

(Abstract)

Revised Scheme, Syllabus and Model Question Papers of M.Sc Wood Science and Technology (Industry - Linked) Programme (CBCSS) - implemented in the University Department - w.e.f. 2020 Admission – Orders issued.

ACADEMIC C SECTION

Acad/C4/9254/2020

Dated: 25.02.2021

- Read:-1. Minutes of the meeting of the Syndicate held on 26.10.2019, vide item No. 2019.676
2. U.O.No.ACAD C3/22373/2019. dated 08.10.2020
 3. U.O.No.Acad/C3/22373/2019, dated 12.11.2020
 4. Department Council Minutes, School of Wood Technology dated 23.11.2020
 5. Letter dated 04.02.2021, from the HoD, School of Wood Technology along with revised Scheme, Syllabus and Model Question Papers of M.Sc Wood Science and Technology (Industry - Linked) Programme

ORDER

1. The meeting of the Syndicate held on 26.10.2019 resolved vide paper read (1) above, to revise the Scheme and Syllabus of all Post Graduate Programmes under Choice Based Credit Semester System (CBCSS) in the Schools/Departments of University with effect from 2020 admission.
2. Subsequently, the Curriculum Committee was reconstituted as per paper read (2) above to monitor and co-ordinate the working of the Choice based Credit Semester System.
3. Accordingly, the revised Regulations for P.G. Programmes under Choice Based Credit Semester System were implemented in the Schools/Departments of the University with effect from 2020 admission as per paper read (3) above.
4. Further, the Department Council, vide paper read (4) above approved the revised Scheme, Syllabus and Model Question papers of M.Sc Wood Science and Technology (Industry - Linked) Programme Under Choice Based Credit Semester System, prepared in line with the revised Regulations for Choice Based Credit Semester System, for implementation w.e.f 2020 admission.
5. Subsequently, the revised Scheme, Syllabus & Model Question Papers of M.Sc Wood Science and Technology (Industry - Linked) Programme, prepared in line with the revised Regulations for Choice Based Credit Semester System, was duly scrutinized by an External Subject Expert and she recommended the Syllabus for implementation.
6. Thereafter, the revised Scheme, Syllabus and Model Question Papers of M.Sc Wood Science and Technology (Industry - Linked) Programme was forwarded by the Head, School of Wood Technology, Mangattuparamba Campus, as per paper read (5) above, for implementation with effect from 2020 admission.
7. 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, accorded sanction to implement the revised Scheme, Syllabus and Model Question Papers of M.Sc Wood Science and Technology (Industry - Linked) Programme under Choice Based Credit

8. The revised Scheme, Syllabus and Model Question Papers of M.Sc Wood Science and Technology (Industry - Linked) Programme(CBCSS) implemented with effect from 2020 admission are uploaded in the University Website.(www.kannuruniversity.ac.in)

Orders are, issued accordingly.

Sd/-

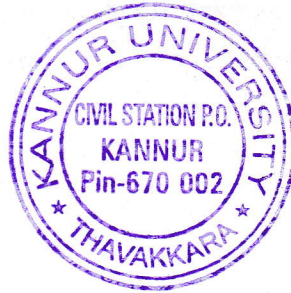
BALACHANDRAN V K
DEPUTY REGISTRAR (ACAD)
For REGISTRAR

To: HoD, School. of Wood Technology
Mangattuparamba Campus, Kannur - 670567

Copy To: 1. The Examination Branch (through PA to CE).
2. PS to VC / PA to PVC / PA to R
3. DR / AR I/AR II (Acad).
4. The Computer Programmer (for uploading in the Website)
5. SF / DF /FC /.

Forwarded / By Order


SECTION OFFICER





KANNUR UNIVERSITY

SCHOOL OF WOOD TECHNOLOGY

Department of Wood Science and Technology

MANGATTUPARAMBA CAMPUS, KANNUR UNIVERSITY

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

Choice based Credit Semester System (CBCSS)

Curriculum and Syllabus

*

Approved by Academic Council on xx xx, 2020

and by Syndicate on xx xx, 2020

CONTENTS

	Page
1. Preamble	3
2. M.Sc. Wood Science & Technology (Industry-Linked) Programme	4
3. Programme objectives	4
4. programme outcomes.....	4
5. Choice based credit semester system.....	4
6. Definition.....	5
7. Eligibility for admission	5
8. Course structure	6
9. Evaluation	7
10. Assignments and tests	8
11. Conduct of end semester examinations	8
12. Attendance	8
13. Grading	9
14. Grade cards	10
15. Department council	11
16. Curriculum committee	11
17. Grievance redressal mechanism	12
18. Transitory provisions	12
19. Repeal	12
20. Curriculum	13
21. Course structure and scheme of examinations.....	14
22. Syllabus – Semester 1.....	17
23. Syllabus – Semester 2.....	28
24. Syllabus – Semester 3.....	41
25. Syllabus - Semester 4	52

PREAMBLE

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 Plywood, Ltd., Valapattanam, Kannur. The Industry-Linked programme is a novel approach, which combines the conventional University level academic system with 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 sessions at The Western India Plywood Ltd. (WIP). Thus, in effect, the students shall get both the University level academic orientation pertaining to the core, elective and open elective courses in the field of wood science and technology as well as in-plant training exposure from the reputed wood-based industry, WIP as per the prescribed syllabus for each modules.

The syllabus offered by the Wood science and Technology Department at Kannur University covers major areas such as Forestry and Dendrology, Wood Identification, Logging and Ergonomics, Wood variation, Wood seasoning, Adhesives for wood panel products, Physical and Chemical properties of wood, Wood bio-degradation, Wood preservation, Wood based composites, Wood working and wood finishing, Wood mechanics and timber engineering, Saw milling and saw doctoring, Paper and pulping technologies, Wood and climate change studies, Management principles and marketing of wood produces, and Production management, Wood Technology-related practical schedules, workshops, seminars, etc., along with individual research works.

The syllabus for Wood Technology Workshops is prepared in such a manner that the students can focus on details of the operations and processes employed in the factory. In order to ensure that the students get real benefits, they have to periodically present their data in seminars and also submit the reports. The performance of the students in these seminars and the written reports as well as their participation in the discussion will be assessed periodically and will be included in the marks for the continuous evaluation.

M.Sc. WOOD SCIENCE AND TECHNOLOGY (INDUSTRY-LINKED) PROGRAMME

Programme Objectives

(i): To provide University level academic orientation in core, elective and open elective courses in wood science and technology as well as in-plant training exposure to students in various industrial operations and processes from an Internationally reputed wood-based industry.

(ii): To develop aptitude and skills to learn various basic and advanced knowledge bases on wood science and technology so as to enable the students to take leading roles in a wide spectrum of employment in wood-based industry sector as well as in research institutions.

Programme Outcomes

On successful completion of the M.Sc. Wood Science and Technology (Industry-Linked) Programme, a student will be able to :

(i) Gain in-depth knowledge on theoretical and practical aspects of wood science & technology.

(ii): Handle and manage the various operating and processing systems in wood-based industry.

(iii): Get exposure to a wide range of job opportunities in wood based industry at national and international levels as well as in research organizations.

CHOICE BASED CREDIT SEMESTER SYSTEM (CBCSS)

The M.Sc. Wood Science and Technology (Industry-Linked) Programme is following the Choice based Credit Semester System (CBCSS). Choice based Credit Semester System presupposes academic autonomy, cafeteria approach in academic environment, semester system, course credits, alphabetical grading and interdepartmental academic collaboration. The CBCSS provides an ample opportunity for the students to choose courses from the prescribed courses comprising core, elective and open elective courses. The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Grading system provides uniformity in the evaluation and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations which enables the student to move across institutions of higher learning. The uniformity in evaluation

system allows more realistic approach and scope in assessing the performance of the candidates by the potential employers.

Definitions:

(i) 'Academic Programme' means an entire course of study comprising its programme structure, course details, evaluation schemes, etc. designed to be taught and evaluated in a teaching Department/School or jointly under more than one such Department/School.

(ii) 'Course' means a segment of a subject that is part of an Academic Programme.

(iii) 'Programme Structure' means a list of courses (Core, Elective, Open Elective) that makes up an Academic Programme, specifying the syllabus, Credits, hours of teaching, evaluation and examination schemes, minimum number of credits required for successful completion of the programme, etc. prepared in conformity to University Rules, eligibility criteria for admission.

(iv) 'Core Course' means a course that a student admitted to a particular programme must successfully complete to receive the degree and which cannot be substituted by any other course.

(v) 'Elective Course' means an optional course to be selected by a student out of such courses offered in the same or any other Department/School

(vi) 'Open Elective' means an elective course which is available for students of all programmes, including students of same Department. Students of other Departments shall opt these courses subject to fulfilling the eligibility criteria as laid down by the Department offering the course.

(vii) 'Credit' means the value assigned to a course which indicates the level of instruction.

ELIGIBILITY FOR ADMISSION

As per the regulations prescribed by the University for the M.Sc. Wood Science and Technology (Industry-Linked) Programme, candidates with Bachelor Degree in Chemistry/ Chemical Sciences/Physics/Botany/Plant Science/ Forestry/ Micro-Biology/ Biotechnology/ Mathematics with at least 50% marks in the concerned optional subjects excluding subsidiaries are eligible for admission to this course. Rules regarding minimum marks required for Bachelor Degree, reservation etc. will be as laid down by the University from time to time. Index marks (5%) will be awarded to the students having degree in Biology related subjects. Admissions to seats to be filled by the

University are purely based on the entrance test. All the eligible applicants have to appear for a written entrance test. Allocation of seats will be strictly following the rules and regulations regarding reservation. Maximum number of students that can be admitted to this programme is 24.

The Department shall have faculty members as student advisors. Each student at the time of admission will be assigned to an advisor by the Department Council. He/she will advise the student about the academic Programme and counsel on the choice of courses depending on the student's academic background and objective. The student will then register for the courses he/she plans to take for the semester before the classes begin. The Department Council will be the authority to fix the Optional Courses that can be offered for a Programme. Elective courses for the next semester will be announced within 10 days of the end of the previous semester.

The student has to complete the prescribed prerequisites for the course before Registration. The student within a maximum of 10 working days after the commencement of the classes can change the Optional Course with the consent of HoD in consultation with the Advisor. The University shall make available to all students a bulletin listing all the courses offered in every Semester specifying the Credits, list of topics the course intends to cover, the name of the instructor, the timetable and examination schedule.

COURSE STRUCTURE

Three kinds of Courses are offered - Core, Elective and Open Elective Courses including MOOC courses. Core and Elective Courses are offered by the Department. Open Elective Courses are offered either by the Department or by any other Department of the University, Institutions or via MOOC. Open Elective Course will be optional with 4 credits. Open Elective Courses can be opted in any of the semesters during the entire Programme other than the first semester.

Each course offered by the University Department is identified by a unique alphanumeric code (e.g. **MSWST 01C01; MSWST01 E01**).

Where first two letters denote Programme name (MS for Master of Science); the next three letters denote the subject. This is followed by semester number such as 01,02,03,04. After semester number single alphabet stands for core (C), elective (E) and Open Elective course (O). The last two digits denote serial number of the course in each semester.

The minimum duration for completion of a two year PG Programme is four (4) Semesters. The maximum period for completion is eight (8) Semesters. Even if a

candidate earns the required number of credits in less than 4 Semesters, he/she has to necessarily study for four semesters of the two year PG. No regular student shall register for more than 24 credits and less than 16 credits per Semester, subject to the provisions of the programme concerned.

The total credits required for the successful completion of a four semester programme will be between 72 to 80, in which minimum credits required for Core courses is 60 and minimum for Elective courses is 12. Those who secure less than the minimum credits for Core/Elective courses has to supplement the deficiency required for obtaining them.

The Department Council shall design the Core, Elective and Open Elective Courses including the detailed syllabus for each Programme offered by the Department. The Department Council shall have the freedom to introduce new courses and/or to modify/redesign existing courses and replace any existing course with a new course to facilitate better exposure and training for the students, with the approval of the Faculty Council and Academic Council.

EVALUATION

Evaluation of the students shall be done by the Faculty member who teaches the courses on the basis of Continuous Evaluation (CE) and an End Semester Examination (ESE). The proportion of the distribution of marks among ESE and CE shall be 60:40. 10% of the scripts will be valued by an External Examiner. If there is an average difference of more than 15%, the script will be valued by one Internal and one External Examiners together. Continuous Evaluation includes Assignments, Seminars, Periodic written examinations, etc. The allocation of marks for each component under Continuous Evaluation shall be in the following Proportions:

Component	Core/Elective/Open Courses	Practical/Industry Workshop
Mid-semester test (1) Tutorial + Viva (1) Assignments	20 (25%) (25%)	- Records 20 (50%)
Mid-semester Test (2) Tutorial +Viva (2)	20 (50%)	10+10= 20 (50%)
Total Marks	40	40

Mode of assessment will be decided by the Department. Performance of each student in an assessment shall be intimated to him/her within two weeks of the assessment.

ASSIGNMENTS AND TESTS

Each student shall be required to do minimum two assignments for each course. Assignments after valuation shall be returned to the students. For each Course there shall be two mid-term class tests during a Semester. Valued answer scripts shall be made available to the students for perusal. Students shall be required to present a seminar on a selected topic in each course. The evaluation of the seminar will be done by the concerned teacher/(s) handling the course based on the presentation of the seminar paper and participation in discussion. All the records of the Continuous Evaluation (CE) shall be kept in the School/Department and shall be made available for verification by the University.

CONDUCT OF END SEMESTER EXAMINATION

The End Semester Examinations (ESE) of each semester will be conducted by the Controller of Examinations in the same pattern of Model Question Papers submitted by the Chairpersons of the Department Councils concerned, as per the Scheme and Syllabus applicable. The tabulation registers of each Semester shall be prepared and maintained by the Examination Branch. There shall be a minimum of one external examiner to ensure transparency in the conduct of examinations. The external examiners will be faculty members appointed from other Colleges/Departments of this University or from other Universities. The duration of End Semester Examination shall be specified in the curriculum.

The Board of Examiners will function as the Pass Board. After the completion of evaluation of each semester examination, a meeting of the Board of Examiners will be convened as Pass Board to finalise the results. The minutes of the Pass Board will be approved by the Vice Chancellor.

ATTENDANCE

The minimum attendance required for each Course shall be 60% of the total number of classes conducted for that semester. Those who secure the minimum attendance in a semester alone will be allowed to register for the End Semester Examination. Condonation of attendance to a maximum of 10 days in a semester subject to a maximum of two spells within a Programme will be granted by the Vice-Chancellor. Benefit of Condonation of attendance will be granted to the students on health grounds, for participating in University Union activities, meetings of the University Bodies and

participation in extracurricular activities on production of genuine supporting documents with the recommendation of the Head of the Department concerned . A student who is not eligible for Condonation shall repeat the Course along with the subsequent batch.

GRADING

An alphabetical Grading System shall be adopted for the assessment of a student's performance in a course. The grade is based on a 6 point scale. The following table gives the range of marks %, grade points and alphabetical grade.

Range of Marks %, Grade Points, Alphabetical Grade

Range of Marks %	Grade Points	Alphabetical Grade
90-100	9	A+
80-89	8	A
70-79	7	B+
60-69	6	B
50-59	5	C
Below 50	0	F

A minimum of grade point 5 (Grade C) is required for the successful completion of a Course. Performance of a student at the end of each semester is indicated by the Grade Point Average (GPA) and is calculated by taking the weighted average of grade points of the Courses successfully completed. Following formula is used for the calculation. The average will be rounded off to two decimal places.

$$\text{GPA} = \frac{\text{Sum of (Grade points in a Course multiplied by its Credit)}}{\text{Sum of Credits of Courses.}}$$

At the end of the programme, the overall performance of a student is indicated by the Cumulative Grade Point Average (CGPA) and is calculated using the same formula given above.

Empirical formula for calculating the percentage of marks will be $(\text{CGPA} \times 10) + 5$. Based on the CGPA overall letter grade of the student shall be in the following way.

CGPA Overall Letter Grade

CGPA	Overall letter Grade	Classification
8.5 and above	A+	First Class with Distinction
7.5 and above but less than 8.5	A	
6.5 and above but less than 7.5	B+	First Class
5.5 and above but less than 6.5	B	
5.0 and above but less than 5.5	C	Second Class

Appearance for Continuous Evaluation (CE) and End Semester Evaluation (ESE) are compulsory and no Grade shall be awarded to a candidate if he/she is absent for

CE/ESE or both. A student who fails to complete the Programme/Semester can repeat the full Programme / Semester once, if the Department Council permits to do so.

No student shall be allowed to take more than eight consecutive Semesters for completing a four Semester Programme from the date of enrolment.

GRADE CARD

The Controller of Examinations shall issue the Grade Cards of all Semesters and the consolidated Grade Cards and Certificates on completion of the Programme, based on the authenticated documents submitted by the Heads of the Departments concerned.

The Grade Card shall contain the following:

- a) Title of the Courses taken as Core, Elective & Open Elective.
- b) The credits associated with and grades awarded for each Course.
- c) The number of credits (Core /Elective / Open) separately earned by the student and the SGPA.
- d) The total credits (Core / Elective / Open) separately earned by a student till that Semester.

The consolidated Grade Statement issued on completion of the Programme shall contain the name of the Programme, the School/Department offering the Programme, the title of the Courses taken, the Credits associated with each Course, Grades awarded, the total Credits (Core /Elective/Open) separately earned by the student, the CGPA and the class in which the student is placed. Rank Certificates will be issued on individual requests, based on CGPA.

DEPARTMENT COUNCIL

All the Permanent and Contract teachers of the Department shall be the members of the Department Council. The Department Council subject to these Regulations shall monitor every academic programme conducted in the School/Department. Department Council shall prescribe the mode of conduct of courses, conduct of examinations and evaluation of the students. It also listens to the grievances of the students-

CURRICULAM COMMITTEE

There shall be a Curriculum Committee constituted by the Vice Chancellor to monitor and co-ordinate the working of the Choice Based Credit Semester System. A senior Professor nominated by the Vice Chancellor shall be the Convener of the Curriculum Committee.

The Committee shall consist of:

- a) Vice-Chancellor or a person nominated by VC (Chairperson)
- b) The Convener of the Curriculum Committee
- c) The Registrar (Secretary)
- d) The Controller of Examinations
- e) Dean
- f) The Head of the Department

The term of office of the Committee shall be two years, but the Committee once constituted shall continue in office until a reconstituted committee assumes office.

GRIEVANCE REDRESSAL MECHANISM

Committees will be constituted at the Department and University levels to look into the written complaints regarding Continuous Evaluation (CE). Department Level Committee (DLC) will consist of the Department Council and a student nominee of the Department Students' Union from the concerned Faculty. University Level Committee (UIC) will consist of the Pro-Vice-Chancellor (Chairman & Convenor), the Convenor of the Curriculum Committee (Vice-Chairman), the Head of the Department concerned and a nominee of the Students' Union. Department Level Committee will be presided over by the HOD and University Level Committee by the Pro-Vice Chancellor. Department Level Committee will have initial jurisdiction over complaints against Continuous Evaluation and University Level Committee will hear appeals against Department level decisions. Complaints will have to be submitted to the Department concerned within two weeks of publication of results of Continuous Evaluation (CE) and disposed of within two weeks of receipt of complaint. Appeals to University Level Committee should be made within one month of the decisions taken by Department level Committee and disposed of within two months of the receipt of the complaint. Complaints unsolved by the University level Grievance Committee shall be placed before the Vice Chancellor.

TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Vice Chancellor shall for a period of one year (may be revised) from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any Programme with such modifications as may be necessary.

REPEAL

The Regulations now in force in so far as they are applicable to programmes offered in the University Departments and to the extent they are inconsistent with these regulations are hereby repealed. In the case of any inconsistency between the implemented regulations of Choice based Credit Semester System and its application to any independent Programme offered in a University Department, the former shall prevail.

CURRICULUM

Type	Credits	Credits			
		Semester 1	Semester 2	Semester 3	Semester 4
Core Course	30	9	9	9	3
Core Course: Wood Science Laboratory	4	2	2	-	-
Core Course: Wood Technology Workshop	11	3	3	3	2
Electives	16	4	4	4	4
Projects (Mini & Detailed) (Core Course)	8	-	-	1	7
Open Elective Course (Optional)	6	-			
Total Credits	75	18	18	18	16

Total Credits: 75

Core Courses: 53 (including Practicals / Workshops, Mini and Detailed Projects)

Elective : 16

Open Elective course (optional): 6

Grand Total: 75

COURSE STRUCTURE AND SCHEME OF EXAMINATION

SEMESTER 1

Sl N	Course Code	Course Title	Units			Marks			Credit
			L	T/S	P	ESE	CE	Total	
1	MSWST 01C01	Forestry and Dendrology	3	-	-	60	40	100	3
2	MSWST 01C02	Wood Structure and Identification	3	-	-	60	40	100	3
3	MSWST01 C03	Plywood and Composites	3	-	-	60	40	100	3
4	MSWST 01E01	Logging and Ergonomics	3	-	-	60	40	100	4
5	MSWST 01E02	Forest Management and Planning							
6	MSWST 01C04	Wood Science Laboratory I			6	60	40	100	2
7	MSWST01C05	Wood Technology Workshop I		2	1	60	40	100	3
Core : 14. Elective:4						600			18

SEMESTER 2

Sl. No.	Course Code	Course Title	Units			Marks			Credit
			L	T/S	P	ESE	CE	Total	
1	MSWST 02C06	Physical and Chemical Properties of Wood	3	-	-	60	40	100	3
2	MSWST 02C07	Wood Biodegradation and Preservation	3	-	-	60	40	100	3
3	MSWST 02C08	Wood Seasoning	3	-	-	60	40	100	3
4	MSWST02 E03	Reconstituted Wood Panels and Advanced Coatings for Wood Panels	3	-	-	60	40	100	4

5	MSWST 02E04	Wood Variation							
6	MSWST 02C09	Wood Science Laboratory II	-	-	6	60	40	100	2
7	MSWST 02C10	Wood Technology Workshop II		2	1	60	40	100	3
			Core :14. Elective:4						18
Open Elective Course									
1	MSWST 02O01	Wood and Climate Change mitigation	3	-	-	60	40	100	6

SEMESTER 3

SI N	Course Code	Course Title	Units			Marks			Credit
			L	T/ P	P	ESE	CE	Total	
1	MSWST 03C11	Adhesives for Plywood and Panel Products	3	-	-	60	40	100	3
2	MSWST 03C12	Pulp & Paper	3	-	-	60	40	100	3
3	MSWST 03C13	Wood Working and Wood Finishing	3	-	-	60	40	100	3
4	MSWST 03E05	Saw Milling and Saw Doctoring	3	-	-	60	40	100	4
5	MSWST 03E06	Wood Mechanics and Timber Engineering							
6	MSWST 03C14	Mini Project	-	-	1	60	40	100	1
7	MSWST 03C15	Wood Technology Workshop III		2	10	60	40	100	3
			Core: 13 Elective: 4						17

SEMESTER 4

Sl. No	Course Code	Course Title	Units			Marks			Credit
			L	T	P	ESE	CE	Total	
1	MSWST04 C16	Management Principles and Marketing of Wood Produce	3	-	-	60	40	100	3
2	MSWST 04E07	Statistical Methods and Computer Applications	3	-	-	60	40	100	4
3	MSWST 04E08	Production Management							
5	MSWST 04C17	Wood Technology Workshop IV	2	-	8	60	40	100	2
6	MSWST 04C18	Dissertation and Viva	14 hrs/week			60	40	100	7
		Core: 12 Elective: 4							16

Pattern of Credit Distribution

Total Credits: 75

Core Courses: 53

Elective Courses: 16

Open Elective Course: 6

SYLLABUS

SEMESTER 1

MSWST 01C 01: FORESTRY AND DENDROLOGY (54 hrs./Semester)

Module 1

Forests – definition, classification and brief description of forest types. Forestry – its scope and branches. 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 plantation. Trees outside forests (TOF). Forest plantations and CDM. Forest certification.

Module 2

Forest health and its management. Sustainable forest management. Social forestry and its role in timber production. Participatory forest management

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).

Module 4

Systematic positions and diagnostic features of important trees of 10 major timber producing families (Verbenaceae, Leguminosae, Dipterocarpaceae, Lythraceae, Meliaceae, Combretaceae, Ebenaceae, Salicaceae, Betulaceae, Pinaceae).

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

Sagwal, S.S. (2006): A Text book of Silviculture, Kalyani Publishers, India
Negi, S.S. (2000): Indian Trees and their Silviculture - Legumes, Bishensingh Mahendrapal Singh (publication), Dehradun, India.
Negi, S.S. (2000): Indian Trees and their Silviculture - Dipterocarpaceae, Bishen Singh Mahendrapal Singh (publication), Dehradun, 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.

MSWST 01C 02: WOOD STRUCTURE AND IDENTIFICATION (54 hrs. /Semester)

Module 1

Wood anatomy – an introduction. Softwoods and hardwoods – important species. Formation of wood - cambium & its derivatives: secondary growth. 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.

Module 2

General and physical features of wood: colour, lustre, odour, taste, weight, grain, texture, figure etc. Variability of anatomical structure: reaction wood, abnormal rings - false rings and discontinuous rings. Important characteristics employed for wood identification – handle features of wood – soft wood – hardwood; microscopic features of softwood and hard wood. Juvenile wood and its characteristics and importance.

Module 3

Defects in wood – Natural defects - knots, shakes, cross grain and other defects due to stress. Defects other than natural.

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 Reading:

- 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.
- Pijush Roy (2006): Plant Anatomy, New Central Book Agency(P) Ltd, Kolkata-India.
- Kollmann, (1968): Principles of Wood Science and Technology - Solid Wood First Volume (Photocopy), Springer-Verlage Publications, New York.
- 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 Dekkar Inc, 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
- Unger A. et.al., (2001): Conservation of Wood Artifacts- a handbook, Springer Publication, Germany
- Kollmann, (1968): Principles of Wood Science & Technology Volume I - Solid Wood, Springer-Verlage Publications, New York

MSWST 01C03: PLYWOOD AND COMPOSITES (54 hrs. /Semester)

Module 1

Introduction to veneering. Pre-treatment of logs prior to peeling and slicing. Steaming, boiling, and cooking of round logs, debarking and cleaning, methods of veneer production. Lathes - Lathes for small diameter logs - Telescopic spindle lathes. Peeling, slicing, clipping.

Module 2

Veneer drying – Types of veneer driers - Veneer matching.- Veneer jointing – splicing - adhesive applications - glue spreaders - assembly time- hot pressing- hydraulic multiday light presses. Defects in peeled veneers.

Module 3

Plywood- Principles of manufacture, composition with regard to veneer thicknesses and species. . Glue spreaders. Optimum glue spreads. Pre-pressing- Advantages of pre-pressing. Storage before pre-pressing/hot pressing. Assembly, Hot pressing - Hot Press design parameters recommended pressing time - sizing, trimming, thickening and

finishing. Compression in hot pressing. Defects in pressed plywood, their control and repair. Properties of plywood- elasticity and rigidity-tensile strength-compressive strength-bending strength-shear strength- hardness- Resistance against destruction - Preservative treatments of plywood.

Module 4

Laminated wood arrangements. Laminated Veneer Lumber(LVL). Glued laminated products- applications as structural composites.General information on production and properties of reconstituted wood. Sandwich Composites - Flush doors- block boards— manufacture- properties and applications. Compreg- production and properties - Reduction of global warming potential of wood products.

Suggested Reading:

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

Panshin, A.J. (1980): Textbook of Wood Technology (4th edition), Mc Graw-Hill Books, United State of America.

ParvizNavi & Sandberg,D. (2012)P: Thermohydro- Mechanical Processing of Wood, EPFL Press,Boca Raton, Florida.

Nath, S.K. Plywood Manufacturing Practices in India (Xerox)

MSWST 01E 01: LOGGING AND ERGONOMICS (54 hrs. /Semester)

Module 1

Brief overview of tree felling operations: rules and methods. Logging: definition and scope. Logging plan and execution. Location and demarcation of the area for logging. Marking of trees and estimation of produce available for extraction. Merchantable wood and cull volume estimation. Implements used in felling and logging operation; traditional and improved tools. Maintenance of various records and registers in logging operations. Conversion, measurement and description of converted material.

Module 2

Modern methods of timber transportation. Central and State rules relating to timber transit. Timber grading. Storage of timber: timber depots - depot management. Pricing, auctioning, E - auctioning or other types of marketing, allotment to industries, pricing etc. Measures to reduce wastage of wood in harvesting, storage and service.

Module 3

Wood based industries. Demand and supply of wood. Local and industrial consumption of wood. bamboos, reed bamboos, and sandalwood - resource base, availability, industrial utilization and end products.

Module 4

Ergonomics: definition, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition. Personal protective equipments, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids. Plants, animals and insect infestations; diseases and their management

Suggested Reading:

Chhabra T.N. & R.K.Suri, R.K. (2007): Industrial Relations- Concepts and Issues, Dhanpat Rai & Co (P) Ltd, New Delhi.

Timpeck, (2001): The International Timber Trade, Woodhead Publishing Limited, England.

MSWST01 E02: FOREST MANAGEMENT AND PLANNING (54 hrs. /Semester)

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 management.

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.

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.

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:

- Troup, R.S. (1921). The Silviculture of Indian Trees. Vol. II Clarendon Press, Oxford.
- Anon. (1984). 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. 3rd Edn. JAFCD, Surendrabag.
- White, T. (1967). A Conceptual Framework for the Tree Improvement Programmes. Martinus Nijhoff Publishers, Dordrecht.
- Chandan, J.S. (1987): Management Theory & Practice, Vikas Publishing House Private Ltd., New Delhi, India.
- Sill, Jr. W.H. (1982). Plant protection: An Integrated Interdisciplinary Approach. Iowa State University Press. Ames, Iowa.
- Gamble, J.S. (1922). A Manual of Indian Timbers. Sampson Low, Martson & Company, London.
- Kotler, P. *et al.*, (2009): Marketing Management (13th edition), Boring Kindersley Pvt.Ltd, Licensees of Pearson Education, India.
- Russel & Taylor, (2009), Operations Management (6th edition), John Willey & Sons, Wiley India Edition, India.
- Koontz, H. & Weihrich, H., (2008): Essentials of Management – An International Perspectives (7th edition), Tata Mc Graw-Hill Publishing Company Limited, New Delhi, India,
- Panneer R. Selavan, (2017): Production and Operations Management (3rd Edition), PHI Learning Private Limited, New Delhi, India.
- Upendra Kachru, (2007): Production and Operations Management (Text and Cases), Excel Books, New Delhi, India.
- Panneer R. Selavan, (2010): Production and Operations Management (2nd edition), PHI Learning Private Limited, New Delhi, India.

MSWST 01C 04: WOOD SCIENCE LABORATORY I (108 hrs. /Semester)

1. Herbarium collection of important timber yielding species for the understanding of its features of identification;
2. Field identification of important timber trees and its 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. Anatomical studies of reaction wood. Modern timber identification techniques.
6. Traditional and modern equipments/tools used in logging operations and their uses.
7. Instructions regarding maintenance of various records and registers in logging operations.
8. Conversion of felled trees into logs, poles, firewood, pulpwood etc.
9. Visit during the auction sale in the government timber depots;
10. Preparation of ergonomic check lists.
11. Determination of density of wood.
12. Determination of moisture content.
13. Preservative treatments of plywood.
14. Treatment of logs prior to peeling and slicing.

MSWST 01C05: WOOD TECHNOLOGY WORKSHOP I (12 hrs./week)

PLYWOOD TECHNOLOGY

I. Storage Yard

Wood species used for production of plywood and other wood based materials in the Western India Plywoods, Application of knowledge of Wood Anatomy learnt in theory, identification of species based on hand lens features ,

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, suggest treatment for protection of wood (Theory)

Seminar Topics- presentation and submitting report for evaluation

Discuss /report on

1. Timber measurements
2. The anatomical features of timber species used in WIP
3. The insects , termites identified from the logs
4. Recommendation of treatment to protect the logs
5. "Report on the appropriate information gathered from library for this seminar

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.

Seminar Topics- presentation and submitting report for evaluation:

1. Reasons for boiling the logs. Calculation for determination of time of boiling
2. Centering the logs for peeling and the benefits
3. "Report on the appropriate information gathered from library for this seminar
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

Seminar Topics- presentation and submitting report for evaluation

1. Rotary peeling of veneers
2. Veneer recovery to be discussed with the staff of WIP
3. To discuss on the Maintenance of peeling lathe carried out
4. "Report on the appropriate information gathered from library for this seminar
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, setting 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.

Seminar Topics- presentation and submitting report for evaluation

1. Presentation of the report slicing of veneers
2. "Report on the appropriate information gathered from library for this seminar

III. Plywood Processing (Dry End)

III. A 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

Seminar Topics- presentation and submitting report for evaluation

1. Principles of drying veneers and discuss how the veneer drying is different from wood seasoning
2. Discuss different types of dryers
3. Discuss the internal design details of WIP the dryers

III.B Glue spreading

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

Seminar Topics- presentation and submitting report for evaluation

1. Discuss the components of glue spreader
2. Type of elastomeric materials employed for the fabrication of rolls in roll coatings
3. "Report on the appropriate information gathered from library for this seminar

III. C 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, briquettes and briquetting machine. Identify the number of Plate and Column presses in the factory and report their construction.

Also identify Single-day light and multi-opening presses the important parts to be studied .Parts to be identified:

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'

Find out 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 for press damage and report

Study the time of pressing for different thicknesses. Calculation of time of pressing from theory

Seminar Topics- presentation and submitting report for evaluation

1. Discuss on each type of hydraulic hot presses in the WIP and the specifications of the presses. The student should cover all the presses.
2. Discuss on how the specific pressures are calculated
3. Discuss the plate and column presses and relative merits of each
4. Discuss on press deflection and damages that can be caused to the press
5. Discuss on the heating medium employed in different presses in WIP
6. Discuss on the need to have simultaneous closing press.
7. Discussion on the calculation of time of pressing in hydraulic hot press
8. "Report on the appropriate information gathered from library for this seminar

III D. Trimming and sanding

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

Seminar Topics- presentation and submitting report for evaluation

1. To discuss on sanding machines and the different types of abrasives used
2. "Report on the appropriate information gathered from library for this seminar

III E. Workshop practice

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

Seminar Topics- presentation and submitting report for Plywood

1. Discuss the workshop practice carried out

2. "Report on the appropriate information gathered from library for this seminar

III F. Sawmill operation,

Studying the timber yard and layout of log unloading, stacks, movement of mechanical log loaders and transport of logs to the mill. Spraying prophylactic preservatives and end coating of logs for protection against bio-degradation Sawmilling equipment, record their capacities and specifications, log chain saws, band saws, circular re-saw, circular cross-cut saw, Study and record Saw doctoring-saw blade geometry, measurement of clearance, sharpness and hook angles and pitch Study and report Gullet capacity, peripheral linear saw speed, feed speed, bite Measurement of yield of converted timber. Identify defects of representative log based on Hoppus and true log volume measures. Finger joining technique- machine for producing fingers and jointing using cold setting adhesive.

Seminar Topics- presentation and submitting report

1. Discuss different machines employed in saw mills
2. Discuss finger joining machine and report on the tensile strength of normal and the finger jointed timber
3. "Report on the appropriate information gathered from library for this seminar

III G. 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.

III H. Preservative treatment

Testing of efficacy of preservatives in the laboratory and field conditions Hot and cold bath diffusion treatment. Calculation of voids for estimating maximum absorption. Impregnation of wood panels with vacuum and pressure.

IV. Boilers and Briquetting plant

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

SEMESTER 2

MSWST 02C06: PHYSICAL AND CHEMICAL PROPERTIES OF WOOD (54 Hrs. /Semester)

Module 1

Physical properties of wood: colour, odour, lustre, fluorescence, weight and density, specific gravity, moisture content variations and their practical significance.

Module 2

Electrical, piezo-electrical, optical, acoustical and thermal properties of wood. Wood-water 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.

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; Important factors affecting the strength of wood-inherent characteristics-growth conditions, tree age etc.

Module 4

Chemical composition and analysis of wood. Chemistry of wood-cell wall components, cellulose, hemi-cellulose, pectin and lignin; extractives, organic and inorganic materials. Their impact on the various strength properties.

Module 5

Structure and ultrastructure of wood –anatomical aspects-ultrastructure of cell walls.
Chemistry of wood and bark extractives. Extractive of heartwood and softwood. resin-
fats and waxes-Tall oil.

Suggested Reading:

Dinwoodie, J.M. (2000): Timber: Its Nature and Behaviour(2nd edition),E&FN Spon, London.
Hon,N.S.D & Shirashi, N.(ed.),(2001): Wood and Cellulosic Chemistry (2nd edition), Marcel Dekkar Inc
Publications ,New York.
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.
Smith,I *et.al.*,(2003): Fracture and Fatigue in Wood, John Wilog & Sons Ltd, England
Kollmann,(1968): Principle of Wood Science and Technology I, Springer-Verlage Publications, New York.
Unger , A. *et.al.*,(2001): Conservation of Wood Artifacts - a Handbook, Springer Publication ,Germany.
Fengel,D. & Wegener,G.,(1984): Wood Chemistry, Ultrastructure, Reaction, Walter de Gruvter & Co.,
New York.

MSWST 02C07: WOOD BIODEGRADATION AND PRESERVATION (54 hrs./Semester)

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. Control measures against wood boring insects. Nature of damage - Galls, cankers etc. Wood attacking termites. Identification, life history and distribution of major and minor wood destroying termites associated with forest and in building structures. Termite control measures.

Module 2

Ecology of microbial invasion of wood. 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. Classification of wood attacking decay fungi. Bacterial decay of wood; symptoms and causes. Detection of wood decay: destructive

and non-destructive methods. Symptoms and effects of wood decay. Decay in buildings. Heart rot in standing timber, management of timber with heart rot.

Module 3

Natural decay resistance of timbers and its evaluation, causes of decay resistance. 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.

Module 4

Importance of wood preservation. Natural durability: Durability of heartwood and sapwood, causes for natural durability, classification of timbers on the basis of natural durability, methods of determination of natural durability. Types of wood preservatives. Merits and demerits of different preservative compositions in relation to end use. Bio-degradable preservatives. Requirements of an ideal preservative. Testing of the efficacy of preservatives under laboratory and field conditions. Preservatives/preservative materials toxic to various bio-degrading agents - their toxicity levels.

Module 5

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, Boucherie treatment and Osrose treatment for green timber. New generation-eco-friendly preservatives. Advanced methods of wood preservation

Suggested Reading:

Olaf Schmidt, (2006): Wood and Tree Fung- Damage, Protection &Uses, Springer Publication ,Germany.
Goodell,B.*et.al.*(ed.),(2003): Deterioration Wood and Preservation – Advanced in Our Changing World, American Chemical Society, Washington.
John C.F. Walker,(2006): Primary Wood Processing- Priciples and Practices (2nd edition), Springer Publication, Netherland.
Kollmann,(1968): Priciples of Wood Science & Technology, Volume I - Solid Wood, Springer-Verlage Publications, New York.

Thompson R (ed.),(1991): The Chemistry of Wood Preservation, Royal Society of Chemistry (publication), Cambridge.

Martin R Speight & Ross F Wylie (2001): Insect Pest in Tropical Forestry – CABI Publishing, United Kingdom.

Dennis Allsopp *et al.*,(2004): Introduction to Biodeterioration(2nd edition),Cambridge University Press, New York.

George M Hunt & George A Garratt, (1967): Wood Preservation (3rd edition) MC Graw Hill Book Companies, United State of America.

Issac Ishawya, *et al.*,(2012) : Advanced Technologies for Managing Insect Pests, Springer-Verlage Publications,New York, London.

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.

Rose F. *et al.*,(2011): Insect Pest in Tropical Forestry (2nd edition),CABI Publishing, United Kingdom.

Ladislav Reinprecht, (2016): Wood Deterioration, Protection and Maintenance, Wiley Blackwell Publication, United Kingdom.

MSWST 02C08: WOOD SEASONING (54 hrs. /Semester)

Module 1

Objectives and importance of wood seasoning. Fundamentals of wood - water relationship. Protection of logs, protection of green sawn timber from fungal stains, insect attack and chemical stain. Prevention of end cracks and surface checks. Recommended moisture content of seasoned timber for different end uses in different climatic zones. Basis of the recommendations.

Module 2

Factors affecting drying rate of timber - thickness, moisture content, temperature, relative humidity and velocity of the drying air, diffusion and permeability characteristics of the species (form of moisture gradients in the timber section), sapwood and heartwood.

Module 3

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.

Module 4

Classification of Indian timbers according to refractoriness to seasoning: Air seasoning: Stacking practice for poles, posts, railway sleepers and sawn timber.

Module 5

Air seasoning sheds. FAN-AIR drying. Kiln seasoning - kiln drying schedules.

Kiln operation: Measuring instruments of different types for temp., relative humidity and air velocity. Selecting material for kiln samples, maintenance of steam traps. Seasoning kilns: General design features and specifications. Heating (steam, hot water, heated mineral oil, direct/indirect heating by wood or gas-fired furnace, 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. Boiler capacity required, kiln heat losses and energy efficiency data. Consumption of different types of fuel.

Module 6

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 drying in vapour with heat recovery, vacuum drying in RF field etc. Comparative economics: Air seasoning, steam heated & solar kilns. Special seasoning methods & pretreatments: (High temperature drying, press drying, chemical seasoning.),

Suggested Reading:

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): Principles of Wood Science & Technology- Volume I - solid Wood, Springer-Verlage Publications, New York

Betts, H.S. (1970). Timber its Strength, Seasoning and Grading. McGraw-Hillbook

Keey,R.B. *et.al.*,(2000): Kiln- Drying of Lumber, Springer-Verlage Publications, Germany.

MSWST02E03: RECONSTITUTED WOOD PANELS AND ADVANCED COATINGS FOR WOOD PANELS (54 hrs. /Semester)

Module 1

Particleboard - definition- types – raw materials - wood and other lingo-cellulosic materials - adhesives- additives- General technology - particle preparation-drying- of chips - size separation and storage of chips. Chip blending – mat lay up- pre-pressing- hot pressing- multi-daylight presses-extruded particleboards- Properties of particleboards - factors affecting the properties-density-moisture content-modulus of elasticity- modulus of rupture-internal bond strength in dry state and after accelerated aging test methods and end uses

Module 2

Fibreboard- definition- types- raw materials and their preparation- wet and dry process - Pulping- chemical and mechanical pulping- Thermo-mechanical pulping- Asplundsdefibrator method- wet process of manufacture of hardboard - mat formation - hot pressing – press cycles. Oil tempering. Dry process of hardboard. MDF- Raw materials- wood & lingo-cellulosic agricultural residues. Testing methods and end uses

Module 3

Advanced coatings for wood panels- Coatings definition- composition of coatings- Film forming resins/binders. Binders based on amino resins- Melamine formaldehyde resins (MF) - reactions with Urea-formaldehyde resins, urethanes- and alkyds in coatings.

Module 4

Drying oils - composition of natural oils- drying, semi-drying and non-drying oils. Autoxidation and cross-linking- non-conjugated and conjugated drying oils.

Module 5

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

Module 6

Environmental impact of coatings. Environmentally friendly coatings. High solids coatings, Radiation curable coatings - Powder coatings. Nanotechnology-inorganic-organic hybrid materials - sol-gel route – scratch resistant coatings. Film defects. Mechanical properties- Abrasion and mark resistance- Measurement of mechanical properties.

Suggested Reading:

Parviz Navi & Dick Sandberg, (2012): Thermohydro-Mechanical Processing of Wood, EPFL Press, Boca Raton, Florida, .

Manfred Bock, (2001): Polyurethanes for Coatings, Curt R. Vincentz Verlag, 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.

MSWST 02E04: WOOD VARIATION (54 hrs. /Semester)

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.

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.

Module 3

Seed production. Seedling seed orchard, clonal seed orchard. Mass multiplication, clonal propagaton, Evaluation and screening, genetic testing program-experimental designs. Tree improvement trial, advanced generations and continued improvement. Gene transfer, genetic markers, DNA finger printing. 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.

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:

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

Bruce, J. Zobel, Johannes, P. van Buijtenen (1989). Wood variation: Its causes and Control Springer-Verlag Publishers.

Bruce, J. Zobel, Jackson B. Jett (1955). Genetics of Wood production. Springer-Verlag Publishers.

Mandal, A.K. (2008). Forest genetics and tree Breeding, CBS Publishers and Distributors.

Namkoong, G., H.c. Kang, J.S. Brouard (1988). Tree Breeding: principles and Strategies. Springer-Verlag Publishers.

Bedell, P.E. (1998). Seed science and technology : Indian Forestry Species. Allied Publishers.

MSWST02C09. WOOD SCIENCE LABORATORY II (108 hrs. /Semester)

1. Marking and conversion of wood into small clear specimens for testing
2. Test for mechanical properties of wood - Static bending, impact bending, compression parallel and perpendicular to grain, hardness, shear, torsion, nail and screw pulling test, brittleness test and calculation of properties;
3. Extractive content analysis of wood sample; Isolation of pure chemical constituents using thin layer and column chromatography;
4. Life cycle of some important insects of forest and plantation origin; Insect control techniques;
5. Seasoning schedule for important timber species; Identification and measurement of different seasoning defects in wood and their evaluation;
6. Visits to paper testing labs/industries and seasoning kilns
7. Visit to seed orchards- seedling seed and clonal seed orchards, Hybrid evaluation techniques

MSWST02C10. WOOD TECHNOLOGY WORKSHOP II (12 hrs./week)

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,

Seminar Topics- presentation and submitting report for evaluation

1. Deterioration of chips during storage, identification of deteriorating organisms in the field (field examination)
2. Cleaning and chip washing system
3. Report on the appropriate information gathered from library for this seminar

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,

Seminar Topics- presentation and submitting report for evaluation

1. Presentation of details of rotating knives. Frequency of change of knives due to dulling of knives
2. Grain direction of the chips of the desired size. Report on the screen analysis
3. "Report on the appropriate information gathered from library for this seminar

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

Seminar Topics- presentation and submitting report for evaluation

1. Presentation of functioning of disk refiners
2. Refiner plate profile as used in WIP and compare the same with other types .
The photograph of the disk plates should be presented. The specifications of the material of construction should be reported.
3. "Report on the appropriate information gathered from library for this seminar

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 .

Seminar Topics- presentation and submitting report for evaluation

1. Report on adjusting of the gap between the disks by adjusting the pressure differential by oil hydraulic piston
2. Report on the profiled segments.
3. Report on the conical horizontal screw feeder functioning, compression ratio, spline
4. Report on the disturbances that can be caused by variation in the raw material composition, wear of refiner plates and other known and unknown causes.
5. "Report on the appropriate information gathered from library for this seminar

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

Seminar Topics- presentation and submitting report for evaluation

1. Discuss the importance of level control provided in the pre-heater
2. Report the refiner motor power
3. "Report on the appropriate information gathered from library for this seminar

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

Seminar Topics- presentation and submitting report for evaluation

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

Seminar Topics- presentation and submitting report for evaluation

1. Discussion on Fourdrinier machine, construction, functioning, various parts, dewatering action. Trimming of wet mat.
2. "Report on the appropriate information gathered from library for this seminar

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-squeeze, low pressure drying and consolidation phase

Seminar Topics- presentation and submitting report for evaluation

1. Discussion on press construction, fast closing type, heating medium, press cycle
2. "Report on the appropriate information gathered from library for this seminar

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

III. G 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 refractoriness in seasoning.

Seminar Topics- presentation and submitting report

1. Discuss on classification of Indian timbers according to refractoriness in seasoning and Identification of seasoning defects (based on field examination)
2. Discuss on the principle of dry bulb and wet bulb temperatures
3. "Report on the appropriate information gathered from library for this seminar

Kiln seasoning: Stacking practice, kiln drying schedules (IS: Specifications). Optimum drying conditions to control at different critical stages. Modification of schedules for higher thickness, lower initial moisture contents. Removal of case hardening. Reverse case hardening. Seasoning kilns- general design features. Heating (steam, hot water, oil,. 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,

Seminar Topics- presentation and submitting report

1. Discuss the Kiln seasoning chambers
2. Discuss the kiln seasoning schedule
3. Report on the appropriate information gathered from library for this seminar

XI Solid waste management

Wastes: Kinds of solid wastes –classification –What makes a waste hazardous? –What are the dangers? –Sources of wastes – Effects of waste if not manages wisely –What should be done –Objectives of SWM Systems, Basic components: -Collection – Transportation –Disposal technologies available –Composting –Incineration – Pelletisation –Pyrolysis –Biomethanation -Landfill gas recovery, Composting –Concept –Process – Types of composting – Aerobic –Anaerobic - Vermicomposting
Vermicomposting 1.Earthworms 2.Methods- Pit below the ground -Heap above the ground - Tank above the ground - Cement ring - Commercial model 3.Nutritional composition 4. Benefits

Seminar Topics- presentation and submitting report

- (1) To discuss the basic principles involved in composting
- (2) To discuss on the various microorganisms involved in the conversion process.
- (3) To discuss on the bio-deterioration and bio-degradation
- (4) “Report on the appropriate information gathered from library for this seminar

OPEN ELECTIVE COURSE

MSWST02001: WOOD AND CLIMATE CHANGE MITIGATION (54 Hrs. /Semester)

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.

Module 2

Trends in wood markets and forests- Global market for wood products and links to forest production.Underlying global trends in the use of industrial wood.Changing patterns of forest cover and the production of industrial wood.Sustainability issues relating to different product types.

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

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 Reading:

IUCN (2016). Making the Case for Forest restoration- A Guide to Engaging Companies. Glands, Switzerland, IUCN

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.

William Nikolakis, John Innes (2014). Forest Globalization: Challenges and Oppertunitiesfor Sustainable development. Routledge, Taylor and Francis Group.

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

SEMESTER 3

MSWST 03C11: ADHESIVES FOR PLYWOOD AND PANEL PRODUCTS (54 hrs. /Semester)

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

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. Stresses in glued joints

Module 3

Chemistry, application, properties and classification of adhesives. Phenol-formaldehyde adhesives; Resoles and novolacs; resorcinol-formaldehyde adhesive. Hydrolysis, polymerization and pH changes causing degradation of glue joints.

Module 4

Description of substituted phenol-formaldehyde resins, PRF adhesives, melamine – formaldehyde adhesives and MUF adhesives. Epoxy resins; polyamine hardeners; polyurethanes. Polyvinyl acetate glues and applications-

Module 5

Electrical grade phenolic resins, CNSL-Phenol-formaldehyde adhesives- Tannin based adhesives. Hot melt adhesive –raw materials- manufacture. Fillers and extenders for UF and PF. Phenolic and amino resins in other areas of applications. Testing of adhesion bonds.

Suggested Reading:

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

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

Manfred Bock,(2001): Polyurethanes for Coatings, Curt R.Vincentz Verlag Germany
Philippe Cognard (Ed.), (2006): Adhesive and Sealants; General Knowledge, Application
Techniques, New Curing Techniques Vol-2, Elsevier Ltd Publications, The Nether land
Marrion, A.(Ed.),(2004),The chemistry and physics of coatings(2nd edition), The Royal
Society of Chemistry, Cambridge, United kingdom.

MSWST 03C12: PULP AND PAPER (54 hrs. /Semester)

Module 1

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

Module 2

Bleaching of pulp: Principles of bleaching- bleaching chemicals- Stages of bleaching – Important parameters of bleaching. Bleaching equipments- . 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.

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.

Module 4

Stock preparation. Loading of fillers - types, properties and efficiencies 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.

Module 5

Overview of paper machines, dry and wet ends, stock and water systems, related machinery. Basic Lab measurements - 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- types of machines used, principles of operation and control, properties and applications of coated papers.

Suggested Reading:

Shirashi, N.(Ed.),(2001): Wood and Cellulosic Chemistry(2nd edition), Marcel Dekkar Inc, New York.

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.

John C.F. Walker,(2006): Primary Wood Processing- Principles and Practices(2nd edition), Springer Publication, The Netherland.

Britt, K.,(Ed.),(1984): Hand Book of Pulp and PaperT(2nd edition), CBS Publishers & Distributers, New Delhi, India.

Henrikson, G. (Ed.),(2009): Pulp and Paper Chemistry & Technology Vol I, Wood Chemistry & Biotechnology, Walter de Gruvter &Co., Berlin.

Henrikson, G. (Ed.),(2009): Pulp and Paper chemistry Technology Vol-3, Walter de Gruvter GmbH & Co.,Berlin.

Kennedy J.F. *et.al.*,(2000): Cellulosic Pulps Fibers and Materials, Wood Heading Publications Limited, England.

Sudhir, M.(2013): Forest Biotechnology, Wisdom Press Publication,New-Delhi, India.

Han Ulrich Suess, (2010): Pulp Bleaching Today, Walter de Gruvter GmbH&Co.,Berlin,Newyork

Mark J Kirwan(Ed.),(2013): Hand Book of Paper and Paper Board Packaging Technology(2nd edition),John Willey & Sons Ltd,England.

Bajpai, P.,(2015): Pulp and Paper Industry : Microbiological Issues in Paper Making, Elsevier,Inc,United State of America.

Bajpai,P.,(2018): Biermanns's Handbook of Pulp and Paper: Paper and Board making Vol 2 (3rd edition), Elsevier Inc. Publications, Nether lands.

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

MSWST 03C13: WOOD WORKING & WOOD FINISHING (54 hrs.

/Semester)

Module 1

Introduction to various wood working industries and operations- planning, thicknessing, mortising, tenoning, rebating, grooving, moulding and shaping, turning, drilling, carving, sanding etc.

Module 2

Essential principles of operation. General features, specifications and design of machines; planer, thicknesser, mortiser, tenoner, moulder, router, turning lathe, drill, etc. Cutting speed of cutter/tool, feed speed, feed mechanism of machines. Advanced woodworking machines.

Module 3

Various working defects; their occurrence in Indian woods and remedies. Moisture related problems in wood working. Method of assessment- ease of working based on energy consumption and assignment of quality ratings for important basics operations; computation of composite working quality index for the species.

Module 4

Elements of basic joinery. Wood working joints. Furniture designs. Knock-down and ready to assemble panel furniture. Bent-wood furniture. Glues recommended for furniture and joinery. Ergonomic considerations in furniture design.

Module 5

Knife geometry. Automatic knife sharpening machine. Tungsten carbide tipped cutters. Figure in wood occasioned by growth increments, nature of woody tissues, radial or tangential cut, grain, uneven infiltration of colouring material, etc.

Module 6

Finishing qualities of Indian woods. Filling, staining and sanding before application of surface coatings. Compositions used. Water based, spirit, oil & NGR, pigment oil and chemical stains. Opaque and clear finishes. Penetrating and non-film forming finishes. Figure and color upgrading by ammonia fumigation and use of natural dyes.

Suggested Reading:

Kollmann,(1968): Principles of Wood Science & Technology- Volume I -Solid Wood, Springer-Verlage publications, New York

Miller, M.R. *et al.*, (2004): *Carpentry and Constructions* (4th Edition), The McGraw-Hill Companies, United States of America.

The Landersson, S. & Larsen, H.J., (2003): *Timber Engineering*, John Wiley & Sons Ltd,

Gupta, R.S., (2011): *Principle of Structural Design Wood, Steel and Concrete*, CRC Press, New York.

Khurmi R.S. & Gupta, J.K. (1981), *A Text Book of Workshop Technology (Manufacturing Processes)*, S.Chand & Company Ltd, New Delhi, India.

Feirer, J.C., (1994): *Wood Technology & Processes* (4th Edition), Glencoe MC Graw-Hill Publications, Peoria.

MSWST 03E05: SAW MILLING AND SAW DOCTORING (54 hrs. /Semester)

Module 1

Wood based industry - Saw mills - types, requirements and layout. Saw mill improvement programme. Timber log yard and its management. Layout comprising space of logs unloading, log stacks, movement of mechanical log loaders/stacker and transport of logs to sawmill. Measures for yard hygiene. Hoppus rule and true volume method for measurement of logs. Smalian's formula, Newton's formula and Huber's formula for volume estimation. Economic conversion of logs. Conversion terms for sawn timber: Baulks, waney baulks, half baulks, hakries, poles, beams, scantlings, blocks, planks etc.

Module 2

Sawmilling: Saw milling equipments, their capacities and specifications. Log chain saws, Horizontal band mill, Vertical band saw benches, Circular re-saws, Circular cross cut saws. Log scanners and computerized BOF system. Sawing equipments for small-girth logs. Gantry equipment for loading/unloading of logs on machines.

Module 3

Modern developments and innovations in saw milling. Degree of automation and mechanical feeds available in indigenous and imported saw mill equipment.

Module 4

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, leveling, straightening, brazing, setting and tempering of saw blades. Automatic/Semi-automatic saw doctoring equipment.

Suggested Reading:

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.

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

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

MSWST03E06: WOOD MECHANICS AND TIMBER ENGINEERING (54 hrs. /Semester)

Module 1

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.

Module 2

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.

Module 3

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. Strength properties and design of structural timber joints, conventional vs new types. Linear structural components: Beams, Ties, Purlins, Columns, Joints. Trusses & arches—Configuration, analysis of simply supported 2 hinged , 3 - hinged types. Timber Lamellas' & timber flooring.

Module 4

Web type girder, composite construction, stressed skin construction, rigid frames, shells, transmission line towers etc. Glue laminated linear and curved structures, shear strength, analysis and design. Design of low cost structures; principles involved in destruction resistant timber structures.

Suggested Reading:

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.

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

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

MSWST 03C14. MINI PROJECT (36 hrs./Semester)

Module 1

Introduction to web browsing, E-Journals, E-books, digital library, soft wares and search engines with special reference to wood science and technology. Data entry and verification Research Methodology – introduction - Motives and benefits of doing research. Basic and applied research. Methods of sampling - experiments and surveys. Experimental designs. Collection of qualitative and quantitative data.

Module 2

Fixing the objective of research. Statistical analysis - Tests of hypothesis, drawing inference. Preparing diagrams and charts. Validation and correction of data and results. Documenting and reporting research results .Preparation of Project Report - structuring,

content validation, acknowledgement, Reference citation - styles .Tips for technical writing. Tools and tips for effective communication.

Module 3 (Practical Session)

1. Familiarization with internet and search engines
2. Computer-aided literature search - Familiarization of important databases relevant to the field of wood science & Technology
3. Structure of a research report
4. Exercises on citing and listing references
5. Exercises on processing of data and illustrations
6. Formulation of a research project
7. Common errors in technical writing

MSWST 03C15. WOOD TECHNOLOGY WORKSHOP III (12 hrs./Week)

Adhesives, Speciality Wood Products such as moulded products and compreg .Production of Surface Coatings and Surface Enhanced Panel Products (WIPLAC), Paper impregnation plant. DAP Plant

I Production of phenolic and amino resins

- (a) To study the formulations of producing general purpose alkali catalysed PF resin and ammonia catalysed PF resin. Study the exothermic process and find out how the temperature is controlled. Following up the degree of conversion with Ford Cup viscometer.
- (b) Manufacture of ammonia catalysed alcohol soluble PF resin for electrical grade compreg.
- (c) Determination of water tolerance, solid content. Preparation of 1 square foot board for testing the adhesive strength.
- (d) To produce UF resin. Determine the solid content. Formulation of hardener for WWR grade plywood.
- (e) To produce Resorcinol-formaldehyde resin
- (f) Experimental Prepare 1 square foot WWR grade plywood and test for glue shear.
- (g) "Report on the appropriate information gathered from library for this seminar

II Speciality resins: DAP and Unsaturated polyester(UP) resin.

DAP and UP resins and the various equipments such as high temperature reaction vessel for preparing DAP monomer, polymerizer for pre-polymer, solid-liquid and liquid-liquid separation equipment, bucket, tubular and disk centrifuges. Mixing equipment such as ribbon blender, sigma blender, two-roll mill, granulators, drying of DAP granules. Steam jet ejector for vacuum distillation, Calendra evaporator.- Compression and transfer moulding presses. DAP molding powder spiral flow testing. Special characteristics of DAP and applications- Study the operation of paper impregnation plant and lamination of the impregnated paper (overlying) on shuttering plywood.

Seminar Topics- presentation and submitting report for evaluation

To discuss on:

- (a) the manufacture of PF .Exothermicity and control
- (b) the manufacture of UF and hardener
- (c) the manufacture of ammonia catalysed resin and its special characteristics
- (d) the manufacture of DAP monomer, prepolymer, moulding compounds. Various separation equipment. Special characteristics of DAP and application
- (e) Paper impregnation and overlying on shuttering plywood. plywood
- (f) "Report on the appropriate information gathered from library for this seminar

Practical

- (a) Determination of phenol
- (b) Determination of formaldehyde
- (c) Determination of solid content of PF and UF

III Compreg production

Impregnation with both normal PF and ammonia catalysed PF. Study the impregnator, make a drawing of the internal parts. Observe how vacuum is applied. Write down the units of vacuum. Study the drying schedules - Study the pressing of compreg in high pressure hydraulic hot press. Study and report the design and functioning of the high pressure press. Learn how the specific pressures are determined. The pressing schedule for producing compreg

Manufacture of moulded wood products by cold pressing technique as well as hot pressing by employing steam and low voltage high amperage heating systems, Determination of Physical Mechanical and Electrical properties of wood products

Indian standardization organization BIS. Studying all the BIS specifications pertaining to wood and wood products Universal testing equipment for determination of MOR.MOE in the tensile and bending modes. Impact testing equipment for impact resistance of wood products. Fire resistance tests. Electrical testing of wood products for high voltage resistance (Dielectric strength)

Seminar Topics- presentation and submitting report for evaluation

- a. Pressure vacuum impregnation of veneers. Explaining the vacuum and pressure levels employed
- b. High pressure hot presses
- c. Moulding of wood products by cold and hot pressing techniques. Clamping facilities
- d. "Report on the appropriate information gathered from library for this seminar

IV Compreg Machine shop

To study the machining of compreg to convert to a number of products by using pattern millers and routers

V. Production of surface coatings

To get acquainted with the production of base coats, filler coats, printing of wood grains, UV curable top coats. The equipment such as high speed dissolver and pearl mill,.

Coating sequence requires to be studied. The functioning of planer for calibration, application of filler coat by reverse roller coater, drying of base coat, Printing wood grains. Application of top coat by precision roller coater/ curtain coater, UV curing

Seminar Topics- presentation and submitting report for evaluation

1. To discuss the functioning of reverse roller coater, precision roller coater and curtain coater
2. To discuss on UV curable coatings
3. "Report on the appropriate information gathered from library for this seminar

VI Paper Impregnation plant

To observe impregnation of paper with phenolic resin. Drying by jet of air from top and bottom to provide a cushion. The dried resin (B-stage) is laminated on plywood.

Seminar Topics- presentation and submitting report for evaluation

1. Discuss the basic principle of PF impregnated overlaying paper

- 2.
3. "Report on the appropriate information gathered from library for this seminar

VI Furniture Unit

Students should study the machines used in the furniture factory and all the operations involved in furniture production. Students should refer to the journals in the library and a number of furniture designs are published. Students should study them and apply the creative designs and fabricate the furniture in the furniture factory

Seminar Topics- presentation and submitting report for evaluation

1. "Report on the appropriate information gathered from library for this seminar on the design of furniture which could be fabricated in the furniture unit.

SEMESTER 4

MSWST 04C16.MANAGEMENT PRINCIPLES AND MARKETING OF WOOD PRODUCE (54 hrs. /Semester)

Module 1

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.

Module 2

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. Demand forecasts. Price determination in timber.

Module 3

Economic features of specialized markets in terms of degree and type of competition in buying and selling, price spread, costs of marketing functions involved like pre-

commercial thinning, commercial thinning, harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in teakwood, rosewood, matchwood, pulpwood, sandalwood, veneers;

Module 4

Type and degree of competition in market for services of saw mill and other intermediate wood processing industries, price spreads across different channels of marketing. Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce. Market inefficiencies in timber, non-timber forest produce and measures to check in efficiencies. Essentials of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and Timber Certification.

Suggested Reading:

Kotler, P. *et al.*, (2009): Marketing Management (13th edition), Boring Kindersley Pvt. Ltd, Licensees of Pearson Education, India.

Russel & Taylor, (2009), Operations Management (6th edition), John Wiley & Sons, Wiley India Edition, India.

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 Mc Graw-Hill Publishing Company Limited, New Delhi, India,

MSWST 04E07: STATISTICAL METHODS AND COMPUTER APPLICATIONS (54 hrs. /Semester)

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.

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. Multiple regressions. Test for significance of regression coefficients.

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.

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 Reading:

Bulmer, M.G. (2012). Principles of Statistics. Courier Corporations.
Narayanan, N.E. (2015). Statistics. PHI Learnings Pvt. Ltd.
Rangaswamy, R. (1995). A Textbook of Agricultural Statistics. New Age International Publishers, New Delhi.
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 2007 Bible, WileyIndia Pvt. Ltd. New Delhi.

MSWST04E08: PRODUCTION MANAGEMENT (54 hrs. /Semester)

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 processes, manufacturing and service operations-classification of manufacturing processes-product design and process design

Module 2

Plant location and layout-nature-Location theories-Steps in location-Location models-Plant layout—Factors influencing lay out-Principles of lay out-Layout tools and techniques- Materials handling principles.

Module 3

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.

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 Reading:

Panneer R. Selavan, (2017): Production and Operations Management (3rd Edition), PHI Learning Private Limited, New Delhi, India.

Upendra Kachru, (2007): Production and Operations Management (Text and Cases), Excel Books, New Delhi, India.

Panneer R. Selavan, (2010): Production and Operations Management (2nd edition), PHI Learning Private Limited, New Delhi, India.

MSWST04C17. WOOD TECHNOLOGY WORKSHOP IV (12 hrs./week)

Introduction: Raw materials - classification- selection- sources—storage- debarking- chipping- screening of chips- types of screens- chip classification- analysis- conveying of chips- chip storage. Pulping processes: Types- principles and details of processes-

properties of pulp- cooking processes. Washing and screening of pulp: principles of washing- types of washers - presses- screening and cleaning of pulp- types of cleaners and screeners.

Bleaching of pulp: Principles of bleaching- bleaching chemicals- stages of bleaching important parameters of bleaching- bleaching equipments- preparation of bleaching chemicals.

Chemical recovery: Black liquor-properties- evaporation: working principles, types - boiler and furnace: types, function- efficiency and steam economy, boiler feed water properties. Causticizing: Functions, batch and continuous processes, green liquor classification and sludge removal of white liquor, classifiers and washers, operating techniques, make up chemicals, Zeolite process, demineralization process.

Effluent treatment: Physical and chemical nature of effluents and their treatment- pollution control and norms, chemicals used in effluent treatment- air pollution and control.

History of paper; Pre- treatment for paper making: Stock preparation; Loading of fillers : types, properties and efficiencies of fillers, effect on paper properties

Sizing: types of sizing, materials used, mechanism of sizing, effect of paper properties; Additives: types, wet strength resins and their effect on strength properties, flocculants, biocides and their effects, synthetic fibers, improvement of dry strength by synthetic polymers; Color and Pigments: dyes, optical whiteners, types and properties, effect on paper, shade matching, color mechanism, retention aids.

Paper making: Introduction to paper making, overview of paper machines, dry and wet ends, stock and water systems, related machinery ; Wet end colloid chemistry, retention performances ; Deposit control in paper making : problems and control;

Basic Lab measurements: experimental methods, liquid –mass balance, paper machine operation; Fourdrinier paper making; Twin and multiple paper making. Pressing: types of presses, pressing operation variables; Drying : theory, systems, plant and equipment; Surface sizing : characteristics of materials used, surface preparation, sizing application, properties of sized papers; Coating: types and properties, types of coating machines and principles of operation; Calendaring and Super Calendaring: types of machines used, principles of operation and control, properties and applications of coated papers

MSWST 04C18. DISSERTATION AND VIVA (14 hrs. / Week)

Module 1

Research Methodology – introduction - Motives and benefits of doing research. Methods of research - Basic and Applied. Collection of qualitative and quantitative data. Methods of sampling - experiments and surveys. Experimental designs. Case studies. Action research. Participatory research.

Module 2

Fixing the objective of research, research hypothesis and time and venue of research. Research management - Manning the research and building the research infrastructure. Collection and analysis of data. Statistical analysis - Tests of hypothesis, Drawing inference. Data entry and verification. Use of Statistical packages - Packages for Statistical investigation and Social Sciences. Preparing diagrams and charts. Validation and correction of data and results. Importance of safe storage of data and results. Documenting and reporting research results .Preparation of research papers - structuring, content validation, acknowledgement, etc. Reference citation - styles .Tips for technical writing. Public presentation of research results . Tools and tips for effective communication. Preparation of slides - Conventional methods, Computer Aided presentations - Power of Power point.

Module 3 (Practical Session)

8. Use of Library - Familiarization with various features of library.
9. Familiarization with internet and search engines
10. Computer-aided literature search - Familiarization of important databases relevant to the field of wood science & Technology
11. Paraphrasing in the context of plagiarism
12. Structure of a research paper
13. Structure of a thesis
14. Exercises on citing and listing references
15. Exercises on processing of data and illustrations
16. Formulation of a research project
17. Presentation of scientific papers
18. Common errors in technical writing

First Semester M.Sc. Degree (CCSS – Reg./Suppl.) Examination

WOOD SCIENCE AND TECHNOLOGY

MSWST 01 C01 FORESTRY AND DENDROLOGY

SECTION –A

Answer any 5 questions (3marks)

Module 1

1. Describe the importance of forest certification
2. Discuss the classification of forest based on the basis of object of management
3. Discuss the major types of forest in India
4. Explain Coppice forest
5. Outline the Bentham and Hooker Classification of Angiosperms
6. Distinguish between Wind breaks and Shelter belts

SECTION B

Answer any 3 questions (5marks)

Module 1

1. Imagine a tree species from Combretaceae and justify how it is classified under that family
2. Design a plan of forest management suitable for an energy plantation
3. Propose an innovative idea to involve the participation of people in forestry
4. Formulate new plan for timber utilization by reducing the pressure on natural forests
5. Explain the characters timber yielding species from the family Pinaceae

Section C (10 marks)

Answer any 3 questions (10 marks)

Module 1

1. Demonstrate how the silvicultural and management interventions in practice helps in sustainable yield of timber
2. Using the information, you have learned explain the role of Social forestry in meeting timber requirements of rural population
3. Analyze the relevance of taxonomy to Wood science
4. Give a comparative account between Verbenaceae and Dipterocarpaceae.
5. Distinguish and write a detailed note on Verbenaceae, Leguminosae and Meliaceae