MDC01 ADVANCED COATING FOR WOOD PANELS(32 hrs. /Semester)

Course Objectives

To explore the current research and innovations in the advanced coating technology

To familiarize with the industry standards for various coating application

To understand the eco-friendly coating technologies and low VOC coating compositions

To provide an overview about the specialized coating application

Course outcomes:

On completion of this course the student will be able to:

C01	Decide the type of polymer coating composition and application methods suitable for different end uses.
C02	Identify the reason for various Coating defects.
C03	Incorporate nanotechnology for producing advanced high-quality industrial coating systems with less impact on the environment.
C04	Recommend the test as per ISO standards to inspect the quality of wood coatings.
C05	Understand the important raw materials used in the wood coating systems

Module 1

Advanced coatings for wood panels- Coatings definition- composition of coatings- Film forming resins/binders. Binders based on amino and phenolic resins, Urethanes and alkyd coating, Drying oil based coating and their crosslinking mechanisms.

Suggested readings specific to module

Zheng, S. X. (2019). *Principles of Organic Coatings and Finishing*. Newcastle upon Tyne: Cambridge Scholars Publishing

Panda H (2010).Alkyd Resins technology Handbook. Asia Pacific Business Press Inc

Jones, F.N., Nichols, M.E. and Pappas, S.P. (2017).Amino Resins. In Organic Coatings (eds F.N. Jones, M.E. Nichols and S.P. Pappas). https://doi.org/10.1002/9781119337201.ch11

Wheeler, D.H. (1950) The chemistry of drying oils. *J Am Oil ChemSoc* **27**, 440–445 (1950).

Module 2

Pigment dispersion and Pigment volume relationship. Coating Application methods- Brushes- Spray applications - Dip coating- Roller coatings- Precision roller and Reverse roll coatings- Curtain coatings.

Suggested readings specific to module

Temple C. Patton (1979) Paint flow and pigment dispersion-a rheological approach to coating and ink technology 2d ed. Wiley publishers.

G.P.A. Turner (1999), Chapter 12, General industrial paints, Editor(s): R. Lambourne, T.A. Strivens, Paint and Surface Coatings (Second Edition), Pages 502-528, Woodhead Publishing.

Module 3

Film defects.Mechanical properties- Abrasion and mark resistance, Scratch resistance- Measurement of mechanical properties of coating.

Suggested readings specific to module

Franco Bulian, Jon A. Graystone. (2009) Chapter 6 - Properties of Wood Coatings – Testing and Characterisation, Editor(s): Franco Bulian, Jon A. Graystone, Wood Coatings, Elsevier, https://doi.org/10.1016/B978-0-444-52840-7.00006-0.

Jones, F.N., Nichols, M.E. and Pappas, S.P. (2017).Film Defects. In Organic Coatings (eds F.N. Jones, M.E. Nichols and S.P. Pappas). https://doi.org/10.1002/9781119337201.ch24

Module 4

Environmental impact of coatings.Environmentally friendly coatings.High solids coatings, Radiation curable coatings - Powder coatings. Nanotechnology-inorganic-organic hybrid materials

Suggested readings specific to module

AnnaritaPaiano, TeodoroGallucci, Andrea Pontrandolfo, Giovanni Lagioia, Paolo Piccinno, AmedeoLacalamita (2021) Sustainable options for paints through a life cycle assessment method, Volume 295, Journal of Cleaner Production, https://doi.org/10.1016/j.jclepro.2021.126464.

Jasmani, L., Rusli, R., Khadiran, T. *et al.* (2020). Application of Nanotechnology in Wood-Based Products Industry: A Review. *Nanoscale Res Lett* **15**, 207. https://doi.org/10.1186/s11671-020-03438-2

***Suggested Reading*:**

Manfred Bock,(2001): Polyurethanes for Coatings, Curt R.VincentzVerlag, Germany.

Franco Bulian& Jon Graystone,(2009): Wood Coatings; Theory and Practices, Elsevier Publications, United Kingdom.

Philippe Cognard (Ed.), (2006): Adhesive and Sealants; General Knowledge, Application Techniques, New Curing Techniques Vol-2**,** Elsevier ltd Publications, Nether land.

Marrion,A.(Ed.),(2004):The Chemistry and Physics of Coatings(2nd edition), The Royal Society of Chemistry, Cambridge, United kingdom.

FulgaTanasă, Carmen-Alice Teacă, MădălinaZănoagă (2021) Protective coatings for wood, Editor(s): MahmoodAliofkhazraei, Nasar Ali, MirceaChipara, NadhiraBensaadaLaidani, Jeff Th.M. De Hosson; Handbook of Modern Coating Technologies, Pages 175-267, https://doi.org/10.1016/B978-0-444-63237-1.00006-1.

Sample Questions to test outcomes

1. Explain the different types of additives which affect the properties of the coating materials

2. Discuss the importance of triglycerides in surface coating
3. Summarize the importance of Pigment dispersion and Pigment Volume Relationship
4. Outline the important mechanical properties of coating. Name the ISO standards used for testing those properties

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔						
CO4	✔					✔	
CO5	✔						

THIRD SEMESTER

CORE COURSE

MSWST 03DSC09: ADHESIVES FOR PLYWOOD AND PANEL PRODUCTS (64 hrs./Semester)

Course Objectives

To understand the basic theories behind the adhesion technology
To provide an overview about the types of adhesives used in wood panel industry
To become acquainted with the basic industrial testing standards for confirming the compatibility of adhesive for specific application
To explore the possibilities of developing hybrid adhesives and bio-based adhesives

Course outcomes:

On completion of this course the student will be able to:

C01	Understand the theories behind adhesion
C02	Estimate the quality of different resins used in wood panel products as per IS standards
C03	Incorporate suitable additives required to control the viscosity of adhesives
C04	Identify the root cause of adhesive failure during panel production
C05	Develop low formaldehyde adhesive system for wood panel products

Module 1

Definition of adhesives. Rheology and viscoelasticity of adhesives (qualitative)- colloidal state of glues- sol-gel transformation- Basics of flow; determination of viscosity of adhesives- (Ostwald viscometer; plate and cone viscometer; Brookfield viscometer etc.) Bubble viscometer. Natural adhesives and synthetic resin adhesives- thermoplastic and thermosetting adhesives- transformation of liquid adhesives into solids

Suggested readings specific to module

Kumar, R.N. and Pizzi, A. (2019).Rheology and Viscoelasticity of Adhesives. In Adhesives for Wood and Lignocellulosic Materials (eds R.N. Kumar and A. Pizzi). https://doi.org/10.1002/9781119605584.ch14
Frihart, C.R.; Hunt, C.G. 2021. Chapter 10: Wood adhesives: bond formation and performance. In: Wood handbook wood as an engineering material. General Technical Report FPL-GTR-282. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 23 pp.
Dillard, D.A. (2011). Physical Properties of Adhesives. In: da Silva, L.F.M., Öchsner, A., Adams, R.D. (eds) Handbook of Adhesion Technology. Springer, Berlin, Heidelberg.https://doi.org/10.1007/978-3-642-01169-6_17

Module 2

Theory of adhesion - intermolecular forces-cohesion and adhesion.Conditions for good adhesion, importance of optimum spread, pressing pressure and wood moisture content.Surface preparation and pre-treatment.Chemistry, application, properties and classification of adhesives. Stresses in glued joints

Suggested readings specific to module

AlirezaAkhavan-Safar, Eduardo A.S. Marques, Ricardo J.C. Carbas, Lucas F.M. da Silva, (2021), Chapter 6 - Stress analysis of adhesive joints,Editor(s): Robert D. Adams, Adhesive Bonding (Second Edition), In Woodhead Publishing Series in Welding and Other Joining Technologies

Packham, D.E. (2018). Theories of Fundamental Adhesion. In: da Silva, L., Öchsner, A., Adams, R. (eds) Handbook of Adhesion Technology. Springer, Cham. https://doi.org/10.1007/978-3-319-55411-2_2

Module 3

Phenol-formaldehyde adhesives; Resoles and novolacs; resorcinol-formaldehyde adhesive.Substituted Phenol Formaldehyde resins. Electrical grade phenolic resins Urea and Melamine formaldehyde resins. Epoxy resins; Isocyanate in Wood Adhesives. Polyvinyl acetate adhesives. Hot melt adhesive

Suggested readings specific to module

Dunky, Manfred.(2003). Adhesives in the Wood Industry.Handbook of Adhesive Technology, Third Edition.70. 10.1201/9780203912225.ch47.

Knop, A., Pilato, L.A. (1985).Composite Wood Materials. In: Phenolic Resins. Springer, Berlin, Heidelberg.

Updegraff, I.H. (1990). Amino Resin Adhesives. In: Skeist, I. (eds) Handbook of Adhesives. Springer, Boston, MA.

Module 4

Bio based adhesives. CNSL-Phenol-formaldehyde adhesives- Tannin based adhesives. Fillers and extenders for UF and PF. Phenolic and amino resins in other areas of applications.Testing of resin properties and adhesive bond strength.Formaldehyde emission from wood panel products.Adhesive system with low formaldehyde emission.

Suggested readings specific to module

He, Z. (Ed.). (2017). Bio-based Wood Adhesives: Preparation, Characterization, and Testing (1st ed.). CRC Press.https://doi.org/10.1201/9781315369242

Pizzi, A., Lipschitz, L. & Valenzuela, J. (1994).Theory and Practice of the Preparation of Low Formaldehyde Emission UF Adhesives. , *48*(3), 254-261.

Suggested Reading:

Rowell, Roger M. (2012) , "Handbook of Wood Chemistry and Wood Composites second edition CRC Press

Pizzi, A. (Ed.). (1989). Wood Adhesives: Chemistry and Technology---Volume 2 (1st ed.). CRC Press.https://doi.org/10.1201/9780203733721

Kumar, Ramamurti&Pizzi, A.Pizzi.(2019). Adhesives for Wood and Lignocellulosic Materials.10.1002/9781119605584.

He, Z. (Ed.). (2017). Bio-based Wood Adhesives: Preparation, Characterization, and Testing (1st ed.). CRC Press. https://doi.org/10.1201/9781315369242

Unger A. *et.al*.,(2001): Conservation of Wood Artifacts - a Handbook, Springer Publication ,Germany

Philippe Cognard (Ed.), (2006): Adhesive and Sealants; General Knowledge, Application Techniques, New Curing Techniques Vol-2, Elsevier ltd Publications, The Nether land

Sample Questions to test outcomes

1. Explain the importance of Contact angle and wetting in gluing
2. Differentiate between cleavage stress and peel stress in adhesive joints
3. Explain the working of any viscometer which can measure the kinematic viscosity
4. Illustrate the formation of resite from the resol in phenolic resin

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔	✔				✔	
CO3	✔						
CO4	✔						
CO5	✔				✔		

MSWST 03DSC10: WOODWORKING PRACTICAL - I (128 hrs./Semester)

Course Objectives

To understand the fundamentals of wood working including measuring, marking drilling etc.
To operate the wood working powers tools and understand various wood working operations.
To familiarize with the application of computer aided designing in wood working
To identify the important hard wares and fittings used in the wood working

Course outcomes:

On completion of this course the student will be able to:

C01	Prepare the cutting list for manufacturing furniture
C02	Perform various operation in woodworking
C03	Understand the basic working of wood working tools
C04	Understand the different elevations of furniture drawings
C05	Develop creative designs for furniture

1. Studying the methods involved in the conversion of wooden logs to commercial sizes for manufacturing different wood products and identifying the market forms of timber like plank, scantling, log, balk, board, square, etc.
2. Familiarization with carpentry tools and woodworking machines
3. Practicing the basic woodworking tools used for marking, sawing, planning, and boring.
4. Practicing power tools used in woodworking.
5. Constructing important joints used in wood product manufacturing like lengthening, widening, and framing joints.
6. Identifying the Important Hardware and fittings used in furniture manufacturing including nails, screws, hinges, etc.
7. Preparation of working drawings, preparation of cutting list, Preparation of bill of materials, and estimating the cost of furniture.
8. Familiarizing the use of computer-aided designing (CAD) technology in furniture design.
9.Learning the basics of making drawings using CAD.
10. Students should design and construct some simple products from wood like Photo frames, Cutting boards, wall hangers, pen stands, etc. as part of their woodworking project

Sample Questions to test outcomes

1. Prepare a cutting list for manufacturing the given furniture drawing
2. Identify the given joint types and specify the purpose
3. Conduct drilling operation on wood using the given power tool
4. Identify the given hardware and list out their applications
5. Demonstrate the cutting patterns used in wood conversion

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔	✔					
CO2	✔	✔					
CO3	✔	✔					
CO4	✔	✔					✔
CO5	✔	✔					

MSWST 03DSC11: WOOD ADHESIVES TECHNOLOGY PRACTICAL (128 hrs./Semester)

Course Objective

To develop the practical skills in manufacturing wood adhesives
To determine the quality of resin including solid content, water tolerance and viscosity
To understand the adhesive application techniques used in industrial wood panel production
To identify and troubleshoot the adhesive failure during production.

Course outcomes:
On completion of this course the student will be able to:

C01	Understand the manufacturing parameters involved in manufacturing industrial wood adhesives
C02	Analyse the suitability of adhesives for manufacturing wood panel products
C03	Testing the bond strength of adhesive as per IS standards
C04	Determine the purity of chemicals used to manufacture adhesive
C05	Prepare the adhesive composition with low formaldehyde emission and fast curing

1. Studying the formulations for producing general purpose alkali catalysed PF resin and ammonia catalysed PF resin. Study the exothermic process and find out how the temperature is controlled.
2. Preparation of UF and PF resins from the laboratory and determine the property of manufactured adhesives including solid content, viscosity, Gel time, water tolerance etc.
3. Determination of shear strength of adhesive bonded wood panel products
4. Determination of the purity of Phenol, Urea and formalin
5. To study the processing parameters involved in the manufacturing of wood panel products with different adhesives.
6. To study the operations involved in the manufacturing of different PF resins from the pilot plant of WIP.
7. To study the glue spreading operations and calculate the coverage of the adhesive.

Sample Questions to test outcomes

1. Prepare the Urea formaldehyde resin in the ratio 1:2.3
2. Determine the water tolerance of the given resin
3. Calculate the glue spread and coverage of the adhesive
4. Estimate the solid content of given Phenolic resin

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔	✔					
CO2	✔	✔					
CO3	✔	✔					
CO4	✔	✔					
CO5	✔	✔			✔		

ELECTIVE COURSES

MSWST 03DSE05: PULP AND PAPER (48 hrs. /Semester)

Course Objectives

To analyze the properties of wood fibers various with species
To understand the waste management system in paper industry
To find the different types of paper in the market
To Learn the manufacturing operations in paper industry

Course Outcome:

On Completion of this course the student will be able to:

C01	Illustrate the application of wood and non woodfibers in paper manufacturing.
C02	Recognize the various modern technologies in the field of paper
C03	Explain the different process of paper production and types of paper
C04	Summarise the basic techniques in solid waste management
C05	Illustrate knowledge on the paper quality testing in laboratory

Module 1

Introduction to paper making: Raw materials - classification- selection- debarking- chipping- screening and classification of chips- types of screens. conveying of chips, chip storage. Pulping processes: Types- principles and details of processes- properties of pulp- cooking processes.Freeness Testing. Washing, screening and cleaning of pulp. Types of cleaners and screeners.

Suggested readings specific to module

Kennedy J.F. et.al.,(2000): Cellulosic Pulps Fibers and Materials, Wood Heading Publications Limited, England.
John C.F. Walker,(2006): Primary Wood Processing- Principles and Practices(2nd edition), Springer Publication, The Netherland.
Fengel,D. &Wegener,G., (1984): Wood Chemistry, Ultrastructure, Reaction, Walter de gruvter& Co., New York.

Module 2

Bleaching of pulp: Principles of bleaching- bleaching chemicals- Stages of bleaching –Important parameters of bleaching.Bleaching equipment- . Chemical recovery: Black liquor-properties- evaporation: working principles, types - boiler and furnace: types, function- efficiency and steam economy, boiler feed water properties. Causticizing: green liquor classification and sludge removal- white liquor, classifiers and washers, operating techniques, make up chemicals, Zeolite process, demineralization process.

Suggested readings specific to module

Sudhir, M.(2013): Forest Biotechnology, Wisdom Press Publication,New-Delhi, India.
Han Ulrich Suess, (2010): Pulp Bleaching Today, Walter de GruyterGmbH&Co..,Berlin,New York

Erosjostrom, E. (1993): Wood Chemistry Fundamental and Applications(2nd edition), Academic Press inc.,California
Henrikrson, G. (Ed.),(2009): Pulp and Paper Chemistry & Technology Vol I, Wood Chemistry & Biotechnology, Walter de Gruvter&Co., Berlin.

Module 3

Effluent treatment: Physical and chemical nature of effluents and their treatment pollution control and norms, chemicals used in effluent treatment- air pollution and control. Stock preparation.Loading of fillers - types, properties and efficiency of fillers, effect on paper properties. Sizing - types of sizing, materials used, mechanism of sizing, effect of paper properties. Additives- types, and their effects.Colour and Pigments- dyes, optical whiteners, types and properties, effect on paper.

Suggested readings specific to module

Bajpai, P.,(2015): Pulp and Paper Industry : Microbiological Issues in Paper Making, Elsevier,Inc,United State of America.
Shirashi, N.(Ed.),(2001): Wood and Cellulosic Chemistry(2nd edition), Marcel DekkarInc, New York.
Henrikrson, G. (Ed.),(2009): Pulp and Paper chemistry Technology Vol-3, Walter de Gruvter GmbH &Co.,Berlin.

Module 4

Overview of paper machines, dry and wet ends, stock and water systems, related machinery.Paper machine operation.Fourdrinier paper making.Twin and multiple paper making.Pressing, drying, surface sizing.Characteristics of materials used, surface preparation, sizing application, properties of sized papers. Coating - calendering and super-calendering-properties and applications of coated papers. Types of Paper, Surface,Physical and Mechanical Properties of Paper

Suggested readings specific to module

Mark J Kirwan(Ed.),(2013): Hand Book of Paper and PaperBoard Packaging Technology(2nd edition),John Willey & Sons Ltd,England.
Britt, K.,(Ed.),(1984): Hand Book of Pulp and PaperT(2nd edition), CBS Publishers & Distributers, New Delhi, India.

Suggested Reading:

1. Bajpai,P.,(2018): Biermanns's Handbook of Pulp and Paper: Paper and Board making Vol 2 (3rd edition),Elsevier Inc. Publications, Nether lands.
2. Bajpai,P.,(2018): Biermanns's Handbook of Pulp and Paper-Vol.I: 3rd Edn. Raw Materials 3.and Pulp Making, Elsevier Inc. Publications, Netherlands

Sample Questions

1. Compose the information of demineralization process
2. Elaborate about forming in paper technology
3. Estimate the major factors to consider when collecting raw material

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔						
CO4	✔						
CO5	✔					✔	

MSWST03DSE06: STATISTICAL METHODS AND COMPUTER APPLICATION (48 hrs. /Semester)

Course Objective

To understand the fundamental statistical concepts to find solutions to research problems
To familiarize with the common statistical softwares
To utilize the statistical techniques for summarizing and presenting the data
To familiarize with the various applications of ANOVA and Regression analysis
To learn the fundamentals of computer application in Research and statistics

Course Outcome:

On Completion of this course the student will be able to:

C01	Familiarize the students with the scope and applications of Statistical methods in Computer Applications.
C02	Impart insights about the concepts of Probability, Tests of significance.
C03	Familiar with the basic concepts of Probability and Sampling Techniques.
C04	Understand tests of the hypothesis as the basis of Inferential Statistics.

Module 1

Statistics- Importance and basic concepts. Data- collection,classification, tabulation,graphical representation of data. Measures Of central tendency- mean, median, mode,geometric mean, harmonic mean. Measures of dispersion- range, quartile deviation,mean deviation, standard deviation. variance and coefficient of variation, probability and probability distributions – binomial,poisson and normal distributions.

Suggested readings specific to module

Rangaswamy, R. (1995). A Textbook of Agricultural Statistics.New Age International Publishers, New Delhi.
Timothy Z.(2015) Keith.Multiple Regression and Beyond An Introduction to Multiple Regression and Structural Equation Modeling,Pearson Education, Inc.

Module 2

Hypothesis testing-basic concepts and test of hypothesis- Z test, t-test, chi square test,F test. Analysis of variance (ANOVA) and its assumptions, one way and two way ANOVA.Correlation- types of correlation, scatter diagram, coefficient of correlation, Test for significance of correlation coefficient.Regression- regression coefficients, linear and curvilinear regressions.Multipleregressions.Test for significance of regression coefficients.

Suggested readings specific to module

Bulmer, M.G. (2012). Principles of Statistics.Courier Corporations. Narayanan, N.E. (2015). Statistics. PHI LearningsPvt. Ltd.

Introduction to linear regression analysis / Douglas C. Montgomery, ElizabethA. Peck, G. Geoffrey Vining. – 5th ed.

Module 3

Sampling- definition and basic concepts-parameter, statistic,standard error, confidence interval, sampling and non-sampling error. Types of sampling (probability sampling)-simple random, stratified, systematic, cluster and multi-stage sampling. Experimental designs- principles (randomization, replication and local control), Experimental designs-CRD, RBD, LSD and Factorial Experiments.

Suggested readings specific to module

P.R. Krishnaiah and C.R. Rao (1988),Handbook of statistics,North-Holland, Amsterdam, Elsevier Science Publishers

Irnein, M.R. ,Wempen, F.W., Alkenbach, J. Bucki, L.A. (2007). Microsoft Office 2007Bible, WileyIndiaPvt. Ltd. New Delhi. N.S.Shagiri,Computer simulation-Indian academy of science-Bangalore

Module 4

Basic concepts of computer, hardware, operating systems: Windows and Linux, word processing, spreadsheets, introduction to web browsing, softwares and search engines with special reference to wood science and technology.

Suggested readings specific to module

Ralston-A-Introduction of programming and computer science.E.C.GrowHillkgakushaLtd.Tokyo

Mason W.L and Mentzalfeidt R.(1984).Computer in Forestry- Institute of chartered Forester S.Publication.

Suggested Reading:

Bulmer, M.G. (2012). Principles of Statistics.Courier Corporations. Narayanan, N.E. (2015). Statistics. PHI LearningsPvt. Ltd.

Rangaswamy, R. (1995). A Textbook of Agricultural Statistics.New Age International Publishers, New Delhi.

Timothy Z.(2015) Keith.Multiple Regression and Beyond An Introduction to Multiple Regression and Structural Equation Modeling,Pearson Education, Inc.

Sinha, P.K. Sinha, P. (2007).Computer Fundamentals, BPB Publications, New Delhi

Irnein, M.R. ,Wempen, F.W., Alkenbach, J. Bucki, L.A. (2007). Microsoft Office 2007Bible, WileyIndiaPvt. Ltd. New Delhi. N.S.Shagiri,Computer simulation-Indian academy of science-Bangalore

Sample questions

1. Define the three measures of central tendency.
2. Discuss the test for significance of regression coefficients.
3. List and explain the differences between t-tests and ANOVA.
4. Difference between Search Engine and Web Browser

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔				✔		
CO2	✔				✔		
CO3	✔				✔		
CO4	✔				✔		

MSWST03DSC12 INSTITUTIONAL / INDUSTRIAL INTERNSHIP AND REPORT SUBMISSION (32 Hrs/Semester)

Course Objective

To gain Hands-on experience in any key areas of application in wood technology
To explore the various career options in industries or research institutes
To gain confidence in their abilities through the successful completion of projects
To apply theoretical knowledge gained in their class roomto real world situation

Course outcomes:

On completion of this course the student will be able to:

C01	Understand whole operations and process in Institution/ industry
C02	Manage activities in Institution
C03	Plan various industrial Manufacturing operations
C04	Understand recent technologies innovations in Institution/ industry

Each student will be placed in a suitable industry or research institute where he will be required to complete practical work on an area related to wood technology in consultation with the institute. A report on the result shall be submitted by him for evaluation at the end of the placement.

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔	✔					
CO2	✔	✔					
CO3	✔	✔					
CO4	✔	✔					

INTERDISCIPLINARY ELECTIVE COURSE (IDC)

MSWST 03IDC02 WOOD AND CLIMATE CHANGE MITIGATION (64 Hrs/Semester)

Course Objectives

To encourage the participants to advocate for sustainable forestry and wood use practices.
To explore the use of wood in sustainable construction and green building practices.
To examine the government policies and regulations related to forestry, land use and carbon emissions reduction.
To explore the use of wood- based biomass as a renewable energy source.
To assess the carbon footprint of various wood products.

Course outcomes:

On completion of this course the student will be able to:

C01	Conclude the importance of EIA and SEA
C02	Explain the global warming reduction potential of wood
C03	Summarize the greenhouse gas profiles of wood with other non-wood materials
C04	Plan the effective upgradation of wood residues
C05	Manage the utilization of wood in a sustainable manner

Module 1

Introduction to forests, wood and climate change - forests and the global carbon cycle; options for mitigating climate change using forestry, wood products and its strategies, the significance of wood as a carbon store.

Suggested readings specific to module

Rizvi, A.R. Baig, S. Barrow, E., Kumar, C. (2015). Synergies Between Climate Mitigation and Adaptation in Forest Landscapes Restoration. Glands, Switzerland, IUCN

Felipe Bravo, Valerie Lemay, Robert Jandl (2017). Managing Forest Ecosystems: The Challenge of Climate Change.Springer Verlag Publishers.

Roger Sands (2013). Forestry in a Global Context; 2nd Edn. CAB International, UK.

Module 2

Global warming - general aspects- wood products and their global warming reduction potential. Wood and agro wastes.Wood residues –types.Their impact on the environment.Upgradation of wood residues.Energy from wood – briquetting, wood gasification- production of bioethanol from lignocellulosics.

Suggested readings specific to module

TuongAn Tran, T., Kim Phung Le, T., Phong Mai, T., &Quan Nguyen, D. (2020). Bioethanol Production from Lignocellulosic Biomass.IntechOpen.doi: 10.5772/intechopen.86437

Zhao, J., Wei, X., & Li, L. (2022). The potential for storing carbon by harvested wood products. *Frontiers in Forests and Global Change*, *5*, 1055410. https://doi.org/10.3389/ffgc.2022.1055410

Module 3

Comparing wood with competing non-wood materials- Greenhouse gas profiles of competing wood and non-wood based materials; barriers to material substitution; potential for market substitution

Suggested readings specific to module

ANON, 2003: The Role of Planted Forests in Sustainable Forest Management, Re-port of the UNFF Intersessional Experts Meeting, 25–27 March, Wellington,New Zealand.

Hair, D., R.N. Sampson, and T.E. Hamilton, 1996: Summary: forest management opportunities for increasing carbon storage. In: Forests and Global Change, Volume 2: Forest Management Opportunities for Mitigating Carbon Emis-sions, R.N. Sampson and D. Hair (eds.), American Forests, Washington, DC,pp. 237–254

Module 4

Wood products and concerns of sustainable development.Situations where SFM and sustainable development can be impeded by the climate change mitigation agenda; assessing sustainable development in the context of SFM and climate change mitigation.A comparison of SEA and EIA.Wood products certification.

Suggested readings specific to module

Rametsteiner, Ewald&Simula, Markku. (2003). Forest Certification—An Instrument to Promote Sustainable Forest Management?.Journal of environmental management. 67. 87-98. 10.1016/S0301-4797(02)00191-3.

Suggested Reading:

1. Rizvi, A.R. Baig, S. Barrow, E., Kumar, C. (2015). Synergies Between Climate Mitigation and Adaptation in Forest Landscapes Restoration. Glands, Switzerland, IUCN

2. Felipe Bravo, Valerie Lemay, Robert Jandl (2017). Managing Forest Ecosystems: The Challenge of Climate Change.Springer Verlag Publishers.

3. Roger Sands (2013). Forestry in a Global Context; 2nd Edn. CAB International, UK.

4. Zhao, J., Wei, X., & Li, L. (2022). The potential for storing carbon by harvested wood products. *Frontiers in 16.Forests and Global Change*, *5*, 1055410. https://doi.org/10.3389/ffgc.2022.1055410

5TuongAn Tran, T., Kim Phung Le, T., Phong Mai, T., &Quan Nguyen, D. (2020). Bioethanol Production from Lignocellulosic Biomass.IntechOpen.doi: 10.5772/intechopen.86437

Sample Questions to test outcomes

1. Formulate a note on the contribution and significance of forest and wood products certification towards sustainability
2. Discuss the current forest certification status and trends in India
3. Evaluate the extent to which SFM and sustainable development can be served by the climate change mitigation agenda

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔						
CO4	✔						
CO5	✔						

VALUE ADDED COURSE (VAC)

MSWST 03VAC01 VERMICOMPOSTING TECHNOLOGY (32 Hrs/Semester)

Course Objectives

To provide the participants with a comprehensive understanding about the vermicomposting
To teach about different species of vermicomposting earthworms
To provide guidance on maintaining the optimum temperature and environmental conditions for vermicomposting
To teach vermicomposting harvesting methods
To encourage the sound waste management practices

Course outcomes:

On completion of this course the student will be able to:

C01	Differentiate between the different composting methods.
C02	Explain the structure and life cycle of common vermicomposting earthworm species.
C03	Explain the different vermicomposting methods.
C04	Summarize the importance of vermicomposting
C05	Manage the waste materials in an environmentally friendly manner.

Module 1

Composting: definition and classification.Kinetics and biochemistry of composting.Composting methods.Composting stages.Role of microbes in compost production.

Suggested readings specific to module

Kulcu, R., &Yaldiz, O, (2004). Determination of aeration rate and kinetics of composting some agricultural wastes.*Bioresource Technology*, *93*(1), 49-57. https://doi.org/10.1016/j.biortech.2003.10.007
Meena, Amrit&Karwal, Minakshi&Dutta, Debashis& Mishra, R.P, (2021).Composting: Phases and Factors Responsible for Efficient and Improved Composting. 10.13140/RG.2.2.13546.95689.
Jamie Mc Sweeney, (2019). Community-Scale Composting Systems: A Comprehensive Practical Guide for Closing the Food System Loop and solving our waste crisis. Chelsea Green Publishing, USA
Grace Gershuny,(1992). The Rodale Book of Composting. Rodale Press Pennsylvania, USA

Module 2

Vermicomposting: definition and scope. Common earthworm species for vermicomposting. Vermicomposting earthworms: structure, life cycle and lifespan. Influence of environmental factors on survival and growth of earthworms.

Suggested readings specific to module

Domínguez, J. (2018). Earthworms and Vermicomposting.InTech.doi: 10.5772/intechopen.76088
Jordan &Verma, (2009). Invertebrate Zoology, Chand & Company Ltd.

Module 3

Vermicomposting of wastes in field pits, ground heaps, tank method, roof shed method, static pile windrows, top fed windrows, wedges & bin method, harvesting the compost, storage. Vermicomposting process.

Suggested readings specific to module

Mary Violet Christy,(2008). Vermitechnology, MJP Publishers, Chennai
Aravind Kumar, (2005). Verms&Vermitechnology, A.P.H. Publishing Corporation, New Delhi.

Module 4

Benefits of vermicompost.Nutrient profile of vermicompost and their role in agriculture.Vermiwash preparation, application and composition. Predator/ pathogen control in vermicomposting: precautions and methods.

Suggested readings specific to module

Sultan Ahmed Ismail, (2005). The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
Bhatnagar&Patla, (2007). Earthworm vermiculture and vermin-composting, KalyaniPublishers,New Delhi
Mukesh Gupta, (2010). Vermiculture Manual, Morarka Foundation, National Foundation, Jaipur.

Suggested Reading:

SreenivasanEttammal,(2022). Hand book on vermicomposting technology. The Western India plywood's Ltd.
Sultan Ahmed Ismail, (2005). The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.
Bhatnagar&Patla,(2007).
Earthworm vermiculture and vermin-composting, KalyaniPublishers,New Delhi
Mukesh Gupta, (2010). Vermiculture Manual, Morarka Foundation, National Foundation, Jaipur.
Jordan &Verma,(2009). Invertebrate Zoology, Chand & Company Ltd.
Edwards, C.A & J.R Lofty Vermicoloogy – The Biology of Earthworm, 1997 Chapman & Hall Publications N.Y.U.S.A.
Jamie Mc Sweeney, (2019). Community-Scale Composting Systems: A Comprehensive Practical Guide for Closing the Food System Loop and solving our waste crisis. Chelsea Green Publishing, USA
Grace Gershuny, (1992). The Rodale Book of Composting. Rodale Press Pennsylvania, USA
Jain, M. S., Paul, S., &Kalamdhad, A. S, 2020. Kinetics and physics during composting of various organic wastes: Statistical approach to interpret compost application feasibility. *Journal of Cleaner Production*, *255*, 120324. https://doi.org/10.1016/j.jclepro.2020.120324

Sample Questions to test outcomes

1. Explain the different composting methods?
2. Create a short note on common vermicomposting earthworm species
3. Summarize the importance of vermicomposting

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔					✔	
CO3	✔						
CO4	✔						
CO5	✔						

FOURTH SEMESTER

CORE COURSE

MSWST04DSC13 PRODUCTION AND MARKETING MANAGEMENT(64Hrs/Semester)

Course Objective

To understand the quality evaluation procedure of different commodities
To create awareness in selection of plant location
To get a foundation in the concepts of production and marketing management
To equip with skills and knowledge required to do market research and decision making

Course outcomes:

On completion of this course the student will be able to:

C01	Understand the duties and responsibilities of Managers
C02	Manage the Production and Operation Policies of Industries
C03	Analyze the products based on best quality management practices
C04	Plan the different marketing strategies in accordance with market conditions
C05	Evaluate the demand and supply for timber and timber products

Module 1

Production as an organization function-Importance of production function- Scope of production and operations management- Characteristics of modern production and operation function. Production /Operations planning & Control- Factors determining production planning- Production planning system-Production control- Elements of production control-Factors determining production control-Objectives of production planning and control.

Suggested readings specific to module

Panneer R. Selavan, (2017): Production and Operations Management (3rd Edition), PHI Learning Private Limitted,NewDelhi,India.
UpendraKachru,(2007): Production and Operations Management (Text and Cases), Excel Books,New-Delhi,India.
Aswathappa K, Bhat KS.Production and Operations Management [electronic Resource] / Dr. K. Aswathappa, K. ShridharaBhat.Rev. ed. Himalaya Pub.House; 2009.

Module 2

Plant location and layout-nature-Location theories-Steps in location-Location models-Plant layout- Factors influencing layout-Principles of layout Basic concepts of demand, supply of wood produce, derived demand, demand and supply schedules, Types of markets for timber produce, market locations of timber produce and their features. Price determination in timber.

Suggested readings specific to module

Panneer R. Selavan,(2010): Production and Operations Management (2nd edition), PHI Learning Private Limitted, New Delhi, India.
Charantinath M Poornima, Entrepreneurship Development Small Business Enterprises: Pearson Education First Impression, 2006

Module 3

Concept, nature and importance of marketing management - marketing mix. Product and pricing decisions-product line and product mix, product life cycle stages. Promotion and distribution-wholesaling and retailing.Consumer behavior-buying roles and behaviour.

Suggested readings specific to module

Chandan, J.S. (1987): Management Theory &Practice, Vikas Publishing House Private Ltd., New Delhi, India
Koontz,H. &Weihrich,H.,(2008): Essentials of Management – An International Perspectives (7th edition),Tata McGraw-Hill Publishing Company Limited, New Delhi, India,
Kotler,P. et.al.,(2009): Marketing Mangement (13th edition), Bording Kindersley Pvt.Ltd, Licensees of Pearson Education,India.

Module 4

Quality control-Organization for quality control- Quality control techniques-Statistical quality control- Types of control charts- Total Quality Management; Plant maintenance - definition-Scope- Importance- Objectives of Plant maintenance; management- Models for maintenance management- Implementation of maintenance management.

Suggested readings specific to module

Aswathappa K, Bhat KS.Production and Operations Management [electronic Resource] / Dr. K. Aswathappa, K. ShridharaBhat.Rev. ed. Himalaya Pub.House; 2009.
SyamsulBahri (2012) "Implementation of TQM and Its Effect on organization performance of manufacturing Industries", IOSR journal of Business and Management, Vol. 5, Issue 1

Suggested Reading:

Jolly, S. S.,"TQM: An Emerging Necessity for Small Scale Industry Sector", Vol. 2, Issue 1, pp. 36-37, 2013
Brown S, Brown S. Operations Management [electronic Resource] : Policy, Practice and Performance Improvement / Steve Brown ... [et Al.]. 1st edition.Butterworth-Heinemann; 2001.
Knapčíková L, Peraković D, eds. 6th EAI International Conference on Management of Manufacturing Systems / Edited by Lucia Knapčíková, DraganPeraković. Springer; 2022.
Plant%20Location%20and%20Layout.pdf
Russel& Taylor,(2009), Operations Management (6th edition),John willey&Sons,Willey India Edition, India.

Sample Questions to test outcomes

1. Elaborate the Benefits of market segmentation
2. Discuss about Plant Location theory
3. Discuss the product life cycle stages

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔						
CO4	✔						✔
CO5	✔						

MSWST 04DSC14 DISSERTATION AND VIVA (128 Hours/Semester)

Course Objectives

To help students to concentrate deeply in to a specific area of research in wood technology
To develop the abilities for writing research proposal and problem solving skills
To evaluate the depth of understanding the research topic, methodologies and findings
To get practical experience in collecting, analysing and interpreting data

Course outcomes:

On completion of this course the student will be able to:

C01	Develop Research competence of the students in the field of Wood science & Technology
C02	Collect data and analyse the result for product development
C03	Prepare of research papers with proper citation
C04	Prepare presentation on their research projects
C05	Conduct independent research areas of their interest to solve the identified problem

Each student shall carry out a research project on any area of wood science and technology. Projects can be carried out from research institutes or industry. A student has to select the topic for their research before the starting of fourth semester and a project proposal also has to be prepared prior to embarking on project work in consultation with the assigned guide.

Training shall be given to the students on:

1. Use of Library - Familiarization with various features of the library.
2. Familiarization with internet and search engines
3. Computer-aided literature search - Familiarization of important databases relevant to the field of wood science & Technology
4. Paraphrasing in the context of plagiarism
5. Structure of a research paper and thesis
6. Exercises on citing and listing references
7. Exercises on the processing of data and illustrations
8. Formulation of a research project
9. Presentation of scientific papers
10. Common errors in technical writing

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔				✔		
CO2	✔				✔		
CO3	✔				✔		
CO4	✔				✔		
CO5	✔				✔		

MSWST 04DSC15 WOODWORKING PRACTICAL II(128Hrs/Semester)

Course Objective

To Familiarize with the tools and equipment used in wood finishing process
To understand the ergonomic considerations in furniture design
To explore the existing mass furniture production technology in different applications
To get practical experience in different wood coating applications

Course outcomes:

On completion of this course the student will be able to:

C01	Understand steps involved in wood finishing process
C02	Operate various types of sanding machine used in wood finishing
C03	Identify and select wood finishes available in the market suitable for various projects
C04	Select the timber species suitable for various finishes and avoid finishing defects
C05	Identify advanced wood finishing technology used in wood industries

1. Understanding the importance of wood finishing
2. Preparation of wood surface for finishing: Basics of Sanding and identifying different sanding machines like belt sanders and orbit sanders. Dust cleaning before finishing. Identifying different wood putties used. Practicing the steps involved in Finishing wood.
3. Familiarizing the important types of finishes used in wood coatings like Shellac, lacquer, Varnish, Drying oils, and synthetic polymeric resin binders. Opaque and clear finishes, penetrating and non-film forming finishes.
4. Practicing the Filling methods used to fill the wood pores and staining of wood using pigments and dyes and identifying the raw materials used for filling and staining. Figure and color upgrading, Use of natural dyes
5. Studying the principles of advanced wood coating application techniques like UV coating, powder coating, High Solid coating, and application of nanotechnology in coating.
6. Finishing qualities of Indian woods, Indices of finish adaptability, testing methods used for measuring properties of wood finish.
7. Study and Prepare presentations and reports on Ergonomic considerations in Furniture Design, Knock down furniture, Bentwood furniture, Glues recommended for furniture design, and Advanced woodworking machines used in the wood industry.
8. Visiting some major furniture industries to identify the machines used for the mass production of furniture.

Sample Questions to test outcomes

1. Prepare the given wood sample for finishing and suggest a suitable finish
2. Identify the wood working machine and write down the applications
3. Prepare a clear coating on a given sanded wood sample.

CO- PSO MAPPING						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	✔	✔				
CO2	✔	✔				
CO3	✔	✔				
CO4	✔	✔				
CO5	✔	✔				

ELECTIVE COURSES

MSWST04DSE07 TIMBER ENGINEERING (48 Hrs/Semester)

Course Objective

To get an overview about the characteristics of timber as a construction material
To explore various types of timber connections and joints and their design principles
To understand the sustainable aspects of timber as renewable resources and life cycle assessment
To emphasize the safety practices and considerations in timber engineering

Course outcomes:

On completion of this course the student will be able to:

C01	Explain the scope and prospectus for timber engineering in India
C02	Conclude about the existing Indian building code based on timber engineering.
C03	Summarize the different structural timber joints
C04	Differentiate between conventional and modern timber joints
C05	Judge the role of wood and bamboo in earthquake-resistant building construction.

Module 1

Scope and significance of modern timber engineering in India in relation to concrete, steel and plastics as construction materials, new development, economy, building code and its application.

Suggested readings specific to module

Bureau of Indian Standards (1986).*Hand book on timber engineering [CED 09: Timber and timber stores]*, (SP 33)
Aejaz, S., Dar, M. A., Dar, A., Bhat, J., &Carvalho, H. (2021). Behaviour of various framed timber joints: Capacity and improved design rules. *Journal of Building Engineering*, *44*, 103417.

Module 2

Strength properties and design of structural timber joints, conventional v s new types. Fasteners strength in single, double and multiple shear. Design of timber joints with nails, bolts, wooden disc dowels, dowel pins, steel ring connectors and adhesives with side members of timber, plywood & MS plates, Scarf, finger and glued lap jointing for load and non-load bearing applications.

Suggested readings specific to module

Bureau of Indian Standards (1986).*Hand book on timber engineering [CED 09: Timber and timber stores],* (SP 33)
Ercüment Erman Ph.D. (1999) A Survey on Structural Timber Joint Classifications and a Proposal Taxonomy, Architectural Science Review, 42:3, 169-180, DOI: 10.1080/00038628.1999.9696874
https://lancastercountybackyard.net/blog/timber-frame-joints

Module 3

Design of linear structural components: Beams, Ties, Purlins, Columns, Joints. Trusses & arches - Configuration, analysis of simply supported 2 hinged ,3 hinged types. Design of Special structures; timber Lamellas & timber flooring.Web type girder, composite construction, stressed skin construction, rigid frames, shells, transmission line towers etc.

Suggested readings specific to module

Bureau of Indian Standards (1986).*Hand book on timber engineering [CED 09: Timber and timber stores],* (SP 33)

Module 4

Glue laminated linear and curved structural members, shear strength, analysis and design. Finger jointing of short length timber for use in door frames & stiles Prefabrication: merits/ demerits, techniques, design of low cost structures. Destructive proof testing of timber structures.Wood and bamboo in earthquake resistant construction.

Suggested readings specific to module

Bureau of Indian Standards (1986).*Hand book on timber engineering [CED 09: Timber and timber stores],* (SP 33)
Okamoto, S., Akiyama, N., Araki, Y., Aoki, K., &Inayama, M. (2021). Study on the strength of glued laminated timber beams with round holes: Difference in structural performance between homogeneous-grade and heterogeneous-grade timber. *Journal of Wood Science*, *67*(1), 1-25. https://doi.org/10.1186/s10086-021-01941-3
Ilharco, T., Lechner, T., & Nowak, T. (2015). Assessment of timber floors by means of non-destructive testing methods. *Construction and Building Materials, 101,* 1206-1214. https://doi.org/10.1016/j.conbuildmat.2015.05.133
https://pdfs.semanticscholar.org/6802/a59d0606cf447faf0a86d74b00ad3fc2ddf9.pdf
Zhao, J., &Qiu, H. (2023). Seismic performance assessment of a multi-story bamboo frame structure. *Advances in Bamboo Science*, *2*, 100011. https://doi.org/10.1016/j.bamboo.2022.100011

Suggested Reading:

1. Bureau of Indian Standards (1986). *Hand book on timber engineering [CED 09: Timber and timber stores],* (SP 33)
2. Karolak, A., Jasieńko, J., &Raszczuk, K. (2020). Historical scarf and splice carpentry joints: State of the art. *Heritage Science*, *8*(1), 1-19. https://doi.org/10.1186/s40494-020-00448-2
3. Ercüment Erman Ph.D. (1999) A Survey on Structural Timber Joint Classifications and a Proposal
4. Taxonomy, Architectural Science Review, 42:3, 169-180, DOI: 10.1080/00038628.1999.9696874
5. Aejaz, S., Dar, M. A., Dar, A., Bhat, J., &Carvalho, H. (2021). Behaviour of various framed timber joints: Capacity and improved design rules. *Journal of Building Engineering*, *44*, 103417.
6. Okamoto, S., Akiyama, N., Araki, Y., Aoki, K., &Inayama, M. (2021). Study on the strength of glued laminated timber beams with round holes: Difference in structural performance between homogeneous-grade and heterogeneous-grade timber. *Journal of Wood Science*, *67*(1), 1-25. https://doi.org/10.1186/s10086-021-01941-3
7. Ilharco, T., Lechner, T., & Nowak, T. (2015). Assessment of timber floors by means of non-destructive testing methods. *Construction and Building Materials, 101,* 1206-1214. https://doi.org/10.1016/j.conbuildmat.2015.05.133
https://pdfs.semanticscholar.org/6802/a59d0606cf447faf0a86d74b00ad3fc2ddf9.pdf
8. Zhao, J., &Qiu, H. (2023). Seismic performance assessment of a multi-story bamboo frame structure. *Advances in Bamboo Science*, *2*, 100011. https://doi.org/10.1016/j.bamboo.2022.100011

Sample Questions to test outcomes

Discuss about different structural timber joints.
Explain the current status of timber engineering in India.

Evaluate the role of wood in earthquake resistant construction.

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔					✔	
CO3	✔						
CO4	✔						
CO5	✔						

MSWST04DSE08 FOREST MANAGEMENT AND PLANNING (48 Hrs/Semester)

Course Objective*:*

To acquire knowledge on the principles and practices for sustainable forest management
To familiarize with the concept of growing stock and working plan
To understand the application of modern tools in preparing working plan
To explore the possibilities of getting yield regulation through proper forest management

Course outcomes:

On completion of this course the student will be able to:

C01	Understand the policies and acts for forest management
C02	Discuss the concept of normal growing stock and its determination
C03	Understand various working plan and method of writing working plan
C04	Demonstrate the role of sustainable yield through proper forest management
C05	Explain the application of GIS in forest management

Module 1

Forest management- definition, object and scope. Forest policies and Acts as the basis of management. Forest organisation- various classification. Sustained yield- concept, scope and limitation. Biotic and abiotic factors including forest fire affecting forest health. Forest health mangement.

Suggested reading specific to module:

Buongiorno, J, and Gilless, J K. *Forest management and economics*. United States: N. p., 1987. Web.
G.T. McDonald and M.B. Lane (2004). Converging global indicators for sustainable forest management, Forest Policy and Economics, Volume 6, Issue 1, Pages 63-70

Module 2

Rotation: definition and types of rotation. Felling series in selection forest and coppice with standard system. Increment- CAI - MAI relationship. Growing stock: concept and definition - determination of growing stock- normal growing stock in regular, shelter, wood system, selection system.

Suggested reading specific to module:

Bhattacharya, R. N., Snyder, D. L., &Biswas, B. (1989). The Optimal Forest Rotation: Some Economic Dimensions. The Indian Economic Journal, 37(2), 69-82.

Khanna, L.S.1989. Principles and Practice of Silviculture.KhannaBandhu, Dehra Dun. 473 p

Module 3

Yield regulation: principles and objective - types of yield- yield regulation in regular forests- various modifications - yield regulation in irregular forests - regulation based on volume increment, volume and increment only.

Suggested reading specific to module:

Negi, S.S. (2000): Indian Trees and their Silviculture - Legumes,BishensinghMahendrapal Singh (pubication),Dehradun,India.

P. W. West, 2016. Growing Plantation Forests Springer Cham

Module 4

Working plan: introduction, definitions, objective and scope. Preparation of working plans - preliminary working plan report. Constitution of a working plan division- field work- compartment histories- maps- working plan maps, stock maps, geology map, regeneration map, forest type map, management map- role of GIS in forest management. Method of writing working plan- Part I and Part II- Use oF Modern tools in WP preparation.

Suggested reading specific to module:

Varghese Mani, Jugal Kishore, Jha, Chandra. (2022). Applications of Geospatial Technology in forest Resource Assessment, Management, and Monitoring.

Singh, Madan& Reddy, Santhosh& Ashraf, Jawaid. (2014). Revised National Working Plan Code in India. Indian Forester. 140. 1267-1270.

Suggested Reading:

Troup, R.S. (1921). TheSilviculture of Indian Trees. Vol. II Clarendon Press, Oxford.

Anon. (19840. Forest Survey of India: Inventory Indian Forests.

Browne, F.G. (1968). Pests and Diseases of Forest Plantation Trees. Clarendon press, oxford.

Patel, V.J. (1991). A New Strategy for High Density Agroforestry.3rdEdn. JAFC, Surendrabag.

White, T. (1967). A Conceptual Framework for the Tree Improvement Programmes.MartinusNijhoff

Sill, Jr. W.H. (1982). Plant protection: An Integrated Interdisciplinary Approach. Iowa State University Press. Ames, Iwoa.

SopheHigman.*et.al.* (2006): The Sustainable Forestry Hand Book(2nd edition), Earthscan Publications Ltd, London

George H.M Lawrence, (1951): Taxonomy of Vascular Plants, Scientific Publishers, India.

Garfitt, J.E. (1995): Natural Management of Wood Continuous Cover Forestry, Research Studies Press Ltd, England.

National Working Plan Code 2023.Ministry of Enivironment and Forest. Government of India

Klaus Gadow, TimoPukkala, Margarinda Tome (2001). Sustainable Forest Management. Kluwer academic publishers, Springer Dordrecht Publishers

CO- PSO MAPPING							
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	✔						
CO2	✔						
CO3	✔						
CO4	✔						
CO5	✔						