COURSE CURRICULUM
FOR

UNDERGRADUATE PROGRAMME
IN
FORESTRY
FOR

UG-CERTIFICATE (FORESTRY)
UG-DIPLOMA (FORESTRY)
&
B.Sc. (Hons.) FORESTRY

AS PER THE
ICAR - SIXTH DEANS' COMMITTEE REPORT
&
NEP-2020
(From Academic Session 2026-27)

H.N.B. GARHWAL UNIVERSITY
(A Central University)
Srinagar Garhwal
Uttarakhand

UG Program in Forestry

Restructuring of UG Programs

The restructuring has been done based on the following NHEQF levels:

- Year-1, Certificate Course, NEP-NHEQF Level 4.5
- Year-2, Diploma Course, NEP-NHEQF Level 5.0
- Year 4, B.Sc. (Hons.) Forestry, NEP-NHEQF Level 6.0

The restructured program for undergraduate Forestry education, with multiple entry and exit options, is illustrated in Figure 1.

The eligibility for entry into the UG programs is 10+2 Science; students will be admitted as per the norms of ICAR/UGC. The 1st year of the programme will include foundation, introductory, and skill enhancement courses. The 2nd year will include basic core courses, along with additional options for skill enhancement. The 3rd year of the programme will have advanced core courses. The 4th year programme will emphasize more on the specialization and elective courses as well as advanced skill enhancement through internship. There will be exit options after the 1st and 2nd years for UG-Certificate and UG-Diploma programs. However, students opting to exit with a UG-Certificate or UG-Diploma will have to undertake 10-weeks internships after the 1st year (2 Semesters) and 2nd year (4 Semesters), respectively.

NOTE: 9th meeting of the school board held on May 19, 2026 advised that any student who exits the programme during the first or second year under the new syllabus (w.e.f. 2026-27), after being awarded a certificate or diploma as applicable, may re-enter in the second or third year respectively and complete the programme within seven years from the date of admission to the first semester in order to obtain a B.Sc. (Hons.) in Forestry.

Admission Criteria:

10+2 Intermediate with PCM/PCMB/Agriculture (P-Physics, C –Chemistry, M-Mathematics, Biology) from a recognized board/university.

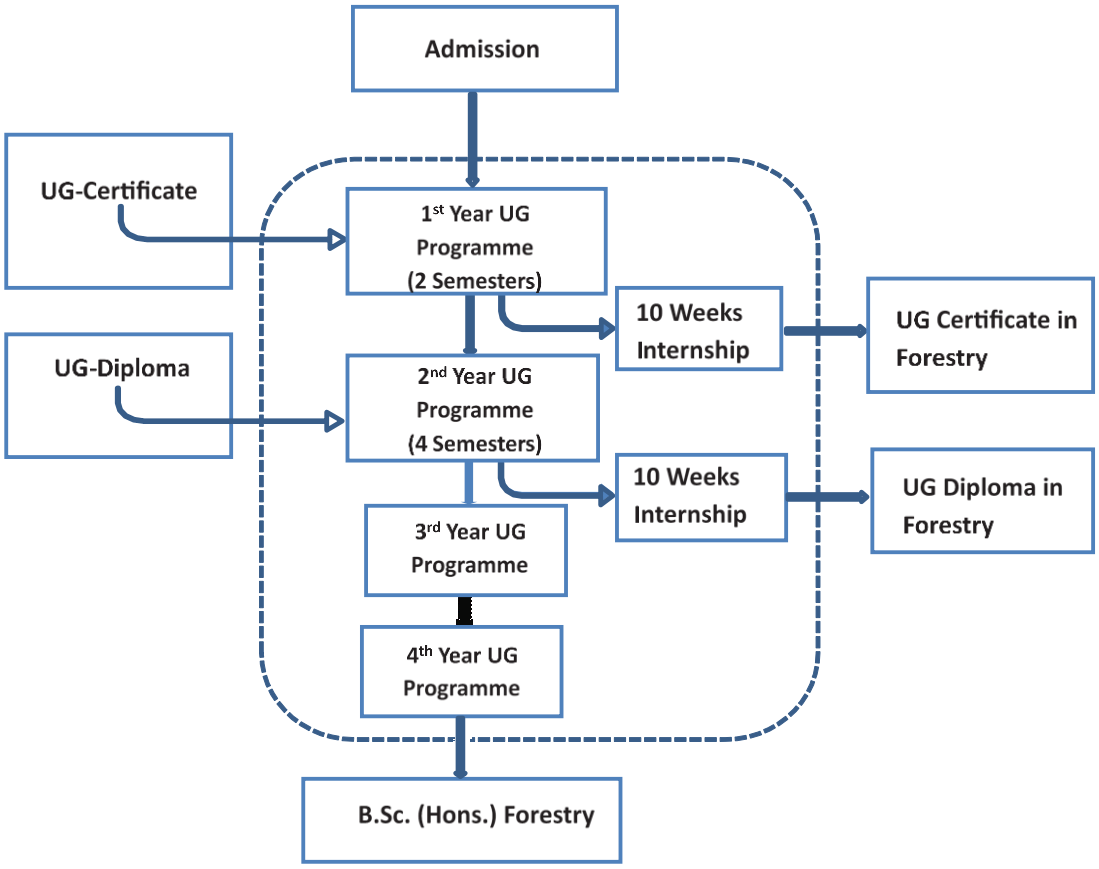

Fig. 1. Framework for Undergraduate Forestry Programme

Entry and Exit Options

The entry and exit options for the UG programs in Forestry are shown:-

Entry options

1. Eligibility for Entry into 1st year UG program: 10+2 Science with PCM/PCB/Agriculture/Forestry
2. Eligibility for Entry into 2nd Year UG Program: Students must hold a UG certificate in Forestry for at least one year.
3. Eligibility for Entry into 3rd Year UG Program: Students must hold a UG diploma in Forestry for a minimum of two years.

Exit options

1. UG Certificate in Forestry-(exit after 1st year and completion of 10 weeks internship)
2. UG Diploma in Forestry-(exit after 2nd year and completion of 10 weeks internship)
3. B.Sc. (Hons) Forestry- (on successful completion of four-year degree requirements) ACADEMIC program

SUMMARY OF CREDIT DISTRIBUTIONS

Type of courses	Credits
Core courses (Major)	100
Core courses (Minor/Electives)	32
Skill Enhancement Courses (SEC)	12
Common courses (MDC+VAC+AECC)	23
Internship / Project/ Student READY	20*
Total	**167**
Non-Gradial Courses (Deekshaarambh and Educational Tour)	04
Online Courses/MOOCS	10
Grand Total	**167+10**

*Credit of Internship/Project/Student READY is included in the total credits of Major courses.

General Credits Allocation Scheme of UG Forestry Programs (Credit hours)

Semester	Core Courses (Major)	Elective/Minor	MDC	VAC	AECC	SEC	Internship/ Project/ Student READY	Total Credits	Non Gradial	Online Courses/ MOOC
I	11	-	03	-	03	04	-	21	02	10
II	09	-	03	03	03	04	-	22	-	
Post-II Semester							10			
III	14	02	-	-	02	02	-	20	-	
IV	10	02	03	03	-	02	-	20	-	
Post-IV Semester							10			
V	18	02	-	-	-	-	-	20	02	
VI	18	02	-	-	-	-	-	20	-	
VII	-	24	-	-	-	-	-	24	-	
VIII	20	-	-	-	-	-	20*	20	-	
Total	**100**	**32**	**09**	**06**	**08**	**12**	**-**	**167**	**04**	**10**

Note: The credit hours mentioned in the table includes both theory and practical.

*Credit of Internship/Project/Student READY is included in the total credits of Major courses.

Semester-Wise Courses and Credits Distribution

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester I				External	Internal	
Induction Cum Foundation Course						
1.	SOA/UG/FNG/01	Deeksharambh (Non-gradial)	2 (0+2)	-	-	-
Core (Major Courses - MJ)						
2.	SOA/UG/FMJ/01 T	Introduction to Forest Resources	2	70	30	100
3.	SOA/UG/FMJ/01 P	Introduction to Forest Resources	1	70	30	100
4.	SOA/UG/FMJ/02 T	Forest Plant Biology	1	70	30	100
5.	SOA/UG/FMJ/02 P	Forest Plant Biology	1	70	30	100
6.	SOA/UG/FMJ/03 T	Silviculture – Principles and Practices	2	70	30	100
7.	SOA/UG/FMJ/03 P	Silviculture – Principles and Practices	1	70	30	100
8.	SOA/UG/FMJ/04 T	Agroforestry Systems and Management	2	70	30	100
9.	SOA/UG/FMJ/04 P	Agroforestry Systems and Management	1	70	30	100
Multidisciplinary Courses (MDC)						
10.	SOA/UG/FMDC/01 T	Farming Based Livelihood Systems	2	70	30	100
11.	SOA/UG/FMDC/01 P	Farming Based Livelihood Systems	1	70	30	100
Ability Enhancement Compulsory Course (AECC)						
12.	SOA/UG/FAECC/01 T	Communication Skills	1	70	30	100
13.	SOA/UG/FAECC/01 P	Communication Skills	1	70	30	100
14.	SOA/UG/FAECC/02 P	NSS/NCC-I	1 (0+1)	70	30	100
Skill Enhancement Courses (Indicative SEC Courses I). Student can opt any two courses with total 4 Credits from the following courses						
15.	SOA/UG/FSEC/01 P	Commercial Seedling Production	2 (0+2)	70	30	100
16.	SOA/UG/FSEC/02 P	Commercial Forestry	2 (0+2)	70	30	100
17.	SOA/UG/FSEC/03 P	Landscape Management and Restoration	2 (0+2)	70	30	100
18.	SOA/UG/FSEC/04 P	Wildlife Photography	2 (0+2)	70	30	100
19.	SOA/UG/FSEC/05 P	Ecotourism	2 (0+2)	70	30	100
20.	SOA/UG/FSEC/06 P	Para-taxonomy	2 (0+2)	70	30	100

Note: Deeksharambh (Induction-cum-Foundation Course) of 2 credits (2 weeks' duration).

Total Credits to earn in the Semester I						
Core (MJ)	**MDC**	**VAC**	**AECC**	**SEC**	**Total Credits**	**Non-Gradial**
11	**03**	**-**	**03**	**04**	**21**	**02**

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester II				External	Internal	
Core (Major Courses - MJ)						
21.	SOA/UG/FMJ/05 T	Tree Seed and Nursery Technology	1	70	30	100
22.	SOA/UG/FMJ/05 P	Tree Seed and Nursery Technology	1	70	30	100
23.	SOA/UG/FMJ/06 T	Fundamental of Forest Genetics	1	70	30	100
24.	SOA/UG/FMJ/06 P	Fundamental of Forest Genetics	1	70	30	100
25.	SOA/UG/FMJ/07 T	Wood Anatomy and Identification	1	70	30	100
26.	SOA/UG/FMJ/07 P	Wood Anatomy and Identification	1	70	30	100
27.	SOA/UG/FMJ/08 T	Forest Measurements and Inventory	2	70	30	100
28.	SOA/UG/FMJ/08 P	Forest Measurements and Inventory	1	70	30	100
Multidisciplinary Courses (MDC)						
29.	SOA/UG/FMDC/02 T	Entrepreneurship Development and Business Management	2	70	30	100
30.	SOA/UG/FMDC/02 P	Entrepreneurship Development and Business Management	1	70	30	100
Value Added Courses (VAC)						
31.	SOA/UG/FVAC/01 T	Environmental Studies and Disaster Management	2	70	30	100
32.	SOA/UG/FVAC/01 P	Environmental Studies and Disaster Management	1	70	30	100
Ability Enhancement Compulsory Course (AECC)						
33.	SOA/UG/FAECC/03 T	Personality Development	1	70	30	100
34.	SOA/UG/FAECC/03 P	Personality Development	1	70	30	100
35.	SOA/UG/FAECC/04 P	NSS/NCC-II	1 (0+1)	70	30	100
Skill Enhancement Courses (Indicative SEC Courses II). Student can opt any two courses with total 4 Credits from the following courses						
36.	SOA/UG/FSEC/07 P	Clonal Seedling Production	2 (0+2)	70	30	100
37.	SOA/UG/FSEC/08 P	Commercial tree seed production	2 (0+2)	70	30	100
38.	SOA/UG/FSEC/09 P	Wild and Commercial Beekeeping	2 (0+2)	70	30	100
39.	SOA/UG/FSEC/10 P	Forest Based Industrial Training	2 (0+2)	70	30	100
40.	SOA/UG/FSEC/11 P	Urban Forestry Designing and Planning	2 (0+2)	70	30	100

Total Credits to earn in the Semester II						
Core (MJ)	**MDC**	**VAC**	**AECC**	**SEC**	**Total Credits**	**Non-Gradial**
09	**03**	**03**	**03**	**04**	**22**	**-**

Post-II[nd] Semester
Internship (for 10 weeks-only for exit option for award of UG- Certificate) 10 (0+10)

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester III				External	Internal	
Core (Major Courses - MJ)						
41.	SOA/UG/FMJ/09 T	Silviculture of Trees	2 (2+0)	70	30	100
42.	SOA/UG/FMJ/10 T	Wood Science and Technology	1	70	30	100
43.	SOA/UG/FMJ/10 P	Wood Science and Technology	1	70	30	100
44.	SOA/UG/FMJ/11 T	Forest Microbiology	1	70	30	100
45.	SOA/UG/FMJ/11 P	Forest Microbiology	1	70	30	100
46.	SOA/UG/FMJ/12 T	Forest Soil and Nutrient Management	1	70	30	100
47.	SOA/UG/FMJ/12 P	Forest Soil and Nutrient Management	1	70	30	100
48.	SOA/UG/FMJ/13 T	Forest Survey and Engineering	1	70	30	100
49.	SOA/UG/FMJ/13 P	Forest Survey and Engineering	1	70	30	100
50.	SOA/UG/FMJ/14 T	Wildlife Sciences	1	70	30	100
51.	SOA/UG/FMJ/14 P	Wildlife Sciences	1	70	30	100
52.	SOA/UG/FMJ/15 T	Forest Health and Protection	1	70	30	100
53.	SOA/UG/FMJ/15 P	Forest Health and Protection	1	70	30	100
Minor Course (MN)						
54.	SOA/UG/FMN/01 T	Arboriculture	1	70	30	100
55.	SOA/UG/FMN/01 P	Arboriculture	1	70	30	100
Ability Enhancement Compulsory Course (AECC)						
56.	SOA/UG/FAECC/05 P	Physical Education, First Aid, Yoga Practices and Meditation	2 (0+2)	70	30	100
Skill Enhancement Courses (Indicative SEC Courses III). Student can opt any one course with total 2 Credits from the following courses						
57.	SOA/UG/FSEC/12 P	Forest Fire Management	2 (0+2)	70	30	100
58.	SOA/UG/FSEC/13 P	Timber Conversion	2 (0+2)	70	30	100
59.	SOA/UG/FSEC/14 P	Activated Carbon Technology	2 (0+2)	70	30	100
60.	SOA/UG/FSEC/15 P	Micro Forest	2 (0+2)	70	30	100
61.	SOA/UG/FSEC/16 P	Community Forest	2 (0+2)	70	30	100
62.	SOA/UG/FSEC/17 P	Human Animal Ecosystem Interface	2 (0+2)	70	30	100
63.	SOA/UG/FSEC/18 P	Forest Resource Assessment	2 (0+2)	70	30	100
64.	SOA/UG/FSEC/19 P	Multifunctional Agroforestry	2 (0+2)	70	30	100
65.	SOA/UG/FSEC/20 P	Value addition of NTFPs	2 (0+2)	70	30	100

Total Credits to earn in the Semester 3[rd]

Core (MJ)	MN	MDC	VAC	AECC	SEC	Total Credits
14	**02**	**-**	**-**	**02**	**02**	**20**

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester IV				External	Internal	
Core (Major Courses - MJ)						
66.	SOA/UG/FMJ/16 T	Commercial Forest Products and Utilization	2	70	30	100
67.	SOA/UG/FMJ/16 P	Commercial Forest Products and Utilization	1	70	30	100
68.	SOA/UG/FMJ/17 T	Forest Ecology and Management	2	70	30	100
69.	SOA/UG/FMJ/17 P	Forest Ecology and Management	1	70	30	100
70.	SOA/UG/FMJ/18 T	Tree Harvesting and Ergonomics	1	70	30	100
71.	SOA/UG/FMJ/18 P	Tree Harvesting and Ergonomics	1	70	30	100
72.	SOA/UG/FMJ/19 T	Forest Policy and Legislation	2 (2+0)	70	30	100
Minor Course (MN)						
73.	SOA/UG/FMN/02 T	Statistical Methods	1	70	30	100
74.	SOA/UG/FMN/02 P	Statistical Methods	1	70	30	100
Multidisciplinary Courses (MDC)						
75.	SOA/UG/FMDC/03 T	Agriculture Marketing and Trade	2	70	30	100
76.	SOA/UG/FMDC/03 P	Agriculture Marketing and Trade	1	70	30	100
Value Added Courses (VAC)						
77.	SOA/UG/FVAC/02 T	Agricultural Informatics and Artificial Intelligence	2	70	30	100
78.	SOA/ UG/FVAC/02 P	Agricultural Informatics and Artificial Intelligence	1	70	30	100
Skill Enhancement Courses (Indicative SEC Courses IV). Student can opt any one course with total 2 Credits from the following courses						
79.	SOA/UG/FSEC/21 P	Dendro-energy generation	2(0+2)	70	30	100
80.	SOA/UG/FSEC/22 P	Big data Management	2(0+2)	70	30	100
81.	SOA/UG/FSEC/23 P	Artificial Intelligence in Forestry operation	2(0+2)	70	30	100
82.	SOA/UG/FSEC/24 P	Speciality seedling production	2(0+2)	70	30	100
83.	SOA/UG/FSEC/25 P	Tools for consulting Forester's	2(0+2)	70	30	100
84.	SOA/UG/FSEC/26 P	Application of Drone in Forestry	2(0+2)	70	30	100
85.	SOA/UG/FSEC/27 P	Forest Certification	2(0+2)	70	30	100
86.	SOA/UG/FSEC/28 P	Forest project designing and analysis	2(0+2)	70	30	100
87.	SOA/UG/FSEC/29 P	Marketing and economics of NTFPs	2(0+2)	70	30	100
88.	SOA/UG/FSEC/30 P	Carbon Financing Project	2(0+2)	70	30	100

Total Credits to earn in the Semester IV						
Core (MJ)	**MN**	**MDC**	**VAC**	**AECC**	**SEC**	**Total Credits**
10	**02**	**03**	**03**	**-**	**02**	**20**

Post-IV Semester
Internship (for 10 weeks-only for exit option for award of UG- Diploma)10 (0+10)

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester V				External	Internal	
Core (Major Courses - MJ)						
89.	SOA/UG/FMJ/20 T	Tree Physiology	1	70	30	100
90.	SOA/UG/FMJ/20 P	Tree Physiology	1	70	30	100
91.	SOA/UG/FMJ/21 T	Plantation Forestry	2	70	30	100
92.	SOA/UG/FMJ/21 P	Plantation Forestry	1	70	30	100
93.	SOA/UG/FMJ/22 T	Tree Improvement	2	70	30	100
94.	SOA/UG/FMJ/22 P	Tree Improvement	1	70	30	100
95.	SOA/UG/FMJ/23 T	Forest Resource Management	1	70	30	100
96.	SOA/UG/FMJ/23 P	Forest Resource Management	1	70	30	100
97.	SOA/UG/FMJ/24 T	Non-Timber Forest Products	2	70	30	100
98.	SOA/UG/FMJ/24 P	Non-Timber Forest Products	1	70	30	100
99.	SOA/UG/FMJ/25 T	Forest Pest and Diseases	2	70	30	100
100.	SOA/UG/FMJ/25 P	Forest Pest and Diseases	1	70	30	100
101.	SOA/UG/FMJ/26 T	Industrial Agroforestry	1	70	30	100
102.	SOA/UG/FMJ/26 P	Industrial Agroforestry	1	70	30	100
Minor Course (MN)						
103.	SOA/UG/FMN/03 T	Wildlife and Protected Area Management	1	70	30	100
104.	SOA/UG/FMN/03 P	Wildlife and Protected Area Management	1	70	30	100
Non Gradial (NG)						
105.	SOA/ UG/FNG/02 P	Study Tour/Techniques	2 (0+2)	-	-	-

Note: Study tour (10-14 days)

Total Credits to earn in the Semester V							
Core (MJ)	**MN**	**MDC**	**VAC**	**AECC**	**SEC**	**Total Credits**	**Non-Gradial**
18	**02**	**-**	**-**	**-**	**-**	**20**	**02**

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester VIth				External	Internal	
Core (Major Courses -MJ)						
106.	SOA/UG/FMJ/27 T	Forest Biotechnology	2	70	30	100
107.	SOA/UG/FMJ/27 P	Forest Biotechnology	1	70	30	100
108.	SOA/UG/FMJ/28 T	Forest Economics and Marketing	1	70	30	100
109.	SOA/UG/FMJ/28 P	Forest Economics and Marketing	1	70	30	100
110.	SOA/UG/FMJ/29 T	Watershed Planning and Management	1	70	30	100
111.	SOA/UG/FMJ/29 P	Watershed Planning and Management	1	70	30	100
112.	SOA/UG/FMJ/30 T	Forest Tribology, Ethno-medicine and Extension	2	70	30	100
113.	SOA/UG/FMJ/30 P	Forest Tribology, Ethno-medicine and Extension	1	70	30	100
114.	SOA/UG/FMJ/31 T	Forest Business Management	1	70	30	100
115.	SOA/UG/FMJ/31 P	Forest Business Management	1	70	30	100
116.	SOA/UG/FMJ/32 T	Forest Landscape Restoration (FLR)	2 (2+0)	70	30	100
117.	SOA/UG/FMJ/33 T	Forest Biomass Energy and Biofuels	1	70	30	100
118.	SOA/UG/FMJ/33 P	Forest Biomass Energy and Biofuels	1	70	30	100
119.	SOA/UG/FMJ/34 T	Trees Outside Forests	2 (2+0)	70	30	100
Minor Course (MN)						
120.	SOA/UG/FMN/04 T	Remote Sensing and GIS	1	70	30	100
121.	SOA/UG/FMN/04 P	Remote Sensing and GIS	1	70	30	100

Total Credits to earn in the Semester VI						
Core (MJ)	**MN**	**MDC**	**VAC**	**AECC**	**SEC**	**Total Credits**
18	**02**	**-**	**-**	**-**	**-**	**20**

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester VII				External	Internal	
Students can opt any one of the following I-V Elective/Minor Courses with 24 credits offered by the Department/University.						
I	**Plantation Forestry**					
122.	SOA/UG/FMN/05 T	Commercial tree seedling production	2	70	30	100
123.	SOA/UG/FMN/05 P	Commercial tree seedling production	1	70	30	100
124.	SOA/UG/FMN/06 T	Commercial plantation development and management	2	70	30	100
125.	SOA/UG/FMN/06 P	Commercial plantation development and management	1	70	30	100
126.	SOA/UG/FMN/07 T	Forest growth modelling	1	70	30	100
127.	SOA/UG/FMN/07 P	Forest growth modelling	1	70	30	100
128.	SOA/UG/FMN/08 T	Marketing and certification of wood products	1	70	30	100
129.	SOA/UG/FMN/08 P	Marketing and certification of wood products	1	70	30	100
130.	SOA/UG/FMN/09 T	Restoration of degraded lands	2	70	30	100
131.	SOA/UG/FMN/09 P	Restoration of degraded lands	1	70	30	100
132.	SOA/UG/FMN/10 T	Dendro-biomass and energy plantation	2	70	30	100
133.	SOA/UG/FMN/10 P	Dendro-biomass and energy plantation	1	70	30	100
134.	SOA/UG/FMN/11 T	Plantation and climate change mitigation	2 (2+0)	70	30	100
135.	SOA/UG/FMN/12 T	Plant Biochemistry	1	70	30	100
136.	SOA/UG/FMN/12 P	Plant Biochemistry	1	70	30	100
137.	SOA/UG/FMN/13 T	Research Methodology	1	70	30	100
138.	SOA/UG/FMN/13 P	Research Methodology	1	70	30	100
139.	SOA/UG/FMN/14 P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100
140.	SOA/UG/FMN/15 P	Internship with forest plantations-based institutions/plantation companies	2 (0+2)	70	30	100
II	**Multi-Functional Agroforestry**					
141.	SOA/UG/FMN/16 T	Agroforestry system	2	70	30	100
142.	SOA/UG/FMN/16 P	Agroforestry system	1	70	30	100
143.	SOA/UG/FMN/17 T	Interactions in Agroforestry Systems	1	70	30	100
144.	SOA/UG/FMN/17 P	Interactions in Agroforestry Systems	1	70	30	100
145.	SOA/UG/FMN/18 T	Agroforestry and Climate Change Mitigation	2 (2+0)	70	30	100
146.	SOA/UG/FMN/19 T	Industrial agroforestry	2	70	30	100
147.	SOA/UG/FMN/19 P	Industrial agroforestry	1	70	30	100

148.	SOA/UG/FMN/20 T	Ecotourism	2	70	30	100
149.	SOA/UG/FMN/20 P	Ecotourism	1	70	30	100
150.	SOA/UG/FMN/21 T	Dendro-biomass and energy plantation	2	70	30	100
151.	SOA/UG/FMN/21 P	Dendro-biomass and energy plantation	1	70	30	100
152.	SOA/UG/FMN/22 T	Introduction to Agronomy and Crop Production Technology	2	70	30	100
153.	SOA/UG/FMN/22 P	Introduction to Agronomy and Crop Production Technology	1	70	30	100
154.	SOA/UG/FMN/23 T	Plant Biochemistry	1	70	30	100
155.	SOA/UG/FMN/23 P	Plant Biochemistry	1	70	30	100
156.	SOA/UG/FMN/24 T	Research Methodology	1	70	30	100
157.	SOA/UG/FMN/24 P	Research Methodology	1	70	30	100
158.	SOA/UG/FMN/25 P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100
159.	SOA/UG/FMN/26 T	Agroforestry business incubation	1	70	30	100
160.	SOA/UG/FMN/26 P	Agroforestry business incubation	1	70	30	100
161.	SOA/UG/FMN/27 P	Internship with agroforestry-based institutions/industries	2 (0+2)	70	30	100
III	**High Yielding Short Rotation (HYSR) forestry**					
162.	SOA/UG/FMN/28 T	Applied Tree Improvement	2	70	30	100
163.	SOA/UG/FMN/28 P	Applied Tree Improvement	1	70	30	100
164.	SOA/UG/FMN/29 T	Reproduction biology of tree crops	2	70	30	100
165.	SOA/UG/FMN/29 P	Reproduction biology of tree crops	1	70	30	100
166.	SOA/UG/FMN/30 T	Biometrical genetics in tree breeding	1	70	30	100
167.	SOA/UG/FMN/30 P	Biometrical genetics in tree breeding	1	70	30	100
168.	SOA/UG/FMN/31 T	Marker assisted breeding in forestry	2	70	30	100
169.	SOA/UG/FMN/31 P	Marker assisted breeding in forestry	1	70	30	100
170.	SOA/UG/FMN/32 T	Tissue culture application in forestry	2	70	30	100
171.	SOA/UG/FMN/32 P	Tissue culture application in forestry	1	70	30	100
172.	SOA/UG/FMN/33 P	Controlled breeding in tree crops	2 (0+2)	70	30	100
173.	SOA/UG/FMN/34 T	Tree seed orchards	2	70	30	100
174.	SOA/UG/FMN/34 P	Tree seed orchards	1	70	30	100
175.	SOA/UG/FMN/35 T	Forest genetic resources	2 (2+0)	70	30	100
176.	SOA/UG/FMN/36 T	Clonal Forestry	1	70	30	100
177.	SOA/UG/FMN/36 P	Clonal Forestry	1	70	30	100
178.	SOA/UG/FMN/37 T	Plant Biochemistry	1	70	30	100

179.	SOA/UG/FMN/37 P	Plant Biochemistry	1	70	30	100
180.	SOA/UG/FMN/38 T	Research Methodology	1	70	30	100
181.	SOA/UG/FMN/38 P	Research Methodology	1	70	30	100
182.	SOA/UG/FMN/39 P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100
183.	SOA/UG/FMN/40 P	Internship with tree breeding and biotechnology-based institutions/ industries	2 (0+2)	70	30	100
IV	**Wood and NWFPs Product Development and Utilization**					
184.	SOA/UG/FMN/41 P	Wood identification	2 (0+2)	70	30	100
185.	SOA/UG/FMN/42 T	Wood physics and chemistry	2	70	30	100
186.	SOA/UG/FMN/42 P	Wood physics and chemistry	1	70	30	100
187.	SOA/UG/FMN/43 P	Forest products laboratory techniques	2 (0+2)	70	30	100
188.	SOA/UG/FMN/44 T	Wood seasoning and preservation	1	70	30	100
189.	SOA/UG/FMN/44 P	Wood seasoning and preservation	2	70	30	100
190.	SOA/UG/FMN/45 P	Wood working and carpentry	2 (0+2)	70	30	100
191.	SOA/UG/FMN/46 T	Composite wood technology	2	70	30	100
192.	SOA/UG/FMN/46 P	Composite wood technology	1	70	30	100
193.	SOA/UG/FMN/47 T	Non-wood forest products and value addition technology	2	70	30	100
194.	SOA/UG/FMN/47 P	Non-wood forest products and value addition technology	1	70	30	100
195.	SOA/UG/FMN/48 T	Ethnobotany, Medicinal and Aromatic plants	2	70	30	100
196.	SOA/UG/FMN/48 P	Ethnobotany, Medicinal and Aromatic plants	1	70	30	100
197.	SOA/UG/FMN/49 T	Certification of Forest Products	2 (2+0)	70	30	100
198.	SOA/UG/FMN/50 T	Plant Biochemistry	1	70	30	100
199.	SOA/UG/FMN/50 P	Plant Biochemistry	1	70	30	100
200.	SOA/UG/FMN/51 T	Research Methodology	1	70	30	100
201.	SOA/UG/FMN/51 P	Research Methodology	1	70	30	100
202.	SOA/UG/FMN/52 P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100
203.	SOA/UG/FMN/53 P	Internship with forest products and technology-based institutions/ industries	2 (0+2)	70	30	100
V	**Forest Resources Management and Utilization**					
204.	SOA/UG/FMN/54 T	RS and GIS Application for Forest Resource Management	2	70	30	100
205.	SOA/UG/FMN/54 P	RS and GIS Application for Forest Resource Management	1	70	30	100
206.	SOA/UG/FMN/55 T	Ecosystem Services and Valuation of Forest Resources	2	70	30	100
207.	SOA/UG/FMN/55 P	Ecosystem Services and Valuation of Forest Resources	1	70	30	100

208.	SOA/UG/FMN/56 T	Entrepreneurship in value chain improvement of Forest Resources	2	70	30	100
209.	SOA/UG/FMN/56 P	Entrepreneurship in value chain improvement of Forest Resources	1	70	30	100
210.	SOA/UG/FMN/57 T	Joint Forest Planning and Management	1	70	30	100
211.	SOA/UG/FMN/57 P	Joint Forest Planning and Management	1	70	30	100
212.	SOA/UG/FMN/58 T	Climate Change Mitigation	2	70	30	100
213.	SOA/UG/FMN/58 P	Climate Change Mitigation	1	70	30	100
214.	SOA/UG/FMN/59 T	Ecotourism	2	70	30	100
215.	SOA/UG/FMN/59 P	Ecotourism	1	70	30	100
216.	SOA/UG/FMN/60 T	Restoration of Degraded Lands	2	70	30	100
217.	SOA/UG/FMN/60 P	Restoration of Degraded Lands	1	70	30	100
218.	SOA/UG/FMN/61 T	Urban Ecology and Environment	2	70	30	100
219.	SOA/UG/FMN/61 P	Urban Ecology and Environment	1	70	30	100
220.	SOA/UG/FMN/62 T	Plant Biochemistry	1	70	30	100
221.	SOA/UG/FMN/62 P	Plant Biochemistry	1	70	30	100
222.	SOA/UG/FMN/63 T	Research Methodology	1	70	30	100
223.	SOA/UG/FMN/63 P	Research Methodology	1	70	30	100
224.	SOA/UG/FMN/64 P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100
225.	SOA/UG/FMN/65 P	Internship with Forest Business Unit/RS-GIS Company or Organization	2 (0+2)	70	30	100

Total Credits to earn in the Semester 7th					
Elective/Minor	**MDC**	**VAC**	**AECC**	**SEC**	**Total Credits**
24	**-**	**-**	**-**	**-**	**24**

Sr. No.	Course Code	Paper Title	Credits	Marks		Total Marks
Semester VIII				External	Internal	
226.	SOA/UG/FMJ/35 P	Internship/ Project / Students READY Program	20 (0+20)	70	30	100

Training attachment in wood-based industry/ forest departments/ Police/ Special Task Force (STF)/ incubation centres/ KVKs or research Institutes/ NGO/ agribusiness entrepreneur, etc. (May be conducted in split manner in more than one industry/ institution/ organization).
Ideally it is recommended to have:

- Internship with Forest Department (Administrative Skill) for 5 weeks
- Internship with wood-based industries (Technical Skill) for 2 weeks
- Internship with Police/ Special Task Force (STF) for Jungle survival for 1 week
- Internship with incubation centres/KVKs/ research Institutes/ NGO/ agribusiness entrepreneur, etc. for 2 weeks
- Either project (R and D based, field study based) or entrepreneurship based (incubation/ experiential learning)

Total Credits to earn in the Semester 8th				
Core (Major)	**AECC**	**SEC**	**Elective**	**Total Credits**
20	**-**	**-**	**-**	**20**

ONLINE COURSES

Students must complete a minimum of 10 credits of online courses (as per UGC guidelines for online courses) as a partial requirement for the B.Sc. (Forestry) program.

Online courses from any field in forestry can be accessed through NPTEL, MOOCs, edX, Coursera, SWAYAM, or any other relevant portal.

The objective is to enable students to cultivate their passion or enhance their knowledge and competency in any field beyond the prescribed courses.

The courses will be non-gradial as separate certificates would be issued by institutes offering the courses. These can be taken any time during the 3rd and 4th years of the UG program. However, the University/ institute will keep a record of such courses registered and completed by each student. It will indicate the title of the (satisfactorily completed) courses in the final transcript issued to the student.

Sr. No.	**Course Code**	**Paper Title**	**Credit**	**Marks**		**Total Marks**
				External	Internal	
227.	*SOA/UG/MOOC/01	On-line courses (MOOC)	10 (non-Gradial)	-	-	(non-Gradial)

* These can be taken any time during the 3rd and 4th years of the UG program.

List of Suggestive Courses on SWAYAM/MOOC

Course title	**Duration**	**Credits**
Forests and their Management	12 Weeks	01
Wildlife Ecology	12 Weeks	01
Introduction to Biology: Ecology	04 Weeks	01
Introduction to Biology: Ecology, Evolution, and Biodiversity	17 Weeks	01
Introduction to Biology: Biodiversity	05 Weeks	01
Ecology: Ecosystem Dynamics and Conservation	05 Weeks	01
Fire Ecology	08 Weeks	01
Ecology and Society	12 Weeks	01
Environmental Studies	12 Weeks	01
Environmental Studies: A Global Perspective	06 Weeks	01
Toolbox for Environmental Management	05 Weeks	01
Environmental Protection and Sustainability	08 Weeks	01
Ecosystem and Natural Resources	12 Weeks	01
NGO'S and Sustainable Development	15 Weeks	01
Nanotechnology Applications in respective fields	08 Weeks	01
Personality Development and Communication Skills	08 Weeks	01
Personality Development	08 Weeks	01
Yoga Practices 1	12 Weeks	01
Yoga Practices 2	12 Weeks	01
Ethics: Theories and Applications	12 Weeks	01

Detailed Syllabus of B.Sc. Forestry Undergraduate Programme
Scheme of Instruction and Credits
Detailed Syllabus

SEMESTER – I

SOA/UG/FNG/01 - Induction Cum-Foundation Course (Deeksharambh)

Course Code	Name of Subject	Credits	Theory Marks	Internal Marks	Total
SOA/UG/FNG/01	Induction Cum Foundation Course (Deeksharambh)	2 (0+2)	-	-	Non-gradial

Aim of the Course

The activities to be taken under Deeksharambh shall aim at creating a platform for students to
• Help for cultural integration of students from different backgrounds
• Know about the operational framework of academic process in university
• Instilling life and social skills
• Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
• Identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

The details of activities will be decided by the parent universities. The structure shall include, but not restricted to:

1. Discussions on operational framework of academic process in university, as well as interactions with academic and research managers of the University Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
2. Group activities to identify the strength and weakness of students (With expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences
3. Activities to enhance cultural Integration of students from different backgrounds.
4. Field visits to related fields/ establishments
5. Sessions on personality development (Instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills.

Core (Major Courses- MJ)

SOA/UG/FMJ/01 – Introduction to Forest Resources

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/01T	Introduction to Forest Resources	2	70	30	100

Aim of the Course

To impart knowledge about the basic concepts of Forestry and familiarize the students about developments in the field of forestry.

Theory

Forests; definitions, role, benefits; direct and indirect. History of Forestry- Forestry- definitions, divisions and interrelationships. Classification of forests- Forest types. Agricultural lands and forests- Agroforestry systems; differences in nutrient cycling, diversity etc. Social forestry, joint forest management; programs and objectives. Important acts and policies related to Indian forests. Global warming; forestry options for mitigation and adaptation- carbon sequestration. Introduction to world forests- Geographical distribution of forests and their classification- Factors influencing world distribution of forests- productivity potential and increment of world forests. Forest resources and forestry practices in different regions of the world; Western Europe, North America, Central Africa, Australia, Central America, Russia, Japan, and China. General problems of forest development and economy. Forest based industries in the developed and developing countries. Trade patterns of forest based raw materials. Recent trends in forestry development in the world. National and international organizations in forestry. Important events/dates related to forests and environment - Themes and philosophy

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/01P	Introduction to Forest Resources	1	70	30	100

Practical

Identification of important farm grown trees. Identification of tree seeds and seedlings. Visit to various forest types, viz., thorn forest, dry deciduous forests, moist deciduous forests, Shola grass land ecosystem, semi evergreen forests and wet evergreen forests to study the factors of locality and species composition. Visit to different forest plantations, Agroforestry plantations and other woodlots. Identification of wood and non- wood forest products. Visit to forest-based institutes and industries.

Suggested Readings

1. Beazley, M. 1981. The International Book of Forest. London
2. Champion and Seth. 1968. Forest types of India.
3. Grebner, D.L., Bettinger, P. and Siry, J.P. 2012. Introduction to Forestry and Natural Resources. Academic Press. 508p (Google eBook).
4. Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi.
5. Mather, A.S. 1990. Global forest resources. Belhaven, London
6. Mitchell Beazly.1981. The International Book of the Forest. Mitchell Beazly Publishers, London.
7. Parthiban, K.T, N. Krishnakumar, B. Palanikumaran, R. Thirunirai Selvan and N. Kanagaraj. 2022. FAQ'S on Forestry for IFS Aspirants. Scientific Publishers, Jodhpur (ISBN No.: 9789392590061)
8. Parthiban, K.T, N. Krishnakumar and M. Karthick. 2018, Introduction to Forestry, Scientific Publisher, Jodhpur. 350p
9. Persson, R. 1992. World forest resources. Periodical experts, New Delhi.
10. Westoby, J. 1991. Introduction to World Forestry. Wiley, 240p.

SOA/UG/FMJ/02T – Forest Plant Biology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/02T	Forest Plant Biology	1	70	30	100

Aim of the Course

To inculcate the fundamentals of botany and taxonomy of gymnosperms and angiosperms

Theory

Plant classification and systematic. Botanical Nomenclature – ICBN (International code of Botanical Nomenclature) - Rules and Codes of ICBN, Binomial and Polynomials. Systems of classification - Natural, Artificial and Phylogenetic classification. Principles of systematics. Demerits and merits of plant classification as given by Engler and Prantl, Hutchinson, Bentham and Hooker, Angiosperm Phylogenic Group (APG) and Other modern classifications. Morphology as a tool for tree identification - Field characters - Branching pattern, Leaf, Fruit and Bark. Role of reproductive characters - Flower types, floral formulas and floral diagrams. Reproductive morphology of plants with reference to description and identification of reproductive parts - General form of woody trunk and deviations like buttresses, flutes, crooks, etc. Morphology and description of bark of common Indian trees - Types of exfoliation patterns in bark. Methods of Floristic survey and need for

botanical explorations. Herbarium techniques -Collection, processing and preservation of plant material. General study of herbarium, arboretum, Palmetum, Fruticetum, Bambusetum and Xylarium. Origin, geographical distribution, phylogenetic position, taxonomic description and economic importance of the flora of families of Gymnosperms viz., Pinaceae, Taxaceae, Coniferae. Origin, geographical distribution, phylogenetic position, taxonomic description and economic importance of the flora for the families of Angiosperms viz., Annonaceae, Magnoliaceae, Rhizophoraceae, Ebenaceae, Sapotaceae, Santalaceae, Mimosaceae, Elaeagnaceae, Fabaceae, Caesalpiniaceae, Meliaceae, Salicaceae, Lauraceae, Apocynaceae and Betulaceae. Origin, geographical distribution, phylogenetic position, taxonomic description and economic importance of the flora for the families of Angiosperms viz., Fagaceae, Moraceae, Tiliaceae, Euphorbiaceae, Dipterocarpaceae, Bixaceae, Cupressaceae, Guttiferae (Clusiaceae), Myrtaceae, Rubiaceae, Sterculiaceae, Bignoniaceae, Verbinaceae and Combretaceae.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/02P	Forest Plant Biology	1	70	30	100

Practical

Morphological description of plant parts with special reference to identification. Study on types of leaves, phyllotaxy and venation, Inflorescence. Methods of plant collections and herbarium preparation. Laboratory and field identification of important forestry species using vegetative and reproductive characteristics of Magnoliaceae, Ebenaceae, Fabaceae, Meliaceae, Salicaceae, Tiliaceae, Taxaceae, Pinaceae, Myrtaceae, Rubiaceae, Sterculiaceae, Bignoniaceae and Combretaceae. Visit to Botanical Garden and Arboretum for identification of trees.

Suggested Readings

1. Bhatnagar, S.P. and Alok Moitra. (2000). Gymnosperms. New age International (P) Ltd.
2. Bor, N. L. (1990). Manual of Indian Forest Botany. Periodical Expert Book Agency. New Delhi.
3. Brandis. Revised by R. D. Jakarti. (2010). Indian Trees. Dehradun.
4. Dasgupta, S. (1998). Systematic Botany for Foresters. Khana Bandhu Publ., New Delhi, India.
5. Datta, S.C. (1999). Systematic Botany. New Age International (p) Ltd. Publ. New Delhi, India.
6. Eric A. Bourdo Jr. (2001). The Illustrated Books of Trees. A Visual Guide to 250 species. Published by Salamander Books Pvt. Ltd. London. (Available online PDF)
7. Jain, S. K. and Rao, R. R. (1977). Handbook of Field and Herbarium Methods. Today and tomorrow's Printers and Publishers. New Delhi.
8. Krishnen, Pradip. (2013). Jungle Trees of Central India. Published by Penguin Books India Pvt. Ltd. New Delhi.
9. Kumar, Ashok. (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
10. Mishra, S. R. (2010). Textbook of Dendrology. Discovery Publishing House Pvt. Ltd. New Delhi.
11. Mishra, S.R. (2010). Textbook of Dendrology. Discovery Publishing House Pvt. Ltd.
12. Naqshi, R. (1993). An Introduction to Botanical Nomenclature. Scientific Publishers. Jodhpur.
13. Pandey, S. N. and Mishra, S. P. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.
14. Parker, R. N. (1933). Forty Common Indian Trees and How to know them. (Available online PDF)
15. Randhawa, M. S. (1957). Flowering Trees in India. Sree Saraswati Press Ltd. Kolkata.
16. Sahni, K. C. (2000). The Book of Indian Trees. Bombay Natural History Society. Mumbai.
17. Santapau, Father H. (1966). Common Trees. (Available online PDF)
18. Singh, Gurucharan. (2000). Plant Systematics. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
19. Tewari, N. (1992). Tropical Forestry in India. International Book Distributors, Dehradun.

SOA/UG/FM/03T – Silviculture – Principles and Practices

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	

SOA/UG/FMJ/03T	Silviculture – Principles and Practices	2	70	30	100

Aim of the Course

1. To develop basic understanding on forest and factors influencing forest growth and development.
2. To develop skill for the artificial and natural regeneration of forest
3. Exposing students to develop skill on raising and maintaining plantation
4. To impart knowledge on tending operations followed in forest with preliminary information on succession in forest

Theory

Definition and classification of Forest and Forestry - Branches of forestry and their relationships - Trees and their distinguishing features. Forest Reproduction - Flowering, fruiting and seeding behaviour. Site factors - Climatic, edaphic, physiographic, biotic and their interactions. Classification of Climatic Factors - Role of light, temperature, rainfall, snow, wind, humidity and evapotranspiration in relation to forest vegetation. Bioclimatic and Micro climate effects. Edaphic factors - Influence of biological agencies, parent rock, topography on the soil formation - Soil profile - Physical and chemical properties, mineral nutrient. Physiographic factors - influence of altitude, latitude, aspect and slope on vegetation. Biotic factors - Influence of plants, insects, wild animals, man and domestic animals on vegetation. Forest types of India - Basis and systems of classification - Major groups - Revised classification of forest types of India - Tropical, Montane sub-tropical, Montane temperate, Subalpine and Alpine - Sub groups - Types - Species composition and distribution. Forest types of Tamil Nadu. Regeneration of forests - Objectives, ecology of regeneration - Natural and Artificial regeneration. Natural regeneration - Seed production, seed dispersal, germination and establishment. Requirement for natural regeneration. Dieback in seedling with examples. Advance growth, coppice - Root sucker. Regeneration survey - Natural regeneration supplemented by artificial regeneration. Artificial regeneration - Object of artificial regeneration - Advantages. Factors governing the choice of regeneration techniques. Choice of species and factors that govern. Sowing v/s planting - Preparation of planting material - Field planting and techniques - Plant protection and sanitation measures - Forest nutrition and irrigation in trees.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/03P	Silviculture – Principles and Practices	2	70	30	100

Practical

Study about habits of plants and developmental stages of tree growth and its structure. Study about tree morphology - Stem, crown and root characters. Assessment of forest composition. Study about stand structure. Assessment of natural regeneration. Planting pattern and planting technique for afforestation and reforestation. Exercise on Seed and nursery practices. Planting pattern and planting technique for afforestation and reforestation. Field preparation, marking, alignment and stacking, pit making and planting. Plant protection and sanitation measures. Study of afforestation and reforestation success.

Suggested Readings

1. Champion, H.G. and S.K. Seth. 1968. A revised survey of the forest types of India. Manager of Publication, Delhi.
2. David M. Smith. 1989. The Practice of Silviculture. EBD Educational Pvt. Ltd., Dehradun. P.526
3. Dwivedi, A. P. 2006. A Text book of Silviculture. International Book Distributors, Dehra Dun. 505 p.
4. Haig, I.T., M.A. Huberman and U. Aung Din. 1986. Tropical Silviculture. Periodical Experts Book Agency, New Delhi. Vol. 1, p. 190.
5. Khanna, L.S. 2000. Principles and practice of Silviculture. Milton Book Company, Dehra Dun. 473
6. Luna, R. K. 1989. Plantation forestry in India. International Book Distributors, Dehra Dun. P. 476
7. Parthiban, K.T, R.J. Sudhagar, S. Umesh Kanna, S. Vennila, I. Sekar and K. Baranidharan. 2016. Forestry: A Subjective Guide for IFS Aspirants. Scientific Publishers - Competition Tutor, Jodhpur (ISBN No.: 9789386102096)

SOA/UG/FMJ/04T – Agroforestry Systems and Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/04T	Agroforestry Systems and Management	2	70	30	100

Aim of the Course

1. To develop basic understanding on agroforestry in different agro-climatic zones.
2. To develop skill on various agroforestry systems and carbon sequestration in agroforestry systems.
3. Exposing students to develop skill on Industrial Agroforestry

Theory

Agroforestry systems in different agro climatic zones – Tropical agroforestry, temperate agroforestry, arid and semi-arid agroforestry and humid agroforestry - components, production and management techniques. Alley cropping- functional and structural attributes of alley cropping, soil management, choice of species - productivity of various Agroforestry systems. High-density short rotation plantation systems – choice of species, design, development and management - Silvicultural woodlots/energy plantations - choice of species, design, development and management. Different types of agroforestry systems – silvi-agriculture - shelterbelts and windbreaks - design, aerodynamics and management - silvopastoral systems - live fences; fodder trees and protein banks and Agri silvopastoral systems – home gardens, hedge rows, Multistorey system and their mangement; Special Systems - Apisilviculture, silvisericulture, aquaforestry etc. Agroforestry for wasteland development. Canopy management - Lopping, pruning, pollarding, and hedging. Diagnosis and design methods and approaches. Biophysical and ecological functions of agroforestry: Nutrient cycling and role of agroforestry in soil and water conservation - micro-site enrichment by trees, N fixation, improvement in soil physico-chemical properties and soil organic matter status, litter and fine root dynamics, nutrient pumping; beneficial effects of species mixture - rhizosphere and phillosphere effects. Adverse effects of trees on soils - competition, allelopathy – Causes and mechanisms. Industrial Agroforestry – scope and potential in India – major wood based industries - People's participation, rural entrepreneurship through Agroforestry and industrial linkages – contract farming – types and systems – successful contract farming models – timber transit rules for farm grown trees - Financial and socio-economic analysis of Agroforestry systems. Evaluation of tangible and intangible benefits – Agroforestry research and development in India - National Agroforestry Policy 2014 – objectives and strategies.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/04P	Agroforestry Systems and Management	1	70	30	100

Practical

Study characteristics of trees/shrubs/grasses for agroforestry – Designing and development of multifunctional agroforestry model - Survey agroforestry practices in local/ adjoining areas - Visit to prominent agroforestry systems, other plantation crop combinations, Homegardens, other integrated multitier agroforestry systems and study their structural and functional attributes- Establishment and management of fodder bank – Studies on Integrated Farming System - Establishment and assessment of Industrial agroforestry plantations - Volume and biomass estimation- Carbon sequestration assessment- Crown measurement, light interception, leaf area index measurements in agroforestry systems. Annual crops/grass growth measurements and yield estimation – Determination of cost and returns of various agroforestry systems.

Suggested Readings

1. Chundawat D.S. and S. K. Gautham. 2017. Textbook of Agroforestry. Oxford and IBH Publishing, (ISBN: 9788120408326)
2. Divya M. P. and K. T. Parthiban. 2005. A Textbook on Social Forestry and Agroforestry. Satish Serial Publishing, New Delhi (ISBN: 9384988952).
3. Nair P. K. Ramachandran. 1993. An Introduction to Agroforestry. Springer Dordrecht (ISBN: 978-0-7923-2134-7)
4. Parthiban, K.T. and A. Keerthika. 2021. A Textbook of Agroforestry – Principles, Practices and Application. Agro Bios (India), Jodhpur. (ISBN: 9788197377689)

5. Parthiban, K.T. and R. Seenivasan. 2017. Plantation and Agroforestry: Pulpwood Value Chain Approach. Published by Scientific Publisher, Jodhpur. Pp: 517.
6. Parthiban, K.T., et al., 2018. Multifunctional Agroforestry – Ecosystem services. Narendra Publishers. New Delhi. Pp: 419.
7. Parthiban, K.T., R. Umarani, S. Umesh Kanna, I. Sekar, P. Rajendran, and P. Durairasu. 2014. Industrial Agroforestry Perspective and Prospectives. Scientific Publisher. Jodhpur. Pp.396.

Multidisciplinary Courses (MDC)

SOA/UG/FMDC/01T – Farming Based Livelihood Systems

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMDC/01T	Farming Based Livelihood Systems	2	70	30	100

Aim of the Course

1. To make the students aware about farming-based livelihood systems in agriculture.
2. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood

Theory

Status of agriculture in India and different states, Income of farmers and rural people in India, Livelihood- Definition, concept and livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approach, approaches and framework, Definition of farming systems and farming based livelihood systems Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems- Crops and cropping systems, Livestock, (dairy, piggery, goatry, poultry, duckry etc.), Horticultural crops, Agro--forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., small, medium and large enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different Agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems, Schemes and programs by Central and State Government, Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMDC/01P	Farming Based Livelihood Systems	1	70	30	100

Practical

Study characteristics of trees/shrubs/grasses for agroforestry – Designing and development of multifunctional agroforestry model - Survey agroforestry practices in local/ adjoining areas - Visit to prominent agroforestry systems, other plantation crop combinations, Homegardens, other integrated multitier agroforestry systems and study their structural and functional attributes- Establishment and management of fodder bank – Studies on Integrated Farming System - Establishment and assessment of Industrial agroforestry plantations - Volume and biomass estimation- Carbon sequestration assessment- Crown measurement, light interception, leaf area index measurements in agroforestry systems. Annual crops/grass growth measurements and yield estimation – Determination of cost and returns of various agroforestry systems.

Suggested Readings

1. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi, India
2. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7. [Google Scholar]
3. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy
4. Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO and World Bank, Rome, Italy and Washington, DC, USA
5. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy
6. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, Amitava Dey Ujjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan, S. K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna - 800 014, Bihar
7. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
8. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
9. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram. 10. Walia, S. S. and U. S.
10. Walia, 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

Ability Enhancement Compulsory Course (AECC)

SOA/UG/FAECC/01T – Communication Skills

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FAECC/01T	Communication Skills	1	70	30	100

Aim of the Course

To acquire competence in oral, written and non-verbal communication, develop strong personal and professional communication and demonstrate positive group communication

Theory

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.

Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FAECC/01P	Communication Skills	1	70	30	100

Practical

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed;

Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

Suggested Readings

1. Allport, G W, 1937, Personality: A Psychological Interpretation. Holt, New York.
2. Brown Michele and Gyles Brandreth, 1994, How to Interview and be Interviewed. Sheldon Press, London.
3. Carnegie Dale, 1997, The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. Francis Peter S J, 2012, Soft Skills and Professional Communication. Tata McGraw Hill, New Delhi.
5. Kumar S and Pushpa Lata, 2011, Communication Skills. Oxford University Press.
6. Neuliep James W, 2003, Intercultural Communication A Contextual Approach. Houghton Mifflin Co Boston.
7. Pease, Allan, 1998, Body Language. Sudha Publications, Delhi.
8. Raman M and Singh P, 2000, Business Communication. Oxford University Press.
9. Seely J, 2013, Oxford Guide to Effective Writing and Speaking. Oxford University Press.
10. Thomson A J and Martinet A V, 1977, A Practical English Grammar. Oxford University

SOA/UG/FAECC/02P – NCC/NSS-I

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FAECC/02P	NCC/NSS-I	1 (0+1)	70	30	100

Aim of the Course

NCC: to develop character, comradeship, discipline, secular outlook, spirit of adventure, and selfless service among youth to create useful citizens. It trains and motivates youth to provide leadership in all walks of life, including the Armed Forces, and fosters national.

NSS: to develop the personality of student volunteers through community service, guided by the motto "Not Me, But You". It focuses on fostering social responsibility, understanding community needs, promoting national integration, and developing leadership and problem-solving skills to address practical community issues.

Practical

National Cadet Corps (NCC-I)

• Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline.

• Drill- aim, general words of command, attention, stands at ease, stand easy and turning. • Sizing, numbering, forming in three ranks, open and close order march, and dressing.

• Saluting at the halt, getting on parade, dismissing, and falling out.

• Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.

• Marking time, forward march, and halt. Changing step, formation of squad and squad drill. • Command and control, organization, badges of rank, honors, and awards

• Nation Building- cultural heritage, religions, traditions, and customs of India. National integration. Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizens. Leadership traits, types of leadership. Character/ personality development. Civil defense organization, types of emergencies, firefighting, protection. Maintenance of essential services, disaster management, aid during development projects.

• Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning.

• Structure and function of human body, diet and exercise, hygiene and sanitation. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control.

National Service Scheme (NSS-I)

Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skilfull in executing democratic leadership, developing skill in program, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society. A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one-day camp in a year and one special camp for

duration of 7 days at any semester break period in the two years. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

Introduction and Basic Components of NSS

• Orientation: history, objectives, principles, symbol, badge; regular programs under NSS

• Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.

• NSS program activities. Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary. Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.

• Community mobilization. Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration.

• Indian history and culture, role of youth in nation building, conflict resolution and peace- building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism.

• Citizenship, constitution, and human rights. Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information. Family and society. Concept of family, community (PRIs and other community based organizations) and society.

Skill Enhancement Courses

SOA/UG/FSEC/01P – Commercial Seedling Production

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/01P	Commercial Seedling Production	2 (0+2)	70	30	100

Aim of the Course

To impart knowledge on seed collection, commercially important seedling production through the natural as well as artificial regeneration techniques

Practical

Raising of stocks, practicing grafting, budding and layering techniques in tree species. Treatment effect and pre curing of scion, growth regulator effect on asexual methods – raising nurseries, practicing seed propagation, taking observations, visit of commercial nurseries. Preparation of production and planning schedule for bare root and containerized nurseries. Nursery site and bed preparation. Pre-sowing treatments. Sowing methods of small, medium, and large sized seeds. Mother bed and transplant bed preparation- Pricking and transplanting of in transplant beds. Intermediate nursery management operations. Preparation of ingredient mixture. Filling of containers Study of vegetative techniques-cutting, grafting etc. Visit to tissue culture laboratory and other nurseries Temporary and permanent nursery development preparation of proposal, layout, economic considerations. Production of quality planting material of commercially important species.

SOA/UG/FSEC/02P – Commercial Forestry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/02P	Commercial Forestry	2 (0+2)	70	30	100

Aim of the Course

To impart knowledge on systematic management, planting, and harvesting of trees on a large scale for profit, primarily producing timber, pulp, paper, and fuel. It combines economic utilization with sustainable practices, such as forest certification, to ensure long-term productivity and resource availability for industries while providing raw materials and rural employment.

Practical

Commercial vs. Conventional Forestry- Differences in objectives (production vs. conservation). Study of fast-growing and high-value and short rotation species - *Eucalyptus*, *Casuarina*, *Tectona grandis*, *Melia dubia, Popular and Bamboos. Study of commercially important and high –value species of NTFPs/NWFPs and medicinal/aromatic plants.* Temporary, permanent, commercial, and hi-tech nurseries, tissue culture. Nursery management - Containerized seedlings, root trainers, and vegetative propagation (cuttings, grafting) - Soil mixtures, potting, nutrient management, protection measures, and hardening of seedlings. Forest Products, Utilization & Economics- Timber, pulpwood, poles, and fuel wood production. Non-Timber Forest Products (NTFPs) in commercial forestry-Gums, resins, medicinal plants, and bamboo processing. Forest Economics- costing & Returns, Valuation of products, marketing, cost-benefit analysis of plantations, and investment analysis. Records, Legal Aspects & Certification Small Commercial Forestry Plan.

SOA/UG/FSEC/03P – Landscape Management and Restoration

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/03P	Landscape Management and Restoration	2 (0+2)	70	30	100

Aim of the Course

To impart the knowledge on landscape design, management and restoration techniques of forestry areas.

Practical

Visit to manage landscaped areas and listing the landscaping components. Listing the various landscaping components in your college campus. Study of the tools and implements used in landscaping. Prepare a lists of trees selected for landscaping based on objectives and localities. Prepare a garden design for the given area. Mapping degraded areas - survey the site using GPS or field observations. Visit erosion control demonstration site- soil analysis of landscape restoration affecting site –physio-chemical properties of soil). Selection of native species for Restoration. Preparation of Landscape Restoration Plan. Monitoring and evaluation of restoration sites. Invasive species management. Design of landscape for ecological stability.

SOA/UG/FSEC/04P – Wildlife Photography

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/04P	Wildlife Photography	2 (0+2)	70	30	100

Aim of the Course

- To understand the importance of composition in Wildlife photography
- To critically evaluate the photographic processes for nature and wildlife, within the larger context of biodiversity documentation

Practical

Introduction to Wildlife Photography equipments. Camera Settings Practice. Study of different type's camera, DSLR vs Mirrorless cameras, Focal length and Lens classification, Picture styles and their use. Sensor Size and Dynamic Range. Different image formats. Raw vs Jpeg, Focusing, its types and uses in the field. Components of a Photographic camera. Field Visit for Wildlife Photography. Bird Photography. Macro Photography of Small Fauna. Habitat Photography. Ethical Wildlife Photography. Photo Documentation and Species Identification. Photo Editing and Processing. Wildlife Photo Report / Portfolio. Job opportunities as a wildlife photographer.

Suggested Readings

- Langford Michael, Fox Anna and Sawdon Smith Richard. (2010). Langford's Basic Photography - The Guide for Serious Photographers (9th Ed). Focal Press
- Ang, Tom (2014). Photography: The Definitive Visual History. London: DK Publishers
- Ang, Tom. (2013). Digital Photography Masterclass. London: DK Publishers Freeman, Michael (2007). The Photographer's eye. London: Focal Press
- Davis, Harold and Davis Phyllis. (2011). the Photoshop Darkroom 2. London: Focal Press
- Kelby Scott. (2011). Light it, Shoot it, Retouch it. San Fransisco: New Riders

- Adobe CreativeTeam (2012). Adobe Photoshop CS6 Classroom in a Book. California: Adobe Press
- Grimmett,Richard and Inskipp Tim and Carol.(2011).Birds of the Indian Subcontinent. Oxford Press. Second Edition
- National Geographic & Spelman, Lucy H. (2012).National Geographic Animal Encyclopedia. National Geographic Books.

SOA/UG/FSEC/05P – Ecotourism

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/05P	Ecotourism	2 (0+2)	70	30	100

Aim of the Course

To impart the knowledge of Ecotourism and hands on training of Ecotourism in Himalayan region

Practical

List out the major ecotourism destinations in India. Visit an ecotourism site and carry out stakeholder analysis and social impact assessment. Estimation of carrying capacity (PCC, RCC and ECC) for a tourism destination. Documentation of flora and fauna in the eco-tourism areas. Prepare an ecotourism plan for a nearby destination. Visit to a protected area or ecotourism destination. Case study and field visit of successful ecotourism models in India and Uttarkhand, Ecotourism in Himalayan regions. Ecotourism study in national parks, wildlife sanctuaries, and biosphere reserves, Case studies from Jim Corbett National Park and Nanda Devi Biosphere Reserve. Preparation of field reports. Interaction with local communities. Ecotourism site evaluation. Ecotourism policies in India, Role of government and non-government organizations, Guidelines for ecotourism development, Role of Ministry of Tourism and United Nations World Tourism Organization. Role of guides and interpretation centres, Community-based ecotourism (CBET), Livelihood opportunities for rural and tribal communities, Community interaction study, Interact with local communities involved in eco-tourism. Benefit sharing and conflict management. Role of local communities in ecotourism. Positive and negative impacts of ecotourism, Strategies to minimize ecological damage, Responsible tourism practices.

SOA/UG/FSEC/06P – Para-taxonomy

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/06P	Para-taxonomy	2 (0+2)	70	30	100

Aim of the Course

To understand the role of Para-taxonomist in forestry, biodiversity assessment and conservation.
Use of basic field and lab. techniques for collecting-preserving-shorting and labelling plant-insect etc. specimen

Practical

Introduction to Para-taxonomy. Taxonomy v/s Para-taxonomy. Field sampling methods-plot-transect methods-collection techniques-field safety/hands-on task. Spaceman handling-preservation and labelling. Plant specimens insect and arthropods-fungi and lichens-seeds-fruit and cones. Herbarium specimens-insect/arthropods specimen. Identification basics use of keys. Morphological characters tools for identification hands-on task. Data management sample reporting-field data, basic analysis, short report preparation hands-on task, lab based specimen work, field equipments.

SEMESTER – II

Core Major Courses –(MJ)

SOA/UG/FMJ/05T – Tree Seed and Nursery Technology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/05T	Tree Seed and Nursery Technology	1	70	30	100

Aim of the Course

1. To impart knowledge on production, collection, processing, quality control and storage of tree seeds and its application in production and conservation of forests.
2. To impart knowledge on quality nursery stock and clonal technologies for production of quality planting stock in forest trees.

Theory

Introduction - Seed technology and its role in forestry. Seed germination. Factors affecting seed germination. Seed dormancy - Types - Causes - Merits and demerits. Production of quality seeds - Candidate tree, plus tree and elite tree. Seed production areas - Establishment and management of SPA. Seed orchards - Types of seed orchard - Establishment and management of seed orchards. Factors affecting tree seed production - Influence of provenance and seed source. Seed collection - Planning and organizing seed collection - Methods and factors affecting choice of seed collection. Seed extraction. Seed treatment - Pre-sowing seed treatments - Priming - Pelleting - Dormancy breaking treatments - Pre-storage treatments. Seed storage - Orthodox and recalcitrant seeds - Natural longevity of tree seeds - Factors affecting longevity in storage - Storage conditions - Methods and containers. Seed testing. Classes of seeds - Seed quality control mechanism - Certification procedure- Classes of tree seeds - OECD procedure for tree seed certification - Plant quarantine - International organizations involved in seed quality control - Seed Legislation in India.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/05P	Tree Seed and Nursery Technology	1	70	30	100

Practical

Tree Seed Technology: Identification and study on external and internal structure of tree seeds and physiological maturity tests. Visit to seed production area. Physical purity analysis, Determination of seed moisture, Seed germination test, Seed viability test, TTZ test, Hydrogen peroxide test, Seed vigour test, Conductivity test, Accelerated ageing test and Seed health testing. Tree Nursery Technology: Nursery technology for quality nursery stock production in small seeded species - Big seeded species - Recalcitrant seeds - Endangered tree species. Nursery techniques for large size seedlings for avenue planting and problem soils. Clonal forestry – Potting media – Plant growth substances – Propagation methods through cuttings, grafting, layering and budding.

Suggested Readings

1. Agrawal, R.L. 1986. Seed Technology. Oxford - IBH Publishing Co. New Delhi.
2. Bedell, P.E. 1998. Seed Science and Technology: Indian Forestry Species. Allied Publishers, New Delhi.
3. Bewely, J.D and Black, M. 1985. Seed- Physiology of development and germination.
4. Chin, H.F. and Roberts, E.H. 1980. Recalcitrant Crop Seeds. Tropical Press Sdn. Bhd. Kuala Lumpur - 22-03, Malaysia.
5. Hannah Jaenicke. 2007. Good Tree Nursery Practices. International Centre for Research in Agro forestry, Kenya.
6. Hartmann, H.T and Kester, D.E. 1968. Plant propagation – principles and practice prentice – Hall of India Private Limited, New Delhi.
7. ISTA. 1993. International Rules for Seed Testing Rules. International Seed Testing Association, Zurich, Switzerland
8. Leadem, C.L. 1984. Quick Tests for Tree Seed Viability. B.C. Ministry of Forests and Lands, Canada.

9. Napier, I. and Robbins, M. 1989. Forest Seed and Nursery Practice in Nepal. Nepal-UK Forestry Research Project, Kathmandu.
10. Ram Prakash. 2007. Plantation and nursery techniques of forest trees. International Book Distributers, Dehra Dun.
11. Ramamoorthy and K. Sivasubramanian. 2006. Seed Legislation in India. Agrobios, Jodhpur.
12. Renugadevi, J., P. Srimathi, P.R. Renganayaki and V. Manonmani. 20101. Seed Testing. Agrobios, Jodhpur.
13. Sharma R.R and Manish Srivastava. 2007. Plant propagation and nursery management. International Book Distributers, Dehra Dun.
14. Umarani, R. 2006. Tree Seed Technology. Scientific Publishers, New Delhi.

SOA/UG/FMJ/06T – Fundamental of Forest Genetics

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/06T	Fundamental of Forest Genetics	1	70	30	100

Aim of the Course

To understand the fundamental concepts of Genetics and Cytogenetics

Theory

Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics. Physical basis of heredity. Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes. Cell division – mitosis- meiosis and their significance - Gametogenesis and syngamy in Plants. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram. Types of chromosomes based on position of centromere, Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Klinefelter syndrome and Turner syndrome; Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, triticale, cotton, tobacco, Brassica. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance, and Non allelic interaction with modification in Mendelian ratio – (I) Dominant epistasis (12:3:1). (ii) Recessive epistasis (9:3:4). (iii) Duplicate and additive epistasis (9:6:1). (iv) Duplicate dominant epistasis (15:1). (v) Duplicate recessive epistasis (9:7). (vi) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i) to (vi). Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in human, coat colour in rabbits, pseudo alleles, isoalleles. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Linkage - coupling and repulsion; Crossing over – significance of crossing over; Factors controlling crossing over. Strength of linkage and recombination; Two point and three points test cross. Double cross over, interference and coincidence; genetic map, physical map.

Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination different types –Sex determination in plants. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in Mirabilis jalapa- cytoplasmic male sterility. Watson and Crick model. Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA. Protein synthesis, Mutation – characteristics of mutation – micro and macro mutation, Transition and trans version; major physical and chemical mutagens.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/06P	Fundamental of Forest Genetics	1	70	30	100

Practical

Study of microscopes – Preparation of fixatives and stains – Pretreatment of materials for mitosis and meiosis – study of mitosis and meiosis. Study of genetic ratios of – monohybrid, dihybrid – incomplete dominance.

Gene interaction - multiple alleles and multiple factors. Study of linkage, Estimation of strength of linkage and recombination frequency in three points test cross data and F2 data – Drawing of genetic map – interference and coincidence. Studies on sex linked inheritance in Humans and Drosophila.

Suggested Readings

1. Benjamin Lewin. 2005. Genes IX Oxford University Press, Oxford.
2. Daniel Sundararaj, G. Thulasidas and M. Stephen Dorairaj, 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot, Chennai.
3. Gupta P.K., 1997. Cytogenetics. Rastogi Publications, Meerut.
4. Pundhansingh. 2014. Elements of Genetics. Kalyani Publishers.
5. Russel, P.J. 2000. Fundamentals of genetics. Addition Wesley Longman Publishers, USA.
6. Singh, B.D. 2004. Fundamentals of Genetics, Kalyani Publishers, Chennai.
7. Stansfield, W.D.1990. Theory and problems of genetics. Mc-Graw Hill Book Co., New York.
8. Strickberger. M.W. 1996. Genetics. Prentice-Hall of India Pvt. Ltd. New Delhi.
9. Verma, P.S. and V.K. Agarwal. 2007. Genetics. S. Chand and Company Ltd. / New Delhi.

SOA/UG/FMJ/07T – Wood Anatomy and Identification

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/07T	Wood Anatomy and Identification	1	70	30	100

Aim of the Course

To develop basic understanding on wood identification, anatomical characterisation of both Gymnosperms and Angiosperms.

Theory

Basics and introduction of wood anatomy - Classification of plant kingdom - Gymnosperms versus angiosperms - Kinds of woody plants. The plant body - a tree and its various parts. Meristems -Promeristem, primary meristem, secondary meristem. Simple tissues - Parenchyma, collenchyma, sclerenchyma and the vascular tissues. Parts of the primary body - Typical stems and roots of dicots and monocots. Basic process in tree growth - Vascular cambium – Expansion of cambium layer – Duration of cambial activity - Secondary growth in woody plants. Mechanism of wood formation - Special reference to typical dicot stem. Ray initials and fusiform initials -Anticlinal and periclinal division. Physiological significance of wood formation. The macroscopic features of wood - Sapwood, heartwood, pith, early wood, late wood, growth rings, abnormal Secondary growth, dendrochronology, wood rays, Knots, Grain orientation etc - Sapwood versus heart wood - Anatomical differences. Transformation of sapwood to heartwood - Factors affecting transformation. Prosenchymatous elements, tracheids, vessels, fibers, parenchyma and rays, resin canals, gum canals, latex canals and infiltrants in wood. Abnormal Secondary growth.

Three dimensional features of wood - Transverse, tangential and radial surfaces. Elements of wood cell walls. Structure and arrangement of cells - Simple pit and bordered pits. Extractives in wood. Comparative anatomy of gymnosperms and angiosperms. Anatomical features of common Indian timbers - Classification into porous and non-porous woods, ring porous and diffuse porous woods. Effect of growth rate on wood properties. Juvenile wood and mature wood. Reaction wood. Bark structure - Composition and functions.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/07P	Wood Anatomy and Identification	1	70	30	100

Practical

Study of primary growth in stems of typical dicots and monocots. Study of wood formation in typical dicot stem. Study of vascular bundles in monocots. Parts of the logs (Woody trunks), and the three distinctive surfaces of wood (i.e. cross, radial and tangential planes). Timber identification and its importance. Procedures for field identification of timbers and examination of wood samples. Study of physical features of wood. Study of gross features of wood. Study of anatomical features of wood, pores or vessels, different types. Study of soft tissue

in timbers and their different types distributions. Study of wood rays, and their different types. Study of the non-porous woods, their physical and anatomical description. Study of infiltration and inclusions in wood. Anatomical keys and methods to use them. Dichotomous keys, punched card keys and computer aided identification. Field identification of important timbers of Tamil Nadu.

Suggested Readings

1. Brown, H.P. 1995. Text Book of Wood Technology, Vol I and II International Books and Periodical supplement service, New Delhi.
2. Haygreen, J.G and Bowyer, J.L. 1982. Forest Products and Wood Science-An Introduction. The Iowa State University press, America P.495.
3. Hoadley, B. 2000. Identifying Wood-Accurate results with simple tools. Taunton Press, Newtown, USA. 223p.
4. Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th edn. McGraw-Hill. New York, USA: 722p.
5. Rao, R. K. and Juneja, K. B. S. 1992. Field identification of fifty important timbers of India. Indian Council of Forestry Research and Education, New Forest, Dehra Dun. 123p.

SOA/UG/FMJ/08T –Forest Measurements and Inventory

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/08T	Forest Measurements and Inventory	2	70	30	100

Aim of the Course

1. To impart various methods of measurements on standing, felled trees, crops and determining the volume of trees
2. To inculcate knowledge on volume table preparation for trees

Theory

Forest Mensuration - Definition and objectives - Scales of measurement - Units of measurements - Precision, bias and accuracy aimed and reasons. Diameter and girth measurements - Breast height measurements - instruments used. Measurement of height - Definitions - Methods of measurement of height - Ocular - non instrumental and instrumental methods. Sources of error in height measurement - Height measurement of leaning trees. Tree stem form - Metzger's theory - Form factor - Types of form factor - Form height, form quotient - Form class. Area measurement in trees and timber - Cross sectional and basal area. Volume measurement of standing trees – Volume of felled logs - Branch wood. Volume table - Definition - Preparation of volume tables - Graphical, regression equation and alignment chart method. Forest inventory - Sampling techniques and methods - Measurement of crops - Sample plots. Increment - CAI and MAI - Increment Percent - Instruments and methods - Increment Borer. Stump analysis - Stem analysis - Increment Boring. Tree crops - Measurements - Objects - Crop diameter, crop height, crop age and crop volume. Yield table and stand table.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/08P	Forest Measurements and Inventory	1	70	30	100

Practical

Determination of length - Measurements of diameter. Girth and basal area of trees using Callipers, Tape, Ruler, Penta Prism, Tree Calliper, etc. Measurement of height using non instrumental method - Shadow method and Single pole method. Measurement of tree height using instrumental methods - Haga altimeter - Clinometer - Blume leiss Hypsometer - Laser Hypsometer. Volume determination of standing and felled trees. Exercise on Stump analysis and Stem analysis. Annual ring counting in trees using ring borer. Preparation of volume tables - Local volume table. Yield Table - Preparation and Application. Point sampling - Theory - Wedge prism. Total enumeration and partial enumeration - Kinds of sampling and elementary statistical computations

Suggested Readings

1. Chaturvedi, A. N. and L. S. Khanna. 1982. Forest Mensuration. International Book Distributors, Dehradun.
2. Manikandan, K and S. Prabhu. 2014. Indian Forestry. A breakthrough approach to Indian Forest Service. Jain Brothers, New Delhi.
3. Eugene, T. Forest Mensuration. McGraw Hill Company.
4. Panwar and Bharadwaj. Handbook of Practical Forestry. Updesh Purohit for Agrobios (India), Jodhpur.

Multidisciplinary Courses (MDC)

SOA/UG/FMDC/02T – Entrepreneurship Development and Business Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMDC/02T	Entrepreneurship Development and Business Management	2	70	30	100

Aim of the Course

- To provide student an insight into the concept and scope of entrepreneurship
- To expose the student to various aspects of establishment and management of a small business unit
- To enable the student to develop financially viable agribusiness proposal

Theory

Development of entrepreneurship, motivational factors, social factors, environmental factors, characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development. Environment scanning and opportunity identification need for scanning–spotting of opportunity-scanning of environment– identification of product / service – starting a project; factors influencing sensing the opportunities. Infrastructure and support systems- good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development. Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management. Production management – product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management – raw material costing, inventory control. Personal management – manpower planning, labour turn over, wages / salaries. Financial management / accounting – funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, and taxation. Marketing management- market, types, marketing assistance, market strategies. Crisis management-raw material, production, leadership, market, finance, natural etc.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMDC/02P	Entrepreneurship Development and Business Management	1	70	30	100

Practical

Visit to small scale industries. Agro-industries, Interaction with successful entrepreneurs, Agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Suggested Readings

1. Charantimath P.M., 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. Desai V, 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
3. Desai, Vasant, 1997, Small Scale Industries and Entrepreneurship. Himalaya Publ. Hous
4. Grover, Indu, 2008, Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Gupta CB, 2001, Management Theory and Practice. Sultan Chand and Sons.
6. Khanka SS, 1999, Entrepreneurial Development. S. Chand and Co.
7. Mehra P, 2016, Business Communication for Managers. Pearson India, New Delhi.
8. Pandey M. and Tewari D., 2010. The Agribusiness Book. IBDC Publishers, Lucknow.
9. Singh D, 1995 Effective Managerial Leadership. Deep and Deep Publ.
10. Singhal R.K., 2013, Entrepreneurship Development and Management, Katson Books.
11. Tripathi PC and Reddy PN, 1991, Principles of Management. Tata McGraw Hill.

Value Added Course (VAC)

SOA/UG/FVAC/01T – Environmental Studies and Disaster Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FVAC/01T	Environmental Studies and Disaster Management	2	70	30	100

Aim of the Course

To expose and acquire knowledge on the environment and to gain the state-of-the-art - skill and expertise on management of disasters.

Theory

Introduction to Environment - Environmental studies - Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystems. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity. Environmental Pollution: Definition, cause, effects and control measures of: (a) Air pollution. (b) Water pollution. (c) Soil pollution. (d) Marine pollution. (e) Noise pollution. (f) Thermal pollution. (h) light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.

Disaster management - Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest f ire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

Course Code		Credit	Marks	Total

	Name of Subject		External	Internal	
SOA/UG/FVAC/01P	Environmental Studies and Disaster Management	1	70	30	100

Practical

Visit to a local area to document environmental assets river/forest/grassland/hill/mountain. Energy: Biogas production from organic wastes. Visit to wind mill / hydro power / solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and un polluted system. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, Alkalinity. Estimation of water hardness. Estimation of DO and BOD in water samples. Estimation of COD in water samples. Enumeration of E. coli in water sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystem – Visit to pond/river/hills. Visit to areas affected by natural disaster

Suggested Readings

1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp
2. Dhar Chakrabarti. P.G. 2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi
4. Parthiban, K.T. Vennila, S. Prasanthrajan, M. Umesh Kanna, S. 2023. (In Press). Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India.
5. Prasanthrajan M, and Mahendran, P.P. 2008. A text book on Ecology and Environmental Science. ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur - 313 002. First Edition: 2008
6. Prasanthrajan M, 2018. Objective environmental studies and disaster management. ISBN 9789387893825. Scientific publishers, Jodhpur, India. Pp. 146.
7. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications, Meerut, India
8. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA.

Ability Enhancement Compulsory Course (AECC)

SOA/UG/FAECC/03T –Personality Development

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FAECC/03T	Personality Development	1	70	30	100

Aim of the Course

To make students realize their potential strengths, cultivate their inter-personal skills and improve employability

Theory

Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviors, personality and Organizational Behavior. Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

Course Code	Name of Subject	Credit	Marks	Total

			External	Internal	
SOA/UG/FAECC/03P	Personality Development	1	70	30	100

Practical

MBTI personality analysis, Learning Styles and Strategies, Motivational needs, Firo-B, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behavior.

Suggested Readings

1. Andrews, Sudhir, 1988, How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw Hill.
2. Heller, Robert, 2002, Effective Leadership. Essential Manager series. Dk Publishing.
3. Hindle, Tim, 2003, Reducing Stress. Essential Manager series. Dk Publishing.
4. Kumar, Pravesh, 2005, All about Self- Motivation. New Delhi. Goodwill Publishing House.
5. Lucas, Stephen, 2001, Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
6. Mile, D J, 2004, Power of Positive Thinking. Delhi. Rohan Book Company.
7. Smith, B, 2004, Body Language. Delhi: Rohan Book Company.
8. Shaffer, D R, 2009, Social and Personality Development (6th edn). Belmont, CA: Wadswor

SOA/UG/FAECC/04P – NSS/NCC - II

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FAECC/04P	NSS/NCC - II	1 (0+1)	70	30	100

Aim of the Course

NCC: to develop character, comradeship, discipline, secular outlook, spirit of adventure, and selfless service among youth to create useful citizens. It trains and motivates youth to provide leadership in all walks of life, including the Armed Forces, and fosters national.

NSS: to develop the personality of student volunteers through community service, guided by the motto "Not Me, But You". It focuses on fostering social responsibility, understanding community needs, promoting national integration, and developing leadership and problem-solving skills to address practical community issues.

Practical

National Cadet Corps (NCC-II)

• Arms Drill- Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/long trail from the order and vice- versa. Guard mounting, guard of honor, Platoon/Coy Drill.

• Characteristics of rifle (22/303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding. • Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.

• Introduction to map, scales, and conventional signs. Topographical forms and technical terms.

• The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs.

• Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

National Service Scheme (NSS-II)

Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skilful in executing democratic leadership, developing skill in program, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.
A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one-day camp in a year and one special camp for duration of 7 days at any semester break period in the two years. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.
• Importance and role of youth leadership
• Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies
• Definition and importance of life competencies, problem-solving and decision-making, interpersonal communication. Youth development programs
• Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations
• Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid. Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

Skill Enhancement Courses (SEC)

SOA/UG/FSEC/07P – Clonal Seedling Production

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/07P	Clonal Seedling Production	2 (0+2)	70	30	100

Aim of the Course

To impart the knowledge and development of clonal seedling production by using forestry principles.

Practical

Clonal nursery introduction and layout; concept of clonal forestry and components (hedge garden, mist chamber, shade/hardening areas); layout drawing. Plus/mother tree selection; field identification; plus-tree/mother stock register. Propagule collection and hedge garden establishment/management. Preparation of cuttings/mini cuttings: types, size, selection, labelling. Rooting media and containers: mixing and filling root trainers, trays, polybags. Rooting hormones and setting cuttings: IBA/NAA use, solution prep, treatment and setting. Propagation structures: mist chamber, polyhouse, shade house – environment control and placement. Rooting management and assessment: routine care, hygiene, callus/root observation, rooting/survival % calculation. Potting and primary hardening: shifting rooted cuttings to media; arrangement in shade house. Clonal seedling management: irrigation, basic fertigation/nutrients, recognition of nutrient disorders, and simple pest/disease control. Secondary hardening and quality assessment: schedule, recording growth/survival, quality standards. Grading and root evaluation: plantable/substandard/discard; sample uprooting and documentation. Lifting, packing, transport and planting techniques. Nursery records and batch tracking: plus-tree, cutting/rooting, production/dispatch, input/cost records. Economics and simple clonal nursery plan (group): cost components, cost/seedling, and brief production/business plan.

SOA/UG/FSEC/08P – Commercial Tree Seed Production

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	

SOA/UG/FSEC/08P	Commercial Tree Seed Production	2 (0+2)	70	30	100
Aim of the Course					
To impart the knowledge on seed collection, commercially important tree seedling production through the natural as well as artificial regeneration techniques					
Practical					
Familiarisation with forest seed production systems: seed orchards, seed stands, seed collection zones. Identification of major forest tree species used in commercial seed production. Visit to seed production areas / seed orchards (field exposure). Techniques of Seed Collection. Processing and Extraction of Seeds. Seed Quality Evaluation. Seed Dormancy and Pre-sowing Treatments. Seed Storage and Packaging. Field Testing and Nursery Raising. Raising of stocks, practicing grafting, budding and layering techniques in tree species. Treatment effect and pre curing of scion, growth regulator effect on asexual methods – raising nurseries, practicing seed propagation, taking observations, visit of commercial nurseries. Preparation of production and planning schedule for bare root and containerized nurseries. Nursery site and bed preparation. Sowing methods of small, medium, and large sized seeds. Mother bed and transplant bed preparation- Pricking and transplanting of in transplant beds. Intermediate nursery management operations. Preparation of ingredient mixture. Filling of containers Study of vegetative techniques-cutting, grafting etc. Visit to tissue culture laboratory and other nurseries Temporary and permanent nursery development preparation of proposal, layout, economic considerations. Production of quality planting material of commercially important tree species. Seed Certification and Seed Enterprise Basics. Records, Reporting.					

SOA/UG/FSEC/09P – Wild and Commercial Beekeeping

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/09P	Wild and Commercial Beekeeping	2 (0+2)	70	30	100
Aim of the Course					
To provide practical knowledge and hands-on training in wild and commercial beekeeping practices, including identification of honey bee species, colony management, honey production, pollination services, pest and disease diagnosis, and sustainable utilization of forest and agricultural bee resources for livelihood generation and biodiversity conservation.					
Practical					
Visit to local forest area to document wild honey bee colonies such as *Apis dorsata* and *Apis florea*; recording nesting sites, supporting tree species and surrounding vegetation. Identification of honey bee species and castes (queen, worker, drone) and study of brood stages (egg, larva, pupa) in managed colonies. Visit to a commercial apiary unit to study hive types, apiary layout and seasonal colony Study and handling of beekeeping equipment including: Langstroth hive Frames, comb foundation sheets, Smoker, hive tool, queen excluder, protective clothing, Demonstration and practice of colony inspection techniques and safe hive handling. Study of bee flora in forest and agricultural ecosystems; preparation of floral calendar indicating nectar and pollen sources. Biodiversity assessment of pollinators in farming and forest ecosystems management. Honey harvesting: uncapping, extraction using honey extractor, filtration and bottling. Identification and processing of bee products: honey, beeswax, pollen, propolis and royal jelly. Visit to honey processing and packaging unit to study grading, storage and labelling. Field visit to wild honey collection area to study traditional and sustainable harvesting practices. Economic analysis of apiary enterprise: cost of establishment, honey yield and profitability estimation.					

SOA/UG/FSEC/10P –Forest Based Industrial Training

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/10P	Forest Based Industrial Training	2 (0+2)	70	30	100

Aim of the Course
To provide practical exposure and industrial training in forest-based enterprises and wood-based industries, enabling students to understand raw material processing, value addition, industrial operations, quality control, environmental safeguards, and entrepreneurship opportunities in forestry-based sectors.
Practical
Visit to saw mill unit to study log reception, log conversion methods, sawing techniques, grading and storage of timber. Study of wood seasoning techniques including air seasoning and kiln seasoning; observation of moisture reduction practices. Visit to plywood and veneer manufacturing unit to study peeling, gluing, pressing and finishing processes. Visit to particle board / fibre board manufacturing unit to study raw material preparation, pressing and finishing techniques. Training in wood preservation methods including chemical treatment processes and preservation plants. Study of pulp and paper industry operations including pulping, bleaching and sheet formation processes. Visit to resin, gum and essential oil extraction units for value addition of non-timber forest products. Study of bamboo-based industries including bamboo treatment, product manufacturing and handicrafts. Visit to medicinal and aromatic plant processing units for drying, grading and packaging techniques. Study of furniture manufacturing unit including wood machining, joining, finishing and polishing techniques. Observation of charcoal and briquette production units. Exposure to forest-based cottage industries and small-scale enterprises. Study of industrial waste management practices in forest-based industries. Assessment of environmental safeguards adopted in industries including pollution control measures. Industrial safety practices including use of protective equipment and accident prevention measures. Study of quality control and grading standards for timber and wood products. Documentation of industrial workflow, raw material sourcing and marketing channels. Preparation and submission of Industrial Training Report based on internship/field attachment.

SOA/UG/FSEC/11P – Urban Forestry Designing and Planning

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FSEC/11P	Urban Forestry Designing and Planning	2 (0+2)	70	30	100

Aim of the Course
To provide the practical knowledge and hands-on training on designing and planning in Urban Forestry.
Practical
Site Survey & Base Map and layout plans using straightforward surveying and mapping tools. Tree & Vegetation Inventory. Urban Tree Species & Selection. Site & Micro-climate Assessment. Basic Mapping Tools (GPS/GIS – Demo). Urban Forest Typologies. Design Principles (Ecological & Social). Functional Zoning & Concept Plan. Planting Design & Layout. Soil, Planting Pits & Establishment. Street Tree Design & Conflicts. Tree Health, Risk & Maintenance. Ecosystem Services & User Perception. Community Participation & Communication, roles of communities/ULBs/NGOs; preparation of a simple awareness poster/leaflet concept. Urban Forest Design & Management Plan (Group). Identify urban green space types and basic urban forest typologies. Perform simple site assessments and tree/vegetation inventory for urban areas. Develop small-scale urban forest/green space plans that incorporate ecological and social functions. Outline a simple management and community participation plan for an urban green site. Study of urban tree inventory. Mapping of urban green spaces. Urban park layout planning. Assessment of ecosystem services in urban areas. Urban tree health assessment – study of pests, diseases, mechanical damage and pruning/thinning tree's. Urban biodiversity observation- record birds, insects, and other organisms associated with trees. Preparation of an urban forestry management plan -conduct site survey. Identify problems -pollution, soil compaction, or lack of trees.

POST-II SEMESTER

Internship (Only for exit option for award of UG-Certificate) -10 (0+10)-10 Week

General objective

To provide students with an opportunity to put into practice the skills they have learned while in the institute, so that in case they exit with UG-certificate, they will be able to get proper engagement/ employment and consider having their own start-ups.

Specific objectives

By the end of the internship, the students should be able to

1. Integrate theory and practice
2. Assess interests and abilities in their field of study
3. Develop work habits and attitudes necessary for job success
4. Develop communication, interpersonal and other critical skills in the job interview process
5. Explore career alternatives prior to graduation.

Activity

The students will have internship/ training for 10 weeks' duration either in the parent institute (attaching the students to facilities such as farm machinery testing centre, incubation centres, prototype production facilities, etc.) or in industry, farm machinery service centre or related organisations involved in agri-engineering activities. The College/ University will facilitate attaching the students to the organisations.

After completion of internship, the students will have to submit a report of their learnings and also present in form of a seminar before nominated faculty members and other students.

The assessment will be based on the report / assessment received from the industry/ organisation and the report and the presentation made at the University. Ideally the weightage will be 70% & 30% for external & internal respectively as per NEP, 2020.

SEMESTER- III

Core (Major Courses - MJ)

SOA/UG/FMJ/09T – Silviculture of Trees

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/09T	Silviculture of Trees	2 (2+0)	70	30	100
Aim of the Course					
To impart basic knowledge on silviculture and regeneration of broad leaved and conifer tree species					
Theory					
Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices, pest and diseases and economic importance of Acacia nilotica, Acacia catechu, Azadirachta indica, Dalbergia sissoo, Shorea robusta, Tectona grandis, Terminalia species, Anogeissus latifolia, Pongamia pinnata, Bassia latifolia, Calophyllum inophyllum, Simarouba glauca and Albizia lebbeck- Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices, pest and diseases and economic importance of Bambusa species, Calamus species, Dendrocalamus strictus and Melocanna bambusoides. Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices, pest and diseases and economic importance of Northern region trees: Abies pindrow, Celtis australis, Diospyros species, Grewia species, Picea smithiana, Pinus wallichiana, Populus spp., Quercus species, Robinia pseudoacacia, Eucalyptus spp. and Salix spp. Eastern trees region trees: Neolamarckia cadamba, Chukrasia				

tabularis Cryptomaria japonica, Dipterocarpus species, Mesua ferrea, Morus laevigata, Pinus kesiya, Shorea assamica and Terminalia myriocarpa. Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices, pest and diseases and economic importance of Acacia spps. (Wattles), Anacardium occidentale, Casuarina spp., Dalbergia latifolia, Pterocarpus spp., Eucalyptus spp., Santalum album, Swietenia mahogany and Tamarindus indica. Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices, pest and diseases and economic importance of the following conifer species: Tropical pines, Abies pindrow, Picea smithiana, Cedrus deodara and Pinus roxburghii.

Suggested Readings

1. Champion, H.G. and A.L. Griffith. 1989. Manual for General Silviculture for India.
2. Dwivedi, A.P. 1993. A Text Book of Silviculture, International Book Distributors, Dehradun.
3. Luna, R.K. 2005. Plantation trees International Book Distributors, Dehradun.
4. Troup, K.S. 1984. The Silviculture of Indian Trees- Volume I, II and III. Controller of Publications, New Delhi.
5. Ralph D. Nyland. 1996. Silviculture concepts and applications. McGraw-Hill, New York.

SOA/UG/FMJ/10T – Wood Science and Technology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/10T	Wood Science and Technology	1	70	30	100

Aim of the Course

1. To make students aware about the problems related to wood as basic material to manufacture various useful products
2. To understand the wood treatment requirement

Theory

Wood – Natural defects in wood. Electrical, thermal and acoustic properties of wood. Mechanical properties of wood like tension, compression, bending, shearing, cleavage, hardness, impact resistance, nail and screw holding capacities. Wood water relationship - Hygroscopic nature of wood – Free and bound water – Shrinkage and swelling - Fibre saturation point - Equilibrium moisture content. Moisture content determination. Durability and treatability of wood – Natural defects and wood deterioration. Wood seasoning; merits, principles, seasoning of timber – Introduction and history of seasoning in India - purpose and scope -Factors influencing seasoning, Mechanism of drying and types; Selection and preparation of material for seasoning. Air seasoning, kiln seasoning and chemical seasoning. Refractory classes of timbers, kiln schedules; Special seasoning methods, Seasoning defects and their control. Wood biodeterioration. Classification of timbers based on durability and seasoning behavior. Wood preservation; Introduction– Development and progress of wood preservation in India - mechanism of wood preservation. Preparation of wood for preservative treatment principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.). General idea about fire retardants and their usage, Durability of timbers. Methods of application of wood preservatives-Non pressure Methods-Brushing-Steeping-Hot and cold bath process Diffusion Process-Momentary Dip Process-Sap displacement method - Boucherie method. Pressure Method-Full cell process - Empty Cell Process-Merits and demerits.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/10P	Wood Science and Technology	1	70	30	100

Practical

Mechanical tests on timber. Static bending, impact bending, and compression parallel and perpendicular to the grain, hardness, shear, torsion, nail and screw pulling test, brittleness test and calculation of properties. Estimation of combustibility of wood using bomb calorimeter. Estimation of directional shrinkage and swelling

of wood. Familiarization of non-destructive wood testing instruments. Visit to wood testing laboratories. Visit to timber depot/saw mill to study the stacking methods and various defects in wood. Determination of moisture content by different methods. Visit to Wood seasoning unit to study the various types of seasoning methods and Safety aspects. Exercise on fixing seasoning schedule for timbers under steam heated kiln and FRI solar heated kiln seasoning method. Visit to wood preservation unit to study the different methods of application of wood preservatives. Study on the environmental health and safety aspects of wood preservatives. Non pressure and pressure methods of application of preservatives. Seasoning and preservative treatments for important tree species.

Suggested Readings

1. Bowyer J. L., Shmulsky, R. and Haygreen, J. G. 2007. Forest products and wood science: An introduction. 5th Ed. Blackwell publishing, Ames, IA. 496p.
2. Brown, H. P. 1985. Manual of Indian wood technology. International books and periodicals supply service, New Delhi. 121 p.
3. Divya, M.P., Parthiban, K.T., Packialakshmi, M. and S. Krishnamoorthi. 2022. Text Book on Wood Products and Utilization. Scientific Publishers, Jodhpur (ISBN No.: 9789392590795).
4. FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.
5. Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.
6. USDA [U.S. Department of Agriculture]. Wood handbook - Wood as an engineered material. 1999. U.S. Department of Agriculture, Forest Service. Forest Products Laboratory, Madison, WI. 508p.

SOA/UG/FMJ/11T – Forest Microbiology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/11T	Forest Microbiology	1	70	30	100

Aim of the Course

To impart the basic knowledge about the microbiological associations involved in promoting the growth of trees.

Theory

Forest soil Microbes. Rhizosphere concept- ecto and endo rhizosphere, rhizoplane and rhizosphere effect (R:S ratio); spermosphere - seed surface microflora and phyllosphere - lichens, algae and leaf nodulating microorganisms. Soil microbial biomass in different forests; qualitative and quantitative nature of microorganisms in various forest ecosystems - their role in improving soil nutrient availability and plant growth. Carbon cycle - forest litter / organic matter – types; composition of organic matter / litter. Biochemistry and microbiology of litter / organic matter decomposition under aerobic - tropical, subtropical and temperate forest ecosystem; and in anaerobic conditions – mangrove and swamp forests. Role of autotrophic microorganisms in sequestering carbon in forest soils. Biochemical cycling of nitrogen. Nitrogen fixation - free living, associative and symbiotic diazotrophs. Nitrogen fixing trees- leguminous trees with Rhizobium and non-leguminous / actinorhizal trees with Frankia and their nitrogen fixing capacity. Biochemistry and microbiology of nitrification and denitrification and their impact on nitrogen availability in aerobic and anaerobic forest ecosystem. Biochemical cycling of phosphorus. Microbial transformation of phosphorus – mycorrhizae – types; mycorrhizal status of tropical, sub-tropical and temperate forest trees; nutritional and non-nutritional effects of mycorrhizae; mechanism of enhanced nutrient uptake and plant growth. Phosphate solubilisers - types – mechanism of phosphate solubilization. Microbial transformation of iron and sulphur. Microbial interactions in soil. Microbial inoculants - mass production, storage methods ISI / BIS standards and quality control; problems and constraints in production and application. Role of microbial inoculants in afforestation program. Generation of biofuels − Development of biological conversion technologies − Biodiesel − Microorganisms and raw materials used for microbial Oil production − Treatment of the feedstocks prior to production of the Biodiesel − Current technologies of biodiesel production. Bioethanol – Properties – Feedstocks − Process technology − Pilot plant for ethanol production from lignocellulosic feedstock − Biomethanol − Principles, materials and feedstocks − Process technologies and techniques − Advantages and limitations.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/11P	Forest Microbiology	1	70	30	100

Practical

Isolation and enumeration of rhizosphere and soil microorganisms. Quantification of heterotrophic microbial population and total microbial activity of different forest ecosystem. Isolation of cellulose and lignin degrading microorganisms from forest floor. Isolation of free living diazotrophs - Azotobacter and Beijerinckia from soil. Isolation of Azospirillum and Phosphobacteria. Study of root nodules of leguminous trees. Isolation of Rhizobium from root nodules of tree legumes. Study of root nodules of non-leguminous trees and isolation of Frankia from Casuarina equisetifolia / Alnus nepalensis. Examination of ecto- and endo-mycorrhizae from different forest soils. Bio composting of leaf litter. Mass culturing of bacterial and fungal inoculants- microbial inoculation techniques.

Suggested Readings

1. Alexander, M. 1985. Introduction to Soil Microbiology. John Wiley and Sons, New York. New Delhi.
2. Paul, E. A. 2007. Soil microbiology, ecology, and biochemistry, 2nd edn. Academic Press
3. Pelczar, M.J., Chan, C.S and Krieg, N.R. 2003. Microbiology, Tata McGraw Hill Pub. Co. Ltd.,
4. Prescott, L.M., Harley, J. P. and Kelin, D.A. 2000. Microbiology, 4th edn, McGraw Hill.
5. Shukla, G. and A. Varma. 2010. Soil Enzymology (Soil Biology), Springer Verlag.
6. Singh, R.P.2010. Microbiology. Kalyani Publishers. Ludhiana. Smith, S.E. and D.J. Read. 1997. Mycorrhizal Symbiosis. 2nd edn. Academic Press, San Diego. Subba Rao N.S and Dommergues, Y.R. 2000. Microbial interactions in Agriculture and Forestry. Vol. II. Oxyford and IBH Publications Co. Pvt. Ltd. New Delhi and Kolkata. Subba Rao, N.S. 1997. Biofertilizers in Agriculture and Forestry. 3rd edn. Oxford and IBH Publishing Co. PVT Ltd., New Delhi. Bombay and Kolkata. 10. Tate, R.L. 1995. Soil Microbiology. John Wiley and sons, Inc New York. 11. Tauro, P. Kapoor, K.K. and Yadav, K.S. 1989. An Introduction to Microbiology, Wiley Pub.

SOA/UG/FMJ/12T – Forest Soil and Nutrient Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/12T	Forest Soil and Nutrient Management	1	70	30	100

Aim of the Course

To impart knowledge about the forest soil fertility and productivity and to enhance the nutrient status in soil.

Theory

Forest soils vs cultivated soils - Soil fertility and productivity - Properties of soils under different forest ecosystem - Arnon's criteria of essentiality. Classification of nutrients based on Arnon's criteria - Sources of nutrients and forms of nutrients. Nutrient transformations – Mineralization and immobilization - Availability and uptake of nutrients by plants – Fixation and loss of nutrients – Nitrogen, Phosphorus and Potassium cycles in soil. Available forms of secondary nutrients – Ca, Mg and S. Availability of micronutrients. Deficiency and toxicity symptoms and their corrective measures for nutrients. Relationship between nutrient concentrations and plant growth. Deficiency, Hidden hunger, Critical limit, Sufficiency level, Excessive and Toxicity limits. Soil Reaction (pH) and Nutrient availability. Cation exchange – CEC – adsorption, desorption. AEC – calculation of BSP. Significance of CEC and exchangeable cations with respect to soil fertility. Factors affecting CEC in soils. Nutrient Interaction – Definition – Mechanisms, types of interactions between macro and micronutrients, chelates and plant nutrition. Diversity of organisms in the soil – Factors affecting their growth and activity in the soils viz., Organic matter, oxygen, temperature, pH etc. Soil Macro organisms - Earthworms, Ants and termites and plant roots, Soil micro animal's nematodes, protozoa etc. and their role in soil. Soil microorganisms- Prokaryotes (Bacteria and archaea), fungi, actinomycetes, Cyanobacteria (Blue-green algae) etc. in the soil ecosystem their distribution. Atmospheric N fixation by organisms and Nitrogen fixing tree species. Mycorrhiza - Types of Mycorrhiza and Beneficial effects on plant nutrition. Concepts of rhizosphere - Rhizodeposition and Phyllosphere. Organic matter decomposition - Factors affecting organic matter

decomposition – Stages of organic matter decomposition - C: N ratio of organic matter, its importance and nutrient availability - Role of organic matter in the Forest soil improvement. Nutrient management - Nutrient Use efficiency – Importance. Methods of soil fertility evaluation – Diagnosis of deficiency symptoms, Biological test, Soil testing and Rapid plant tissue analysis and Fertilizers recommendation. Soil fertility management: Optimum, efficient and balanced use of nutrients. INM – SSNM – Fertigation - Crop rotation, Nutrient management through fortification of fertilizers. Permanent manurial experiments - LTFE experiments. Methods of fertilizer recommendations.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/12T	Forest Soil and Nutrient Management	1	70	30	100

Practical

Available N, available $P_2 O_5$, available K_2O, and micronutrients from the soils and interpretation of their results. Determination of CEC and derivation of ESP. Estimate the gypsum requirement of sodic soils and lime requirement of acid soils. Enumeration of soil micro-organisms -Estimation of N fixing micro-Organisms- Organic matter decomposition.

Suggested Readings

1. Brady, N.C. The Nature and Properties of Soils. Mac Millan Pub. Comp. New York.
2. Burges, A. and Raw, F. 1967. Soil Biology. Acad. Press, New York.
3. Mengel, K. and Kirkby, A. 1978. Principles of Plant Nutrition. International Potash Institute, Switzerland.
4. Pritchett and Fisher R.F. 1987. Properties and Management of Forest Soils. John Wiley, New York.
5. Tisdale, L. S. Nelson, L.W. and Beaton, J. D. 1985. Soil Fertility and Fertilizers. Macmillan Publishing Company, New York.
6. Young, A. 1989. Agroforestry for Soil Conservation. CAB International, U.K.

SOA/UG/FMJ/13T – Forest Survey and Engineering

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/13T	Forest Survey and Engineering	1	70	30	100

Aim of the Course

1. To educate the students on different types of surveying and latest technologies involved in surveying
2. To impart basic knowledge on building materials, construction, roads and bridges, its types and its adoptability in forest areas

Theory

Surveying – Scales - Measurement of distances - Chains – Cross staff - Chain surveying - Chaining on plain and sloping lands - Chaining around obstacles - Offset – Measurement of angles – Bearings and Meridians. Compass – Types: Prismatic and surveyor's compass. Compass surveying - Traversing – Closed and open - Methods of surveying - Radiation, intersection and traversing. Local attraction - Theodolite surveying – Methods: Repetition and reiteration. Measurement of horizontal angles and distances, vertical angles. Levelling - Utility and scope – Definitions - Methods - Levelling instruments - Dumpy level - Temporary and permanent adjustments. Bench marks – Types. Reduction of levels - Rise and fall method - height of collimation method. Topographical surveying - Methods of contouring - Characteristics and use of contours - Maps and Map Projections – Basics of Total Station – EDM - GPS - Study of minor survey instruments. Aerial Surveying – Concept - Stereo Photogrammetry – Aerial photogrammetry – Overlaps – Scale of photographs – Vertical and titled photographs distortion in aerial photographs – Stereostopic vision – Photo interpretation – Application. GPS Surveying –Basic Concept – Space, control and user segments – Satellite configuration – Signal structure – Orbit determination and representation – Hand held and geodetic receivers – Field work procedures – Data processing and application. Materials for construction – Bricks, Lime and Cement - Mortar – Concrete – Foundation and types -Bearing Capacity of soil – Brick masonry - Stone masonry - Roofs – Floors –Dampness – Anti termite treatment in buildings - Precautions – Safety measures. Estimating and costing - PWD schedule

of rates – Preparation of estimate. Road – Introduction, definitions, types, road profile - Demarcation, alignment in plains and hills, curves and drainage. WBM and earthen road, road maintenance and road signs - Retaining wall – Types and construction features - Bridges – Principles of construction, selection of site and types - Culverts – Types.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/13P	Forest Survey and Engineering	1	70	30	100

Practical

Chain surveying –study of different types of chains - chaining on plain and sloping lands - chaining around obstacles - field work – plotting. Cross staff surveying and computation of areas. Compass surveying - radiation, intersection and traversing. Theodolite surveying - measuring horizontal angles and distances, vertical angles. Levelling – study of instruments - reduction of levels - rise and fall method - height of collimation method. Study of coordinate system – Aerial surveying - Total Station – GPS Surveying – Preparation of contour maps - Brick, Lime and cement manufacturing - Visit to Brick and Lime kilns - Design of foundation - Brick and stone masonry – section showing different components of brick and stone masonry. Types of roofs – trusses – king and queen post truss. Drawings of different types of windows and doors. Preparation of estimates for small structures and measurement book entries

Suggested Readings

1. Arora, K.R. 2007. Surveying Vol. I and II. Standard Book House, Delhi-6.
2. Basak, N.N. 1994. Surveying and levelling. Tata McGraw hill publications, New Delhi.
3. Deodhar S.V. and Singhal. 2001. Civil Engineering Materials. Khanna Publishers, New Delhi.
4. Duggal, S.K. 2008. Building Materials. New Age International Publishers, New Delhi
5. Masani, N.J. 2001. Forest Engineering without Tears, Nataraj Publication, Dehra Dun.
6. Ram Prakash. 1997. Forest Surveying, International Book Distributors, Dehra Dun.
7. Rangawala, S.C and Rangwala, P.S. 1985. Surveying and Leveling, Character Publishing House, Anand.
8. Rangwala. S.C. 1991. Estimating and costing. Charotar book stall, station road, Anand.
9. Rangwala. S.C. 2000, Building construction, Charotar publishing house, Anand

SOA/UG/FMJ/14T –Wildlife Sciences

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/14T	Wildlife Sciences	1	70	30	100

Aim of the Course

To develop basic understanding on Reptiles, Aves and Amphibians and their ecology, behaviour and the habitat.

Theory

Wildlife – Definition - Types - Free living, Captive, domesticated and feral animals - History of Wildlife studies in India - Evolution of geological time scale - Significance - Classification of Indian Mammals - Description of Mammal, Reptiles, Aves and Amphibians Basic requirements of wildlife - food, water, shelter, space, limiting factors - Food chain, Food web, Ecological pyramids; Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity; Effect of light and temperature on animals - Impact of Water and Temperature; Animal behavior - Systems of perception - Thermo receptors - Tactile receptors - Auditory receptors - Visual receptors - Chemo receptors - Biological rhythms - Circadian - Tidal - Lunar. Kinds of behavior - Innate - learning methods of communication - Mimicry - Aggressions - Social groups - Coronial - Fossorial - Seasonal - Aquatic adaptations. Niche- Territory - Home range - Cursing radius - Edge - Eco tone - Juxtaposition - Interspersion - Carrying capacity - Cover and its types - Habitat analysis and evaluation - Alternate Habitat AnalysisHabitat Improvement - Manipulation of forestry operations - Food and Water development - Cover construction - Shelter improvement.

Course Code		Credit	Marks	Total

	Name of Subject		External	Internal	
SOA/UG/FMJ/14P	Wildlife Sciences	1	70	30	100

Practical

Visit to various protected areas and observations on the morphological, behavioural, feeding and reproductive activities of different species of wild animals in India. Various study methods on the wild animals, such as focal animal sampling, Sherman trapping, mist netting, camera trapping, for identification, determination of age and sexing of animals including the small mammals. Faecal analysis of wild animals.

Suggested Readings

1. Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. Oxford University Press, New Delhi.
2. Dasmann, R.F. 1982. Wildlife Biology. Wiley Eastern Ltd. New Delhi.
3. Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA. International Zoo Books, Published by New York Zoological Society, New York
4. Johnsingh, A.J.T. and Manjrekar, N. 2014. Mammals of South Asia. Vol. I. University Press, 614p
5. Johnsingh, A.J.T. and Manjrekar, N. 2015. Mammals of South Asia. II. University Press, 739p
6. Krebs, C. and Davis, N. 1978. Introduction to behavioral ecology. Oxford University Press.
7. Menon, V. 2014. Indian Mammals: A field guide. Hachette. 528p.
8. Mittermeier, R.A., Rylands, A.B. and Wilson, D.E. 2013. Handbook of the Mammals of the World - Volume 3. Lynx Edicions. 952.
9. Prater, S.H. 1971. The Book of Indian Animals. Oxford University press, Bombay. 324p.
10. Sukumar, R. Asian Elephant. Ecology and Management. Oxford University Press Cambridge.
11. Wilson, D.E. and Mittermeier, R.A. 2009. Handbook of the Mammals of the World - Volume 1. Lynx Edicions. 728.
12. Wilson, D.E. and Mittermeier, R.A. 2011. Handbook of the Mammals of the World - Volume 2. Lynx Edicions. 886. Forest Health and Protection

SOA/UG/FMJ/15T – Forest Health and Protection

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/15T	Forest Health and Protection	1	70	30	100

Aim of the Course

To create professional knowledge on various disturbances, problems and other issues to forest and the associated heath and protection

Theory

Disturbances – Importance and Scope – Causes and kinds of forest disturbances – Problems due to the forest disturbances - Factors that determines the forest protection. Deforestation – Causes of deforestation – Extent and causes of forest and land degradation – Extent of global and national forest cover changes – Effects of deforestation – Strategies to reduce and control deforestation – Preventive and remedial measures. Shifting Cultivation – Causes – Extent of shifting cultivation areas – Methods of shifting cultivation areas – Impact of shifting cultivation - Preventive and remedial measures – Alternative land use practices to shifting cultivation. Forest fires – Characters, Components, Causes, Types – Status of forest fire in Global and Indian scenario – Injuries and Impact – Fire detection methods. Forest fires and its effect on forest ecosystems. Fire suppression – Firefighting equipment – Fire control policy and objectives. Fire fighting in other countries. Post f ire suppression operations -Legal provisions – Economics of fire protection. Encroachment - Types, control of encroachment, illegal felling of trees – Legislation mechanism in encroachment. Damage caused by domestic and wild animals. Defective management – Errors in execution – Preventive measures. Invasive alien species in forests – Its effect on forest ecosystem - management techniques. Community forest protection – Role of forest dwellers and Village Forest committee (VFC). Awareness creation. Community participation in forest protection.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

SOA/UG/FMJ/15P	Forest Health and Protection	1	70	30	100

Practical

Visit to deforestation and shifting cultivation areas in nearby forest and study about its causes and prevention. Visit to forest areas with fire damages. Study of fire registers, records and fire monitoring stations. Fire line creation in forest. Study of fire reporting methods and instruments. Visit to fire station - Study and acquaint with machinery used for fire control. Application of recent techniques in fire forecasting, monitoring and mapping. Study of problems in forest encroachment. Field study of role of forest dwellers in forest protection. Visit to Community Forest protection area. Identification of weeds, parasites and epiphytes – Its impact in forest. Tree transplanting techniques and revival packages in wind and cyclone damaged trees. Symptoms of damages, causes their management methods.

Suggested Readings

1. Basher, A.E.S. (1983). Forest Fires and Their Control. Gulab Primlani Amerind Publishing, New Delhi.159p.
2. Elton, C. S. (2000). The Ecology of Invasions by Animals and Plants. University of Chicago Press.
3. Fuller, M. (1991). Forest Fires. Wiley Nature Editions, New York.
4. Khanna, L.S. (1988). Forest Protection. Khanna Bandhu, Dehra Dun.206p
5. Parthiban, K.T., M. Suganthy and N. Krishna Kumar. (2019). Forest Protection – Principles and Application. Jain Brothers, New Delhi (ISBN No.: 9788183602952)

Core (Minor Course - MN)

SOA/UG/FMN/01T – Arboriculture

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/01T	Arboriculture	1	70	30	100

Aim of the Course

To impart skill and expertise on urban tree management coupled with the knowledge on landscape management

Theory

Arboriculture – Tree identification and principles. Tree anatomy – Structure, function and mechanics. Tree physiology – Environmental factors affecting Photosynthesis, Respiration and Transpiration. Selection of trees – Tree propagation – Tree planting – Various tree planting techniques – Water and Plant Growth – Tree guards. Soil and Tree growth – Fertilizing Trees and Compacted Soils – Soil Nutrition. Tree disorder and Health – Frost protection – Wind damage minimizing – Mulching and watering – Diagnosing and management. Health disorders in trees – Pest and diseases in urban trees – Identification and diagnosing – Integrated pest and disease management. Tree pruning – Techniques, essential and safety – Basic pruning principles of woody plants – Canopy architecture: Crown cleaning, crown reduction, crown lifting. Felling a whole tree and felling in sections. Burlapping techniques. Arboricultural equipment – Pruning tools: Secateurs, Hand saws, Power tools – Felling tools: Chain saws, Hedge trimmers, Climbing equipment (Ladder, harness, rope, belt, sprus, etc.) – Tool maintenance. Tree surgery – Types of surgery: Cavity treatment, rods, cables, etc. – Propping – Treating bark wounds – Removing large branches. Climbing techniques – Preparing to climb, how to climb and anchoring point. Knots – Tree surgery safety. Workplace safety – Protective equipment: Personal protection, gloves, eyewear, hearing protection, skin protection, etc. Handling tools and machinery safety. Risk management, legal issues, and aesthetic considerations. Landscaping – Principles and elements – Types of landscape designs – Formal: Persian and Mughal designs – Informal: British and Japanese. Landscape components – Plant and other components – Lawn, pergolas, hedges, edges, topiary, balloon, arbours, carpet beds, trees, f lower beds, annuals and climbers. Practices of landscaping. Tools and implements for landscaping. Specialised gardens - Butterfly, water, bog or marsh, terrace, roof, sunken, indoor and rock. Planning and planting programs in institutional and industrial complexes, roads, bridges, parking area and other structures.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/01P	Arboriculture	1	70	30	100

Practical
Tree Identification and principles – Tree Propagation – Tree planting techniques –Canopy architecture – Tree pruning techniques. Burlapping techniques. Arboricultural equipment – Pruning tools and Feeling tools – Tool maintenance. Tree surgery: Cavity treatment, rods, cables, etc. Climbing techniques – Tree climbing and equipment – Preparing to climb, how to climb and anchoring point. Common Insect pests and diseases to trees and woody plants. Landscaping – Types of landscape designs – Tools and implements for landscaping. Specialised gardens. Visit to different landscapes and gardens. Workplace safety and Protective equipment
Suggested Readings
1. Harris, R. W. (1992). Arboriculture: integrated management of landscape trees, shrubs, and vines (No. Ed. 2). Prentice-Hall International. 2. Konijnendijk, C., Nilsson, K., Randrup, T., and Schipperijn, J. (Eds.). (2005). Urban forests and trees: a reference book. Berlin, Heidelberg: Springer Berlin Heidelberg. 3. Shigo, A. L. (1991). Modern arboriculture: a systems approach to the care of trees and their associates. Shigo and Trees, Associates. 4. Watson, G. W., and Himelick, E. B. (1997). Principles and practice of planting trees and shrubs (pp. 107-113). Savoy, IL: International Society of Arboriculture.

Ability Enhancement Compulsory Course (AECC)

SOA/UG/FAECC/05P - Physical Education, First Aid, Yoga Practice and Meditation

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FAECC/05P	Physical Education, First Aid, Yoga Practice and Meditation	2 (0+2)	70	30	100

Practical

Physical education; Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.

Yoga; History of Yoga, Types of Yoga, Introduction to Yoga,

• Asanas (Definition and Importance) Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan–left leg right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhdhanurasan, Sawasan

• Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari

• Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh

• Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra

• Role of yoga in sports

• Teaching of Asanas – demonstration, practice, correction and practice. History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics Need and requirement of first aid. First Aid equipment and upkeep. First AID Techniques, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and

Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

Skill Enhancement Courses (SEC)

SOA/UG/FSEC/12P – Forest Fire Management

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/12P	Forest Fire Management	2 (0+2)	70	30	100
Aim of the Course					
To impart the knowledge on forest fire and its management using modern tools/machines for sustainable forest management.					
Practical					
Forest Fire Environment & Safety Orientation. Fuel Sampling and Fuel Load Estimation. Fire Weather Observation and Fire Danger Rating. Forest Fire Detection and Reporting Systems. Use of Remote Sensing and GIS in Forest Fire Management. Fire Prevention and Fuel Management Practices. Firefighting Tools, Equipment, and Suppression Techniques. Incident Command System (ICS) and Fire Crew Organization. Community-based Forest Fire Management. Case Study and Simple Fire Management Plan. Demonstrations of traditional and modern for firefighting tool. Uses of Fire-Fighting equipment's. Mock drills. Field mapping. Utilizing drones and GPS for mapping of fire affected areas. Fire as a silvicultural tool for controlled burning, training for creating fire lines. Identification of Fire-Prone Areas. Study of causes of forest fire. Demonstration of fire control methods. Impact Assessment of Forest Fire awareness and prevention program for fire control. Preparation of forest fire report.					

SOA/UG/FSEC/13P – Timber Conversion

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/13P	Timber Conversion	2 (0+2)	70	30	100
Aim of the Course					
To provide practical skills in timber conversion processes, including log measurement, sawing operations, timber grading, seasoning techniques, preservation treatments, wood machining, quality evaluation and economically efficient utilization of wood in forest industries.					
Practical					
Identification and use of timber conversion tools and equipment; measurement and scaling of logs and estimation of recoverable timber; log debarking and preparation for sawing; sawmill operations including plain and quarter sawing; timber grading and sorting; identification of common wood defects (knots, shakes, splits, warping); determination of moisture content and observation of seasoning methods (air and kiln); basic wood machining operations such as planing, sanding, and simple joining; timber preservation methods; evaluation of timber yield and conversion efficiency; industrial visits to sawmills, seasoning yards, and plywood/veneer units; maintenance of practical records including measurements, grading sheets, and conversion calculations; adherence to workshop safety practices.					

SOA/UG/FSEC/14P – Activated Carbon Technology

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

SOA/UG/FSEC/14P	Activated Carbon Technology	2 (0+2)	70	30	100
Aim of the Course					
To impart the knowledge of basic principles and uses of activated carbon to suitable forest/agro-based raw materials, carbonization and activation operations; perform basic quality tests; handle materials and chemicals safely; prepare simple records and cost estimates for small-scale activated carbon production.					
Practical					
Introduction & Applications. Raw Material Selection & Basic Characterisation. Size Reduction & Feedstock. Carbonization Set-up & Safety. Charcoal Recovery & Evaluation. Principles of Activation (Physical/Chemical). Chemical Impregnation / Activation Preparation. Activation Process & Monitoring. Washing, Neutralisation & Drying. Physical Tests: Moisture, Ash, Bulk Density. Simple Adsorption Test (Dye/Colour Removal). Water Filtration Demonstration. Quality & Product Grading (Introductory). Economics & Small-scale Enterprise Aspects. Mini-project & Documentation.					

SOA/UG/FSEC/15P – Micro Forest

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/15P	Micro Forest	2 (0+2)	70	30	100
Aim of the Course					
To develop practical understanding and analytical skills required for planning, establishing, managing, and assessing Micro Forests with focus on species composition, soil and site evaluation, biodiversity enhancement, ecosystem services measurement, and socio-ecological benefits in urban, peri-urban and degraded landscapes.					
Practical					
Site selection and preparation for Micro Forest planting; measurement of soil parameters (texture, pH, moisture) and light intensity; preparation of planting layout including species selection, spacing, and zonation; nursery raising of seedlings; transplanting and planting of saplings with pit preparation and initial care; recording plant survival and growth parameters (height, collar diameter, crown spread); identification of planted tree species and associated flora; monitoring of insects, birds, and small fauna in the plot; weed identification and management; estimation of litter fall and ground cover; observation of water retention and infiltration; photo-documentation and mapping of plot; preparation of field records and reports; visits to established Micro Forests for comparison of design, species composition, and growth performance.					

SOA/UG/FSEC/16P – Community Forest

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/16P	Community Forest	2 (0+2)	70	30	100
Aim of the Course					
To train and exposure of students in sustainable forest management, restoration, and income generation, often involving participatory techniques like Joint Forest Management (JFM) and focus on enhancing skills in forest conservation, biodiversity monitoring, sustainable harvesting, and enterprise development, frequently addressing institutional capacity gaps.					
Practical					
Organisation/institution – national and international organisation support programs that assist countries in strengthening **community** forestry management, **functioning, and organisation structure. Community Organisation in India- Indigenous Community Forest Management (ICFM), Sacred Groves, Crafted Community Forest management (CCFM), Gramdan Villages, Cooperatives, Gram Sabhas in Scheduled Areas, Van Panchayat (Forest Council), Joint Forest Management (JFM). Capacity Building & Skills Development- t**raining practitioners and community members on legal issues, resource management, and technical skills. Empowerment, Gender analysis, Participatory resource management- forest villages					

management committees (Van Panchayat, village council etc). **SWOT analysis. Microplanning- tools, technique and methodology, PRA and RRA exercises. Research management, monitoring and evaluation. Action plan development and implementation- ISO and organizational or institutional level implementation, Conflicts concerning the resources and their management. Sustainable Forest Management-** practices such as agroforestry, community forest and community-managed woodland management, Joint Forest Management (JFM)**- c**ollaborative initiatives between forest departments and communities to manage degraded forests, empowering local communities to protect resources. **Income & Employment. Cost & benefits of management. Financial and administrative analysis. Project formulation and implementation.**

SOA/UG/FSEC/17P – Human -Animal Ecosystem Interface

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/12P	Human -Animal Ecosystem Interface	2 (0+2)	70	30	100
Aim of the Course					
To impart the knowledge about Human-Animal Ecosystem interface includes observe and record major types of human–animal interactions (benefits and conflicts) in forest–village and urban–rural interfaces; recognise key wild and domestic animal groups and their links with forest, agro-forest and village ecosystems and prepare a brief site-specific human–animal interface profile and a simple coexistence/management plan.					
Practical					
Introduction & Local Context. Site Familiarisation & preparation of Base Map. Animal Sign and Presence Survey. Livestock and Free-Ranging Animal Use. Crop Raiding and Property Damage. HWC Documentation Methods. Community Perceptions & Interviews. Health & Zoonotic Interface (Introductory). Habitat Features & Interface Hotspots. Simple Mapping of Interface Zones. Existing Coexistence & Mitigation Measures. Institutional Roles & Procedures. Case Study Exercise – human- wildlife conflicts. Monitoring Format Design. Site Profile & Coexistence Plan.					

SOA/UG/FSEC/18P – Forest Resource Assessment

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/18P	Forest Resource Assessment	2 (0+2)	70	30	100
Aim of the Course					
To provide hands-on training in the measurement, evaluation, and documentation of forest resources, enabling students to assess forest composition, structure, density, regeneration, biomass, and productivity for sustainable forest management and planning.					
Practical					
Measurement and mapping of forest compartments and plots; identification and enumeration of tree species, shrubs, and herbaceous flora; determination of tree diameter at breast height (DBH) and basal area; measurement of tree height using clinometer or hypsometer; estimation of tree volume using volume tables or geometric methods; canopy cover and crown dimension assessment; calculation of density, frequency, and dominance of tree species; assessment of regeneration through seedling and sapling counts; biomass estimation using allometric equations; soil sampling for texture, moisture, and organic content; documentation of deadwood and litter; GPS mapping and field sketching of forest types; observation and recording of major forest products and uses; preparation of field data sheets and forest resource assessment report; field visits to different forest types (natural, plantation, degraded) for comparative study.					

SOA/UG/FSEC/19P – Multifunctional Agroforestry

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/19P	Multifunctional Agroforestry	2 (0+2)	70	30	100
Aim of the Course					
To impart the knowledge about multifunctional agroforestry is a sustainable, resilient land-use system integrating trees/shrubs with crops or livestock, designed to enhance smallholder income, secure food, and provide environmental services and productivity continuous year-round income.					
Practical					
Income & Productivity- through diversified products like fruits trees, timber, nut trees, shrubs (currents & berries), herbaceous (beets & herbs), rhizomatous crop (root vegetables), pulses crop, oil crops and medicinal plants. Suitable agroforestry model in different agro-climatic zone in India. Farming based system- Livestock rearing, Lac cultivation, Honey bees cultivation, Sheep/Goat farming, Chicken farming, Pig farming, Fish farming (Pisciculture) etc. Environmental Services- acts as a carbon sink, improves soil fertility, manages nutrient cycles, and creates windbreaks. Resilience & Security- improves nutritional security, reduces reliance on chemical inputs, and enhances farm adaptation to climate change. System Components- combines high-value trees (timber/fruit) with agricultural crops and animal husbandry to form a complete, self-sustaining system. Economic benefits- offers diversified income streams (food, fodder, fuel, firewood). Ecological benefits- improves water quality, soil health, and biodiversity conservation. Social benefits- supports rural livelihood improvement, social cohesion, and community resilience.					

SOA/UG/FSEC/20P – Value addition of NTFPs

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/20P	Value addition of NTFPs	2 (0+2)	70	30	100
Aim of the Course					
To provide practical training in the processing, value addition, and utilization of non-timber forest products (NTFPs), enabling students to understand post-harvest techniques, quality enhancement, product development, and sustainable management of NTFPs for livelihood and commercial purposes.					
Practical					
Identification and collection of locally available NTFPs (fruits, nuts, seeds, gums, resins, medicinal plants, aromatic plants); sorting, grading, and cleaning of NTFPs; basic post-harvest processing techniques including drying, roasting, extraction, and powdering; preparation of value-added products such as jams, juices, oils, herbal teas, essential oils, incense sticks, and herbal formulations; preservation and storage methods; packaging and labelling techniques; quality assessment (moisture content, organoleptic evaluation); demonstration of simple processing equipment; estimation of yield and product recovery; documentation of processing steps; field visits to NTFP processing units, cottage industries, and local collection centers; preparation of practical records and reports.					

SEMESTER – IV

Core (Major Courses – MJ)

SOA/UG/FMJ/16T – Commercial Forest Products and Utilization

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/16T	Commercial Forest Products and Utilization	2	70	30	100

Aim of the Course

To develop an understanding on the wood and wood panel related industries 3 (2+1) To understand the secondary timber species, composite wood products for structural usage, new generation wood composite and improved woods.

Theory

Indian Timbers - Growth of wood-based industry in India and its relation to Indian economy – Production of roundwood and engineered wood in global and Indian scenario – National, International trade of important primary timber species – Volume of Import and Export details of wood and wood panels in India – Present status of wood and wood panel industries in India and Global scenario. Description of different forest-based industries – Paper and Pulp, Furniture, Bamboo, Sports Goods, Pencil, Match wood and Splint making and Composite wood industries. Primary conversion: Sawing techniques, kinds of saws – Wood Machining – Wood working tools used in wood working (Parting, Slicing, Shaping, Measuring and marking tools). Various stages in wood working – Wood Joinery – Finger Jointed Lumber – Veneer Production Process – Rotary cutting and Slicing – Types of veneer and their uses – Advantages of the use of veneered panels in wood products – Veneer jointing – Veneer grading – Storage and handling of veneers. Modern technologies for furniture making – Computer Numerical Control (CNC). Production, properties, properties and application of Plywood, Particle board, Sandwich board, Core board, Flake board, Fibre board (LDF, MDF, HDF). Production, properties, properties and application of Glue Laminated Timber (GLT), Structural Composite Lumber (LVL, PSL, LSL). Laminated wood – Multispecies laminates – Types of laminates – Matte finish laminates. Textured laminate, Gloss-finish laminates, Metallic laminate, PVC-finish laminate, Acrylic-finish laminates and Exterior laminates. Laminated wood from bamboo and bamboo laminates. Acoustic panels from laminated wood – Densified laminated panels. Wood adhesives – Types, characteristics and application. Eco friendly wood composites – Lignocellulosic composites – Adhesives for composites – Natural fibres – Wood plastic composites – Reinforced composite structures – Nano based wood composites – Bioactive wood polymer composites, Biotechnological production of wood composites – Wood polymer; Hybrid composite processing. Cross – Laminated Timber (CLT), Wood Plastic Composites (WPCs), Wood Inorganic Composites (WIC) approach. Chemical modification of wood, Thermal modification, acetylation and Furfurylation processes – Nanomaterials – Carbon nanotubes and cellulose nanofibres for wood modification, Impregnation / Polymerisation, microwave modification, Plasma and Laser for wood modification, Enzymatic modification. Scarification of wood – Wood Molasses, alcohol and yeast – Biochar and activated carbon technology.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/16P	Commercial Forest Products and Utilization	1	70	30	100

Practical

Visit to saw mill to study primary conversions of wood and Wood working industry for studying basic wood carpentry tools and application - Visit to pulp and paper industry, furniture industry, industrial plantations, pencil industry, matchwood industry, plywood industry, Briquette making industries and Gasification industries to study the production, manufacturing, grades and training process - Study the production, properties, and application of Particle board, Sandwich board, Core board, Flake board, Fibre board, Glue Laminated Timber, Structural Composite Lumber, Laminated wood, PVC-finish laminate, Acrylic-finish laminates and Exterior laminates. Wood Plastic Composites (WPCs), Wood Inorganic Composites (WIC) approach. Chemical modification of wood - Carbon nanotubes and cellulose nanofibres for wood modification - Scarification of wood - Biochar and activated carbon technology.

Suggested Readings

1. Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2nd edn. Miller and Freeman Publication, Inc. USA. 388p.
2. FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.
3. Hoadley, B. 2000. Understanding Wood: A Craftsman's guide to wood technology. Taunton Press. Newtown, USA. 223p.

SOA/UG/FMJ/17T – Forest Ecology and Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/17T	Forest Ecology and Management	2	70	30	100

Aim of the Course

Develop basic understanding on ecology and its application in Forest ecology, biodiversity and conservation. 2. 3. Develop a working knowledge on forest ecosystem, productivity and conservation forest bio resources Be able to apply this knowledge base to unknown situations related to forest ecology.

Theory

Definitions- interactions of biotic and abiotic components. Historical development of ecology as a science. Levels of biological organization. Major forest Ecosystem. Forest environment- major abiotic and biotic components and their interaction, trophic levels, food webs, ecological pyramids and energy flow. Population ecology - definition, population dynamics and carrying capacity. Speciation- sympatric and allopatrty. Population growth models-. Population distribution- Characters of forest communities. Community ecology species interactions. Ecological succession-Definition- terminology, basic concepts, theories of succession-climax vegetation types. Production ecology – primary and secondary production – Paterson's productivity index. Autecology of important tree species. Biodiversity – Definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, World mega biodiversity countries. Biodiversity of Western Ghats and Eastern Ghats. Measurement of diversity and diversity indices. Endemism – categories of endemism Rarity and Extinction of species - threat values of species - categories of existence. Principles of conservation biology, ex-situ and in-situ methods of conservation. Genetic and evolutionary principles in conservation. Sacred groves-concept-uses. Biosphere concept. Conservation – efforts in India and worldwide. - National Biodiversity Authority (NBA) - Salient features of NB Act - Convention on biological diversity (CBD) - Access and benefit sharing (ABS).

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/17P	Forest Ecology and Management	1	70	30	100

Practical

Study of ecological modifications in plants; Effects of fire on forest ecosystem; Study of population dynamics using model systems; Preparation of life tables; Study of spatial dispersion among plants; Study of Forest composition; Niche analysis; Computation of diversity indices; Measurement of diversity of plants and insects in a nearby forest; Forest productivity estimation methods through harvest, Leaf area, LAI. Study of succession in field and water bodies; Visit to different ecosystems. Recording light transmission in forest relative to open fields. Estimation of growth and productivity of Plantation/site. Field data processing and Analysis-Calculation of IVI, Diversity indices Assessment of tree volume and carbon sequestration. Visit to ex situ, in situ conservation and Nilgiri biosphere reserve.

Suggested Readings

1. Frankel, O.H., Brown, A.H.D., Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p.
2. Kimmins, J.P. 1976. Forest Ecology. MacMillan.
3. Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw Hill Pub. Co. New Delhi, 404p.

4. Misra, K. C. 1974. Manual of Plant Ecology. Oxford and IBH Pub Co. New Delhi etc. 491p.
5. Montagnini, F. and Jordan, C.F. 2005. Tropical Forest Ecology: The Basis for Conservation and Management. Springer. 295p.
6. Nautiyal, S. and Koul, A.K. 1999. Forest Biodiversity and its Conservation Practices in India. Oriental Enterprise.
7. Odum, E. P. 1983. Basic Ecology. Saunders College Publishing, Philadelphia etc. 613p.
8. Saggwal, S.S. 1995. Forest Ecology of India. Pioneer Publishers, India. 368p.
9. Sharma, P. D. 2013. Ecology and Environment. 11th edn, Rastogi Publications, Meerut.

SOA/UG/FMJ/18T – Tree Harvesting and Ergonomics

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/18T	Tree Harvesting and Ergonomics	1	70	30	100

Aim of the Course

To provide an understanding about the tools and implements used for logging mechanism, reduced impact during logging, transportation, grading and storage of felled logs

Theory

Definition, history, objective, and scope of harvesting, harvesting plan and execution. Location and demarcation of the area for logging and estimation of produce available for extraction – Phases of harvesting. Tools and Implements used in harvesting operation; traditional and improved tools, axes, saws, types of saws, accessory implements, mechanized felling machines and operations. Felling rules, felling season, felling methods, safety rules Work contracts related to felling and removing (Contract system, convener systems) etc. Conversion, cross cutting, hand and machine sawing, conversion of specialized logs, measurement and description of converted material. Recent trends in timber harvesting. Reduced impact logging (RIL), Concept - scope and objectives – impediments to adoption - difference between reduced impact logging and conventional logging - Criteria and Indicators - operations and ITTO guidelines - Steps beyond reduced impact logging towards Sustaining timber yield (STY) – Recent developments. Timber logistics; types and means of transport of timber, off and on road transportation; Minor transportation methods carts, dragging, skidding, overhead transport, ropeways, skylines. Major transportation methods, Transport by road and railways. Transport by water; floating, rafting and concept of booms. Grading of timbers - storage and disposal of timber in the depots - Temporary and final storage. Timber Depots; types, layout and management. Protection from plants, animals and insect infestations – Diseases and their prevention. Systems of disposal of timber. Harvesting productivity – Economics of recovery – Cost of production – Constraints and Techniques used in harvest unit. Ergonomics: Definition, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition. Personal protective equipment, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/18P	Tree Harvesting and Ergonomics	1	70	30	100

Practical

Equipment and tools used in harvesting operations, their uses and their maintenance. Instructions regarding maintenance of various records and registers in harvesting operations; Conversion of felled trees into logs, poles, firewood, pulpwood. Visit to local saw mills to study the equipment used and process of conversion. Field exercise on uses of axes (Traditional and improved), saws (Manual and power operated), felling of trees. Field exercise on estimation of felling and conversion waste. Visit to industrial plantation to study the mechanized means of felling and conversion of trees. Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers. Visit to Timber depot to trace the logs delivered from different forest sites. Sorting of logs, poles and firewood in the depots according to species, quality, length and girth classes. Stacking and stock checking of different logs, poles and firewood in the depots so as to confirm that

all the converted materials in the forests have reached their destination. Stacking of the lots for display and final disposal; recording of the lots for auction sale. Final disposal of the material. Visit during the auction sale in the government timber depots; Visit to Range Office to understand about transit permits for various types of forest produce. Cost of production of timber harvesting. Preparation of ergonomic check lists. Familiarize the e-auctioning procedure of State Forest Department.

Suggested Readings

1. Brown, N. C. 2002. Principles and methods of harvesting of timber. Biotech books, Delhi. 430p.
2. Forest Engineering Technology Program. 1996. Introduction to forest harvesting methods. Vancouver, BC: BCIT.
3. FRI (Forest Research Institute). 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.
4. GFC (Guyana Forestry Commission). 2002. Code of practice for timber harvest. 2nd edn. Georgetown, Guayana, 42p.
5. Hakkila, P. 1989. Utilization of residual forest biomass. Springer-Verlag, Berlin. 567p.
6. Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.
7. Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.
8. Mehta, T. 1981. A Hand book on forest utilization. IBD, Dehradun
9. Sharma, P.K. 1991. Forest resource and its utilization in India. Mittal Publication, New Delhi
10. Staaf, K.A.G. and Wiksten, N.A. 1984. Tree Harvesting Techniques. DR W. Junk Publishers, Netherlands. 11.
11. Wakermann, A. E. 2002. Harvesting timber crops. Biotech books, Delhi. 433p.

SOA/UG/FMJ/19T – Forest Policy and Legislation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/19T	Forest Policy and Legislation	2 (2+0)	70	30	100

Aim of the Course

To impart knowledge on various policies and acts related to forests.

Theory

Necessity of a Forest policy in a country. General basis of formulation, various considerations. National Forest Policies of 1894, 1952 and 1988 their comparative study, basis of their formulation and after effects. Constraints in the implementation of Forest Policy in India. Need based law for implementation of policy. National Forestry Action Program, formulation and constraint in implementation and State Forestry Action Programs. Code of Criminal Procedure, 1973 - Definitions. Position of forest offences - Constitution and powers of Criminal courts and important sections. Code of Civil Procedure 1908 - Summons and discovery. Indian Penal Code, 1860 - Abetment of forest offences - Offences directly connected with forests and its produce and Protection extended by law to Forest Officers. Forest Law: legal definition. Indian Evidence Act, 1872 as applied to forestry matters. Indian Forest Act. Detailed study of IFA 1927.Forest (Conservation) Act, 1980 and its amendments. The Biological Diversity Act, 2002, The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 and Environmental Protection Act, 1986. Brief description about other major forest laws of regional, national and international significance. National Green Tribunal.

Suggested Readings

1. Chaturvedi, A.N. 2011. Forest Policy and Law. Khanna Bandhu Publishers, Dehradun.
2. Negi, S.S. 1997. Forest Policy and Law, IBD, Dehradun.
3. Dutta, R. and Yadav, B. 2012. Supreme Court on Forest Conservation. Universal Law Publishing Co., New Delhi, India
4. Ernakulam Shetty, B. J. 1985. A Manual of Law for Forest Officers, Sharda Press, Mangalore
5. Takwani, C. K. T and Thakker, M. C. (2012). Takwani Criminal Procedure. Lexis Nexis Butterwarths Wadhwa, Nagpur.

Core (Minor Courses – MN)

SOA/UG/FMN/02T – Statistical Methods

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/02T	Statistical Methods	1	70	30	100

Aim of the Course

To provide students with practical knowledge and understanding of statistical techniques for analyzing forestry and ecological data, enabling them to organize, summarize, interpret, and make informed decisions from field and laboratory datasets.

Theory

Basic concepts – statistics – variable – types and sources of data – classification and tabulation of data. Diagrammatic and graphical representation of data – simple, multiple, component and percentage bar diagrams, pie diagram – frequency polygon, frequency curve and histogram. Construction of frequency distribution tables. Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode – merits and demerits. Measures of dispersion: range, quartile deviation, mean deviation, standard deviation, and coefficient of variation – skewness and kurtosis – merits and demerits. Probability – basic concepts – additive and multiplicative laws (without proof). Probability distributions – Discrete distributions: Binomial and Poisson. Continuous distribution: Normal distribution – definitions and properties. Sampling theory – population – sample – parameter and statistic – sampling distribution – sampling vs complete enumeration – Types of sampling – simple random sampling – selection of simple random sample using random number tables. Null and alternative hypothesis – types of errors – critical region and level of significance – degrees of freedom. Large sample test – single proportion and difference between two proportions – single mean and difference between two means. Small sample tests – F-test – t-test for testing the significance of single mean – independent t test and paired t test – chi square test for goodness of fit – chi square test for testing the association of attributes by m × n contingency table – 2 × 2 contingency table – Yates' correction for continuity. Correlation – Scatter diagram – Karl Pearson's correlation coefficient definition – computation – types of correlation and properties. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient. Analysis of Variance (ANOVA) – assumptions – one way and two-way classifications. Basic principles of experimental designs – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) – lay out, analysis, merits and demerits of the above-mentioned designs.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/02P	Statistical Methods	1	70	30	100

Practical

Formation of frequency distribution tables – Diagrammatic and graphical representation. Computation of different measures of central tendency and computation of various measures of dispersion for raw and grouped data – calculation of coefficient of variation (CV) – measures of skewness and kurtosis. Simple problems in Binomial distribution, Poisson and Normal distribution – Selection of simple random sampling. Large sample test for single proportion and difference between two proportions and Large sample test for single mean and difference between two means. t-test for single mean – t-test for testing the significance of two means for independent and paired samples – chi square test for goodness of fit and test for independence of two attributes in a contingency table – Yates correction for continuity – calculation of the correlation coefficient – fitting of simple linear regression equation – One way and two-way ANOVA – completely randomized design (CRD) – randomized block design (RBD) – Latin square design (LSD).

Suggested Readings

1. **Fundamentals of Statistics** by **S. C. Gupta & V. K. Kapoor**
2. **Statistical Methods** by **G. W. Snedecor & W. G. Cochran**
3. **Primer of Biostatistics** by **M. Glantz**
4. **Statistical Methods for Research Workers** by **R. A. Fisher**
5. **Design and Analysis of Experiments** by **D. C. Montgomery**

6. **Practical Statistics for Field Biology** by **Jim Fowler, Lou Cohen & Phil Jarvis**
7. **Biostatistics: A Foundation for Analysis in the Health Sciences** by **Wayne W. Daniel & Chad L. Cross**

Multidisciplinary Courses (MDC)

SOA/UG/FMDC/03T – Agriculture Marketing and Trade

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMDC/03 T	Agriculture Marketing and Trade	2	70	30	100

Aim of the Course

To understand the fundamentals of agricultural marketing and trade.
To analyze the factors influencing supply and demand in agricultural markets To explore different marketing channels and strategies in agriculture To examine the role of government policies and regulations in agricultural markets

Theory

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities; pricing and promotion strategies: pricing considerations and approaches – cost based and competition based pricing; market promotion – advertising, personal selling, sales promotion and publicity – their meaning and merits and demerits; marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark);Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading; Agricultural prices and policy: Meaning and functions of price; administered prices; need for agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; GATT and WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR. Role of government in agricultural marketing. Role of APMC and its relevance in the present-day context.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMDC/03 P	Agriculture Marketing and Trade	1	70	30	100

Practical

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning; Application of principles of comparative advantage of international trade.

Suggested Readings

1. Acharya, S.S. and Agarwal, N.L., 2006, Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
2. Chinna, S.S., 2005, Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
3. Dominic Salvatore, Micro Economic Theory
4. Kohls Richard, L. and Uhl Josheph, N., 2002, Marketing of Agricultural Products, Prentice Hall of India Private Ltd., New Delhi.
5. Kotler and Armstrong, 2005, Principles of Marketing, Pearson Prentice-Hall.
6. Lekhi, R. K. and Singh, Joginder, 2006, Agricultural Economics. Kalyani Publishers, Delhi.
7. Memoria, C.B., Joshi, R.L. and Mulla, N.I., 2003, Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
8. Pandey Mukesh and Tewari, Deepali, 2004, Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
9. Sharma, R., 2005, Export Management, Laxmi Narain Agarwal, Agra.

Value Added Courses (VAC)

SOA/UG/FVAC/02T – Agricultural Informatics and Artificial Intelligence

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FVAC/02T	Agricultural Informatics and Artificial Intelligence	2	70	30	100

Aim of the Course

To acquaint students with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc. To provide basic knowledge of computer with applications in Agriculture To make the students familiar with Agricultural-Informatics, its components and applications in agriculture

Theory

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions, Database, concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components.

Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations.

e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputs outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation, IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc., Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information, Decision support systems: Concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FVAC/02T	Agricultural Informatics and Artificial Intelligence	1	70	30	100

Practical

Study of computer components, accessories, practice of important DOS commands. Introduction of different operating systems such as windows, Unix, Linux, creating files and folders, file management. Use of MS-Word and MS Power Point for creating, editing and presenting a scientific document, handling of tabular data, animation, video tools, art tool, graphics, template and designs. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros. MS-ACCESS: Creating database, preparing, queries and reports. Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation, and management of health information through web. Use of smart phones and other devices in agriculture and human health warning systems. Hands on practice on preparation of decision support system for the above-mentioned aspects.

Suggested Readings

1. Fundamentals of Computer by V. Rajaroman.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C. J. Date.
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
5. Introductory Agri Informatics by Mahapatra, Subrat K et al, Jain Brother Publication.

Skill Enhancement Courses (SEC)

SOA/UG/FSEC/21P – Dendro-energy generation

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/21P	Dendro-energy generation	2 (0+2)	70	30	100

Aim of the Course

To identify major dendro-energy feedstock from forest and agroforestry systems, operate or demonstrate small-scale dendro-energy devices with efficiency, emissions and health/safety aspects and prepare simple cost–benefit estimates for small dendro-energy applications.

Practical

Introduction to Dendro-Energy. Feedstock Identification & Classification. Measurement of Biomass & Bulk Density. Moisture Content estimation. Harvesting, Collection & Safety. Size Reduction & Preparation. Drying, Seasoning & Storage. Improved Cookstoves & Combustion Basics. Simple Efficiency / Fuel Use Comparison. Charcoal & Briquettes. Demostration of Small-scale Gasifier / Biomass Device. Emissions, Ash & Safety. Sustainable Supply & Land-use Linkages. Economic Aspects Mini-Project & Documentation.

SOA/UG/FSEC/22P – Big Data Management

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/22P	Big Data Management	2 (0+2)	70	30	100

Aim of the Course

To understand spatial and time-series data and when "big data" tools are needed for modern, sustainable, and productive forest management and follow simple data-ethics principles and produce a brief data-based report.

Practical
Introduction & Data Types. Forestry Data Sources. Field Forms & Digital Templates. Data Entry & Cleaning. Data Organisation. Queries & Summaries. Demonstration of Spatial Data- raster & vector data, loading a simple forest map or plot layer in QGIS/other (if available); massive datasets from Satellite imagery (Landsat, Sentinel), LiDAR (3D structure) - Structured data (inventories), unstructured (images), and semi-structured (GPS logs), weather stations, soil moisture sensors, camera traps, High-resolution mapping and inventory, Geospatial Data- GIS tools for mapping and modeling. Time-Series & Trends- Real-time data from IoT sensors for fire/weather, unmanned Aerial Vehicles (UAVs/Drones). Big Data Tools – Overview. Data Visualisation. Integrating Datasets. Data Ethics & Access. Metadata & Documentation. Mini-Project & Presentation. Big Data Management in smart Forestry: Modern Technologies and Strategies - Leveraging Data for Sustainable Forest Management. Management Data- Historical harvest records, legal documentation. Hadoop Distributed File System (HDFS)- NoSQL Databases. Precision Forestry-LiDAR: Measuring tree height, spacing, and density. GIS Tools (Esri)- visualizing and analyzing forest data to improve management decisions.

SOA/UG/FSEC/23P – Artificial Intelligence in Forestry Operation

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/23P	Artificial Intelligence in Forestry Operation	2 (0+2)	70	30	100
Aim of the Course					
To understand basic AI concepts relevant to forestry operations (machine learning/ IoT data), user-friendly AI tools and platforms, apply AI-assisted methods for typical forestry tasks and prepare basic digital records, simple AI workflows and a concise, data-driven mini-project report related to forestry operations.					
Practical					
Introduction to AI in Forestry Operations. Forestry Data for AI – Types and Sources. Data Preparation for AI Models. Basic Concepts of Machine Learning (Classification & Regression). AI for Tree Species/Health Identification (Introductory Image-based Exercise). AI for Forest Fire Risk Indication (Basic). AI in Forest Inventory & Yield Prediction. Remote Sensing & AI (Introductory) for Forest Cover and Degradation. AI for Pest/Disease & Health Monitoring (Concept + Simple Exercise). AI-assisted Decision Support in Forestry Operations. AI Tools and Platforms – Hands-on Orientation. Interpreting AI Outputs, Errors and Limitations. Ethical, Legal and Social Aspects of AI in Forestry. Documentation, Metadata and Workflow Recording for AI Projects. Mini-Project on AI in Forestry Operations.					

SOA/UG/FSEC/24P – Specialty Seedling Production

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/24P	Specialty Seedling Production	2 (0+2)	70	30	100
Aim of the Course					
To impart knowledge on commercially important seedling production especially forest and agroforestry seedling production through the natural as well as artificial regeneration techniques.					
Practical					
Introduction to Seedling Production & Nursery Types, Nursery Layout and Site Selection. Species Choice, Seed Sources and Plus Tree Selection. Seed Collection Planning and Techniques. Seed Processing, Cleaning and Grading. Seed Quality Testing, Dormancy and Pre-sowing Treatments simple germination test. Seed Storage, Packaging and Labelling - Preparation of a simple seed lot register. Nursery Site and Bed Preparation.					

Potting Media and Container Systems. Seed Sowing Methods, Pricking Out and Transplanting. Seedling Management- Watering, Shade and Nutrition. Pest, Disease and Weed Management in Nurseries - integrated pest management (IPM). Grading, Hardening and Root Pruning. Lifting, Packing, Transport and Planting Techniques- Demonstration of field planting technique. Nursery Records, Cost of Seedlings and Simple Business Plan- simple calculation of cost per seedling- Group exercise- brief small nursery plan. Record Completion, Revision.

SOA/UG/FSEC/25P – Tools for Consulting Forester's

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/25P	Tools for Consulting Forester's	2 (0+2)	70	30	100

Aim of the Course
To impart the knowledge and hands-on of technical, field, digital, and communication tools used by consulting foresters in different areas i.e. inventory, valuation, management planning, certification, ESG, litigation support, etc.
Practical
Role of Consulting Foresters & Overview of Tools- Field tools -Digital tools. Communication & documentation tools. Terms of Reference (ToR), Scope, and Work Planning. Field Measurement Tools – Inventory & Assessment- basic mensuration tools- measurement accuracy, calibration, and common errors. GPS, Compass and Simple Navigation for Consulting Projects- GPS receivers and mobile mapping apps- field sketch mapping- location map sketch. Field Data Sheets, Mobile Data Collection & Photography- field data sheets- digital template- field photography. Basic Office Tools for Data Handling (Spreadsheets). Introductory Mapping & GIS Tools for Consulting Foresters. Valuation, Costing and Simple Financial Tools. Report Writing Tools and Templates for Consulting Outputs. Presentation and Communication Tools. Legal, Certification and Compliance Tools – Introductory. Stakeholder Engagement and Survey Tools. Risk Assessment and Monitoring Tools in Consulting Projects. Professional Ethics, Contracts and Practice Management Tools. Mini-Project: Simulated Consulting Assignment.

SOA/UG/FSEC/26P – Application of Drone in Forestry

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/26P	Application of Drone in Forestry	2 (0+2)	70	30	100

Aim of the Course
• To impart the knowledge and hands-on operational protocols of drone (UAVs), interpret simple products (orthomosaics, basic canopy maps, sample 3D views/DSM) for typical forestry tasks. • Plan and execute simple drone flights for forestry purposes (e.g., mapping, stand assessment, damage detection) using drone data for forest management and rural landscapes.
Practical
Introduction to Drones in Forestry- Concept of UAVs/drones, demonstration of at least one training/mini drone, basic parts identification. Safety, Regulations and Ethics. Drone Hardware, Sensors and Accessories. Basic Flight Controls and Manual Flying (Simulation/Training Area). Mission Planning for Forestry Mapping. Field Exercise I – Simple Aerial Survey (Visual). Field Exercise II – Automated Mapping Flight. Image Management, Geotagging and Basic Pre-processing. Introduction to Photogrammetry and Orthomosaic Generation (Demo + Hands-on). Basic Interpretation of Drone-Derived Maps for Forestry. Sample Applications I – Plantation Monitoring & Survival Estimation. Sample Applications II – Damage / Disturbance Assessment. Introduction to Advanced Sensors and Indices (Concept + Demo)- concept of multispectral imagery (NIR, red-edge) and NDVI/vegetation indices for assessing vigour, Short exercise- interpret 3–4

sample points of different index values and relate to possible field conditions. Integration with GIS and Other Forestry Data- loading orthomosaic or georeferenced image into QGIS (or similar GIS) – demo and simple exercise, overlaying basic layers (forest boundary, compartments, roads, streams) if available, digitising simple features (e.g., a firebreak line, plantation block boundary, water point) from the drone map. Preparation of a basic thematic map (e.g., plantation block with identified gaps or risk zones). Small-Project & documentation – Drone-based Forestry Application - Group-wise mini-project using one small area/dataset (nursery, plantation, campus forest patch or case study imagery). Define objective -quick plantation condition check, mapping of a campus green, damage assessment after a fire event, mapping forest boundary encroachment – real or simulated). Plan & document mission. Organise data- images, orthomosaic, logs. Prepare simple outputs: one orthomosaic/map view with legend, plus basic measurements (area, counts/samples). Write a concise 2–3 page note -covering context, data, methods, key findings, limitations, and management recommendations. Group presentation.

SOA/UG/FSEC/27P – Forest Certification

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/27P	Forest Certification	2 (0+2)	70	30	100
Aim of the Course					
To provide students with practical knowledge and skills related to forest certification, enabling them to assess forest management practices, understand certification standards, evaluate compliance, and promote sustainable forest management and responsible use of forest resources.					
Practical					
Study of major forest certification standards (FSC, PEFC, ISO 14001); field visits to certified and non-certified forest areas to observe forest management practices; identification and assessment of management indicators such as biodiversity, timber harvesting practices, soil and water conservation, and community engagement; preparation of forest management checklists; evaluation of compliance with certification criteria; documentation of forest inventory and harvesting records; assessment of traceability and chain-of-custody procedures; use of GIS and GPS for mapping certified forest plots; preparation of practical reports on forest certification assessment; discussion of social, environmental, and economic benefits of certified forests.					
Suggested Readings					
1. **The Forest Certification Handbook (2nd Edition)** by *Ruth Nussbaum & Markku Simula* *2.* **The Forest Certification Handbook** by *Christopher Upton & Steve Bass* *3.* **Forest Certification in Sustainable Development: Healing the Landscape** by *Walter Smith & Chris Maser* *4.* **Forest Management Auditing: Certification of Forest Products and Services** edited by *Lucio Brotto & Davide Pettenella* **5.** **Forest Certification and Sustainable Forest Management: A Global Perspective** by *Ahmad Fariz Mohamed, Shaharuddin Mohammad Ismail & Nurul Hidayah Shamsul Ariffin*					

SOA/UG/FSEC/28P – Forest Project Designing and Analysis

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/28P	Forest Project Designing and Analysis	2 (0+2)	70	30	100
Aim of the Course					
To provide practical knowledge with skills related on identify and define small- to medium-scale forestry project ideas relevant to production forestry, community forestry, urban forestry, ecosystem services, and enterprises.					
Practical					

Introduction to Forest Projects & Project Cycle-discussion of 2–3 real/flagship forestry schemes (e.g. CAMPA, NAP, Green India Mission, urban greening projects). Exercise- Students write a short note on one local forestry project they know/observe. Problem Analysis and Stakeholder Identification- forest department, local communities, JFMCs, NGOs, private sector, urban bodies, research institutions, and exercise-group-wise select local forestry issue (e.g., poor plantation survival, forest fire, human–wildlife conflict, urban heat island). Project Objectives, Outcomes and Logical Framework exercise- selected problem, each group drafts one overall goal and 2–3 specific objectives. Project Site Selection and Situation Analysis - biophysical (soil, slope, rainfall, forest type), socio-economic (user groups, land tenure, demand), accessibility and risk, use of simple tools/maps: forest type maps, land-use maps, Google Earth/QGIS demo. Field/desk exercise- prepare a brief site description sheet for the proposed project area, location, area, forest type/land use, communities, key issues/opportunities. Basic Field Data Collection for Project Design-exercise (field-based where feasible) - conduct a short reconnaissance survey (rapid appraisal) and fill sample data sheets for the project site. Socio-economic and Participatory Tools- PRA, RRA, semi-structured interviews, focus group discussion (FGD), resource mapping, seasonal calendar, preference ranking. Role-play exercise- conduct a mock FGD or interview on community needs and preferences for forestry interventions; summarise key points. Project Components, Activities and Work Breakdown- components and activities: e.g., nursery raising, planting, soil & water conservation, fire lines, capacity building, monitoring, enterprise support, exercise: groups wise prepare a structured activity list for their project (year-wise or phase-wise) in tabular form. Time Planning and Gantt Charts- costing, Budgeting and Simple Financial Analysis - exercise (spreadsheet or manual), prepare a simple project budget table and estimate cost per hectare or cost per household/beneficiary. Indicators, Monitoring and Evaluation (M&E) Framework –exercise a simple M&E matrix for their project (indicator, baseline, target, frequency, responsible person). Risk Analysis and Assumptions-exercise-preparation of a risk register or simple risk matrix (risk, likelihood, impact, mitigation) for the group project. Environmental and Social Safeguards – exercise- short checklist of environmental and social safeguards for the project- exercise- each group prepares 1–2 tables and 1–2 simple graphs from their data (real or provided sample data) to insert into the project document. Project Document Structure and Writing- exercise -drafting a 2–3 page project concept note using a standard template. Project Presentation and Feedback (group wise). Record Completion, Reflection.

SOA/UG/FSEC/29P – Marketing and Economics of NTFPs

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/29P	Marketing and Economics of NTFPs	2 (0+2)	70	30	100
Aim of the Course					
To provide practical knowledge and skills in the marketing, pricing, trade, and economic evaluation of non-timber forest products (NTFPs), enabling students to understand market chains, value addition, livelihood implications, and sustainable management strategies.					
Practical					
Identification and documentation of locally available NTFPs; collection and sorting of NTFPs for market-ready quality; grading and standardization of products; determination of cost of collection, processing, and transportation; analysis of local, regional, and national market prices; preparation of simple price lists and marketing plans; assessment of supply chains and marketing channels; calculation of profit margins and benefit-cost ratios for selected NTFPs; study of post-harvest storage, packaging, and shelf-life enhancement techniques; field visits to NTFP markets, collection centers, and cottage processing units; interviews with collectors, traders, and entrepreneurs; preparation of field reports including economic analysis, marketing observations, and recommendations for sustainable trade.					
Suggested Readings					
1. **Non-Timber Forest Products: Marketing and Trade** by *Sharma, R.P*					

2. **Economics of Non-Timber Forest Products in India** by *Ved, D.K. & N. Bawa*
3. **Marketing of Non-Timber Forest Products in India** by *K. P. Singh & D. K. Ved*
4. **Non-Timber Forest Products: Utilization and Conservation** by *M. P. Chandrashekara*
5. Forest Economics and NTFPs by *P. K. Gupta & R. Sharma*

SOA/UG/FSEC/30P – Carbon Financing Projects

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FSEC/30P	Carbon financing projects	2 (0+2)	70	30	100

Aim of the Course

To provide practical knowledge and skills in the carbon sequestration, carbon stocks, carbon credits and carbon markets in the context of forestry and different land-use for carbon projects (afforestation/reforestation, improved forest management, agroforestry, REDD+.

Practical

Introduction to Carbon Financing and Forestry- climate change, greenhouse gases, and role of forests as carbon sinks, carbon sequestration, carbon stock, carbon credits, carbon markets (compliance vs voluntary – simple explanation), forestry-related carbon projects in India and globally (afforestation, community forestry, agroforestry, REDD+. Forest Carbon Pools and Project Types- carbon pools, forestry carbon project types, plantations, improved forest management (IFM), agroforestry, avoided deforestation (REDD+ concept only), urban forestry. Basics of Biomass and Carbon Measurement. Plot Establishment and Simple Forest Inventory for Carbon. Biomass Estimation Using Simple Allometric Equations. Baseline and Additionality–conceptual & simple Example. Carbon Stock Change and Credit Estimation. Project Boundary, Leakage and Permanence (Conceptual). Data Management for Carbon Projects. Monitoring Plan and Simple MRV Concepts. Overview of Standards, Methodologies and Carbon Markets (Non-technical). Socio-economic and Community Aspects of Carbon Projects - Role of local communities, JFMCs, farmers, private landholders in forestry carbon projects. Simple Financial Analysis of a Small Carbon Project - carbon price (e.g., ₹/tCO_2e) and projected credits per year, estimate gross revenue, calculate net benefit over a 10–20 year, cost–benefit snapshot. Risk, Safeguards and Ethics in Carbon Financing. Mini-Project: Designing a Small Carbon Financing Project (Group Work) Group Presentations.

POST-IV SEMESTER

Internship (only for exit option for award of UG Diploma) - 10 weeks 2 (0+2) - 10 (0+10)

General objectives

To provide students with an opportunity to put into practice the skills they have learned while in the institute, so that in case they exit with UG-Diploma, they will be able to get proper engagement/ employment and consider having their own startups.

Specific objectives

By the end of the internship, the students should be able to

1. Integrate theory and practice
2. Assess interests and abilities in their field of study
3. Develop work habits and attitudes necessary for job success
4. Develop communication, interpersonal and other critical skills in the job interview process
5. Explore career alternatives prior to graduation

Activity

The students will have internship/ training for 10 weeks' duration either in the institute or in industry or related organisations. The College/ University will facilitate attaching the students to the organisations.

After completion of internship, the students will have to submit a report of their learnings and also present in form of a seminar before nominated faculty members and other students.

The assessment will be based on the report / assessment received from the industry/ organisation and the report and the presentation made at the University. Ideally the weightage will be 70% & 30% for external & internal respectively as per NEP, 2020.

SEMESTER - V

Core (Major Courses -MJ)

SOA/UG/FMJ/20T – Tree Physiology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/20T	Tree Physiology	1	70	30	100

Aim of the Course

To impart basic knowledge on various functions and processes related to production, mineral nutrition, plant growth regulators and environmental stresses with reference to forestry.

Theory

Introduction to Tree Physiology and cell organelles - Plasma membrane, chloroplast, mitochondria, peroxisome and vacuole, Structure and role of water - Diffusion, osmosis, imbibition, plasmolysis, water potential and its components, Translocation of water, Ascent of sap, Stomata - Structure and function, Stomatal conductance and resistance, Water relations of forest trees, Transpiration from forest canopies – Evapo-transpiration models - Water use efficiency of forest stands. Criteria of essentiality - Classification of nutrients - Macro nutrients, micro nutrients, beneficial nutrients, Mechanism of nutrient uptake - Physiological functions, deficiencies and disorders of macro nutrients and micro nutrients, Nutrient dynamics and plant growth – Nutrient cycling of C,N,P,S. Photosystems, Light reaction - Photolysis of water and photo phosphorylation, Photosynthetic pathways - C3, C4 and CAM - difference between three pathways - Factors affecting photosynthesis - Photorespiration- pathway and its significance - Phloem transport, Munch hypothesis - Phloem loading and unloading. Plant Growth regulators – Classification and biosynthetic pathways, Sun plants and shade plants, shade tolerance, Carbon cycling, Carbon balance and dry matter production in forest trees. Classification of stress - Water stress - Mechanism of drought tolerance and drought resistance - Physiological basis of drought avoidance and tolerance – Temperature stress - Temperature influence on forest development - Low and high temperature- Physiological adaptations for high temperature, Salinity stress - Effects on tree growth tolerance mechanisms.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FVAC/20P	Tree Physiology	1	70	30	100

Practical

Preparation of different types of solutions, Measurement of plant water potential by different methods, Estimation of chlorophyll, Estimation of stomatal index- Determination of leaf area of plants, Estimation of transpiration, Estimation of photosynthetic efficiency, Growth analysis – LAI, CGR, LAD etc., Identification of macro nutrients and micro nutrients deficiencies, Measurement of stress tolerance parameters in trees – soluble protein, membrane stability index, chlorophyll stability index, proline content, wax and cuticle thickness, Demonstration of practical applications of PGRs.

Suggested Readings

1. Jain, V.K. 2007. Fundamentals of plant physiology, S, Chand and company Ltd., New Delhi.
2. Luttge, U. 2008. Physiological ecology of trophical plants. Springer – Verlag, Germany
3. Lamber, H. Chapin III. F.S and Pons. T.L. 2008 Plant physiological ecology. 2nd edn, Sprinjer, Newyork, USA.
4. Stephen. G. Pallardy. 2008. Physiology of woody plants. 3rd edn, Elsevier Incl. Academic press.
5. Taiz. L. and Zeiger. E., 2010 (fifth edition). Plant physiology. Publishers: Sinauer Associates, Inc., Masachusetts, USA

SOA/UG/FMJ/21T – Plantation Forestry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	

SOA/UG/FMJ/21T	Plantation Forestry	2	70	30	100

Aim of the Course

To acquire knowledge on intensive silvicultural practices for different forest plantations for obtaining higher utilizable biomass

Theory

Plantation - Definition and scope - aims and objectives of Plantation forestry - Historical perspectives in plantation forestry - Indian and global scenario - Role of plantation forestry in meeting the wood demand-purpose of plantations, factors determining scale and rate of plantation. Plantation sites - Choice of species for plantation – Tree species suitable for different sites - Production technology for quality planting materials – Site selection and site preparation – Mechanization in plantation establishment - Planting program, planting season, planting pattern, spacing, planting method. Post planting activities in plantation - Tending operations – Irrigation and nutrient management in plantation – Plantation health management and sanitary measures – Stand dynamics- Stand density management in plantation – Biology of growth and development in plantation. Energy and Industrial plantations – definition and scope - project formulation - planning in plantation - choice of species and spacing - precision silvicultural techniques - Industrial plantation models - captive and agroforestry models. Plantation for specific purpose - timber - paper and pulp - match wood - ply wood - Plantation for NTFPs. High Density Short Rotation Forestry practices - Plantations as potential Carbon sinks- Carbon credits- Afforestation/ reforestation based CDM projects for climate change mitigation. Harvesting in plantation – harvesting types and patterns based on domestic, industrial, and export requirements – Machineries used in harvesting operations – primary conversion at plantation site – Delimbing, bucking, debarking, stacking, in situ chipping, and transportation. Coppice silviculture – principle, mechanisms and management. Economics of plantation – Scale of finance of plantations.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/21P	Plantation Forestry	1	70	30	100

Practical

Study the tools and equipment in plantation establishment – Visits to small and large plantations and study their management - Exercise on plantation project planning, evaluation and appraisal. Choice of species for various types of plantations - Quality planting material for plantations - Layout of site and stacking - Planting and after care activities for different types of plantations - Irrigation and fertilizer application techniques for plantation – Fertilizer and irrigation schedule for various tree species – Tending operations - Study of Forest Development Corporation plantations – Plantation maintenance – Plantation records and plantation journal - Economic considerations in plantation: Preparation of scale of finance for various out growers and plantation schemes - Study of government vs. private plantations.

Suggested Readings

1. Balasubramanian, A., Hari Prasath, C.N., Radhakrishnan, S. 2020. Textbook on Plantation Forestry. Jain Publication, New Delhi, p336.
2. Dwivedi, A.P. 1993. A. Text book of Silviculture, International Book Distributors, Dehra Dun.
3. Luna, R. K. 1989. Plantation Forestry in India. International Book Distributors, Dehradun.
4. Ram Prakash, R. 1998. Plantation and nursery technique of forest trees. International Book Distributors, Dehradun.
5. Evans, J. 1982. Plantation forestry in the tropics: Clarendon Press, Oxford, Oxford Science Publications, Oxford University Press.

SOA/UG/FMJ/22 T – Tree Improvement

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/22 T	Tree Improvement	2	70	30	100

Aim of the Course

To develop a balanced and broad understanding of concepts and techniques related to tree breeding and tree improvement strategies

Theory

Tree Breeding – Tree Improvement – History and development. Essential of Tree improvement – Tree Breeding – Objectives – Advantages – Disadvantages – Limitations. Terminologies commonly used in tree improvement – Important tree breeding program in the Global and India – ICFRE and State Agricultural Universities. Introduction – Domestication. World collections – Centre of origin of cultivated species. Exotic forest species – Advantages – Problems. Reproductive systems – Devices of pollination control – Anthesis – Pollination – Self-pollination and cross pollination – Variation and its uses. Breeding methods – Introduction – Selection - Mass selection - Pure line selection – Plus tree selection – Comparison tree selection. Hybridization – Mutation – Biotechnology based tree breeding. Hybrid – Hybridization – Genetic consequences – Gene character – Relationship - Segregation – Recombination of genes. Hybrid vigour – Heterosis – Luxuriance. Tree hybrids developed in Global and India – Natural hybrids – Definition – Occurrence – Reasons determination of natural hybrids. Hybrids in trees – Crossing in trees – Problems and perspectives – Crossing hybrids and hybrid breakdown – Hybrid nomenclature in trees – Future of hybrids in applied tree improvement. Mating design – Types – Advantages and disadvantages. Heritability - Genetic gain – Genetic advance – Combining ability – Types – GCA and SCA. Genetic tests – Provenance test – Seed source evaluation test – Progeny test – Clonal test. Experimental design – RBD – Analysis of Genetic test – Genotype and environment interaction. Release of tree varieties – Procedure and Protocol – Released tree varieties of regional and national importance. Varietal registration (PPVFRA) – Definition – Breeder's variety – Famer's variety – Traditional variety – Tribal varieties – Essentially derived varieties. Descriptors – development validation. DUS test – Definition, need and importance. Test guide lines –procedures – Conducting DUS test. Tree DUS testing – Development of descriptors for trees – DUS test centres. Recent developments in tree DUS testing.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/22P	Tree Improvement	1	70	30	100

Practical

Selection for different tree improvement programs – Hybridization – Inter and Intra specific - Evaluation. Controlled breeding – Phenotypic and genotypic coefficients of variation. Estimation of genetic advance – Heritability - Combining ability – GCA and SCA. Genetic tests – Provenance test – Seed source evaluation test – Progeny test – Clonal test. Experimental design – RBD – Analysis of Genetic test. Seed orchards – Genetical behaviour in seed orchard. Forest genetic resource – Visit to progeny evaluation genotypes. Developing descriptors for varietal registration in trees

Suggested Readings

1. Bruce Zobel and John Talbert. 1984. Applied Forest Tree Improvement. John Wiley and Sons, New York. pp504.
2. Parthiban, K.T., N. Krishna Kumar and P.S. Devanand. 2020. Tree Breeding and Improvement – Theory and Technology. Scientific Publishers (India), Jodhpur, India (ISBN No.: 978-93 89412-83-3).
3. Surendran, C., R.N. Sehgal and M. Paramathma. 2003. Forest Tree Breeding. ICAR, New Delhi. P. 204

SOA/UG/FMJ/23T – Forest Resource Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/23T	Forest Resource Management	1	70	30	100

Aim of the Course

1. To understand the principles and concepts of basic forest management, normal forest, sustainable forest management
2. 2. To acquire knowledge on methodology of working plan preparation

Theory

Forest Management - Definition and scope - Management of forests and its peculiarities - Forest management for environmental conservation - Forest management for soil and water conservation - Principles of forest management and their application. Objects of management: Purpose and policy, Objectives, Owner's attitude and social role of forestry. Sustained yield - Concept and meaning of sustained yield - Progressive yield - Sustained yield in relation to environmental management. Sustainable forest management-criteria and indicators - Increasing and progressive yields. Rotation-definitions-various types of rotations length of rotations - choice of type and kind of rotation. Normal forest – Definitions - Basic factors of normality. Factors governing the yield and growth of forest stand. Growing Stock - General considerations - Distribution of age gradations or classes in regular forests, irregular forests and coppice systems. Growth estimation and reduction factors for density and Quality and price increment. Yield regulation - General principles of yield calculation - Silvicultural system in relation to yield regulation. Methods of yield regulation – Yield regulation in regular forests - By area, reduced area, Hufnagl's modification and By volume and increment methods. Yield regulation in irregular forests - Methods based on growing stock only, Von Mantel's formula and its modifications, Methods based on volume and increment, Austrian method, Method based on number of trees in various age classes and time taken to pass from one age class to next, Brandis method, Hufnagl's method and Smithies safeguard formula. Application of different methods of yield regulations in forest management in Indian forestry. Management (Working) Plan - Definition, object, scope, sphere, necessity for revisions - Division of forests into various units – Maps - Management (Working) Plan Code. Preparation of Management (Working) Plan - Preliminary Management Plan report - Field work - Stock mapping - Checking of maps - Compartment description - Collection of statistical data and other data.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/23P	Forest Resource Management	1	70	30	100

Practical

Visit to different forest divisions to study the various stand management aspects including thinning, felling and sale of timber. Study forest organizational set up and forest range administration including booking of offences. Visit to forest plantation- Field Exercise for the estimation of actual growing stock volume. Yield regulation in regular forests and irregular forest. Field visit to JFM operational areas. Study the different field exercises for data collection for working plan. Writing preliminary working plan report and actual working plan report of a given area. New proposal for writing fire management plan.

Suggested Readings

1. Balakathiresan, S. 1986. Essentials of forest management. Natraj Publishers. Dehradun.
2. Negi, S.S. 1988. Forest working plan. B.S.M. Pal Singh, Dehradun
3. Ramprakash, 1986. Forest Management. IBD Distributors, Dehradun

SOA/UG/FMJ/24T – Non-Timber Forest Products

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/24T	Non-Timber Forest Products	2	70	30	100

Aim of the Course

To impart knowledge on various Non-Timber Forest Products and their harvesting, processing, value addition, marketing and industries involved in NTFPs production

Theory

Non-Wood Forest Products – Definition, scope and present status, survey, economic importance, classification, distribution, marketing. Role of tribal co-operative societies in NWFPs. Recent trends in NWFP. Gums: Occurrence – Origin – Functions – Kinds – Properties – Tapping methods – Processing – Grading – Storage – Factors affecting gum formation - Commercial valuation – Industrial application. Resins and Oleoresins: Occurrence – Origin – Functions – Kinds – Properties – Tapping methods – Processing – Grading – Storage – Factors affecting resin and oleoresin formation - Commercial valuation – Industrial application. Grasses: types – Species – Uses. Various grasses and their uses in village and cottage industries. Bamboos – Distribution,

harvesting and uses, raw material scenario in bamboos. Canes - Distribution, harvesting, processing and uses. Fibres: species – Types – Soft, hard and surface fibres – Extraction and uses. Flosses: Species – Distribution – Collection – Extraction – Uses. Essential oils: Species – Types – Grass oils, wood oils, leaf oils, root oils, flower oils and minor essential oils. Tree Borne Oil seeds (TBOs): Collection – Extraction methods – Uses – Value addition. Tan: – Species – Nature and kinds – Occurrence – Function – Collection – Extraction – Uses – Supply and demand. Dyes: Definition – Species – types – Wood dyes – Bark dyes – Flower and fruit dyes – Leaf dyes – Extraction and uses. Cutch and Katha: Species – Extraction methods – Uses. Rubber: Cultivation, and tapping – Processing - Uses of rubber. Lac: Species – Distribution – Improved method of cultivation – Collection and storage – Uses. Shellac: Cleaning and grading – Properties – Uses. Drugs, spices, wild edible plants part like fruits, flowers, roots, tubers, vegetables, leaves and edible products, poisons and bio-pesticides. Bidi leaves - Leaf fodder - Animal products – Honey and wax, collection, processing, storage, silk.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/24P	Non-Timber Forest Products	1	70	30	100

Practical

Identification of non-wood forest products; Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and tree leaves. Study of canes and bamboos and their sources. Study of essential oils and their sources. Visit to oil extraction unit Study of non-essential oils and their sources. Study of gums and resins and their collection. Study of tans and Visit to tannin industry; Study of dyes and Visit to dye extraction unit and their sources. Study of fibers, flosses and their collection from nearby forests. Visit to Herbal Gardens and herbaria to study medicinal plants. Study of plants yielding drugs, spices, wild edible plants, poisons and bio-pesticides and their collection from nearby forests. Visit to a tribal village involved in collection, processing and sale of NTFP's. Visit to nearby extraction units and NTFP museum. Visit to forest range office and study about the permits issued and collection methods of various NWFPs.

Suggested Readings

1. FRI (Forest Research Institute). (1976) Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehra Dun. 941p.
2. Krishnamurthi T. (1993) Minor forest products of India, Oxford and IBH Publishing Co Pvt. Ltd.
3. Krishnamurthi T. (2010) Minor forest products of India (Non- Timber Forest Products), Second edition. BS Publications.
4. Mehta, T. (1981) A Handbook of Forest Utilization, Periodical Expert Book Agency.
5. Mishra, T.K., Banerjee, S.K and Pal, D.C. (2004) An Omnibus of Non- Timber Forest Products of India, Prashant Gahlot at Valley Offset Printers and Publishers, Dehra Dun.
6. Nair, K.K.N. (2000) Manual of Non-Wood Forest Produce Plants of Kerala, Kerala Forest Department, Government of Kerala, Thiruvananthapuram.
7. Nautiyal, S and Kaul, A.K. (2003) Non –Timber Forest Products of India, Jyothi- Publishers and Distributors, Dehra Dun

SOA/UG/FMJ/25T – Forest Pest and Diseases

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/25T	Forest Pest and Diseases	2	70	30	100

Aim of the Course

To impart the knowledge on basic concepts and management of pest and diseases in forest trees

Theory

Insects - Insect Body regions - Position of Insect in Animal Kingdom - Reasons for insect dominance - Insect Systematics - major orders- Categories of pest - IPM definition – Economic Threshold Level- Economic Injury Level- Components of IPM - Pest Surveillance - Forecasting - Pest management - methods - Silvicultural - Mechanical - Physical - Host Plant Resistance - Biological (Parasitoid, Predators, Microbials) - forest (insects) biological chain - Legal - Chemical - Classification of Insecticides - Chlorinated Hydrocarbons-

Organophosphates- Carbamates - Botanicals - Newer molecules (Photostable) -IBPM. Nursery Pests - Pests of Major trees and their management - Teak, Sandal, Sal, Ailanthus, Bamboo, Gmelina, Eucalyptus, Tamarind, Casuarina, Melia, Silk Cotton, Neem, Pungam - Termites - Termite pests of timbers - Dampwood termites - Drywood termites - Subterranean termites - Termites Castes and Management. Forest pathology - Definition - importance –History of forest pathology- Losses due to forest tree diseases- Etiology, symptoms, mode of spread and management practices for Teak, Sal, Sandal, *Gmelina, Dalbergia*, Silver oak, Hardwickia, *Eucalyptus*, *Casuarina,* Bamboo, *Acacia, Ailanthus*, *Melia dubia*, Neem and Pungam, Chir pine and Blue pine. Disease assessment- IDM in forest trees- pathogens affecting timber, sap and pulpwood in storage - timber decay, white fibrous rot, white pocket rot, dry rot, brown rot - Stains - blue - sap stain - factors determining different wood decay - IDM practices for decay and wood preservation techniques

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/25P	Forest Pest and Diseases	1	70	30	100

Practical

Study of External structure of Insect; Type species - Grasshopper / Cockroach. Methods of Insect Collection, preservation, display and storage. Types of insect Head, antenna, mouthparts, Legs and Wings and Modifications. Major Orders Orthoptera, Thysanoptera, Diptera, Hymenoptera, Coleoptera, Hemiptera, Lepidoptera. Assessment of Insect and mite damage in nursery and plantations. Observing the characters and identification of Pests on Teak, Sandal, Bamboo, Eucalyptus, Ailanthus, Melia, Casuarina, Tamarind, and Pungam. Insecticide Formulations, Appliances and Applications. Study the symptoms and microscopic observation, Etiology of the diseases of Teak (*Tectona grandis*), Sal (*Shorea robusta*), Sandal, *Gmelina, Dalbergia*, Silver oak, *Hardwickia, Eucalyptus* sp., *Casuarina* sp., *Bamboo* sp., *Ailanthus* sp. and *Melia dubia*, Neem, Pungam, Chir pine, Blue pine. Disease assessment in forest trees. Study of fungi infecting timber, sap and pulp wood in storage, wood staining fungi. Study of wood decay and wood preservation technique.

Suggested Readings

1. P. K. Sehgal. Forest Entomology and Nematology. Kalyani Publishers
2. Menka Sisodia. Entomology, Ane Publishers and Distributors LLP
3. O. W. Oesthund. A Laboratory Guide in Entomology, Hotson Street Press.
4. J. D. Allison *et. al.* Forest Entomology and Pathology Vol 1., Springer Publication.
5. Dr. Ataur Rahman. Text Book of Entomology, ICAR, New Delhi
6. Bipin Bihari. Forest Entomology, Bishen Singh Mahendra Pal Singh
7. A. K. Diwedi *et. al.* Introduction of General Entomology, Prachi Digital Publication.

SOA/UG/FMJ/26T – Industrial Agroforestry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/26T	Industrial Agroforestry	1	70	30	100

Aim of the Course

To develop skill and expertise on Industrial Agroforestry and associated supply and value chain management

Theory

Forests and Agroforestry – Extent of Area - Current status – National and International scenario – Role of Forests in Industrial sector – Industrial raw material – Demand and supply – Indigenous and exotic industrial resources – Policy and legal issues in industrial wood plantations and agroforestry - Major wood-based industries in India – Timber, pulpwood, plywood, panel. match splints, sports and goods, agricultural implements, construction, body building, ship industry, etc. - raw material requirements and procurements – Industrial important NTFPs – Scope and importance - Promotion of industry-based farm and agroforestry – Strategies for promotional activities. Industrial Agroforestry plantations – Status in India – Preferred species – Plantation management and establishment – Precision silvicultural techniques for Timber, pulp and paper, Match, plywood, dendro power– Propagation and plantation techniques – Pest and disease management for major industrial agroforestry tree species. Harvest operation – Mechanization – Yield potential. Value addition – Utilization of plantation and industrial residues – Briquettes and pellets. Contract farming - Definition –

Concept and methods of contract farming – Contract tree farming systems in India – Experiences of wood based industries in contract farming – buy back– Corporates in Industrial Agroforestry – International corporate involved in Industrial Agroforestry –Success stories - Corporate social responsibilities – Tree Insurance Scheme (TIS) – Felling regulatory mechanism. Consortium of Industrial Agroforestry – TNAU Model for sustaining industrial agroforestry - Agroforestry business innovations and entrepreneurship development - Agroforestry based business incubation opportunities. Impact of Industrial Agroforestry – Economic and Ecological impacts: Climatic, edaphic and biotic– Carbon sequestration – Carbon storage potential of Industrial Agroforestry and carbon trading mechanism of Industrial Agroforestry – Socio-economic impacts – Rural livelihood improvement and economic return – Environmental impact.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/26P	Industrial Agroforestry	1	70	30	100

Practical

Study of various wood based industries – Preferred species (State specific) – Timber agroforestry -Pulp and paper based agroforestry– Plywood based agroforestry – Matchwood based agroforestry – Dendro energy agroforestry – NTFPs agroforestry - Plantation management – Harvest and mechanization – Value addition Technology – Contract tree farming – Economics – Bankable project preparation - Visit to wood and non-wood based industries – Exposure to Business opportunities –DPR preparation for industrial agroforestry based business model.

Suggested Readings

1. Balasubramanian, A., Hari Prasath, C.N., Radhakrishnan, S. 2020. Textbook on Plantation Forestry. Jain Publication, New Delhi, p336.
2. Parthiban, K.T., R. Umarani, S. Umesh Kanna, I. Sekar, P. Rajendran and P. Durairasu. 2014. Industrial Agroforestry: Perspective and Prospective. Scientific Publishers, Jodhpur, India. Pp:396.
3. Parthiban, K.T. and R. Seenivasan. 2017. Forestry Technologies- A complete Value Chain Approach. Scientific Publishers, Jodhpur. p 629.
4. Parthiban, K.T. and Keerthika, A. 2020. Textbook on Agroforestry – Principles, practices and Applications. Agrobios, Jodhpur, p256

Core (Minor Courses -MN)

SOA/UG/FMN/03T – Wildlife and Protected Area Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/03T	Wildlife and Protected Area Management	1	70	30	100

Aim of the Course

1. To impart basics, functional and technical knowledge to the students on the various aspects of management strategies of the wildlife in natural ecosystem and captive conditions
2. To acquire knowledge on principles and concepts of habitat management help to understand a challenge/opportunity in a given protected area and also to understand the global protected area system

Theory

Foundation and basics of protected area management - History of the IUCN protected area categories - Purpose of the protected area management categories. Global and Indian status of protected area management. Biogeographic regions of India - Wild animal distribution pattern in India- IUCN Red data book. Habitat requirements of animals - Management of protected areas (In-situ conservation) - National parks - Sanctuaries – Tiger Reserves – Community reserves – Conservation reserves. Wildlife census - Purpose, techniques. Direct and indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities, block counts, road side counts, dung counts, pug mark census, water hole census, line transect – Scat analysis. Statistical analysis- Software's in wildlife management - Special projects for wildlife conservation – Biotelemetry - Transmitters, receivers, analysis of data, visual tagging and marking- - Role of Camera traps

and MSTripES App- Role of Remote Sensing and GIS in Wildlife management. Captive wildlife – Zoos, Biological parks and safari parks - Captive breeding program- Conservation breeding program - Central Zoo Authority of India and its function - Wildlife (Protection) Act, 1972 and its amendments. Role of NGOs in wildlife management. Introduction and reintroduction of species - International conventions MAB, CITES, CMS and CBD. Wildlife corridors -. Human Animal Coexistence- Wildlife Damage - Appraisal, Mitigation measures and Management. Healthcare, Disease Management and Nutrition in Wildlife sanctuaries and National parks, Biosphere reserves and Zoos - Major protected areas of India - Wildlife education - Wildlife tourism

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/03P	Wildlife and Protected Area Management	1	70	30	100

Practical

Exercise on the census methods - Direct method - Total count, block count, water hole count, capture, mark and recapture method, point transect, and line transect method – Use of software for analysis. Indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for other ungulates. Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife. Study on habitat analysis and evaluation. Studying habitat management and manipulation techniques. Wildlife damage and mitigation measures: Questionnaire survey. Wildlife photography. Wildlife tourism management.

Suggested Readings

1. Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA. International Zoo Books, Published by New York Zoological Society, New York
2. Krebs, C. and Davis, N. 1978. Introduction to behavioral ecology. Oxford University Press
3. Lever, C. 1985. Naturalised mammals of the world. John Wiley, London
4. Mills, L. S. 2013. Conservation of Wildlife Populations Demography, Genetics and Management (2nd edn). Wiley-Blackwell.
5. Nigel Dudley. 2013. Guidelines for Applying Protected Area Management Categories. IUCN, Gland, Switzerland.
6. Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.
7. Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun
8. Wildlife Institute of India (2004) Compendium on the notes on the course Captive management of Endangered Species. Wildlife Institute of India. Dehra Dun
9. Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England.
10. Zoos Print and Zoo Zen, Published by Zoo Outreaches Organization, Coimbatore

Non Gradial (NG)

SOA/UG/FNG/02 P –Study Tour / Techniques

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FNG/02 P	Study Tour / Techniques	2 (0+2)	70	30	100

Aim of the Course

- To know about the local and state forest areas.
- To learn about the nursery practices.

Practical

To identify the vegetation pattern of different plant species of the areas to be visited during the study tour (live specimen) and preparation of herbarium. Visits of various scientific and research institutes/ Universities related to forestry, botany, remote sensing etc. Visit to various wood based industries (wood products, NTFP, medicinal and aromatic plants). Collection of various seeds of trees species for future nursery experiments.

Preparation of nursery beds and growing the seedling in earthen pots, root trainers and poly bags. Seed sowing, hoeing, weeding and transplantation of nursery seedlings in barren and wastelands.

SEMESTER - VI

Core (Major Courses – MJ)

SOA/UG/FMJ/27T – Forest Biotechnology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/27T	Forest Biotechnology	2	70	30	100

Aim of the Course

To educate on the principles, tools, possibilities and progress made in biotechnology

Theory

Basics of Plant Tissue Culture Plant tissue culture: Concepts, history and scope – Components of Media and their role; Sterilization techniques ,Culture Conditions and Factors affecting in vitro cultures; Regeneration methods - morphogenesis, organogenesis and embryogenesis; Techniques in plant tissue culture - Micropropagation, meristem tip culture, another culture, pollen culture, ovule culture, embryo culture, callus culture and suspension culture; Somatic embryogenesis and synthetic seed production; Protoplast isolation, fusion and cybrids applications in crop improvement; Soma clonal variation, types, causes and applications; Secondary metabolite production and in vitro germplasm conservation ; National certification and Quality management of TC plants. Biotechnology- Definition, History and scope. Importance of biotechnology in Crop improvement. Genome organization. Structure of nucleic acids-Concept of gene and gene architecture. Central Dogma of molecular biology. Overview of DNA replication, transcription and translation. Regulation of gene expression. Basic techniques in molecular biology-Blotting techniques- Polymerase chain reaction- DNA sequencing methods. DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases - Different types of vectors: plasmids, phagemids, cosmids, BAC,YAC,PAC, Expression, Shuttle, binary and co-integrate vectors - Construction of recombinant DNA molecules- Bacterial transformation - Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, Agrobacterium mediated method - Tissue specific promoters, selectable and scorable markers, reporter genes- Molecular analysis of transgenic plants – Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality- Detection of GMOs – regulations and biosafety. DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, SCAR, AFLP, STS and SNPs - DNA fingerprinting of crop varieties – Development of mapping populations- linkage and QTL analysis- principles, methods and applications of Marker Assisted Selection in crop improvement; Applications of Plant Genomics and genome databases. Micropropagation in forest trees – successful examples – bamboo, sandal wood, eucalyptus, Paulownia and Melia. Bioprospecting industrially useful compounds from forest trees. Application of genetic engineering in forestry sciences –Molecular markers and its applications in forestry, Lignocellulose degrading microorganisms, Cellulose gene in tree species

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/27P	Forest Biotechnology	1	70	30	100

Practical

Biotechnology Laboratory organization - safety regulations-Sterilization techniques for aseptic manipulation-Calculations in Biotechnology and preparation of plant nutrient stock solutions Preparation of plant nutrient medium -Shoot Tip Culture, Meristem Tip Culture, Anther and embryo culture, Callus culture and suspension culture -Hardening and acclimation of in vitro regenerated plants. Isolation of bacterial plasmid DNA - Agarose Gel Electrophoresis - Gene cloning and Bacterial transformation-Genomic DNA extraction - Quantification of DNA and quality check- Plant genetic transformation- biolistic and Agrobacterium mediated transformation-DNA amplification using PCR -NTSys- Analysis of Diversity in Crop Plants- Visit to a Plant Biotechnology Lab /Commercial Plant Tissue Culture facility.

Suggested Readings

1. Brown, T. A. 2010. Gene Cloning and DNA Analysis: An Introduction, 6th edn, Wiley-Blackwell Companion site

2. Krebs, J.E, Goldstein, E.S, Kilpatrick, S.T. 2017. Lewin's Genes XII. Jones and Bartlett Publishers, Inc., p.838
3. Malacinski, GM (2015) Freifelder's Essentials of Molecular Biology (4th Student edn) Jones and Bartlett Publishers, Inc.
4. Nelson D.L and M.M. Cox. 2017. Lehninger Principles of Biochemistry, (7th edn) W. H. Freeman and Company, New York, USA. p.1328.
5. George, E. F., Hall, M. A. and De Klerk, G. J. (Eds), Plant propagation by tissue culture. Volume 1. The background. 3rd edn. Springer, 2008, 501 p, ISBN 978-1-4020-5004-6.
6. Stewart, Neal Jr. C. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications John Wiley and Sons, Inc ISBN: 978-0-470-04381-3. Singh, B.D. 2012. Plant Biotechnology. Kalyani publishers, Ludhiana. Tomar, R.S., Parakhia, M.V., Patel, S.V. and Golakia, B.A., 2010. Molecular markers and Plant Biotechnology, New Publishers, New Delhi.

SOA/UG/FMJ/28T – Forest Economics and Marketing

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/28T	Forest Economics and Marketing	1	70	30	100

Aim of the Course

To give exposure to the students on market concepts, marketing of forestry commodities, intermediaries involved, risks in forestry marketing, marketing institutions involved, price dynamics and the role of Government in regulation of markets

Theory

Economics - Definition and concepts, divisions of economics, economic systems, approaches to the study of economics. Forest economics - Definition, characteristics of Forestry sector and its role in economic development. National Income – Definition and concepts: Gross National Product and Gross Domestic Product. Consumption - Utility and its measurement: Cardinal and Ordinal. T heory of consumer behavior – Law of diminishing marginal utility, law of equi-marginal utility, indifference curve and its properties, consumer equilibrium. Demand – Law of Demand - Elasticity of demand – Types of elasticity of demand - Importance of elasticity of demand. Engel's law of family expenditure. Consumer surplus. Theory of firm, concept of production, factors of production – Land and its characteristics, labour and division of labour and theories of population. Capital and its characteristics. Enterprises - Factor – Product relationship. Laws of returns – Law of diminishing marginal return – Law of supply – Distribution. Exchange: Marketing – Role of marketing – Marketing functions – Producer surplus – Marketable and Marketed surplus – Marketing channels of forest products – Price spread – Marketing Efficiency – Integration – Market intelligence. Market equilibrium, Price determination and forecasting under various market structures. Basic guidelines for preparation of project reports – Bank norms and Farm Financial Analysis – Crop Insurance – SWOT analysis – Crisis management. International Trade: Concept of International Trade - Free trade, Autarky and it needs - Absolute and Comparative advantage; present status and prospects of exports / imports - Role of institutions like APEDA, MPEDA, ITTO, UNCTAD and GATT – WTO. Free Trade Agreements – AoA and its implications on Indian agriculture.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/28P	Forest Economics and Marketing	1	70	30	100

Practical

Estimation of consumer's equilibrium – Cardinal and Ordinal Utility Approaches. Plotting and study of demand and supply curves and calculation of elasticities of demand and supply. Study on law of diminishing marginal return. Estimation of Optimal input and Output levels. Estimation of cost of cultivation and cost of production for forest products. Preparation of Bankable projects for forestry products and its value added products. Estimation of farm financial ratios. Computation of marketable and marketed surplus of important commodities, Identification of marketing channel of Agriculture / Horticulture / Forest products – Calculation

of Price Spread – Identification of Market Structure – Time series analysis of prices - TCSI. Index number construction and uses. Visit to wood depot/LAMPS/Co-operative marketing society/ Farmers' Markets. Visit to Commercial / Co-operative Bank. Visit to different markets and processing units of Forest products.

Suggested Readings

1. Acharya S.S. and Agarwal NL. 2011. Agricultural Marketing in India. Fifth Edition. Oxford and IBH Publishers, New Delhi
2. Chadra P. 1984. Projects: Preparation, Appraisal and Implementation, McGraw Hill Inc.
3. Charya SS and Agarwal NL. 2011. Agricultural Marketing in India. Fifth Edition. Oxford and IBH Publishers, New Delhi.
4. Dewett K. K. 2005. Modern Economic Theory. S. Chand and Company, New Delhi.
5. Dewett K. K., Verma. 2004. Elementary Economic Theory, S. Chand, New Delhi.
6. Jhingan M. L. 2012. Macro -Economic Theory. Vrinda publishers, New Delhi.
7. Reddy S.S., Raghu Ram P., Neelakanta Sastry T.V. and Bhavani D.I. 2004. Agricultural Economics. Oxford and IBH Publishers, New Delhi

SOA/UG/FMJ/27P – Watershed Planning and Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/29T	Watershed Planning and Management	1	70	30	100

Aim of the Course

To teach the students on different aspects of hydrology and watershed management and to impart basic knowledge on various measures of soil and water conservation

Theory

Introduction – Hydrology and its importance in forestry. Hydrologic cycle. Precipitation – forms. Rainfall – types. Intensity, duration and frequency. Infiltration, percolation, evaporation, transpiration and evapotranspiration. Runoff - runoff process – factors affecting runoff - prediction and estimation of runoff. Hydrograph – unit hydrograph. Sedimentation and stream gauging. Soil erosion – Principles - types of erosion - geological and accelerated. Forms of erosion - water erosion - kinds and forms - causes and effects - degree of erosion. Wind erosion – types – saltation, suspension, surface creep. Control of wind erosion - shelter belts and wind breaks. Sand dune stabilization. Land capability classification - recommended land use. Soil and water conservation - historical review – its need. Biological measures – afforestation, contour farming, strip cropping, cropping systems as inter cropping, crop rotation and mixed cropping, mulching and tillage practices. Grassland management. Mechanical measures - Contour bunds, Graded bunds, Bench terracing and Stone wall - Design of structures for soil conservation. Erosion control measures for non-agricultural lands, Soil conservation on Wastelands - contour and staggered trenching. Gully control structures - Temporary and permanent –check dams – types. Spillways – drop and chute spillways, drop inlet. Water Harvesting – definition, methods and techniques - treatment of catchments. Water Harvesting for Trees and Shrubs. Ground water – Aquifer – water harvesting for ground water recharge. Storage structures – Ponds – types. Watershed Management – definitions. Characteristics of watershed - elements and components. Selection of Priority areas - Planning and implementation of watershed programs in forest watersheds. Watershed work plan. Monitoring and evaluation of watershed programs. Remote sensing and GIS in watershed management.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/29P	Watershed Planning and Management	1	70	30	100

Practical

Computation of mean rainfall – Isohyet and Thiessen polygon methods. Determination of infiltration with double ring infiltrometer. Estimation of runoff. Erosion estimation – Problems on USLE. Design of shelterbelts and windbreaks. Design of contour bunds, stone wall and bench terraces. Design of check dams. Visit to erosion prone and watershed areas. Design of water harvesting systems – roof water harvesting and percolation ponds. Design of micro catchment water harvesting systems for trees. Visit to soil conservation sites and silt

monitoring station. Exercises on Demarcation of watershed. Preparation of watershed plan - monitoring and evaluation of watershed programs.

Suggested Readings

1. Das, Ghanshyam. 2009. Hydrology and Soil Conservation Engineering. PHI Publishers, New Delhi.
2. Datta, S.K. 1986. Soil Conservation and Land Management, International Book Distributors, Dehra Dun.
3. Hamilton, I.S. 1987. Forest and Watershed Development and Conservation in Asia and the Pacific, International Book Distributors, Dehra Dun.
4. Oswal, M.C. 1999. Watershed Management (For Dry land Agriculture), Associated Publishing Company, New Delhi.
5. Rama Rao. 1980. Soil Conservation. Standard Book Depot, Bangalore.
6. Richard, Lee. 1980. Forest Hydrology, Columbia University Press, New York. Suresh, R. 2000. Soil and Water Conservation Engineering. Standard Publishers, New Delhi.

SOA/UG/FMJ/30T – Forest Tribology, Ethno-medicine and Extension

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/30T	Forest Tribology, Ethno-medicine and Extension	2	70	30	100

Aim of the Course

To impart basic knowledge on local indigenous peoples their knowledge on ethno medicines and the extension skills and knowledge with reference to forestry

Theory

Definition and characteristics of a tribe. Tribes and aborigines- an anthropological perspective. Racial classification and distribution of tribes. Tribes in India and Kerala. Tribal economy. Tribals and Constitution of India Administration of tribal areas in independent India- appraisal of tribal development - problems of tribal identity and integration in the mainstream. Relation between tribes and forests- forest as their immediate environment. Forests as the means of livelihood. Girijan habitat - changes consequent to government control of forests. Forest management and tribal welfare- management conflicts and way forward. Role of forest department in tribal welfare. Role of Non wood Forest products in the economy of tribal's and Tribal cooperative societies. Social forestry and tribal welfare. Ethno- medicines of tribals in Southern India. Traditional Botanical Knowledge. Ethno- medicines of the plants from the following families. Guttiferae (Clusiaceae), Malvaceae, Fabaceae, Mimosaceae, Caesalpiniaceae, Combretaceae, Umbelliferae (Apiaceae), Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae and Thymeliaceae. Introduction- human behaviour and psychology. Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Types of education, Formal, informal non-formal education. Rural Development: meaning, definition, objectives and genesis. Transfer of technology programs like RD, OFT, FLD, KVKs – AKIS (Agricultural Information System), ATMA – ICT enable extension services. Communication: meaning, definition, elements and selected models. Audio-visual aids: importance, classification and selection. Diffusion and adoption process. Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA). Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group, classification of group.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/30P	Forest Tribology, Ethno-medicine and Extension	1	70	30	100

Practical

Visits to study structure, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/Mahila Mandal/Village Panchayat/Van Panchayat/ State Forest Department (Social forestry wing). Group discussion at farm homesteads. Preparing individual and village level production plans. Preparation of charts, posters and flash cards. Participation in conducting exhibitions and method demonstrations/campaigns at the village level. Familiarization of the use of audio-visual aids. PRA exercises. Field visit to Different tribal regions to gain ethnobotanical knowledge and the interrelation between plant and people - Survey and identification of plants used by the tribals for medicine, food and other social purposes - Collection and preparation of herbarium specimens of the above plants.

Suggested Readings

1. FAO. 1984. Forestry extension, making it works, An international journal of forestry and forest industries, Unasylva - No. 143, Published by FAO.
2. Furer-Haimendorf, C.V. 1985. Tribes of India - the struggle for survival. OUP. New Delhi
3. Hasnain, N. 2007. Tribal India. New Royal Book Company
4. K.A. Jalihal and V. Veerabhadraiah. 2007. Fundamentals of Extension Education and Management in Extension, Concept Publishing Company.
5. L.K. Jha and P. K. Sen Sarma, A.P.H. 2008. A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.
6. Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers, Jodhpur, India, 672 p.
7. Sharma, R.N. and Bakshi, S. 1984. Tribes and tribal development. Uppal Publ. House, New Delhi.
8. Sim, D. and Hilmi, H. A.1987. Forestry Extension Methods, FAO Forestry Paper-80, P. 153.
9. Thakur, D. 1986. Socio-economic development of tribes in India. Deep and Deep Publications, New Delhi.
10. Vidyarthi, L.P. and Rai, B.K. 1985. The tribal culture of India. Concept Publ. Co., New Delhi.

SOA/UG/FMJ/31T – Forest Business Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/31T	Forest Business Management	1	70	30	100

Aim of the Course

To understand the concept of forest business management and steps to start and manage the forest based business

Theory

Management – Definition – Importance of Management – Evolution of Management thoughts - Management functions – Nature of management functions – Management Roles – Functions at various levels of Management – Management skills. Forest Business Management – Definition, Scope, Importance and Characteristics of Forest Business Management -. Special features of Forest Business – Classification of Enterprises-Micro, Small, Medium and Large. Forms of Business Organisations – Sole Proprietorship – Partnership –Private and Public Limited - Business environment – Micro and Macro environment - Startup and Business incubators. Planning – Concept – Nature – Types of Planning – Importance of Planning - Plans-Types of plans –Steps in planning - Organising – Concept of Organising - Departmentation – Basis of Departmentation – Span of control Co-ordination -– Types and Techniques. Staffing – Concept – Human Resource Planning – Process. Recruitment and Selection - Training – Concepts – Methods – Evaluation. Directing – Concept – Principles – Techniques – Supervision. Controlling – Concept – Types. Operations Management – Meaning and Scope, Supply Chain Management – Drivers and flows– Meaning and Principles, Marketing Management – Market Segmentation and Marketing Mix Financial Management – Meaning, Objectives and Scope.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/31P	Forest Business Management	1	70	30	100

Practical

Assessment of entrepreneurial traits-Identification of new business opportunities-Exercise on SWOC Analysis of Agribusiness Sector in India -Market survey for understanding customer needs Starting new business - Visit

to firms / discussion with entrepreneurs-Documenting Procedure for Establishing Agribusiness Firms-Government programs and institutions for entrepreneurship development-Financing new agribusiness ventures - Visit to banks / discussion-Exercise on Demand Forecasting for Agricultural Inputs/Products - Preparation of Advertisement and Sales Promotion Measures for Agribusiness - Exercise on Inventory Management – ABC Analysis and EOQ Model Exercise on discounted measures of Capital Budgeting-Calculation of Break Even Point and its Business Implication-Understanding balance sheet and income statement-Financial Performance Analysis - Ratio Analysis.

Suggested Readings

1. Girish B and S S Inamati. Forest Business Management by Shahapurmath. Satish Serial Publishing House
2. Koontz. H and Weihrich, H, 2007, Principles of Management, Tata McGraw Hill, New Delhi.
3. Charles W L Hill and Steven L McShane, 2007, Principles of Management, Tata McGraw Hill, New Delhi.
4. Massie, J.L, 1995, Essentials of Management, Prentice Hall of India Pvt. Ltd., New Delhi. Prasad, L.M, 2005, Principles and Practices of Management, Sultan Chand and Sons Educational Publishers, New Delhi.
5. Rao, V.S.B, and P.S. Narayana, 2004, Principles and Practices of Management, Konark Publishing Pvt. Ltd. New Delhi.

SOA/UG/FMJ/32T – Forest Landscape Restoration (FLR)

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/32T	Forest Landscape Restoration (FLR)	2 (2+0)	70	30	100

Aim of the Course

To develop students' in-depth understanding of forest landscape restoration through both traditional and modern technology

Theory

Definition, Scope and Objectives of FLR – Role of FLR in national, regional and global commitments – Land Capability Classification and Forest Cover Classification. Need for forest restoration programs. Principles and Guiding Elements. Diverse Knowledge Systems in Forest Landscape Restoration – Social-Ecological Systems and Forest Landscape Restoration - Integrated Landscape Approaches to Forest Restoration. Landscape Ecology - Scope of landscape ecology - Spatial statistics in landscape ecology - Landscape disturbance - Organisms and landscape pattern - Ecosystems processes on landscapes - Land use planning and conservation - Landscape Ecology's contribution to Forest Landscape Restoration. Different Techniques for Forest Restoration – Broad Scale Traditional Restoration of Landscape techniques – Reforestation with Timber and other woods, Invasive Species Management, Restoring Historic Groundwater Levels and restoration with carbon efficiency trees. Integration of Traditional and Western Knowledge in Forest Landscape Restoration. Restoration to conserve and increase biodiversity - Achieve Climate Goals - Achieve the Sustainable Development Goal - Spiritual and Social Renewal. Linking forest conservation and food security through agroecology: Insights for Forest Landscape Restoration. Integration for Forest Landscape Restoration Implementation. Stakeholders and Forest Landscape Restoration - Tenure, Property Rights and Forest Landscape Restoration - Polycentric Governance and FLR: Governance process versus governance outcome, Formal and informal governance and Re-scaling, mapping and contextualizing.

Suggested Readings

1. Erbaugh, J. T., and Oldekop, J. A. (2018). Forest landscape restoration for livelihoods and well being. Current Opinion in Environmental Sustainability, 32, 76-83.
2. Lamb, D., Stanturf, J., and Madsen, P. (2012). What is forest landscape restoration? Forest landscape restoration: integrating natural and social sciences, 3-23.
3. Maginnis, S., Rietbergen-McCracken, J., and Sarre, A. (Eds). (2012). The forest landscape restoration handbook. Routledge.
4. Mansourian, S., Vallauri, D., Dudley, N., Dudley, N., Mansourian, S., and Vallauri, D. (2005). Forest landscape restoration in context. Forest restoration in landscapes: Beyond planting trees, 3-7.
5. Schultz, C. A., Jedd, T., and Beam, R. D. (2012). The Collaborative Forest Landscape Restoration Program: a history and overview of the first projects. Journal of Forestry, 110(7), 381-391.

6. Stanturf, J. A., and Mansourian, S. (2020). Forest landscape restoration: state of play. Royal Society open science, 7(12), 201218.
7. Chaturvedi, R., Duraisami, M., Jayahari, K. M., Kanchana, C. B., Singh, R., Segarin, S., and Rajagopal, P. (2018). Restoration opportunities atlas of India. Washington, DC: World Resources Institute. Retrieved November, 10, 2019.
8. Singh, R., Shelar, K., Chaturvedi, R., Duraisami, M., andGautam, R. S. (2020). Restoring Landscapes in India for Climate and Communities.
9. ITTO. (2020). Guidelines for forest landscape restoration in the tropics. ITTO Policy Development Series No. 24.

SOA/UG/FMJ/33T –Forest Biomass Energy and Biofuels

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/33T	Forest Biomass Energy and Biofuels	1	70	30	100

Aim of the Course

1. To expose the graduating scholars on the existing challenges in energy sector.
2. To create skill and expertise on the need for forest-based bioenergy and biofuel towards creating self-reliance in raw material besides combating the climate change risks and uncertainties

Theory

Energy status in India – demand for electricity –energy generation from various sources- Coal demand and supply-demand for liquid fuels –Petrol and diesel - Need for alternate energy resources – forest biomass and biofuel as an alternate- Government initiatives and policies - National Policy on Biofuels (2018) - National Policy on Biofuels (2018) Amendment, 2022. Indian scenario – biomass availability - types of biomasses – Agricultural residues - Short Gestation non-edible oil rich crops - Algal feedstock - Non- Edible Oilseeds (TBOs) - Used Cooking Oil (UCO) - Animal tallow – Acid oils - Current challenges and constraints. Forest-based biomass and biofuels.

Introduction - scope and potential of dendro energy in India – Dendro biomass: composition, sources, benefits - biomass properties of dendro energy species. Potential dendro energy species – cultivation technology - plantation models – High density energy plantation (HDEP). Harvesting of biomass – hrvesting methods – plantation residues - value addition technology - biomass briquettes, pellets and biocoal. TBOs for biofuels - Introduction and scope - International Scenario - Indian Scenario – Current availability and potential of TBOs- Properties of TBOs - Major TBOs in India – *Jatropha curcas, Pongamia pinnata* - *Azadirachta indica* - *Calophyllum inophyllum* - *Madhuca latifolia, Simorouba glauca* - Other TBOs – Plantation technologies for major TBOs– Value chain on TBOs – marketing potential of TBOs.

Forest biomass - Biomass based power production methods – Pyrolysis - Gasification – Combustion - TBO based biofuels - oil extraction methods - transesterification for biodiesel production -SAF Production process through TBO - Hydroprocessing of Esters and Fatty Acids (HEFA) process – quality characteristics of biodiesel and SAF.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMJ/33P	Forest Biomass Energy and Biofuels	1	70	30	100

Practical

Dendro energy resources – study of different tree species – short, medium and long duration- QPM Production technology for energy species- Wood and biomass quality characterization – physical and chemical properties - Wood and biomass quality characterization – thermo chemical properties - Study of energy plantation models – block, agroforestry, farm forestry, linear, multifunctional etc - Primary conversion technology for biomass – biomass – converted woods – chips – various sizes and grades – visit to an industry - Study of dendro energy generation technology – pyrolysis, gasification – visit to a gasification unit - Visit to thermal power plants/ biomass combustion plant – study of energy generation through combustion and co-firing process - Study of biofuel crops - TBOs – *Jatropha curcas, Pongamia pinnata, Azadirachta indica, Calophyllum inophyllum, Madhuca latifolia, Simorouba glauca*. Nursery production technology for TBOs - Plantation production

technology for TBOs - block, agroforestry, farm forestry, linear, multifunctional, etc - Study of seed collection, storage and processing of TBOs- Oil quality characterization of various TBOs – laboratory analysis - Visit to oil processing centre – study of oil production and by-products - Study of biodiesel production technology – transesterification and by-products - Study of SAF – properties.

Suggested Readings

1. Adams P, Bridgwater T, Langton L A, Ross A and Watson I. 2018. Biomass Conversion Technologies. Greenhouse Gas Balances of Bioenergy Systems. p134 (ISBN: 9780081010365).
2. Bajpai P. 2020. Biomass to Energy Conversion Technologies -The Road to Commercialization. Elsevier. P 204. (ISBN: 978-0-12-818400-4).
3. Hakem K R, Jawaid M and Rashid U. 2014. Biomass and Bioenergy - Processing and properties. Springer. P343. (ISBN: 978-3-319-07641-6).
4. Pande M and Bhaskarwar A N. 2012. Biomass conversion to Energy - The Interface of Biotechnology, Chemistry and Materials Science. Springer. p.468. (ISBN: 978-3-642-28418-2).
5. Parthiban K.T. and R. Seenivasan. 2017. Forestry Technologies- A Complete Value Chain Approach. Scientific Publisher. Jodhpur. p.629 (ISBN: 978-93-86102-60-7).
6. Parthiban, K. T., Kumar, N. Krishna; Palanikumaran, B.; Kanna, S. Umesh. Dendro biomass resources for solid and liquid fuel generation - Opportunities and challenges. Authors Madras Agricultural Journal, 2020, p30.
7. Paramathma M, Parthiban, K.T. and Neelakantan, K.S. Strategies for improvement and utilization of Tree Borne oil seeds. 2004. Forest College and Research Institute, TNAU, Mettupalayam. p.218.
8. Radhakrishna. P. 2003. Tree Borne oil seeds as a source of energy for decentralised planning. Renewable energy science series XII. Government of India. Ministry of non-conventional energy sources, Regional office, Chennai.
9. Venkata R P and Srinivas S N .1996. Biomass Energy Systems. Tata Energy Research Institute. p345 -87(ISBN: 81-85419-25-6).

SOA/UG/FMJ/34T – Trees Outside Forests

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/34T	Trees Outside Forests	2 (2+0)	70	30	100

Aim of the Course

1. To expose students to the growing importance of trees outside forests
2. To make student understand the need of augmenting tree cover towards meeting the domestic and industrial wood requirement
3. To expose students to the existing technologies, models, policies and other government schemes

Theory

Trees Outside Forests (TOF) – introduction –classification-based on Land use – Trees with Settlements- Trees with Agricultural Lands–Trees along Manmade or Natural Features–based on Geometrical Formation - Isolated and scattered trees - Zonal Trees - Methodology of Assessment by FSI - Stratified random sampling design - Multistage stratified sampling design – Status of TOF in India - State wise TOF status and opportunities – demand and supply pattern of wood and non -wood requirements - Government policies to promote TOF – National Forest Policy (1988), National Agroforestry Policy (2014). TOF- Regeneration, restoration and rehabilitation opportunities and methods– Quality Planting Material (QPM)- Principles and criteria - design and development - General Quality Standards for Nurseries and Plants Produced - Hi-tech Nursery - Design and Development – Components and characteristics - Choice of species – utility based – general plantation techniques for prioritized species –Market and industrial linkages – timber and NTFPs –economically important tree species – various models for TOF –Agroforestry – Farm forestry - Linear plantations-windbreaks-shelterbelts -boundary plantations- riverbank plantations - trees on pasture lands- green cities-urban green space – micro forests– Impacts of TOF – contribution to Forest cover - Restoration of degraded lands – ecosystem services – Provisional – Regulating – Cultural – Supporting.

Timber products – Global status- National status- Saw logs and veneer logs- Pulpwood - Ply and panel-Industrial round wood - Non-timber products- Global status and National status- Gums- Resins- Latex – Dammar – Tannins - Fibres- Floss - Market size -Demand and supply - Processing technology- Value addition-Government regulations- Trade channels-Organizations involved -TOF based TBE opportunities – Production – processing – marketing – value addition-based business enterprises – creation of startups – MSMEs –

Business incubation. TOF certification - schemes – scope and opportunities – International certification agencies - certification Institution and organization - FSC certification - PEFC certification - Sustainable Forestry initiative (SFI) – Indian Forest and Wood Certification Council (IFWCC) - NCCF - Quality Planting Material – Government Initiatives- Carbon sequestration potential- UNFCC - Kyoto protocol- COP - carbon credit – International and national status - TOF based carbon trading opportunities -Types of carbon markets – Methodology - Benefits to farmers – Circular economy from TOF based products- Significance of TOF in achieving SDGs and NDCs. TOF related Schemes and Programs - National Bamboo Mission –Submission on Agroforestry- Green highways missions - Mission for integrated development of horticulture -Nagar Van Yojana (NVY) -National Mission for a Green India (GIM) - USAID funded project on TOFI – objectives, activities and partner institution - participating states – innovative platform – tree out growers schemes-NITI Aayog: Greening and Restoration of Wastelands with Agroforestry (G.R.O.W)- National Mission on Oilseeds and Oil Palm (NMOOP): Mini Mission - III (TBOs).

Suggested Readings

1. Parthiban, K.T. and A. Keerthika. 2020. A textbook of Agroforestry: Principles, Practices and Applications. AgroBios (India), Jodhpur. P. 256 (ISBN: 978-81-973776-8-9).
2. Parthiban, K.T. and R. Seenivasan. 2017. Forestry Technologies- A Complete Value Chain Approach. Scientific Publisher. Jodhpur. P.629 (ISBN: 978-93-86102-60-7).
3. Parthiban, K.T., R. Jude Sudhagar, C. Cinthia Fernandaz and K.K. Suresh. 2018. Agroforestry strategies for climate change (Mitigation and adaptation). Jaya Publishing House, New Delhi. P. 395 (ISBN:978-93-86110-53-4).
4. Atyi E and Simmula, M. 2002. Forest certification: pending challenges for tropical timber. Background paper prepared for the ITTO International workshop on comparability and equivalence of forest certification schemes. Kuala Lumpur. April 3- 4, 2002.
5. Indian Forest and Wood Certification Scheme – Guidelines. Program for Recognition and Accreditation of Sustainable Management Practices for Agroforestry and Natural Forestry Resources. Ministry of Environment, Forest and Climate Change Government of India. P.76
6. NITI Aayog. Technical Report on Greening and Restoration of Wastelands with Agroforestry. (G.R.O.W). 2024.p.96. (ISBN No. 978-81-956821-3-3)
7. Pandey, D. 2008. Trees Outside the Forest (TOF) resources in India. The International forestry review, vol. 10, no. 2, pp. 125–33. JSTOR, http://www.jstor.org/ stable/43740329. Accessed 17 Apr. 2024.
8. Hegde, N.G. 1991. Agroforestry in India: Scope and Strategies. Agroforestry in Asia and Pacific. RAPA publication:1991/5 Regional Office for Asia and the Pacific. FAO. Bangkok. 47-63 pp.
9. ICFRE (Indian Council of Forestry Research and Education). 2023. Forestry Statistics India 2023. Directorate of Statistics. New Forest. Dehradun. 200 pp.
10. Rudolph S and Aydos E. 2021. Carbon Markets Around the Globe. Sustainability and Political Feasibility. Elgar online. (ISBN: 978-18-391090-8-9).
11. Duraisami M, Singh R and Chalia S. 2022. Roadmap for Scaling Trees outside Forests in India: Learning from select States on Policy Incentives, Enabling Conditions, and Barriers. Working Paper. Mumbai: World Resources India. Available online at https://www.wri.org/research/ roadmap-scaling-trees-outside-forests-india.
12. Parthiban K.T, Subbalakshmi V, Jawahar Vishnu M.V and Dabbas M. 2024. A textbook on Trees outside Forests. Scientific publisher. Jodhpur (In Press).

Core (Minor Courses -MN)

SOA/UG/FMN/04T – Remote Sensing and GIS

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/04T	Remote Sensing and GIS	1	70	30	100

Aim of the Course

To inculcate students regarding the concept of Remote sensing and GIS tools in forestry sector

Theory

Definition, scope, history and development of remote sensing; Electromagnetic radiation (EMR) and electromagnetic spectrum; EMR interaction with atmosphere and earth surface; Types of remote sensing; Principles and applications of optical, thermal and microwave remote sensing; Aerial photographs – types,

scale, and resolution; Photo interpretation, Satellite remote sensing - platforms and sensors; Satellite systems. Indian Remote Sensing Program. Different concepts of RS. Visual and digital image processing; Application of satellite based remote sensing techniques in forestry - vegetation mapping using satellite imagery; Forest cover monitoring and Forest fire damage assessment; Microwave remote sensing. Studies of different vegetation indices like NDVI. Introduction to GIS - Components of GIS, Hardwares and software's; Differences between GIS and conventional cartography; Spatial and non-spatial data, Integration of attribute data with spatial data. Spatial data - Raster and Vector data. Thematic over lays in GIS- topology building and calculation of area and length etc. Application of GIS in forestry – using imageries and integration with GIS data. Maps-its projection, Toposheet and Map reading; Global Positioning System (GPS) applications in resource inventory, Global Navigation Satellite System, Galileo, IRNSS.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/04P	Remote Sensing and GIS	1	70	30	100

Practical

Preparation of base maps, thematic maps; Visual interpretation of satellite imagery; Forest cover mapping and land use mapping; Digital image processing; Introduction to various GIS and RS software; Exercises in viewing, editing, overlay. Visit to the RS and GIS labs at State level. Using of QGIS Software to prepare different maps.

Suggested Readings

1. Curran, P.J. 1985. Principles of Remote Sensing, Long man Group Ltd., England.
2. Janssen, L.F.2000. Principles of Remote Sensing. ITC. Edl. Text Book Series II. The Netherlands.
3. Rolf A.de by. 2000. Principles of Geographical Information Systems. ITC. Edl. Text Book Series I. The Netherlands.
4. Sabins, F.F.1978. Remote Sensing-Principles and Interpretation. W.H. Freeman and Co. San Francisco.
5. Sharma, M.K.1986. Remote Sensing and Forest Surveys, International Book Distributors, Dehra Dun.
6. Sharma, S. and Dey, S. K. 2021. Entrepreneurship Development and Business Ethics. V.K. Global Pvt. Ltd., New Delhi.

SEMESTER - VII (ELECTIVE/MINOR COURSES)

The student will choose one Elective group among the five major disciplines with a total of 20 credits

S. No.	Course category	Credit Hours
1	Plantation Forestry	20
2	Multi-Functional Agroforestry	20
3	High Yielding Short Rotation Forestry	20
4	Forest Product Development and Utilization	20
5	Forest Resource Management and Utilization	20
Total		**20**

Elective/Minor Courses

I - Plantation Forestry

SOA/UG/FMN/05T – Commercial Tree Seedling Production

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	

SOA/UG/FMN/05T	Commercial Tree Seedling Production	12	70	30	100

Aim of the Course

To impart knowledge on seed collection, tree seedling production through the natural as well as artificial regeneration techniques.

Theory

Introduction and scope for nursery technology. Nursery establishment-site selection – planning, and layout of nursery area. Types of nursery, types of nursery beds, preparation of beds, fumigation. Pre- sowing treatments. Methods of seed sowing and mulching, seed size and position of sowing, seedling growth and development, pricking, watering methods, weeding, hoeing, rotation, organic matter supplements and cover crops, mycorrhizae, fertilization, shading, pruning, root culturing techniques, lifting windows, grading, packaging. Storing and transportation. Containerised nursery technique – advantages, disadvantages – root deformations- container designs and types/root trainers and rooting media. Conditions/practices affecting survival and early growth, acclimating containerised stock, field handling of containerised stock, planting techniques for containerized stock. Planting bare-root seedlings: advantages, disadvantages, conditions/practices affecting early survival and early growth. Methods for field handling and planting bare-root stock. Containerised nursery Technique-Type and size of containers. Merits and demerits of containerized nursery. Root trainer techniques Preparation of ingredient mixture. Nursery practices that influence seedling uniformity, diameter/height and size of root system. Stump preparation. Target seedling concept. Temporary and permanent nursery development- preparation of proposal, layout, economic Considerations-Implementation-Emerging trends in forest tree propagation and nursery technology, VMG: Vegetative multiplication garden.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/05P	Commercial Tree Seedling Production	1	70	30	100

Practical

Raising of stocks, practicing grafting, budding and layering techniques in tree species-anatomical studies of graft and bud joints – studies on cell differentiation and union-studies on treatment effect and pre curing of scion, growth regulator effect on asexual methods – raising nurseries, practicing seed propagation, taking observations, visit of commercial nurseries. Preparation of production and planning schedule for bare root and containerized nurseries. Nursery site and bed preparation. Pre-sowing treatments. Sowing methods of small, medium, and large sized seeds. Mother bed and transplant bed preparation- Pricking and transplanting of in transplant beds. Intermediate nursery management operations. Preparation of ingredient mixture. Filling of containers Study of vegetative techniques-cutting, grafting etc. Visit to tissue culture laboratory and other nurseries Temporary and permanent nursery development preparation of proposal, layout, economic considerations.

Suggested Readings

- Bewely, J.D. and Black, M. 1985. Seed physiology of development and germination.
- Bose, T.K., Mitra, S.K. and Sadhu, M.K. 1986 Propagation of tropical and sub-tropical. Crops. Naya Prakash, Calcutta
- Duryea, M.L. and Landis, T. D. (eds.) 1984. Forest Nursery Manual: Production of Bare root Seedlings. Dr. W. Junk Publishers, The Hague/Boston/Lancaster for Forest Research Laboratory, Oregon State University, Corvallis, 386 p.
- Evans, J. 1982. Plantation Forestry in the Tropics. The English Language Book Society and Claredon Press.
- Liegel, L.H. and Venator, R. 1987. A Technical Guide for Forest Nursery Management in the Carribean and Latin America. Gen. Tech. Rep. SO-67, New Orleans, LA: U.S. Department of Agriculture.
- May, J.T., Belcher, Jr. E. W., Cordell, C.E., Filer, Jr. T. H., David South, and Lantz. C. W. 1985. Southern Pine Nursery Handbook, USDA Forest Service, Southern Region, Cooperative Forestry Mehta, A.R and Bhatt, P.N. 1990. Hand book of plant tissue and all cultures. Academic book centre, Ahmedabad

- Napier and Robbins, M. 1989. Forest Seed and Nursery Practice in Nepal. Nepal UK Forestry Research Prakash, R. 1990. Propagation Practices of Important Indian Trees. International Book Distributors, Dehra Dun. Project, Kathmandu Oxford. 472p.

SOA/UG/FMN/06T – Commercial Plantation Development and Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/06T	Commercial Plantation Development and Management	2	70	30	100

Aim of the Course

To acquaint students with various aspects of production, integrated nutrient and irrigation management and ecological factors in raising forest plantations

Theory

Role of plantation forestry in meeting the wood demand - Plantation forestry in India and abroad. Production technology for quality planting stock - preliminary site preparation for establishing plantation - Enrichment of site - Planting program - time of planting - planting pattern - spacing - planting methods. Precision silviculture - concept - advantages of precision silviculture. Tree management - canopy, root and stem engineering. Fertigation system - drip irrigation management for short and long rotation tree species. Fertilizer management for plantation productivity. Assessment and yield prediction in plantation. Nutrient and irrigation management in plantation, INM, mulching, weed management - Mechanization of plantation operation - Protection and after care of plantation - Pruning and thinning of plantation for quality wood production - Rotation in plantation - Failure of plantations. Management of coppice stand. Industrial Plantation – Importance - Demand and supply scenario in India - Wood based industries - NTFP Plantations - Choice of species and plantation technology - Silvicultural packages for Eucalyptus, Casuarina, Acacias, Silver Oak, Ailanthus, Bamboo, Melia dubia, Gmelina, Teak, Sandal and Red sanders. Post-harvest silvicultural techniques. Tools and Implements used in logging operation. Reduced impact logging (RIL), Concept - scope and objectives – impediments to adoption - difference between reduced impact logging and conventional logging. Economics of commercial plantation.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/06P	Commercial Plantation Development and Management	1	70	30	100

Practical

Plantation planning - Preparation of plantation calendar- Arrangement and preparation of improved planting stock - Planting geometry and calculation of planting stock - Site preparation and planting - Studies on wood-based industries - Plantation geometry - Canopy architecture and management, root pruning and root management, stem management and inter-callery augmentation. Plantation techniques for difficult sites - saline, alkaline soils, rocky area and waterlogged areas and other inhospitable sites. Modern plantation techniques for Eucalyptus, Casuarina, Teak, Acacias and Bamboo plantations - Production technology for energy plantations and NTFP Plantations - Economics of commercial plantation.

Suggested Readings

- Dwivedi, A.P.1992. Principles and Practices of Indian Silviculture, Surya Publications.420p.
- Julius, E. 1992. Plantation Forestry in the Tropics. Oxford University Press.
- Khanna, L.S. 2015. Theory and Practice of Indian Silviculture Systems. Bio-Green Publisher.
- Lamprecht. 1986. Silviculture in the Tropics. Verlag Paul Parey, Hamburg und Berlin.

SOA/UG/FMN/07T – Forest Growth Modelling

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/T	Forest Growth Modelling	1	70	30	100

Aim of the Course

To impart knowledge on forest growth model for predicting the future of the forest by incorporating the silvicultural treatments

Theory

Model development and validation - Important uses - Indices of competition - Two-sided competition (Distance-independent vs. Distance-dependent) - One-sided competition (Distance independent vs. Distance-dependent) – Limitations - Low predictive power (Distance-independent vs. distance-dependent) - Influence of sampling design. Whole-stand models - Yield tables and equations - Compatible growth and yield equations - Systems of equations - State-space models - Transition matrix models. Size-class models - Stand table projection - Matrix models – Diameter (Class models and Cohort models) - Single-tree distance-dependent models - Tree-list distance independent models. Stand-level mortality – Individual tree-level mortality - Mechanistic models of mortality -Development and application of mortality equations. Genetic improvements (Stand level and Tree-level) - Early stand treatments (Stand-level and Tree -level) –Thinning (Stand-level and Tree-level) – Fertilization (Stand-level and Tree-level)- Combined thinning and fertilization (Stand-level and Tree-level) – Harvesting (Stand-level and Tree-level).Types of hybrid models - Statistical growth equations with physiologically derived covariate -Statistical growth equations with physiologically derived external modifier - Allometric models -Comparison to statistical models.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/07P	Forest Growth Modelling	1	70	30	100

Practical

Collection of biometric data for growth model preparation – Sampling design analysis. Whole stand models - Yield tables and equations. Mortality model and mechanism of model. Modelling silvicultural treatments are Genetic improvements - Early stand treatments –Thinning – Fertilization - Combined thinning and fertilization – Harvesting models. Benefits and uses of working out the growth models.

Suggested Readings

- **Aaron R. Weiskittel, David W. Hann, John A. Kershaw, and Jerome K. Vanclay** (2011), **Forest Growth and Yield Modeling. Jhon Wiely & Sons Pvt.**
- **V.P. Tiwari (2026),** Forest Trees and Stand Growth Modeling. Scientific publishers.
- Jerome K. Vanclay (1994), Forest Growth Modeling Techniques.CAB International, Wallingford, UK.
- Hans Pretzsch (2009), Forest Dynamics, Growth & Yield: From Mesurement to Model.Springer Publication.

SOA/UG/FMN/08T – Marketing and Certification of Wood Products

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/08T	Marketing and Certification of Wood Products	1	70	30	100

Aim of the Course

To impart knowledge on marketing of the wood products and certification of the forest plantations and wood.

Theory

Market, definition, types of markets for timber produce, 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 harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in timber, composite wood, pulp wood, match wood. Demand forecasts. Price determination in timber produce. Domestic and International demand and trade in timber products. Market integration and market inefficiencies in timber and measures to check inefficiencies. Role of cooperative societies and NGO's in marketing of timber and non-timber forest produce. Economic policy and regulations of international timber trade. WTO - background, structure, functions and decision-making process. Essentials of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO). Forest Certification- Definition of forest certification- Origin of certification-process and methods – Advantages and Disadvantages. Principal stages in the process of certification. Producer's motivation for supplying certified forest products. Key aspects of certification. Principles of sustainable forest management. Organizations involved in certification. Legislations and policies of importance. Certification schemes in operation. Forest Stewardship Council (FSC), Program for Endorsement of Forest Certification Schemes (PEFC) etc. CIFOR certification tool kit. Indian scenario in certification. International trade in tropical logs and sawn wood. Pros and cons of certification. Potential for certifying forests and forest products of India. Tracing illegal logging. Identification of species and region of origin. Case studies in forest certification.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/08P	Marketing and Certification of Wood Products	1	70	30	100

Practical

Questionnaire preparation for primary data collection; Visit to various wood based (Timber, composite wood, pulp wood, match wood) and non-wood-based industries to study its role in marketing; identification of marketing channel and estimation of price spread for major timber and non-timber forest products; Estimation of marketing efficiency; Analysis of price and quantity data of timber a produce for examining trend, seasonal, cyclical and secular variations. Valuation of timber (Existence value, use and option values, intrinsic value etc).

Suggested Readings

- Bass, S., Thornber, K., Markopoulos, M., Roberts, S. and Grieg-gran, M. 2001. Certification's Impact on forests, stakeholders and supply changes. International Institute for Environment and Development. London. 153p.
- Conroy, M. E. 2007. Branded! How the "certification revolution" is transforming global corporations. New Society publishers, Gabriola Island, BC. 354p.
- Gupta, H. S., Yadav, M., Sharma, D. K. and Singh, A. M. 2013. Ensuring sustainability in forestry: certification of forests. TERI, New Delhi. 284p.
- Kula, E. 1996. The economics of forestry: Modern theory and practice. Timber press, Portland, Oregon. 182p.
- Muraleedharan, P. K., Subramanian, K. K., and Pillai, P. P. 1998. Basic readings in forest economics. Kerala Forest Research Institute and Ford Foundation, Thrissur, Kerala. 177p.
- Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers and Publishers), Dehradun, India. 140p

SOA/UG/FMN/09T – Restoration of Degraded Lands

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/09T	Restoration of Degraded Lands	2	70	30	100

Aim of the Course

To impart practical understanding about rejuvenation of forest with tree vegetation and to develop skills on tacking different problem soils with suitable vegetation

Theory

Degraded lands: Concept, classification, status, extent and causes of degraded lands/ wastelands, different types of degraded lands – physical, chemical and biological land degradation. Soil erosion- types, causes and mechanism, measures to control erosion, ravine and sand dune formation and their control measures. Salt affected soils- classes of salt affected soils, causes, extent and their effects on plant growth and afforestation / reclamation practices. Acid soils- definition, characteristics, causes and afforestation. Water logged areas- explanation, impact on pant growth and Biodrainage techniques. Afforestation and reclamation of denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas. Desertification- definition, impact and causes, prevention and counter measures (shelter belts and wind breaks). Soil pollution- types, effects and control measures through forestry techniques. National and state level programs on degraded lands/wasteland development. Role of Government agencies and NGO's in degraded lands/wasteland development program

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/09P	Restoration of Degraded Lands	1	70	30	100

Practical

Tree species suitable for different degraded lands. Identification and study of various degraded lands. Visit to nearby degraded lands (Eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas) and afforestation program.

Suggested Readings

- Hegde NG 1987. Handbook of Wasteland Development. BAIF, Pune 102p.
- ICAR 1977. Desertification and its Control. ICAR, New Delhi 358p. National Commission on Agriculture 1976. Report of the National Commission on Agriculture, Part ix.
- Imeson A 2012. Desertification, Land Degradation and Sustainability, John Wiley and Sons.
- Kumar Anil and Pandey R N 1989.Wastelands Management in India. Ashish Publishing House, New Delhi.
- Luna R K 1989 Plantation Forestry in India, International book distributors, Dehra Dun. Forestry; Ministry of Agriculture and Irrigation, Govt. of India, New Delhi 457p.

SOA/UG/FMN/10T – Dendro-biomass and Energy Plantation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/10T	Dendro- biomass and Energy Plantation	2	70	30	100

Aim of the Course

To develop skill and expertise among the students regarding the Forest Energy Resources

Theory

Forests and Dendro-energy – Definition and Scope Role of Forests – Forest Energy Potential – Status of Forest Biomass – Applications of forest biomass energy resources – Advantages and Disadvantages of Forest Biomass energy resources. Introduction – Biomass Production – Photosynthetic and energy production– Biomass Composition – (Cellulose, Hemicellulose, Lignin, Starch, Proteins, Mineral Elements, Other components (Organic and inorganic) – Biomass Energy Content – Properties of Forest Biomass – Physical – Thermodynamic and other properties. Energy Trees – Short rotation species – Eucalyptus, Casuarina, Subabul, Prosopis and Bamboos – Medium rotation species – All Acacias – Long rotation species – Energy characteristics of the species – Tree borne oilseeds as a source of biofuel – Dendro energy production technology – Site selection – Choice of species – Plantation establishment– Maintenance of plantation–

Protection – Harvesting of biomass – Harvesting Methods – Plantation residues – Types – Utilization and value addition through briquetting — Yield potential of different dendro energy species. Dendro energy models – Farm Forestry – Agroforestry – Captive Plantations – High Density Short Rotation Model (HDSR) – High Density Energy Plantation (HDEP) – Clonal Plantations – Monoclonal and Polyclonal Model – Sporadic model – Linear model – Paired row model– Establishment and management – Economics – Handling of Biomass – Drying biomass material –Drying techniques – Biomass storage and Transportation – Sustainable Production of woody biomass for energy generation. Introduction– Species selection – Energy species amenable for farm forestry – Types of farm forestry models. CDM approach– CDM benefits through Energy Plantations – Carbon sequestration potential of energy trees. Contract energy farming – Scope and methods – Dendro biomass power plants in India – Scope and potential.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/10P	Dendro-biomass and Energy Plantation	1	70	30	100

Practical

Study on natural and artificial methods for tree biomass production. Identifying suitable tree species (Short rotation, medium rotation and long rotation species) for energy generation. Estimation of calorific value for Short rotation, medium rotation and long rotation species. Study on energy characteristics of the species. Dendro energy production technology – Site selection – Plantation establishment – Plantation management – Harvesting operation. Biomass estimation in trees by using both destructive and non-destructive methods. Plantation residues for dendro-energy production. Dendro energy models. High Density Short Rotation Model (HDSR) and High Density Energy Plantation (HDEP).

Suggested Readings

- Divya, M.P., K.T. Parthiban, K. Vanangamudi, K. Srinivasan and M. Govinda Rao. 2008. A text Book on Social Forestry and Agroforestry. Sathish Serial Publishing House, Delhi. ISBN: 81 89304-48-8. P.315.
- Luna, R.K. 1989. Plantation Forestry in India. International Book Distributors. Pp. 320 – 338.
- Khanna, L.S. 1999. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi. ISBN: 81-58-933-01-4. P.473.
- Parthiban, K.T., Umarani, R., Umesh Kanna, S., Sekar, I., Rajedran P. and Durairasu, P. Industrial Agroforestry Perspectives and Prospectives. Scientific Publishers. Jodhpur. P. 396
- Parthiban, K.T., Subbulakshmi, V., Umesh Kanna, S., Sekar, I., Rajendran, P., Durairasu, P. and Suresh, G. 2013. Dendro Power Generation - Principles and Applications. FCRI, Publications. P.275.
- Parthiban, K.T, Paramathma, M. and Neelakantan, K.S. 2006, Clonal forestry, FC&RI publication (ISBN no.81-902081-2-8). P. 209.

SOA/UG/FMN/11T – Plantation and Climate Change Mitigation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/11T	Plantation and Climate Change Mitigation	2 (2+0)	70	30	100

Aim of the Course

To understand the scenario of climate change and international treaties on climate change, adaptive silviculture for climate change mitigation, silviculture for conservation of ecosystems

Theory

Global climate change - factors involved greenhouse gases, potential threats, global carbon cycle and C-budget, carbon sequestration. Forests and climate change. Forest responses and vulnerabilities to climate change mitigation. Status of forests in global climate change. Harnessing Forests for Climate Change Mitigation, International climate negotiation, UNFCCC, IPCC, CoP, LULUCF, REDD++ and CDM. National action plan for climate change - Green India mission- Indian Network for Climate Change Assessment

(INCCA) - State Action Plan on Climate Change. Silviculture and sustainability- criteria and indicators for sustainable plantation forestry in India. CIFOR guidelines. Silvicultural and stand management strategies for carbon sink maximization and source minimization. Adaptive silviculture for climate change. Analog forestry for site productivity and carbon value. Disturbance- natural and anthropogenic, short- and long- term impacts and their implications. Fire loss estimation in forests. Deforestation and degradation trends at global, national and regional levels. Mega development projects, Road widening projects and conservation of native and threatened species, management and rehabilitation plans. Invasive – major invasive species in forests – area affected and methodology for mapping. Eradication methods- management. Restoration of invasive affected areas – types - methods approaches, strategies and opportunities. Silvicultural treatments for habitat restoration, catchment area treatments, enrichment planting. Silviculture Climate resilience - definition - resilient forestry - concept - practices and models - resilient forestry practices for different land use systems - Role of canopy in regulating functional inputs to stand: canopy and forest continuum, Continuous Cover Forestry. Silviculture of old growth stands and sacred grooves- their ecological significance and biodiversity values. Silviculture activities for conserving forest resources. Expanding forest and tree cover area - TOF sector in India. Carbon sequestration potential of Trees Outside forests (TOFs), home gardens and urban forests.
Suggested Readings
Adam Markham (Editor). 2010. Potential Impacts of Climate Change on Tropical Forest Ecosystems. Amazon publishers. Anderson, P, and Palik, B. 2011. Silviculture for Climate Change. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center. Bravo, F., LeMay, V., Jandl R. and Gadow, von K. (Eds). 2008. Managing Forest Ecosystems: The Challenge of Climate Change. Springer publication. Pp 324 Claussen, Eileen, Cochran, Vicki, Davis, Arroyo and Debra, P. and Pew. 2001. Climate Change: Science, Strategies, and Solutions. Brill Academic Pub. Pp 393 Streck, Charlotte, O'Sullivan, Robert, Richard Tarasofsky, G. and Janson-Smith, Toby. 2011. Climate Change and Forests: Emerging Policy and Market Opportunities. Brookings Institution Press

SOA/UG/FMN/12T – Plant Biochemistry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/12T	Plant Biochemistry	1	70	30	100

Aim of the Course
To understand the basic scenario of biochemical action that happens in the plant system
Theory
Introduction to biomolecules. Chemistry of carbohydrates: Monosaccharides, classification, Configurations and conformations (Anomerism, epimersim, mutarotation, inversion); Disaccharides and polysaccharides (structural and storage); Glycosaminoglycans and glycoproteins. Chemistry of lipids: Lipid classification-Fatty acids, triacylglycerols, glycerophospholipids and sphingolipids. Amino acids of proteins – General properties, peptide bonds, classification and characteristics, acid base properties; Optical activity. Primary, secondary, tertiary and quaternary structure of proteins; f ibrous and globular proteins; protein stability and denaturation. Chemistry of nucleic acids: Bases, sugars, Nucleosides and nucleotides. Chemical structure and properties of DNA and RNA. Chemical catalysts vs. biological catalysts; substrate specificity-stereo, geometric specificities; Enzymes – nomenclature, classification, enzyme kinetics- rates of reactions; Lock and Key hypothesis and induced fit models; Enzyme assay, transition state theory, Michaelis Menten equation, Lineweaver Burk plot, enzyme inhibition-reversible (Competitive, uncompetitive and mixed) and irreversible, allosteric enzymes, Effect of pH and temperature on enzyme activity; Isozymes, coenzymes. Photosynthesis – light reactions, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3, C4 and CAM plants, CO2 fixation, regulation of photosynthesis. Metabolism of carbohydrates -glycolysis, TCA cycle, electron transport chain. Lipid metabolism – beta oxidation and fatty acid biosynthesis. Secondary metabolites- Classification and functions of phenolics, terpenoids and alkaloids.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

SOA/UG/FMN/12P	Plant Biochemistry	1	70	30	100

Practical

Qualitative analysis of carbohydrates. Estimation of sugar by Dubois method. Determination of reducing sugars by DNS method. Determination of total carbohydrate by anthrone method. Protein estimation by Bradford method. Absorbance curve of two dyes. Qualitative analysis of amino acids. Titration of amino acids. Purification of acid phosphatase from mustard seedlings. Qualitative analysis of oils and fats. Estimation of saponification value of oils. Estimation of iodine number of oils/fats. Chromatography of photosynthetic pigments. Lipid analysis by thin layer chromatography. Total protein estimation by Lowry's method. Kinetics of alkaline phosphatase.

Suggested Readings

- Berg J M, Tymoczko J L and Stryer L. 2007. Biochemistry, 7th edn. Wiley Eastern Ltd. ISBN:0 7167-8724-5.
- Buchanan, Bob B. Gruissem, Wilhelm and L. Jones, Russell. Biochemistry and Molecular Biology of Plants.
- Jeremy M., Berg, Lubert Stryer, Tymoczko, John and Gregory Gatto. Biochemistry.
- Lehninger. Principles of Biochemistry –David L. Nelson and Michael M. Cox
- Plummer, David T. An Introduction to Practical Biochemistry.
- Rao, Beedu Sashidhar, Deshpande, Vijay. Experimental Biochemistry: A student companion.
- Sadasivam, S and Manickam, A. 2009. Biochemical Methods, 3rdEdn, New Age International.
- Thayumanavan, B., Krishnaveni, S. and Parvathi, K. 2004. Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4
- Voet, Donald and Voet, Judith. Biochemistry.
- Wilson, K. and Walker, J.M. 2000. Principles and techniques of Practical Biochemistry

SOA/UG/FMN/13T – Research Methodology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/13T	Research Methodology	1	70	30	100

Aim of the Course

To inculcate the art of research and expose the students through various methodologies of data collection, processing, tabulation and interpretation

Theory

Role of research methodology - Induction and deduction, Sources of information - Review of literature, Identification of problem - Formulation of objectives and hypothesis - Scope of survey based research - Types of surveys- identification of research problem - Analysis of research problem, customer identification, categorization- Data collection, analysis and compilation of survey report - Types of data, concepts of population - Analysis of data, graphical and diagrammatic presentation - Measures of central tendencies- mean, median, mode- problems- Reliability and validity of measuring tools.- Reporting: Significance of report writing, steps in report writing- Processing Information in Research Methodology - Importance of Experiments in research - Interview studies in Research methodology -Solutions of research methodology

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/13P	Research Methodology	1	70	30	100

Practical

Research problem identification, objective and Hypothesis Formulation - Research design, Collection of data, Analysis of Data for the identified Problem- Hypothesis testing, interpretation and report writing for the identified problem- Application of Scales for measurement – Nominal and ordinal- Application of Scales for measurement –Interval and Ratio- Application of Scales for measurement – Likert and other scales- Identification of Primary and Secondary Data -Correlation - Simple and partial correlation - Correlation -

Multiple correlation analysis - Regression – Simple and Multiple regression analysis- Dummy variable analysis - Construction of Index Numbers - Factor analysis - Cluster analysis.
Suggested Readings
• C.R. Kothari and Gaurav Garg (2023). Research Methodology: Methods and Techniques, New Age International Publishers. • Ranjit Kumar (2005), Research Methodology: A Step-By-Step Guide for Beginners, SAGE Publications. • R. Pannerselvam (2023), Research Methodology. PHI Learning. • R. Cauvery, U.K. Sudha Nayak, M.Girija, R. Meenakashi (2003),Research Methodology, S. Chand & Company Ltd.

SOA/UG/FMN/14T – Statistical Packages for Data Analysis

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/14P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100
Aim of the Course					
To learn the art of data collection, processing, analysis and interpretation will be developed to translate simple data into scientific data					
Practical					
SYSTAT package – data entry and creation of a data file – importing an excel file, SPSS file, database file, BMDP file and SAS file in Systat for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SYSTAT- SAS package – data entry and creation of data files in SAS – opening a file – importing an excel file, Systat file, database file and SPSS file in SAS for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SAS- Data analysis using SYSTAT and SAS packages- Descriptive statistics- Cross tabulation – one way, two way and multi-way tables- Chi square test- Student's t test – comparing a single mean- Comparison of two means – independent t test- Comparison of two means – paired t test- One way ANOVA- Two way ANOVA- Correlation analysis- Spearman's rank correlation and Kendall's tau- Jaccard and tetra correlation coefficients- Complete regression analysis.					
Suggested Readings					
• Nigam A.K. and Gupta, V.K. (1979). Hand book on Analysis of Agricultural Experiments. IASRI Publication, New Delhi. • Panse, V.G. and Sukhatme, P.V. (1967). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India. • Petersen Roger G. (1994). Agricultural Field Experiments: Design and Analysis. Marcel Dekker, New York. • Jayaraman, K. and Rugmini, P. (1990). Statistical techniques in forestry - Research and forestry. Kerala Forest Research Institute, Peechi, Thrissur.					

SOA/UG/FMN/15P – Internship with Forest Plantations-Based Institutions/Plantation Companies.

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/15P	Internship	2 (0+2)	70	30	100
Aim of the Course					
To provide students with practical exposure and professional training in forest plantation management, enabling them to understand silvicultural practices, plantation operations, monitoring, record-keeping, and sustainable management of plantation forests for timber, pulp, and environmental services.					
Practical					
Field visits and attachment to forest plantation institutions or commercial plantation companies; observation and participation in site preparation, planting layout, and species selection; nursery management including seed treatment, sowing, and seedling care; transplanting and establishment of saplings; monitoring plantation					

growth and survival; measurement of tree height, diameter, and crown spread; assessment of plant health and identification of pests and diseases; pruning, thinning, and weeding operations; soil and water conservation practices in plantations; record-keeping of plantation operations, growth data, and yield projections; exposure to harvesting, post-harvest handling, and value addition (if applicable); documentation of plantation management plans; preparation of an internship report summarizing activities, observations, and recommendations.

II - Multi-Functional Agroforestry

SOA/UG/FMN/16 T – Agroforestry system

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/16T	Agroforestry system	2	70	30	100

Aim of the Course

To impart knowledge on suitable agroforestry practices for different land uses To study their role in ecosystem services To teach recent trends in agroforestry research and development

Theory

Agroforestry - objectives, importance, potential and limitations for implementation. Agroforestry systems - simultaneous and sequential agroforestry systems, Basis for classification of agroforestry systems and principles - Structural, functional, ecological and socio-economic basis of classification - Indigenous vs exotic tree species in agroforestry, intraspecific variations- Tree crown architecture and tree root architecture – silvicultural options to minimize negative interactions- Ideotype concept for selection of multipurpose trees and nitrogen fixing trees. Land use – Land capability classification- Survey and analysis of land use system Description of agroforestry systems viz. agri-silviculture, silvipasture, agro-silvipasture, horti-silvipasture - Description of other systems – silvi-mediculture, silvi-pisciculture, silvi-apiculture, urban agroforestry systems and aqua forestry- Wind break and shelter belt agroforestry systems – Agroforestry practices for wetlands – Agroforestry practices for garden land - Agroforestry practices for semi-arid and arid lands Agroforestry practices for coastal and hilly areas - Bio saline agroforestry. Ecosystem services – Provisional services – food, fuel, fodder, fibre, timber and non-timber resources, Regulating services - Agroforestry for soil enrichment-biodiversity conservation - improved air and water quality - Cultural services – Religious, aesthetic, recreation - Supporting services – education, soil and environmental conservation, carbon sequestration, climate change mitigation. Nutrient cycling and nutrient pumping in agroforestry systems - Soil productivity and management in agroforestry - Plant management in Agroforestry – manipulation of trees, population densities and mixture of trees and herbaceous crops – ecosystem structure and function-interactions relevant to agroforestry. Formulation of Agroforestry projects - preparation of bankable projects, economic analysis of various agroforestry systems - Budget and other constraints - Financial and socio-economic analysis of agroforestry projects - Role of time in decision making- social and private discount rate - Role of risk and uncertainty in decision making- Participatory Rural Appraisal (PRA) -Rapid Rural Appraisal (RRA) tools for Agroforestry problem diagnosis.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/16P	Agroforestry system	1	70	30	100

Practical

Studies on global agroforestry systems - Designing agroforestry practices for wet lands - garden lands - dry lands -coastal and hilly areas - multitier systems - light intensity and shade effect under agroforestry systems-quantifying tree-crop interaction by LER method allelopathic studies- case studies on role of agroforestry in carbon sequestration, biodiversity conservation and air and water quality-Agroforestry D &D exercise - Preparation of bankable projects - financial and economic appraisal - Profitability analysis of various agroforestry systems.

Suggested Readings

- Divya, M.P., Parthiban, K.T., Srinivasan, K., Vanangamudi, K. and M. Govinda Rao. 2008. A Textbook on Social Forestry and Agroforestry. Satish Publishers, Delhi, 315p.
- Janaki, R. R., Alavalapati and Mercer, D. Evan (Eds). 2005. Valuing Agroforestry Systems, Methods and Applications. Advances in Agroforestry, Vol. 2, Kluwer Academic Publishers.314p.
- Jose, S. 2009. Agroforestry for Ecosystem Services and Environmental Benefits. Springer Science, The Netherlands. 266p.
- Nair, P.K.R.1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, 499.
- Kumar, B.M and Nair, P.K.R. 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry, Vol-8, Springer Science, The Netherlands p307.
- Ong, C. K. and Huxley, P.K. 1996. Tree Crop Interactions -A Physiological Approach. ICRAF.
- Parthiban, K.T. Ramah, K., Sivakumar, K and Rao G.R. 2019. Multifunctional Agroforestry Volume – I &II. Jaya Publishing House, New Delhi.
- Parthiban, K. T. and Keerthika, A. 2021. A Text book of Agroforestry – Principles, Practices and Applications, Agrobios, Jodhpur.
- Puri, Sunil and Panwar, Pankaj. 2007. Agroforestry systems and practices. New India Publishing Agency, New Delhi, 641p. 10.
- Raj, Antony Joesph and Lal, S. B. 2014. Agroforestry- Theory and Practices, Scientific Publishers (India), New Delhi.

SOA/UG/FMN/17T – Interactions in Agroforestry Systems

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/17T	Interactions in Agroforestry Systems	1	70	30	100

Aim of the Course

To make students understand the concepts of tree- crop interactions, their quantification and techniques to neutralize the negative interactions

Theory

Agroforestry –general principles of plant productivity – photosynthesis – respiration – plant productivity – manipulation of photosynthesis in Agroforestry – multipurpose tree species - fodder trees – fuel wood trees – fruit trees – industrial wood species – other woody perennials – herbaceous species. Tree-crop interface – factors influencing tree – crop interaction- types of tree –crop interactions based on effect, association and output, position – positive interactions – competition, complementarity in resource sharing – above ground and below ground interaction. Negative interaction – competition, allelopathy – characteristics of tree species and crops – Allelochemicals - source of allelochemicals - process and leaching of allelochemicals - Tree management – manipulation of densities and arrangement of trees – Tree crown and root manipulation - Animal-tree-crop interaction. Method for quantifying interactions, principles of resource capture and utilization of light and water, nutrition and space. Tree-soil-crop interactions- nitrogen fixing trees interactions in agroforestry systems – Use of radioisotopes in tree-crop interaction studies - Root distribution of trees and crops. Management options to neutralize negative interactions – tree husbandry practices for alleviating competition – thinning, pruning, pollarding, lopping, hedging etc. – management of light interception.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/17P	Interactions in Agroforestry Systems	1	70	30	100

Practical

Different methods for quantifying interactions- Studies on allelopathy - Laboratory bioassay with tree /crop parts and rhizosphere soil - different plant mixtures and estimating tree-soil crop interactions - Working out indices for evaluating agroforestry systems - Measurement and interpretation of light interception in

agroforestry system - Interpretation of yield responses to shelter, soil water and drainage measurement - transpiration measurement, quantifying root distribution.
Suggested Readings
• Avery, M.A. Cannel, M.G.R. and Ong, C.K. 2005. Biophysical Research for Asian Agroforestry. Oxford and IBH Publishing Co. Pvt. Ltd • Dagar, J.C. and Tewari, J.C. 2016. Agroforestry Research Developments. • Parthiban, K.T. and Keerthika, A. 2021. A Text book of Agroforestry – Principles, Practices and Applications, Agrobios, Jodhpur. • Raj, Antony Joesph and Lal, S.B. 2014. Agroforestry- Theory and Practices, Scientific Publishers (India), New Delhi.

SOA/UG/FMN/18T – Agroforestry and Climate Change Mitigation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/18T	Agroforestry and Climate Change Mitigation	2 (2+0)	70	30	100

Aim of the Course
To develop understanding of students about ecosystem services, environmental benefits and quantification of ecosystem services along with their valuation.
Theory
Global CO2 emission and patterns of climate variability - Multifunctionality of Agroforestry - Major ecosystem services, environmental benefits and international conventions, charters on climate change (UNFCCC, UNCCD, Agroforestry and Kyoto protocol – genesis, goals, signatories and latest developments - climate change negotiations (CoP), Reduced Emissions from Deforestation and Degradation (REDD) and biodiversity conservation (CBD) – an overview. Agroforestry for carbon conservation, sequestration, substitution – role and potential of various agroforestry systems - Estimates of carbon sequestration potential – measurement – Aspects and criticisms, Factors affecting above and belowground carbon sequestration potential. Agroforestry for soil enrichment – mechanisms – litter and fine root dynamics, rhizo-deposition and other rhizosphere effects, symbiotic and free-living N2 fixation, mycorrhizal associations - Soil and water conservation benefits through agroforestry. Agroforestry for biodiversity conservation - Synergy with climate change mitigation - Landscape connectivity for wildlife, supporting the pollinators of plant species - Agroforestry for improved air and water quality - Non-point source pollution in Indian agro-ecosystems - Riparian buffers for alleviating agricultural non-point source pollution – Pollution reduction measures in forestry. Private profitability vs. social profitability - exclusion or inclusion of social benefits and costs and non-market values, or externalities - Theory of externalities, effect of environmental costs and benefits on the profitability of agroforestry practices - Valuing environmental services - Profitability of timber, pulp wood, ply wood and match wood-based agroforestry systems - Costs and benefits in agroforestry- valuation of inputs and outputs- environmental outputs.
Suggested Readings
• Alavalapati JRR, Shrestha RK, Stainback GA and Matta JR. 2004. Agroforestry development: Anenvironmental Economic Perspective. Agroforestry Systems. 61: 299– 310. • Huxley P. 1999. Tropical Agroforestry. Blackwell. • IPCC. 2007. Climate Change 2007. Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. • Jain SK and Singh P. 2000. Economic Analysis of Industrial Agroforestry: Poplar (*Populus deltoides*) In Uttar Pradesh (India). Agroforestry Systems. 49: 255–273. • Jeffers JNR. 1978. An Introduction to System Analysis with Ecological Application. Edward Arnold. • Jose S. 2009. Agroforestry for Ecosystem Services and Environmental Benefits: An Overview. Agroforestry Systems. 76: 1-10. • Lyngbaek AE, Muschler RG and Sinclair FL. 2001. Productivity and Profitability for Multistrata.

- Nair PKR. 1993. An Introduction to Agroforestry. Kluwer, Netherlands.
- Organic Versus Conventional Coffee Farms in Costa Rica. Agroforest. Syst. 53: 205–213.
- Schroth G and Sinclair F. 2003. Tree Crops and Soil Fertility: Concepts and Research Methods, CABI, Wallingford, UK.
- Young A. 1997. Agroforestry for Soil Management. 2nd edn. CABI, Wallingofrd, UK.

SOA/UG/FMN/19T – Industrial Agroforestry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/19T	Industrial Agroforestry	2	70	30	100

Aim of the Course

To develop skill and expertise on Industrial Agroforestry and associated supply and value chain management

Theory

Forests and Agroforestry – Extent of Area - Current status – National and International scenario – Role of Forests in Industrial sector – Industrial raw material – Demand and supply – Indigenous and exotic industrial resources – Policy and legal issues in industrial wood plantations and agroforestry - Major wood-based industries in India – Timber, pulpwood, plywood, panel. match splints, sports and goods, agricultural implements, construction, body building, ship industry, etc. - raw material requirements and procurements – Industrial important NTFPs – Scope and importance - Promotion of industry-based farm and agroforestry – Strategies for promotional activities. Industrial Agroforestry plantations – Status in India – Preferred species – Plantation management and establishment – Precision silvicultural techniques for Timber, pulp and paper, Match, plywood, dendro power– Propagation and plantation techniques – Pest and disease management for major industrial agroforestry tree species. Harvest operation – Mechanization – Yield potential. Value addition – Utilization of plantation and industrial residues – Briquettes and pellets. Supply Chain - Definition – Concept – Supply chain network – Logistic activities – Marketing system – Marketing type and channel – Price patterns of various agroforestry industrial wood products – Contract farming - Definition – Concept and methods of contract farming – Contract tree farming systems in India – Experiences of wood based industries in contract farming – buy back– Corporates in Industrial Agroforestry – International corporate involved in Industrial Agroforestry –Success stories- Corporate social responsibilities – Tree Insurance Scheme (TIS) – Felling regulatory mechanism. Consortium of Industrial Agroforestry – TNAU Model for sustaining industrial agroforestry - Agroforestry business innovations and entrepreneurship development - Agroforestry based business incubation opportunities. Impact of Industrial Agroforestry – Economic and Ecological impacts: Climatic, edaphic and biotic– Carbon sequestration – Carbon storage potential of Industrial Agroforestry and carbon trading mechanism of Industrial Agroforestry – Socio-economic impacts – Rural livelihood improvement and economic return – Environmental impact.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/19P	Industrial Agroforestry	1	70	30	100

Practical

Study of various wood based industries – Preferred species (State specific) – Timber agroforestry -Pulp and paper based agroforestry– Plywood based agroforestry – Matchwood based agroforestry – Dendro energy agroforestry – NTFPs agroforestry - Plantation management – Harvest and mechanization – Value addition Technology – Contract tree farming – Economics – Bankable project preparation - Visit to wood and non-wood based industries – Exposure to Business opportunities –DPR preparation for industrial agroforestry based business model.

Suggested Readings

- Balasubramanian, A., Hari Prasath, C.N., Radhakrishnan, S. 2020. Textbook on Plantation Forestry. Jain Publication, New Delhi, p336
- Parthiban, K.T., Umarani, R., Umesh Kanna, S., Sekar, I., Rajendran, P. and Durairasu, P. 2014. Industrial Agroforestry: Perspective and Prospective. Scientific Publishers, Jodhpur, India. Pp:396.

- Parthiban, K.T. and Seenivasan, R. 2017. Forestry Technologies- A Complete Value Chain Approach. Scientific Publishers. Jodhpur. p 629.
- Parthiban, K.T. and Keerthika, A. 2020. Textbook on Agroforestry – Principles, practices and Applications. Agrobios, Jodhpur, p256

SOA/UG/FMN/20T – Ecotourism

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/20T	Ecotourism	2	70	30	100

Aim of the Course

To develop knowledge, understanding, and appreciation of environmentally responsible travel to relatively undisturbed natural areas that promote biodiversity conservation, has low negative visitor impact, and provide socio-economic benefits to the local stakeholder communities

Theory

Ecotourism – Definition - History of tourism and evolution of ecotourism. Various forms of tourism - Dimensions of tourism and essential conditions for tourism to occur. Differences between tourism components. Mass tourism versus ecotourism. Organised tours and Free Independent Traveller – World Tourism Organization. Concept of ecotourism and flaws in real world. Problems with definition of ecotourism and criticisms. Dimensions of ecotourism and the criteria to qualify for ecotourism. Declaration – Different forms of ecotourism. Ecotourism indicators and conceptual differences between developing and developed countries. International organizations and NGOs promoting ecotourism. Ecotourism-its potential in developing countries- Poverty and biodiversity, Ecotourism as a rural development strategy in tropical countries Ecotourism as a land use- possibilities of integration – Ecotourism policies at national and local level. Environmental Impacts of ecotourism and its mitigation - Case studies from different parts of the world- Concept of "scale". The checks and controls and institutional mechanisms for controlling the environmental impacts, Mitigation of pollution. Social Impacts of ecotourism and precautionary principles to avoid ill effects Stories from different parts of the world narrating ecotourism development and its influence on society and their culture – The societal advantages and the negative impacts of ecotourism development – Ways forward to address the negative social impacts Indigenous people and ecotourism. Ecotourism economics and business – Investment of international agencies like World Bank in ecotourism projects Ecotourism economics at macro and micro economic level in developing countries Ecotourism as a green business and role of green consumerism – Business plans- unique selling points for marketing – Potential of internet in marketing ecotourism – Payments for Environmental services and role of ecotourism Multiplier effects, opportunity costs and leakage in ecotourism industry Sharing ecotourism revenues among stakeholders – Training in ecotourism to deliver quality service. Ecotourism as a vehicle for the conservation of common property resources – potentials and pitfalls, Dangers involved in management of common property resources Relations between the government and the private sector. Ecotourism and Protected Areas Changing paradigms in the Protected Area Management Support at international level for ecotourism Integrated Conservation Development Projects (ICDPS) and role of ecotourism Community based ecotourism programs. Planning and management of ecotourism – Ecotourism plans and management of visitors and other resources including human and natural resources – Quality control, codes of conduct etc. Use of GIS and ICT for effectively managing and planning ecotourism – Criteria and indicators for sustainable management and monitoring – Charter for Sustainable Tourism – Sustainability issues in ecotourism management and ecotourism certification. Ecotourism design – Role of socio-economic factors in decision making – Designing ecotourism products using local technologies – Carrying capacity considerations. – Use of GIS in ecotourism. Ecotourism markets and influences of climate change Existing ecotourism markets and ecotourism market segmentation – Paradigm shifts possible due to climate change and its potential influence of carbon economy on existing ecotourism markets.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/20P	Ecotourism	1	70	30	100

Practical

Preparation of a thematic compendium after extensive and original independent investigation about the chosen Protected Area. Be familiar with Government policy and legislation, the current policies regarding the component land uses of the study site. Stakeholder analysis and social Impacts Assessment. Identify different stakeholders at different levels. Based on this perform a stakeholder analysis and then conduct social surveys to gather the information required for assessing the impacts of current management and to explore the intervention needed in the chosen protected area. Ecological surveys including Environmental Impact Assessment. Assess the ecological impacts of current human use using standard techniques in order to identify the intervention needed in the chosen protected area.
Suggested Readings
• Bhatt, S. and Liyakhat, S. 2014. Ecotourism Development in India: Communities, Capital and Conservation • Lindberg, K., Wood, M. E. and Engeldrum, D. 1998. Ecotourism- A guide for planners and managers (Environment and Development). Foundation Books • Page, S. J. and Dowling, R. K. 2002. Ecotourism. Pearson Education Limited, Essex. The Ecotourism Society, Vermont. • Weaver, D. 2002. Ecotourism. Milton, Queensland, Australia: John Wiley and Sons Australia.

SOA/UG/FMN/21T – Dendro- Biomass and Energy Plantation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/2121T	Dendro- biomass and Energy Plantation	2	70	30	100
Aim of the Course					
To develop skill and expertise among the students regarding the Forest Energy Resources					
Theory					
Forests and Dendro-energy – Definition and Scope Role of Forests – Forest Energy Potential – Status of Forest Biomass – Applications of forest biomass energy resources – Advantages and Disadvantages of Forest Biomass energy resources. Introduction – Biomass Production – Photosynthetic and energy production– Biomass Composition – (Cellulose, Hemicellulose, Lignin, Starch, Proteins, Mineral Elements, Other components (Organic and inorganic) – Biomass Energy Content – Properties of Forest Biomass – Physical – Thermodynamic and other properties. Energy Trees – Short rotation species – Eucalyptus, Casuarina, Subabul, Prosopis and Bamboos – Medium rotation species – All Acacias – Long rotation species – Energy characteristics of the species – Tree borne oilseeds as a source of biofuel – Dendro energy production technology – Site selection – Choice of species – Plantation establishment– Maintenance of plantation– Protection – Harvesting of biomass – Harvesting Methods – Plantation residues – Types – Utilization and value addition through briquetting — Yield potential of different dendro energy species. Dendro energy models – Farm Forestry – Agroforestry – Captive Plantations – High Density Short Rotation Model (HDSR) – High Density Energy Plantation (HDEP) – Clonal Plantations – Monoclonal and Polyclonal Model – Sporadic model – Linear model – Paired row model– Establishment and management – Economics – Handling of Biomass – Drying biomass material –Drying techniques – Biomass storage and Transportation – Sustainable Production of woody biomass for energy generation. Introduction– Species selection – Energy species amenable for agroforestry – Types of agroforestry models– Silvi agriculture – Silvi pastoral based energy farming– Alley cropping– CDM approach– CDM benefits through Energy Plantations – Carbon sequestration potential of energy trees. – Contract energy farming – Scope and methods – Dendro biomass power plants in India – Scope and potential.					

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

SOA/UG/FMN/21P	Dendro-biomass and Energy Plantation	1	70	30	100

Practical

Study on natural and artificial methods for tree biomass production. Identifying suitable tree species (Short rotation, medium rotation and long rotation species) for energy generation. Estimation of calorific value for Short rotation, medium rotation and long rotation species. Study on energy characteristics of the species. Dendro energy production technology – Site selection – Plantation establishment – Plantation management – Harvesting operation. Biomass estimation in trees by using both destructive and non-destructive methods. Plantation residues for dendro-energy production. Dendro energy models. High Density Short Rotation Model (HDSR) and High-Density Energy Plantation (HDEP).

Suggested Readings

- Luna, R.K. 1989. Plantation Forestry in India. International Book Distributors. Pp. 320 – 338.
- Divya M.P., Parthiban, K.T., Vanangamudi, K., Srinivasan, K. and Rao, M. Govinda. 2008. A text Book on Social Forestry and Agroforestry. Sathish Serial Publishing House, Delhi. ISBN: 81-89304-48-8. P.315.
- Khanna, L.S. 1999. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi. ISBN: 81-58-933-01-4. P.473.
- Parthiban, K.T., Umarani, R., Umesh Kanna, S., Sekar, I., Rajendran, P. and Durairasu, P. 2014. Industrial Agroforestry: Perspective and Prospective. Scientific Publishers, Jodhpur, India. Pp:396.
- Parthiban, K.T, Subbulakshmi, V., Umesh Kanna, S., Sekar, I., Rajendran, P., Durairasu, P. and Suresh, G. 2013. Dendro Power Generation - Principles and Applications. FCRI, Publications. P.275.
- Parthiban, K.T., Paramathma, M. and Neelakantan, K.S. 2006, Clonal forestry, FC&RI publication (ISBN no.81-902081-2-8). P. 209.

SOA/UG/FMN/22T – Introduction to Agronomy and Crop Production Technology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/22T	Introduction to Agronomy and Crop Production Technology	2	70	30	100

Aim of the Course

To impart the basic and fundamental knowledge of Agronomy

Theory

Agronomy and its scope: Definition, Meaning and scope of Agronomy; Art, science and business of crop production, relation of Agronomy with other disciplines of Agricultural Science, Fields crops and classification, importance, ecology and ecosystem, Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate, depth and method of sowing: broadcasting, drilling, dibbling, transplanting etc. Tillage and tilth: Definition, objectives, types, advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, classification of essential nutrients, role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined / un-combined forms Manures and fertilizers, nutrient use efficiency: Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, method of preparation and role of organic manures in crop production Integrated Nutrient Management: Meaning, different approaches and advantages of INM Green manure- role in crop production: Definition, objectives types of green manuring, desirable characteristics, advantages and limitations of green manuring , Water management: Water resources of the world, India and the state; Soil Moisture Constants – gravitational water, capillary water, hygroscopic water, Soil moisture constants, Concept of water availability to plants, soilplant-water relationship, crop water requirement, water use efficiency, Methods of irrigation : Scheduling of irrigation, different approaches of scheduling irrigation Weeds: Definition, Importance and

basics of classification of weeds and their control Cropping systems: Factors affecting cropping systems, major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices, natural resources and conservation pollution and pollutants, Allelopathy: Meaning and importance in crop production, Growth and development of crops: Definition, Meaning and factors affecting growth and development.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/22P	Introduction to Agronomy and Crop Production Technology	1	70	30	100

Practical

A visit to Instructional Crop farm and study on field crops, Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state, Study of some preparatory tillage implements, Study of inter tillage implements, Practice of ploughing / puddling, Study and practice of inter cultivation in field crops, Numerical exercises on calculation of seed, plant population and fertilizer requirement, Study of yield contributing characters and yield estimation of crops, Identification of weeds in different crops, Seed germination and viability test of seed, Practice on time and method of application of manures and fertilizers, Measurement of soil moisture by gravimetric and volumetric method and bulk density.

Suggested Readings

- Donn, William L. 1965. Meteorology. McGraw-Hill Book Co. New York.
- Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
- Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers 6. Ludhiana. Reddy S R. 2008. Principle of Crop Production. Kalyani Publisher, Ludhiana.
- Yawalkar K S and Agarwal J P. 1977. Manures and Fertilizers. Agricultural Horticultural Publishing House, 3. Nagpur. 90.

SOA/UG/FMN/23T – Plant Biochemistry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/23T	Plant Biochemistry	1	70	30	100

Aim of the Course

To understand the basic scenario of biochemical action that happens in the plant system

Theory

Introduction to biomolecules. Chemistry of carbohydrates: Monosaccharides, classification, Configurations and conformations (Anomerism, epimersim, mutarotation, inversion); Disaccharides and polysaccharides (structural and storage); Glycosaminoglycans and glycoproteins. Chemistry of lipids: Lipid classification-Fatty acids, triacylglycerols, glycerophospholipids and sphingolipids. Amino acids of proteins – General properties, peptide bonds, classification and characteristics, acid base properties; Optical activity. Primary, secondary, tertiary and quaternary structure of proteins; f ibrous and globular proteins; protein stability and denaturation. Chemistry of nucleic acids: Bases, sugars, Nucleosides and nucleotides. Chemical structure and properties of DNA and RNA. Chemical catalysts vs. biological catalysts; substrate specificity-stereo, geometric specificities; Enzymes – nomenclature, classification, enzyme kinetics- rates of reactions; Lock and Key hypothesis and induced fit models; Enzyme assay, transition state theory, Michaelis Menten equation, Lineweaver Burk plot, enzyme inhibition-reversible (Competitive, uncompetitive and mixed) and irreversible, allosteric enzymes, Effect of pH and temperature on enzyme activity; Isozymes, coenzymes. Photosynthesis – light reactions, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3, C4 and CAM plants, CO2 fixation, regulation of photosynthesis. Metabolism of carbohydrates -glycolysis, TCA cycle, electron transport chain. Lipid metabolism – beta oxidation and fatty acid biosynthesis. Secondary metabolites- Classification and functions of phenolics, terpenoids and alkaloids.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/23P	Plant Biochemistry	1	70	30	100

Practical

Qualitative analysis of carbohydrates. Estimation of sugar by Dubois method. Determination of reducing sugars by DNS method. Determination of total carbohydrate by anthrone method. Protein estimation by Bradford method. Absorbance curve of two dyes. Qualitative analysis of amino acids. Titration of amino acids. Purification of acid phosphatase from mustard seedlings. Qualitative analysis of oils and fats. Estimation of saponification value of oils. Estimation of iodine number of oils/fats. Chromatography of photosynthetic pigments. Lipid analysis by thin layer chromatography. Total protein estimation by Lowry's method. Kinetics of alkaline phosphatase.

Suggested Readings

- Berg J M, Tymoczko J L and Stryer L (2007) Biochemistry. 7th edn. Wiley Eastern Ltd. ISBN:0 7167-8724-5.
- Berg Jeremy M., Stryer Lubert, Tymoczko John and Gatto Gregory. Biochemistry.
- Buchanan Bob B, Gruissem Wilhelm and Jones, Russell L.. Biochemistry and Molecular Biology of Plants.
- Lehninger. Principles of Biochemistry –David L. Nelson and Michael M. Cox
- Plummer David T. An Introduction to Practical Biochemistry.
- Rao Beedu Sashidhar and Deshpande Vijay Experimental Biochemistry: A student companion.
- Sadasivam S and Manickam A (2009), Biochemical Methods, 3rd edn, New Age International.
- Thayumanavan B, Krishnaveni S and Parvathi K (2004), Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4.
- Voet Donald and Voet Judith. Biochemistry.
- Wilson K and Walker J M (2000), Principles and techniques of Practical Biochemistry

SOA/UG/FMN/24T – Research Methodology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/24T	Research Methodology	1	70	30	100

Aim of the Course

To inculcate the art of research and expose the students through various methodologies of data collection, processing, tabulation and interpretation

Theory

Role of research methodology - Induction and deduction, Sources of information - Review of literature, Identification of problem - Formulation of objectives and hypothesis - Scope of survey based research - Types of surveys- identification of research problem - Analysis of research problem, customer identification, categorization- Data collection, analysis and compilation of survey report - Types of data, concepts of population - Analysis of data, graphical and diagrammatic presentation - Measures of central tendencies- mean, median, mode- problems- Reliability and validity of measuring tools.- Reporting: Significance of report writing, steps in report writing- Processing Information in Research Methodology - Importance of Experiments in research - Interview studies in Research methodology -Solutions of research methodology.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

SOA/UG/FMN/24P	Research Methodology	1	70	30	100

Practical

Research problem identification, objective and Hypothesis Formulation - Research design, Collection of data, Analysis of Data for the identified Problem- Hypothesis testing, interpretation and report writing for the identified problem- Application of Scales for measurement – Nominal and ordinal- Application of Scales for measurement –Interval and Ratio- Application of Scales for measurement – Likert and other scales- Identification of Primary and Secondary Data -Correlation - Simple and partial correlation - Correlation - Multiple correlation analysis - Regression – Simple and Multiple regression analysis- Dummy variable analysis - Construction of Index Numbers - Factor analysis - Cluster analysis

Suggested Readings

C.R. Kothari and Gaurav Garg (2023). Research Methodology: Methods and Techniques, New Age International Publishers.
Ranjit Kumar (2005), Research Methodology: A Step-By-Step Guide for Beginners, SAGE Publications.
R. Pannerselvam (2023), Research Methodology. PHI Learning.
R. Cauvery, U.K. Sudha Nayak, M.Girija, R. Meenakashi (2003),Research Methodology, S. Chand & Company Ltd.

SOA/UG/FMN/25P – Statistical Packages for Data Analysis

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/25P	Statistical Packages for Data Analysis	1(0+1)	70	30	100

Aim of the Course

The art of data collection, processing, analysis and interpretation will be developed to the translate simple data in to scientific data

Practical

SYSTAT package – data entry and creation of a data file – importing an excel file, SPSS file, database file, BMDP file and SAS file in Systat for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SYSTAT- SAS package – data entry and creation of data files in SAS – opening a file – importing an excel file, Systat file, database file and SPSS file in SAS for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SAS- Data analysis using SYSTAT and SAS packages- Descriptive statistics- Cross tabulation – one way, two way and multi-way tables- Chi square test- Student's t test – comparing a single mean- Comparison of two means – independent t test- Comparison of two means – paired t test- One way ANOVA- Two way ANOVA- Correlation analysis- Spearman's rank correlation and Kendall's tau- Jaccard and tetra correlation coefficients- Complete regression analysis.

Suggested Readings

- Jayaraman, K. and Rugmini, P. 1990. Statistical techniques in forestry - Research and forestry. Kerala Forest Research Institute, Peechi, Thrissur.
- Nigam, A.K. and Gupta, V.K.1979. Hand book on Analysis of Agricultural Experiments. IASRI Publication, New Delhi.
- Panse, V. G. and Sukhatme, P.V. 1967. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India.
- Petersen Roger G. 1994. Agricultural Field Experiments: Design and Analysis. Marcel Dekker, New York.

SOA/UG/FMN/26T – Agroforestry Business Incubation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/26T	Agroforestry Business Incubation	1	70	30	100

Aim of the Course

The aim of this unique incubation course is to leverage forestry and agroforestry technologies into business enterprises with main focus of inspiring sustainable economic development through start-ups and micro, medium and macro enterprises (MSMEs).

Theory

Technology, mentoring, and market linkages with traditional farming and wood and non wood based industries. Fostering rural entrepreneurship- entrepreneurs developing sustainable, nature-based businesses by integrating trees with crops or livestock, enhancing income. Technical, financial, and marketing support for value-added products like biofuels, aromatic oils, and wood crafts. Nurture startups and MSMEs that integrate trees and shrubs into agricultural systems for commercial gain. Incubators provide technical mentorship (e.g., mini-clonal technology), value-addition training, market linkages, and financial assistance. Focus areas includes nurseries (fruit/timber), biofuel production, wood seasoning, and aromatic oil processing, briquetting, and wood antiques, rural entrepreneurship, preservation technology, burlapping technology, multifunctional agroforestry technology, production of activated carbon, cocoon crafting, and fatty oil and aromatic oil processing, biofuel technology, etc. offering support in company formation, consultancy, and patenting for agroforestry innovations. Hands-on training in nursery management, quality seedling production, and multifunctional agroforestry models, carbon credits, biomass energy, and agroforestry consultancy. Wood preservation, aromatic and medicinal herb production, and eco-friendly wooden crafts. Beekeeping, sericulture, and nursery businesses for high-quality planting materials. Access to state-of-the-art laboratories, value-addition units (e.g., for wood seasoning or oil extraction), and co-working spaces. **Innovation Voucher Programme (IVP)** or schemes under the MSME Innovative Scheme. Assistance with product licensing, export procedures, and connecting with wood-based industries for buy-back arrangements. Agroforestry incubation centres in India- ICAR (Indian Council of Agricultural Research), TNAU (Tamil Nadu Agricultural University), MABIF (Madurai Agri Business Incubation Forum), Mettupalayam Agroforestry Business Incubation Forum (MAFBIF), and Agroforestry Business Incubation Centre (ABiC), ICAR-CAFRI etc. Common species utilized for business development include Neem, Teak, *Eucalyptus*, Popular, *Melia dubia* and Bamboo etc.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/P	Agroforestry Business Incubation	1	70	30	100

Practical

Identified Agroforestry business incubation focuses on technologies like mini-clonal production, briquetting, and wood antiques, rural entrepreneurship, offering support in company formation, consultancy, and patenting for agroforestry innovations. Hands-on training in nursery management, quality seedling production, and multifunctional agroforestry models, Carbon credits, biomass energy, and agroforestry consultancy. Wood preservation, aromatic and medicinal herb production, and eco-friendly wooden crafts. Beekeeping, sericulture, and nursery businesses for high-quality planting materials. Access to state-of-the-art laboratories, value-addition units (e.g., for wood seasoning or oil extraction), and co-working spaces. **Innovation Voucher Programme (IVP)** or schemes under the MSME Innovative Scheme. Assistance with product licensing, export procedures, and connecting with wood-based industries for buy-back arrangements. Study of agroforestry business incubation centres in India- ICAR (Indian Council of Agricultural Research), TNAU (Tamil Nadu Agricultural University), MABIF (Madurai Agri Business Incubation Forum), Mettupalayam Agroforestry Business Incubation Forum (MAFBIF), and Agroforestry Business Incubation Centre (ABiC), ICAR-CAFRI etc.

Suggested Readings

SOA/UG/FMN/27P – Internship with Agroforestry-Based Institutions/Industries

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

SOA/UG/FMN/27P	Internship with Agroforestry-based Institutions/Industries	2 (0+2)	70	30	100
Aim of the Course					
To provide hands-on training and professional exposure to agroforestry-based products processing, technology applications, and industrial operations, enabling students to understand production techniques, value addition, quality control, and sustainable management of agroforestry -based products.					
Practical					
Field attachment to agroforestry-based product processing units. Major wood-based industries- Timber, Pulpwwod, Plywood, Panel, Match, Splints, Sports and goods, Agricultural implements, Construction, Body building, Ship industry, etc., Agroforestry based NTFP processing centers. Attchement with industry –based farm and agroforestry plantation, Energy plantation, High density plantation, wood –based industry in contract farming, medicinal and aromatic based industry, agroforestry based-institutes at national/regional level, NGOs, etc.					

III - High Yielding Short Rotation (HYSR) Forestry

SOA/UG/FMN/28T – Applied Tree Improvement

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/28T	Applied Tree Improvement	2	70	30	100

Aim of the Course

To impart applications of principles of tree breeding and improvement to the students
To breed new varieties with increased productivity to cater needs of user agencies

Theory

General concept of tree breeding, tree improvement and forest genetics – History of tree improvement – Reproduction in forest trees - Mode of Reproduction – Significance – Pollination – Types of pollination – Pollination mechanism - Pollination in cross pollinated and self-pollinated tree species. Pollen dispersion distances, pollinators and their energetics. Pollen handling - Forced f lowering for seed orchard manipulation. Variation in trees, importance and its causes. Natural variation as a basis for tree improvement. Geographic variations – Ecotypes, clines, races and land races – Selective breeding methods. Plus tree selection for wood quality, disease resistance and agroforestry objectives. Selection strategies and choice of breeding methods and progress in selective breeding for forest trees. Indirect selection for biotic and abiotic stresses. Wood and tree improvement – wood properties and their genetic relationships. Progeny selection and clonal selection – Concepts – scope – limitations. Progeny and clonal testing. Estimating genetic parameters and genetic gain breeding values. Average performance of half sibs and full-sibs. GxE interaction in trees. Seed orchards – type, functions and importance. Exotic forestry and tree breeding - gains and risks - donor and receptor countries - genetic improvement of exotics. Heterosis breeding: inbreeding and hybrid vigour. Manifestation and fixation of heterosis. Species and racial hybridization. Natural and artificial hybrids - Indian examples – Teak, sal, shisham, eucalypts, acacias, pines and poplars. Polyploidy, aneuploidy and haploidy in soft and hard wood species. Induction of polyploidy. Mutation Breeding and its application in tree improvement. Biotechnology in tree improvement. Genetically Modified tree species – Varietal registration- procedures-conducting DUS test. Tree DUS testing- development of descriptors for trees. Economics of tree improvement.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/28P	Applied Tree Improvement	1	70	30	100

Practical

Identification of ecotypes, races, and land-races in natural forest. Selection of superior phenotypes. Marking of candidate trees, plus trees and elite trees. Progeny and clone testing. Mating and field designs. Estimating genetic parameters and genetic gain - Visit to species, provenance and progeny trials. Visit to seed orchards. Comparison of parents and their putative hybrids. Macro and micro propagation. Tree Improvement Programs in Timber species and non-Timber species.

Suggested Readings

- FAO. 1985. Forest Tree Improvement, FAO. Publication
- Faulkner R. 1975. Seed Orchard Forestry. Commission Bull. No. 34
- Khosla PK. 1981. Advances in Forest Genetics. Ambika Publ., New Delhi
- Mandal AK and Gibson GL. (Eds). 1997. Forest Genetics and Tree Breeding. CBS
- Parthiban, K.T, Krishnakumar, N. and Devanand, P.S. 2020. Tree Breeding and Improvement – Theories and Techniques. Scientific Publishers. Jodhpur
- Sandeep Kumar and Matthias Fladung. 2005. Molecular genetics and breeding of forest trees, International book distribution Co. India 436 pages
- Surendran C, Sehgal RN and Paramathma M. 2003. Text Book of Forest Tree Breeding. ICAR Publ.
- White JW. 1976. Introduction to Forest Genetics. Academic Press
- Zobel BJ and Talber J. 1984. Applied Forest Tree Improvement. John Wiley and Sons.

SOA/UG/FMN/29T – Reproduction Biology of Tree Crops

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/29T	Reproduction biology of tree crops	2	70	30	100

Aim of the Course

To impart the knowledge of reproduction in forest tree species and to make them understand the mechanism of breeding and sex expression

Theory

Reproductive Biology – Introduction – Concepts – Importance – Mode of reproduction – types – Tropical trees – Temperate trees – Tree characteristics - growth and development (both vegetative and reproductive) - Floral morphology and types of flowers- floral initiation and breeding systems. Floral Measurement and prediction of Flowering-Juvenility and vernalization - Floral diversity and pollination. Mode of pollination – Cross pollinated and self-pollinated tree species. Mechanisms and significance - Pollination syndromes and their evolution; Plant – Pollinator systems, Diversity of pollination syndromes in selected plant families. Sex expression, monoecy, dioecy and its evolution. Environmental effects on sex expression. Floral attractants and rewards; Biology of floral and extra f loral nectaries; Examples of plant insect interactions involving pollination. Floral characteristics of the main pollination syndromes- Mating system dynamics in Forest trees – Factors affecting different mechanisms – Mechanisms promoting high levels of Out-Crossing – self incompatibility – Factors leading to unusually low levels of out crossing – Factors that prevent or limit self-fertilization. Environmental effects on sex expression - Plant-pollination interactions, Pollinator energetic and nectar production, Pollen travel within and between trees – pollination efficiency, reproductive efficiency, Distance of pollen travel, pollen transport and pollen viability. Fertilization in hard wood trees – Double fertilization – Seed formation in angiosperms - fertilization in soft wood trees – Cone formation in softwood trees. Seed dispersal – Benefits of seed dispersal – types of dispersal – consequences of seed dispersal – Gene flow- Barrier to gene flow – Gene flow between species (Genetic pollution) – Models of gene flow – Gene flow mitigation.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/29P	Reproduction biology of tree crops	1	70	30	100

Practical

Sex expression in forest trees – Out crossing mechanisms in forest trees – Measurement of pollen flow in wind – pollinated and insect-pollinated species – Pollen viability – Hanging drop techniques and fertility – Seed dispersal mechanisms – wind – water.

Suggested Readings

- Dattee, Christian Dumas and Andre Gallais.1992. Reproductive Biology and Plant Breeding. Springer
- Khosla PK. 1981. Advances in Forest Genetics. Ambika Publ., New Delhi
- Mandal AK and Gibson GL. (Eds) 1997. Forest Genetics and Tree Breeding
- Ramawat Kishan Gopal, Mérillon Jean-Michel, and Shivanna K R. 2014. Reproductive Biology of Plants. CRC Press.
- Shivanna K R and Rangaswamy N S.1992. Pollen Biology a Laboratory Manual. Springer Verlag. New York
- Zobel BJ and Talbert J. 1984. Applied Forest Tree Improvement. John Wiley and Sons
- Zobel BJ, Wyk GV and Stahl P. 1987. Growing Exotic Forests. John Wiley and Sons.

SOA/UG/FMN/30T – Biometrical Genetics in Tree Breeding

Course Code	Name of Subject	Credits	Marks	Total

			External	Internal	
SOA/UG/FMN/30T	Biometrical genetics in tree breeding	1	70	30	100

Aim of the Course

To impart knowledge in the field of biometry as applied to breeding population, provinces and making experiment in forest genetics and tree breeding.

Theory

History and principles of quantitative genetics in forest trees and importance of qualitative and quantitative traits in tree breeding; Basic statistical Tools-Mean, mean, mode, standard deviation; Experimental design, principles and components of experimental design; Phenotypic variance, genotypic variance and its partitioning, models of gene action. Nature of Gene Action - Dominance and Epistatic-Qualitative and quantitative traits in tree breeding; Biometrical Techniques used for assessing the variability in germplasm collection various types of variability – Significance; Heterosis, types of heterosis, Factors affecting heterosis, Genetic basis of heterosis; Heritability, Types of heritability – methods of estimation of heritability, genetic gain and genetic advance. Association analysis - Correlation coefficient analysis – Types of correlation – Application in tree improvement; Path analysis Merits, Demerits, Application in Plant Breeding; Combining ability, types of combining ability –Inbreeding depression and its effects in tree breeding; Mating design in trees and its classification. D2 statistics – Merits and Demerits; Molecular Diversity Analysis –marker approach – Computation of Data; Adaptation, Types of adaptation, causes of adaptation; Stability analysis of important fast-growing trees; Comparison of stability, combining ability and Heritability analysis.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/30P	Biometrical genetics in tree breeding	1	70	30	100

Practical

Estimation of first and second degree of statistics -mean, median, range, mode, standard deviation and coefficient of variation in tree species-Problems on multiple factor inheritance - Estimation of genotypic and phenotypic variance in Eucalyptus tree species - Analysis of additive and dominance component of variances in red sanders - Estimation of heterosis in Kadamba trees - Estimation of heritability and genetic gain in Casuarina - Analysis of phenotypic and genotypic correlation in Eucalyptus - Estimation of path analysis in sandal trees - Estimation of GCA and SCA in teak tree species - Studies of different mating design in tree species - Estimation of selection methods in tree species of Melia dubia - Line × tester analysis in Eucalyptus tree species - Diallel analysis in Melia dubia - Stability analysis in teak tree species - D2 analysis in Kadamba tree species - Studies of different DNA markers in improving tree species.

Suggested Readings

- Nadarajan N. and M. Gunasekaran. 2005. Quantitative Genetics and biometrical techniques in plant breeding. Kalyani Publishers.

SOA/UG/FMN/31T – Marker Assisted Breeding in Forestry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/31T	Marker assisted breeding in forestry	2	70	30	100

Aim of the Course

To provide insight into development of markers in the tree improvement program for identifying the important traits.

Theory

Domestication: The Evolution of Crop Plants – Breeding methods- transgenic technology- Molecular markers- Achievement and future prospective in Marker Assisted breeding. Hybridization based markers- Restriction Fragment Length polymorphism (RFLP) techniques and application; PCR based markers – Randomly Amplified Polymorphic DNA marker (RAPD) and its types; Amplified Fragment Length

polymorphism (AFLP) principle and their application - Microsatellites marker/ Simple Sequence Repeat maker (SSR) development and application - Development of SCAR and STS marker principle and application. Introduction – SNP marker discovery – methods and tools - whole genome SNP analysis for major gene discovery – Allele mining; Applications of DNA markers in diversity analysis – characterization of plant genetic resources – role of markers in Plant Variety protection. Mapping populations- Linkage Mapping of Molecular Markers and Oligogenes- Mapping of Quantitative Trait Loci - Association Mapping. Marker-Assisted characterization of germplasm and genetic purity- Marker-Assisted Backcrossing- Multitrait Introgression- Innovative Breeding methods for effective use of MAS- Genomic Selection- Phylogenetic Relationships and Genetic Diversity- High-Throughput SNP Genotyping- Bioinformatics Tools and Databases for Genomics Research-Phenomics.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/31P	Marker assisted breeding in forestry	1	70	30	100

Practical

Analysis of morphological diversity through statistical package like NTSYS - Extraction, quantification and separation of protein markers using SDS-PAGE. Isolation of plant genomic DNA, quantification and quality assessment by agarose gel - PCR using RAPD primers and separation of RAPD fragment using agarose gel electrophoresis. Amplified Fragment Length Polymorphism marker data generation - PCR amplification of genomic DNA using SSR primers -Separation of SSR markers using urea PAGE denaturing gel and silver staining - Finger printing of germplasm lines and seed varietal purity test using SSR markers -Development of SCAR marker from RAPD marker. Phenotyping the mapping population RILs or F2 using the morphological traits - Genotyping the mapping population RILs or F2 using the SSR markers - Construction of linkage map using map maker software and QTL analysis. SNP markers data generation and analysis using Real time PCR. Whole genome SNP array data analysis using the Microarray platform. SNP data analysis using pLink software. Marker assisted breeding – MABB studies.

Suggested Readings

- Ahmar, S., Ballesta, P., Ali, M. and Mora-Poblete, F. (2021). Achievements and challenges of genomics-assisted breeding in forest trees: From marker-assisted selection to genome editing. International Journal of Molecular Sciences, 22(19), 10583.
- Grattapaglia, D. (2008). Perspectives on genome mapping and marker-assisted breeding of eucalypts. Southern Forests: a Journal of Forest Science, 70(2), 69-75.
- Nilausen, C., Gélinas, N., and Bull, G. (2016). Perceived acceptability of implementing marker assisted selection in the forests of British Columbia. Forests, 7(11), 286.
- O'malley, D. M., and McKeand, S. E. (1994). Marker assisted selection for breeding value in forest trees.

SOA/UG/FMN/32T – Tissue Culture Application in Forestry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/32T	Tissue culture application in Forestry	2	70	30	100

Aim of the Course

To provide basic knowledge on the plant tissue culture, techniques, mass propagation, hardening and certification.

Theory

Introduction-Concepts and principles. History of Plant tissue culture. Sterilization Techniques Nutritional requirements for plant tissue culture - Factors affecting plant tissue Culture-Commercial PTC Lab Organization-Micropropagation – applications and limitations. Low cost alternatives in micro propagation. Morphogenesis – direct and indirect, organogenesis and somatic embryogenesis. Callus initiation -

establishment and maintenance. Synthetic seeds and applications. Meristem culture and virus elimination - virus indexing methods. Shoot tip culture and in vitro clonal Multiplication-Applications. Embryo culture and embryo rescue-applications. In vitro fertilization techniques. Ovule, ovary and endosperm culture. Anther and microspore culture - production of Haploids-Protoplast isolation, culture and protoplast fusion - applications - Somaclonal variation - applications. In vitro germplasm conservation. Commercial scale micropropagation Micropropagation of - Neem, Teak, Bamboo, Paulownia, Eucalyptus, Red sanders, Mahogany, Sandal wood, Melia, Casuarina and Gmelina. Micropropagation of rare and endangered plants. Methods for Hardening-Acclimatization-Physiological changes during hardening. Packaging and transport of tissue cultured plants – Domestic and export. National certification system – Guidelines for Accreditation of Test laboratory for virus diagnosis and genetic fidelity testing of tissue culture raised plants and Tissue Culture Production Facility. Classification of secondary plant metabolites. Extraction and quantification methods for secondary metabolites. Plant Cell cultures for secondary metabolite production–steps. Large scale production through bioreactors.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/32P	Tissue culture application in Forestry	1	70	30	100

Practical

Laboratory organization - safety regulations and Sterilization techniques for aseptic manipulation. Nutrient stock and growth regulator stock preparation -Culture media preparation. Micropropagation of Neem, Teak, Bamboo, Paulownia, Eucalyptus, Red sanders, Mahogany, Sandal wood, Melia, Casuarina, Gmelina. Inoculation of explants for callus culture - Clonal propagation through meristem culture - Anther and Microspore culture - Embryo culture - Sub-culturing technique for regeneration. In vitro and ex vitro rooting of tissue culture plantlets - Induction of somatic embryos and synthetic seeds - Establishment of suspensions and viability assay - Determination of cell growth in suspensions - Extraction of secondary metabolites. Phytochemical assay of secondary metabolites - Quantification by HPLC and GC-MS - Testing anti-microbial activity. Induction of hairy roots-medium preparation, strain selection, co-cultivation and maintenance of hairy roots. NCSTCP-Procedures and Quality analysis by Genetic Fidelity test - Virus indexing in TC plants - A demonstration on hardening and field transfer of TC plants - Visit to commercial tissue culture laboratory - Project preparation for establishment of tissue culture lab.

Suggested Readings

- Bonga, J. M. and Durzan, D. J. (Eds). (1982). Tissue culture in forestry. Springer Science and Business Media.
- Bonga, J. M. and Durzan, D. J. (Eds). (2012). Cell and Tissue Culture in Forestry: Volume 2 Specific Principles and Methods: Growth and Developments (Vol. 24). Springer Science and Business Media.
- Hasnain, S. and Cheliak, W. (1986). Tissue culture in forestry: economic and genetic potential. The forestry chronicle, 62(4), 219-225.
- Savangikar, V. A. (2004, February). Role of low cost options in tissue culture. In Low cost options for tissue culture technology in developing countries. Proceedings of a Technical Meeting organized by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture (pp. 11-15).
- Tanase, C., Volf, I., Vintu, S., Gradinaru, R., and Popa, V. I. (2013). Potential applications of wastes from energy and forestry industry in plant tissue culture. Cell. Chem. Technol, 47(7-8), 553-563.
- T horpe, T. A. (1983). Biotechnological applications of tissue culture to forest tree improvement. Biotechnology Advances, 1(2), 263-278.

SOA/UG/FMN/33P – Controlled Breeding in Tree Crops

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/33P	Controlled breeding in tree crops	2 (0+2)	70	30	100

Aim of the Course
To provide insight into development of hybrids for tree crops and its exploitation for yield improvement through conventional and modern plant breeding approaches.
Practical
Pollination and Reproduction in tree crops - Alternation of generation and life cycle -Mode of pollination - Mechanisms enforcing self and cross pollination in tree crops. Methods of survey, exploration and collection of genetic resources of tree crops - Methods of conservation and maintenance of different tree crops. Study of germplasm characterization and evaluation of different tree crops. Study of cataloguing and data storage of genetic resources of tree crops. Study of Cryopreservation techniques of different tree crops – need and utilization. Breeder's kit and its components for tree crops. Pollen morphology - Exine structure of different tree crops. Techniques for pollen collection and storage for different tree crops. Study of pollen viability and sterility for different tree crops. Emasculation and pollination techniques for self-pollinated tree crops. Emasculation and pollination techniques for cross pollinated tree crops. Basic techniques for selfing in tree crops. Basic techniques for crossing in tree crops. Lay out of different yield trials - Observing the experimental plots in tree crops. Assessment of variability parameters (mean, range, PCV, GCV, heritability, genetic advance) in tree crops. Studies on hybrids – Estimation of heterosis in different tree crops. Studies on segregating generations and maintenance of records of different tree crops. Studies on different wild species in tree crops and wide hybridization. Mutagenesis study - physical and chemical mutagens. Polyploidy breeding - Agents for the induction of various ploidy levels. Identification of polyploids in different tree crops. Screening methods – laboratory – field – for specific traits. Screening techniques for biotic stresses in tree crops. Screening techniques for abiotic stresses in tree crops. Floral Biology, Anthesis, Pollination, Selfing and Crossing techniques in Teak. Rosewood, Sandalwood, Eucalypts, Melia dubia, Acacia and Mahogany.
Suggested Readings
• Mandal, A. K. and Gibson, G. L. (Eds). (1998). Forest genetics and tree breeding. CBS Publishers and Distributors. • Schmidt, L. H. (1997). Tree Improvement Glossary Illustrated glossary of terms used in forest tree improvement. Danida Forest Seed Centre (Technical Note No. 46). • Singh, B. D. (2016). Plant Breeding: Principles and Methods. Kalyani publishers. • Zobel, B. and Talbert, J. (1984). Applied forest tree improvement. John Wiley and Sons.

SOA/UG/FMN/34T – Tree Seed Orchards

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/34T	Tree seed orchards	2	70	30	100

Aim of the Course
To develop understanding among students about tree seed orchards.
Theory
Importance of genetically improved seed in plantation forestry. Status of seed production among major plantation species. Short term supply of superior seed. Selection and delineation of seed stands, seed production areas, seed zones, seed ecological zones. Seed orchard: need, evolving seed orchards, containerized seed, hybrid and research seed orchards; first, second and advanced generation seed orchards. Seed orchard genetics: random mating, gamete exchange and parental balance. Estimation of genetic parameters from seed orchard data. Ortet age and its effect on seed production. Importance of progeny testing. Establishment of seed orchards, selection and preparation of orchard site, isolation, orchard size, and designs. Seed orchard management: rouging, silvicultural practices to increase seed yield. Pest and disease management. Seed collection and record keeping, seed orchard registration and documentation. Importance of seed orchards in gene conservation.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

SOA/UG/FMN/34P	Tree seed orchards	1	70	30	100

Practical

Seed orchard - Visits and study of seed orchard designs - Estimation of overlap in flowering among genotypes - Study of inter and intra-clonal variation in floral, seed characters - Effect of girdling on flowering. Plant growth regulator application for flower induction - Pollen viability/ fertility - Assessment of pollen dispersal. Supplemental mass-pollination - Effects of foliar application of fertilizers on seed set - Estimation of genetic parameters for a few traits - Estimation of parental balance.

Suggested Readings

- Faulkner R. 1975. Seed Orchard Forestry. Commission Bull. No. 34.
- Fins L, Friedman ST and Brotschol JV. 1992. Handbook of Quantitative Forest Genetics.
- Khosla PK. 1981. Advances in Forest Genetics.
- Mandal AK and Gibson GL. (Eds). 1997. Forest Genetics and Tree Breeding. Ambika Publ., New Delhi. CBS.
- Nanson A. 2004. Genetics of Forest Tree Breeding. Agronomic Press
- Surendran C, Sehgal RN and Parmathama M. (Eds). 2003. A Text Book of Forest Tree Breeding. ICAR.
- Wright JW. 1976. Introduction to Forest Genetics. Academic Press.
- Zobel BJ and Talbert J. 1984. Applied Forest Tree Improvement. John Wiley and Sons.

SOA/UG/FMN/35T – Forest Genetics Resources

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/35T	Forest genetics resources	2 (2+0)	70	30	100

Aim of the Course

To impart knowledge on forest genetic diversity, biodiversity assessment, global conservation initiatives and conventions related to conservation of forest genetic diversity.

Theory

Genetic diversity and differentiation: definition, characteristics and importance for tree breeding. Genetic erosion. Techniques to assess genetic diversity. Analysis of karyotypic variation. Molecular approaches for assessing genetic diversity; isozymes, biochemical makers and molecular markers: principles, importance and relevance. Biological diversity: concept and levels. Inventory and monitoring biodiversity: sampling strategies for genetic diversity assessments sufficiency of sampling procedures, neutral allele model and optimal allocation of sampling efforts. Effects of sampling on genetic diversity. Factors influencing levels of genetic diversity in woody plant species. Population size and genetic variability – Genetic variation in natural population: data, models and hypotheses – Inbreeding depression -Changes genetic diversity over time – Effects of logging and other forms of harvesting - Forest Fragmentation and environmental population - Gene flow in forest trees – Methods of estimating gene flow – Conservation methods - Threats to in situ and ex situ Genetic Conservation. Conservation of genetic diversity and invasive species. Global and local initiations for biodiversity conservation. Law and policies. Criteria and indicators for the conservation of genetic diversity. Methods for maintenance of conservation: gene banks, arboreta, botanical gardens, breeding populations as repositories of gene conservation. Rare, threatened biodiversity, endangered and endemise plants (IUCN). Global and local initiations for Biodiversity conservation. Concept of island biogeography. Managing corridors and natural habitat fragments. Monitoring and recovery plans for endangered plants. Plant community reserves. Managing wild f lora, tourism impacts and urbanization of rare plants. Implications of rarity. Dunkal draft – need for trade agreement – TRIPS, TRIMS – IPR - WTO – TRIPS and Patenting Issues – The Protection of Plant Varieties and Farmers' Rights Act 2001 - National Biodiversity Act 2002 – Biopiracy – CITES – Cartagena Protocol on Biosafety - Biosafety protocol.

Suggested Readings

- Bebarta, Kailash Chandra. 2002. Planning for forest resources and bio-diversity management principles, organization and methodology. Concept publishing company, New Delhi, India. ISBN 81-7022-879-4.

- Groom, M. J., Meffe, G. K. and Carroll, C. R. 2006. Principles of conservation biology. Sinauer Associates Inc. USA.
- Heywood, V.H. and Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge University Press. P. 1140.
- Mandal, A. K. and Gibson, G. L. (Ed.). 1997, Forest Genetics and Tree Breeding. CBS.
- Kotwal, P.C. and Banerjee, Sujoy. 2004. Biodiversity conservation-in managed forests and protected areas. Agrobios (India). 81-7754-119-6.
- Parthiban K.T., Krishnakumar, N. and P.S Devanand. 2020. Tree Breeding - Theories and Techniques. Scientific Publishers, P 391.

SOA/UG/FMN/36T – Clonal Forestry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/36T	Clonal forestry	1	70	30	100

Aim of the Course

To learn the state-of-the-art clonal technology and its application in operational plantation development program.

Theory

Clonal Forestry – definition – History of clonal forestry- Basic concepts in clonal forestry – Strategies for clonal forestry for higher productive potential – advantages of clonal forestry constraints – Selection of Plus Trees – Propagation methods- auto and hetero propagation methods – rooting of cutting, grafting, layering, budding- micro-clonal propagation methods. Potting media – components of potting media - physical and chemical characteristics of potting media – peat, vermiculite, perlite, styrofoam, soil, sand - Plant growth substances – Auxins – cytokinins – gibberellins – ethylene – preparation of powder and liquid formulations –Applications in clonal multiplication. Juvenility and maturation, rejuvenation and maintenance, regulation of phase changes, markers of phase changes. Breeding strategies using vegetative propagation- selection and breeding for extreme genotypes. Physiological research for higher productivity of clonal forest. Field design, testing and evaluation of clones. Genetic gains from breeding with clonal option. Clonal conservation approaches- management of populations for genetic diversity and gain - Designs of clonal evaluation – Amplified clonal test. Hi-tech Nursery – Components and Characters. Mini clonal technology – Clonal mother garden – Care and Management of mother garden – Multiplication technology for commercially important species - Clonal plantation establishment- management strategies – Problem and constraints in clonal forestry – Development of QPM through clonal plants - Role of industries in clonal production.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/36P	Clonal forestry	1	70	30	100

Practical

Clonal forestry – Hi-tech nursery – Components and characters – Biological components – Clonal genetic resources – Commercially important species – Mother Garden establishment – Care and management – Irrigation – Fertilization. Physical components - Propagation Chambers – Mist chamber – Green house – Cost of establishment – Technology component – Mini clonal technology – Design and Development – Potting media – Hardware's – Growth regulators – Root trainer technology. Visit to industries and other nurseries involved in clonal production – Economics of clonal production.

Suggested Readings

- Ahuja and Libby. 1986. Clonal Forestry. Martinus Nijhoff Publishers, Dordrecht.
- Hartman, H.T., Kester, D.E., Davies, F.T. and Geneve, R.L. 1997. Plant Propagation –Principles and Practices. Prentice- Hall of India Pvt. Ltd., New Delhi. P 770.
- Parthiban K.T. 2024. Hi-tech Nursery – Components and Characters. Technical Bulletin, TNAU Publication
- Parthiban K.T., Paramathma, M., and Neelakantan, K.S. 2004. Clonal Forestry. TNAU Publications, Coimbatore. Pp: 209.

SOA/UG/FMN/37T – Plant Biochemistry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/23T	Plant Biochemistry	1	70	30	100

Aim of the Course

To understand the basic scenario of biochemical action that happens in the plant system

Theory

Introduction to biomolecules. Chemistry of carbohydrates: Monosaccharides, classification, Configurations and conformations (Anomerism, epimersim, mutarotation, inversion); Disaccharides and polysaccharides (structural and storage); Glycosaminoglycans and glycoproteins. Chemistry of lipids: Lipid classification-Fatty acids, triacylglycerols, glycerophospholipids and sphingolipids. Amino acids of proteins – General properties, peptide bonds, classification and characteristics, acid base properties; Optical activity. Primary, secondary, tertiary and quaternary structure of proteins; f ibrous and globular proteins; protein stability and denaturation. Chemistry of nucleic acids: Bases, sugars, Nucleosides and nucleotides. Chemical structure and properties of DNA and RNA. Chemical catalysts vs. biological catalysts; substrate specificity-stereo, geometric specificities; Enzymes – nomenclature, classification, enzyme kinetics- rates of reactions; Lock and Key hypothesis and induced fit models; Enzyme assay, transition state theory, Michaelis Menten equation, Lineweaver Burk plot, enzyme inhibition-reversible (Competitive, uncompetitive and mixed) and irreversible, allosteric enzymes, Effect of pH and temperature on enzyme activity; Isozymes, coenzymes. Photosynthesis – light reactions, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3, C4 and CAM plants, CO2 fixation, regulation of photosynthesis. Metabolism of carbohydrates -glycolysis, TCA cycle, electron transport chain. Lipid metabolism – beta oxidation and fatty acid biosynthesis. Secondary metabolites- Classification and functions of phenolics, terpenoids and alkaloids.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/37P	Plant Biochemistry	1	70	30	100

Practical

Qualitative analysis of carbohydrates. Estimation of sugar by Dubois method. Determination of reducing sugars by DNS method. Determination of total carbohydrate by anthrone method. Protein estimation by Bradford method. Absorbance curve of two dyes. Qualitative analysis of amino acids. Titration of amino acids. Purification of acid phosphatase from mustard seedlings. Qualitative analysis of oils and fats. Estimation of saponification value of oils. Estimation of iodine number of oils/fats. Chromatography of photosynthetic pigments. Lipid analysis by thin layer chromatography. Total protein estimation by Lowry's method. Kinetics of alkaline phosphatase.

Suggested Readings

- Berg J M, Tymoczko J L and Stryer L (2007) Biochemistry. 7th edn. Wiley Eastern Ltd. ISBN:0 7167-8724-5.
- Berg Jeremy M., Stryer Lubert, Tymoczko John and Gatto Gregory. Biochemistry.
- Buchanan Bob B, Gruissem Wilhelm and Jones, Russell L.. Biochemistry and Molecular Biology of Plants.
- Lehninger. Principles of Biochemistry –David L. Nelson and Michael M. Cox
- Plummer David T. An Introduction to Practical Biochemistry.
- Rao Beedu Sashidhar and Deshpande Vijay Experimental Biochemistry: A student companion.
- Sadasivam S and Manickam A (2009), Biochemical Methods, 3rd edn, New Age International.
- Thayumanavan B, Krishnaveni S and Parvathi K (2004), Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4.
- Voet Donald and Voet Judith. Biochemistry.
- Wilson K and Walker J M (2000), Principles and techniques of Practical Biochemistry

SOA/UG/FMN/38T – Research Methodology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/38T	Research Methodology	1	70	30	100

Aim of the Course

To inculcate the art of research and expose the students through various methodologies of data collection, processing, tabulation and interpretation

Theory

Role of research methodology - Induction and deduction, Sources of information - Review of literature, Identification of problem - Formulation of objectives and hypothesis - Scope of survey based research - Types of surveys- identification of research problem - Analysis of research problem, customer identification, categorization- Data collection, analysis and compilation of survey report - Types of data, concepts of population - Analysis of data, graphical and diagrammatic presentation - Measures of central tendencies- mean, median, mode- problems- Reliability and validity of measuring tools.- Reporting: Significance of report writing, steps in report writing- Processing Information in Research Methodology - Importance of Experiments in research - Interview studies in Research methodology -Solutions of research methodology.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/38P	Research Methodology	1	70	30	100

Practical

Research problem identification, objective and Hypothesis Formulation - Research design, Collection of data, Analysis of Data for the identified Problem- Hypothesis testing, interpretation and report writing for the identified problem- Application of Scales for measurement – Nominal and ordinal- Application of Scales for measurement –Interval and Ratio- Application of Scales for measurement – Likert and other scales- Identification of Primary and Secondary Data -Correlation - Simple and partial correlation - Correlation - Multiple correlation analysis - Regression – Simple and Multiple regression analysis- Dummy variable analysis - Construction of Index Numbers - Factor analysis - Cluster analysis

Suggested Readings

- C.R. Kothari and Gaurav Garg (2023). Research Methodology: Methods and Techniques, New Age International Publishers.
- Ranjit Kumar (2005), Research Methodology: A Step-By-Step Guide for Beginners, SAGE Publications.
- R. Pannerselvam (2023), Research Methodology. PHI Learning.
- R. Cauvery, U.K. Sudha Nayak, M.Girija, R. Meenakashi (2003),Research Methodology, S. Chand & Company Ltd.

SOA/UG/FMN/39P – Statistical Packages for Data Analysis

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/39P	Statistical Packages for Data Analysis	1(0+1)	70	30	100

Aim of the Course

The art of data collection, processing, analysis and interpretation will be developed to the translate simple data in to scientific data

Practical

SYSTAT package – data entry and creation of a data file – importing an excel file, SPSS file, database file, BMDP file and SAS file in Systat for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SYSTAT- SAS package – data entry and creation of data files in SAS – opening a file – importing an excel file, Systat file, database file and SPSS file in SAS for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SAS- Data analysis using SYSTAT and SAS packages- Descriptive statistics- Cross tabulation – one way, two way

and multi-way tables- Chi square test- Student's t test – comparing a single mean- Comparison of two means – independent t test- Comparison of two means – paired t test- One way ANOVA- Two way ANOVA- Correlation analysis- Spearman's rank correlation and Kendall's tau- Jaccard and tetra correlation coefficients- Complete regression analysis.
Suggested Readings
• Jayaraman, K. and Rugmini, P. 1990. Statistical techniques in forestry - Research and forestry. Kerala Forest Research Institute, Peechi, Thrissur. • Nigam, A.K. and Gupta, V.K.1979. Hand book on Analysis of Agricultural Experiments. IASRI Publication, New Delhi. • Panse, V. G. and Sukhatme, P.V. 1967. Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India. • Petersen Roger G. 1994. Agricultural Field Experiments: Design and Analysis. Marcel Dekker, New York.

SOA/UG/FMN/40P – Internship with Tree Breeding and Biotechnology-Based Institutions/Industries

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/40P	Internship with tree breeding and biotechnology-based institutions/Industries	2 (0+2)	70	30	100
Aim of the Course					
To provide hands-on training and professional exposure to plant tissue culture techniques, mass propagation, hardening and certification, enabling students to understand tree breeding programme.					
Practical					
Field attachment to biotechnology-based institutions/Industries. Learning exposure in Clonal forestry – Hi-tech nursery Propagation Chambers – Mist chamber – Green house, Growth regulators – Root trainer technology. Laboratory organization - safety regulations and Sterilization techniques for aseptic manipulation. Nutrient stock and growth regulator stock preparation -Culture media preparation. Micropropagation. Inoculation of explants for callus culture - Clonal propagation through meristem culture - Anther and Microspore culture - Embryo culture - Sub-culturing technique for regeneration. In vitro and ex vitro rooting of tissue culture plantlets - Induction of somatic embryos and synthetic seeds - Establishment of suspensions and viability assay - Determination of cell growth in suspensions - Extraction of secondary metabolites. Phytochemical assay of secondary metabolites - Quantification by HPLC and GC-MS - Testing anti-microbial activity. Induction of hairy roots-medium preparation, strain selection, co-cultivation and maintenance of hairy roots. NCSTCP-Procedures and Quality analysis by Genetic Fidelity test - Virus indexing in TC plants - A demonstration on hardening and field transfer of TC plants. Project preparation for establishment of tissue culture lab.					

IV - Wood and NWFPs Product Development and Utilization

SOA/UG/FMN/41P – Wood Identification

Aim of the Course					
To equips students with knowledge of macro and micro-structure of softwoods and hardwoods and their relation with properties of wood To exposes students to use of anatomical features of wood in timber identification and classification					
Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/41P	Wood Identification	2 (0+2)	70	30	100

Practical

Planes of wood and physical characteristics of important woods. Identification of different types of cells and tissues. Anatomical studies of soft and hard woods. Hand lens features and identification of wood - soft wood and hardwood, sapwood and heartwood specimens. Maceration, staining, slide preparation and measurement of dimensions of woody tissues. Anatomical studies of reaction wood. Ultrastructures and their interpretation. Measurement of fibril angle and tissue proportions. Microscopic features of Bamboo, Palmyrah, Cane and Coconut. Classification of timber using dichotomous keys. Modern timber identification techniques. Microscopic features, slide inspection of twenty-five species characteristics. Morphological observations on import timber species of common occurrence for architectural patterns of habit, and buttress.

Suggested Readings

- Meier, E. 2015. Wood identifying and using hundreds of woods worldwide. Wood database.
- Porter, T. 2004. Wood identification and use. Guild of Master Craftsman, UK.
- Purkayastha, S K. 1982. Indian woods: Their identification properties and uses. Controller of Publication
- Ratura and Juneja, K.D.S.1971. A Handbook for field identification of fifty important timbers of India. Manager of Publications.

SOA/UG/FMN/42T – Wood Physics and Chemistry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/42T	Wood Physics and Chemistry	2	70	30	100

Aim of the Course

To impart knowledge about the physical and chemical properties of wood, cell wall constituents and wood extractions

To study the industrial utilization of wood extractives

Theory

Density and specific gravity. Variation in density of early and late wood constituents. Effect of growth rings on density. Pith to peripheral density variations. Different modes of presentation in relation to moisture content-wood water relationship and moisture estimation in wood. Physical properties of wood as influenced by moisture content. Specific gravity of wood substance. Anisotropy in Wood. Dimensional changes on heating green wood. Effect of dry and wet heat and heating in presence or absence of air on strength and dimensional stability. Thermal expansion, specific heat, thermal insulation value, ignition of wood and fuel value. Thermal conductivity and diffusivity. Change of temperature in wood under heating. Effect of moisture on thermal properties. Thermal properties of wood composites. DC and AC characteristics of wood-electrical conductivity, effect of moisture content and temperature. Activation energy associated with electrical conduction. Voltage breakdown strength. Dielectric properties of wood under alternating current and electro. Dielectric strength - dielectric constant and loss. Power factor - magnetic field conditions, effect of specific gravity, moisture content, temperature and extractives. Principles of induction and dielectric heating. Piezo-electric properties of wood and its applications. Sound transmission and acoustics in buildings. Speed of sound- wave resistance - coefficient of sound absorption - Response of defects to stress waves in timber-

acousto-ultrasonics based non-destructive evaluation techniques. Wood chemistry-introduction-present status-scope of wood chemical Industry-Chemical composition of cell wall. Carbohydrate polymers - holo cellulose, cellulose, hemi-cellulose and other minor polysaccharides. Lignin and extractives. Chemistry of bark, extractives, hemi celluloses, cellulose, lignin and inorganics. Distribution of chemical components in the cell wall. Components of cell. Volatile oils and extractives. Chemical relativities of cellulose, hemicellulose and lignin. Cellulose derivatives and their applications. Lignin based products. Hydrolysis and fermentation of ligno cellulosic materials. Pyrolysis and gasification of wood. Bioactive components from wood. Eco friendly dyes from bark and wood. Isolation of extractives from wood and bark. Separation of secondary metabolites. Industrial utilization of wood and bark extractives such as natural rubber, resin and turpentine from pines, tannins, pharmacologically active metabolites and future directions for their utilization.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/42P	Wood Physics and Chemistry	1	70	30	100

Practical

Properties of wood, electrical, acoustic. Sonic and ultra-sonic properties. Determination of strength properties, specific gravity, F.S.P. from shrinkage and sorption. Determination of thermal conductivity, dielectric constant, permeability of wood to air. Extraction of cellulose, hemicellulose, lignin, extractives and ash content of wood. Determination of calorific value of different wood species and ligno cellulosic wastes. Making charcoal and briquettes. Wood chemical isolation through chromatography. Isolation of pure chemical constituents using thin layer and column chromatography. Estimation of turpentine and resin. Isolation of polysaccharides and characterization of mono sugars. Estimation of oil from sandal wood. Extraction of dyes from different wood species. Visit to natural dye industry and study its properties.

Suggested Readings

- Franz, F.P, Kollmann, Kuwnzi, E and Stamm, A.J. 1975. Principle of wood science and technology. Wood based material. Vol. II Springer-Verlag, Berlin, Heidelberg.
- Meyland, B.A and Butterfield, B.G (Eds). 1972. Three-dimensional structure of wood: a scanning electron microscope study. Syracuse University Press.
- Roger, R.M (Ed). 2013. Handbook of wood chemistry and wood composition. 2nd Ed. CRC Press.
- Rowell, R.M. 1984. The chemistry of solid wood (advances in chemistry series). American Chemical Society.

SOA/UG/FMN/43P – Forest Products Laboratory Techniques

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/43P	Forest Products Laboratory Techniques	2 (0+2)	70	30	100

Aim of the Course

To acquaint the students to commonly used techniques in laboratory
To expose the students to the practical aspects of laboratory techniques employed in forest products

Practical

Introduction to laboratory techniques - Applicability of laboratory techniques in Forest Products Lab - Practicing of machine vision techniques - Morphometric and anatomical changes during wood Seasoning and Preservation - Wood and non-wood product sampling, drying and storage. Estimation of extraneous components of wood. Analysis of volatile compounds. Estimation of chemical composition of wood samples (Hardwoods, softwood and other lingo cellulosic material) and ash. Separation of components by column, paper, and thin layer chromatography. HPLC techniques. Determination of strength properties of paper and wood composites.

Suggested Readings

- Furr A K. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
- Meyland BA and Butterfield BG. 1972. Three-Dimensional Structure of Wood: A Scanning Electron Microscope Study. Syracuse University Press.

SOA/UG/FMN/44T – Wood Seasoning and Preservation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/44T	Wood Seasoning and Preservation	1	70	30	100

Aim of the Course

To understand the importance of wood seasoning and preservation for utilizing secondary timber for multipurpose use.

Theory

Wood water relationship, absorption behavior and wood drying, Refractory and non-refractory behavior of wood, Wood seasoning, types- air, kiln and special seasoning methods like steaming, chemical, high temperature drying, vacuum drying and water conditioning. Defects of timber - natural, seasoning defects, defects due to external agencies, machining defects. Effect of defects on utilization. Detection and diagnosis of discoloration and decay in wood: decaying agencies - fungi, insects and borer. Durability of timbers. Mechanism of wood preservation – kinds of wood preservatives - Advantages and safety concern of wood preservatives, fire retardants. Graveyard test and anti-fungal activity of wood. Biopreservation. Methods of application of wood preservatives – Non pressure methods – Brushing – Steeping – Hot and cold bath process – Diffusion process – Momentary dip process – Sap displacement method – Boucherie method – Pressure method – Full cell process – Empty cell process.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/44P	Wood Seasoning and Preservation	2	70	30	100

Practical

Determination of moisture content and swelling coefficients of different woods. Visit to timber depot/saw mill to study the stacking methods and various defects in wood. Visit to Wood seasoning unit to study the various types of seasoning methods and Safety aspects. Exercise on f ixing seasoning schedule for timbers under steam heated kiln and FRI solar heated kiln seasoning method. Comparative studies on air and kiln dried woods. Analysis of decayed wood for physical and chemical parameters. Visit to wood testing laboratories. Laboratory methods for testing efficacy of wood preservative against fungi and termite. Study on the environmental health and safety aspects of wood preservatives. Exercise on non-pressure methods of application of preservatives for plantation timber - End coating - Sap Displacement Method and Boucherie process. Exercise on Full cell process techniques. Study of seasoning and preservative treatments for fast growing tree species. Study of seasoning and preservative treatments for lesser known tree species. Conducting Grave yard test to evaluate natural durability of plantation and imported timber.

Suggested Readings

- FAO. 2007. Wood preservation manual. International Book Distributor
- Hunt GM. 1967. Wood Preservation. 3rd edn. McGraw-Hill Book Company.
- Purushotham A, Pande JN and Jadhav. 1959. Wood Preservation in India. Manager of Publications.

SOA/UG/FMN/45P – Wood Working and Carpentry

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/45P	Wood Working and Carpentry	2 (0+2)	70	30	100

Aim of the Course
To make students to understand and learn about the wood working and carpentry skills
Practical
Identify timber/ wood and apply measuring, marking and testing instrument and holding and supporting hand tools following safety precautions. Work on various saws and portable power saw machines for Ripping, cross cutting, Oblique sawing and curve cutting. Analyze the surface finish with exact sizing by planning operation - Identify and apply various shaving tools or portable power planning machine. Identify and apply various paring tools and analyze and choose the positioning and employ holding device for chiselling. Identify and classify various types of joints, analyze and prepare correct joint at correct position, related with strength and appearance. Make small wooden job as per drawing with schedule sizes of timber or alternatives of timber. Analyze and identify various carving tools and convert a wooden block/ piece into a decorative article. Demonstrate preservation of wooden item through surface finishing with various processes such as painting, polishing, varnishing etc. Demonstrate ripping, cross cutting, pedestal grinding, Tenon and mortise machine. Demonstrate different operations on Sanding machine. Prepare various roof truss, door and windows frame and shutters. Check, identify, analyze and repair the wooden job.
Suggested Readings
• Bates, D. (2013). Carpentry and Joinery Book 1. Routledge. • Brett, P. (2012). Carpentry and Joinery Book Two: Practical Activities. Oxford University Press-Children. • Goring, L. (2018). Manual of First and Second Fixing Carpentry. Routledge. • Wheeler, C. G. (2018). Wood-Working for Beginners. BoD–Books on Demand.

SOA/UG/FMN/46T – Composite Wood Technology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/46T	Composite Wood Technology	2	70	30	100

Aim of the Course
To impart knowledge regarding the processing technology for wood composites and modified woods
Theory
Introduction to wood modification, its need and scope, chemical modification of wood (Acetylation, reaction with isocyanates, acetates, ethers, epoxides, etc.). Wood impregnation and compregnation, heat stabilization, compressed wood, wood densification. Wood plastic composites polymer used-manufacturing process. Scope and importance-veneer production process-rotary cutting and slicing-types of veneer and their uses-advantages of veneered panels in wood products veneer jointing – finger joints -veneer grading-storage and handling of veneer. Production, properties, performance and application of Glue Laminated Timber (GLT), Structural Composite Lumber (LVL, PSL, LSL). Production, properties, performance and application of plywood, Particle board, Sandwich board, Core board, Flake board, Fibre board (LDF, MDF, HDF) and Nano Composites. Wood adhesives - types, characteristics and their applications. Scope and merits of laminated wood-choice of species and dimensional stability consideration, multispecies laminates types of Laminates-Matte-finish laminate, textured laminate, gloss-finish laminate, metallic laminate, PVC-finish laminate, acrylic-finish laminate and exterior laminate. Laminated wood from bamboo and bamboo laminates. Acoustic panels from laminated wood densified laminate panels. Bamboo composite wood-based Industries. Bamboo Mat based Products-Bamboo Mat Board (BMB), Bamboo Mat Veneer Composites [(BMVC) and Bamboo Mat Corrugated Sheet (BMCS), Bamboo mat tray. Bamboo strip-based products - Bamboo flooring tiles and high density transport flooring.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/46P	Composite Wood Technology	1	70	30	100

Practical

Preparation of veneer and testing the quality. Visit to plywood industry, particle board and hard board industry. Plywood preparation and Accelerated ageing test on plywood. Preparation of particle board and hard board and conducting accelerated ageing test, glue shear strength and internal bond strength test. Assessment of wood quality in plantation grown timber for the production of plywood and particle board. Visit to Wood Plastic Composite manufacturing unit, wood plasticization unit and studying the plasticity of wood. Determination of linear and volumetric shrinkage of composite wood. Study of different grades of composite wood, nano composite preparation and commercial utilization. Assessment of different grades of plywood. Evaluation of penetrability of preservatives in composite wood. Study on wood modification technology. Study on Bamboo Mat Based Products BMB, BMVC and BMCS. Study on Bamboo Strip Based Products - Bamboo flooring tiles and high density transport flooring. Visit to Laminated bamboo furniture industry.

Suggested Readings

- Antole A. Klyosov, 2007. Wood Plastic Composites. Wiley-Interscience, 1st edn.
- Ansell Martin P, 2015. Wood Composites. Wood head publishing.
- Jin Kuk Kim, 2011. Recent Advances in the Processing of wood-plastic composites. Springer publications.
- Papadopoulos Antonios N, 2020. Advances in Wood Composites.
- Roger M and Rowell, 2005. Handbook of Wood Chemistry and Wood Composites. Published by Taylor and Francis.

SOA/UG/FMN/47T – Non-Wood Forest Products and Value addition Technology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/47T	Non-Wood Forest Products and Value addition Technology	2	70	30	100

Aim of the Course

To make students understand and learn about the different non wood Forest Products and their scientific extraction, processing and disposal

Theory

Non-Wood Forest Products - Present status, demand and supply, classification, distribution and marketing. Role of tribal co-operative societies in NWFPs. Recent trends in NWFP. Quality assessment of important products and their methods for storage. Important non-wood forest products industries. Gums – Occurrence, origin, functions, kinds, properties, tapping methods, factors affecting gum formation, scientific management, collection, processing and storage -value addition - industrial application- uses. Resins –occurrence, origin, kinds, properties, tapping methods, processing and storage, uses, industrial application and value addition. Lac -different species, distribution, improved method of cultivation, scientific management, collection, processing and storage, value addition and uses. Shellac - cleaning and grading, properties, value addition and their uses. Tannins - Definition, species - nature and kinds, occurrence, function, collection, extraction, processing, value addition and uses. Dyes - definition, species, types, extraction, processing value addition and uses. Cutch and Katha - species, extraction methods, processing value addition and uses. Essential oils - species, types, extraction process, value addition and commercial applications -Tree Borne Oil seeds (TBOs) tree species, collection, extraction methods and uses. Drugs species – extraction process – industrial applications. Animal products – honey and wax-collection, processing, storage. Silk – silk farming – silk types, mulberry –types, distribution, improved method of cultivation, collection and storage, value addition and uses. Mineral products - other miscellaneous products.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/47P	Non-Wood Forest Products and Value addition Technology	1	70	30	100

Practical

Visit to nearby forests to study important NTFP yielding plants. Visit to non-wood forest products-based industries. Visit to agave extraction unit and study the fiber extraction process. Visit to Sericulture unit to study Silk production technology. Visit to Essential oil extraction unit and study the different extraction methods. Study of tans and visit to tannin industry. Study of dyes and visit to dye extraction unit and their sources. Visit to biodiesel production and study the trans-estrification process. Visit to Herbal Gardens and herbaria to study medicinal plants. Quality assessment of important NWFP and their methods for storage. Study of plants yielding drugs, spices, wild edible plants, poisons and bio-pesticides and their collection from nearby forests. Visit to a tribal village involved in collection, processing and sale of NTFPs. Utilization of various NWFP and their scientific management for processing, value addition and disposal.

Suggested Readings

- Linskens H F and Jackson J F. 1991. Essential oils and waxes (Ed.). Springer-Verlag Berlin Heidelberg.
- Mathe A. 2015. Medicinal and aromatic plants of the world-scientific, production, commercial and utilization aspects. Springer, Netherlands.
- Panda H. 2005. Hand book on specialty gums, adhesive, oils, rosin and derivatives, resins, oleoresins, katha, chemicals with others natural products. Asia Pacific business press. Inc.
- Panshin A J, Harrer E S and Bethel J S. Forest products, their sources, production and utilization.
- Shackleton S, Shackleton C and Shanley P. (Ed.) 2011.Non-timber forest products in the global context. Springer-Verlag Berlin Heidelberg.

SOA/UG/FMN/48T – Ethnobotany, Medicinal and Aromatic plants

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/48T	Ethnobotany, Medicinal and Aromatic plants	2	70	30	100

Aim of the Course

To introduce students to the traditional and scientific knowledge of ethnobotany, focusing on medicinal and aromatic plants, their cultivation, processing, uses, and conservation, and to highlight their economic and therapeutic importance.

Theory

Definition and scope of ethno-botany. Terms employed in relation to ethnobotany and its relationship with man and domestic animals. Ethnic – people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects. Important plants and their folk uses for medicines, food, dyes, tans, etc Methods and tools in Ethnobotanical studies. Ethnobotany of tribals in Southern India. Traditional Botanical Knowledge- concepts.

Definition - role of medicinal and aromatic plants in Indian economy - Important essential oil yielding plants in India - Detailed study of lemon grass, citronella, palmarosa, vetiver, japanese mint, eucalyptus, Champaka, Sandal, Cinnamum spp., Bursera delpechiana - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils. Medicinal plants in India and Karnataka - history, origin, area and distribution, production, botany and varieties - cultivation, extraction of active principles and their uses - uses of different medicinal plants like atropa, cinchona, rauvolfia, opium, sandal, acorus, cannabis, digitalis, Strychnos nux-vomica, Aconitum, Neem, Dioscorea, Costus, Solanum etc. Cultivation practices of medicinal plants like Adhathoda zylanica, Sida cordifolia, Sterospermum colais, Plumbago zylanica, Tinospora cordifolia, Kaemferia glanga, Indigofera tinctoria, Morinda citricifolia and Phyllanthus neeruri. Conservation packages for the medicinal plants collected in wild.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/48P	Ethnobotany, Medicinal and	1	70	30	100

	Aromatic plants				

Practical

Ethnobotanical studies of the important plants from the following families: Guttiferae (Clusiaceae), Malvaceae, Fabaceae, Mimosaceae, Caesalpinaceae, Combretaceae, Umbelliferae (Apiaceae), Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae, Thymeliaceae.

Field visit to different tribal regions to gain ethno-botanical knowledge and the inter-relation between plant and people- Survey and identification of plants used by the tribals for medicine, food and other social purposes- Collection and preparation of herbarium specimens of the above plants- Identification of medicinal and aromatic plants – propagation techniques – Harvesting and oil extraction of aromatic plants – Field visit, collection and preparation of herbarium – Visiting commercial units of medicinal plants.

Suggested Readings

- Atul, C.K. and Kapur, B.K. (1982). Cultivation and utilization of medicinal plants. RRL., CSIR, Jammu-Tawi. Chopra, R.N., Nayar, S.L. and
- Chopra, I.C. (1956). Glossary of Indian medicinal plants. CSIR, New Delhi.
- Cunningham, A. 2014. Applied Ethnobotany: People, Wild Plant Use and Conservation. Taylor and Francis.
- EIRI Board. (2007). Handbook of Medicinal and Aromatic Plants: Cultivation, Utilisation and Extraction
- Ethnobotany. Principles and applications. (1997). C. M. Cotton. John Wiley and Sons Ltd. 424p.
- Gunther, E. (1975). The essential oils. Robert, K Krieger Pub. Co., New York.
- Jain, S.K. 2010. Manual of Ethnobotany (2nd edn). Scientific Publishers, India, 242p.
- Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers, Jodhpur, India, 672p.

SOA/UG/FMN/49T – Certification of Forest Products

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/49T	Certification of Forest Products	2	70	30	100

Aim of the Course

To introduce students to forest product certification, its standards, processes, and role in promoting sustainable and legally compliant forest management and trade.

Theory

Definition of forest certification. Responsible sourcing of wood. Principal stages in the process of certification. Producer's motivation for supplying certified forest products. Key aspects of certification. Principles of sustainable forest management. Origin of certification. Organizations responsible. Legislations and policies of importance. Certification schemes in operation. Forest Stewardship Council (FSC), Program for Endorsement of Forest Certification Schemes (PEFC) etc. CIFOR certification tool kit. Indian scenario in certification. International trade in tropical logs and sawn wood. Pros and cons of certification. Potential for certifying forests and forest products of India. Tracing illegal logging. Identification of species and region of origin. Timber tracing through genetic methods and (analysis of stable isotope ratios).

Suggested Readings

- Bass, S. 1996. Introducing forest certification. A report prepared by the Forest Certification Advisory Group (FCAG) for DGVII of the European Commission. European Forest Institute, Discussion Paper 1. 30p. Details available at: http://www.giz.de/Themen/de/dokumente/en d28-inenpenennt-certification-verification-forest-manage.pdf.
- Bass, S., Thornber, K., Markopoulos, M., Roberts, S. and Grieg-gran, M. 2001. Certification's Impact on forests, stakeholders and supply changes. International Institute for Environment and Development. London. 153p.

- Conroy, M. E. 2007. Branded! How the "certification revolution" is transforming global corporations. New Society publishers, Gabriola Island, BC. 354p.
- Gupta, H. S., Yadav, M., Sharma, D. K. and Singh, A. M. 2013. Ensuring sustainability in forestry: certification of forests. TERI, New Delhi. 284p.

SOA/UG/FMN/50T – Plant Biochemistry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/50T	Plant Biochemistry	1	70	30	100

Aim of the Course

To understand the basic scenario of biochemical action that happens in the plant system

Theory

Introduction to biomolecules. Chemistry of carbohydrates: Monosaccharides, classification, Configurations and conformations (Anomerism, epimersim, mutarotation, inversion); Disaccharides and polysaccharides (structural and storage); Glycosaminoglycans and glycoproteins. Chemistry of lipids: Lipid classification-Fatty acids, triacylglycerols, glycerophospholipids and sphingolipids. Amino acids of proteins – General properties, peptide bonds, classification and characteristics, acid base properties; Optical activity. Primary, secondary, tertiary and quaternary structure of proteins; f ibrous and globular proteins; protein stability and denaturation. Chemistry of nucleic acids: Bases, sugars, Nucleosides and nucleotides. Chemical structure and properties of DNA and RNA. Chemical catalysts vs. biological catalysts; substrate specificity-stereo, geometric specificities; Enzymes – nomenclature, classification, enzyme kinetics- rates of reactions; Lock and Key hypothesis and induced fit models; Enzyme assay, transition state theory, Michaelis Menten equation, Lineweaver Burk plot, enzyme inhibition-reversible (Competitive, uncompetitive and mixed) and irreversible, allosteric enzymes, Effect of pH and temperature on enzyme activity; Isozymes, coenzymes. Photosynthesis – light reactions, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3, C4 and CAM plants, CO2 fixation, regulation of photosynthesis. Metabolism of carbohydrates -glycolysis, TCA cycle, electron transport chain. Lipid metabolism – beta oxidation and fatty acid biosynthesis. Secondary metabolites- Classification and functions of phenolics, terpenoids and alkaloids.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/50P	Plant Biochemistry	1	70	30	100

Practical

Qualitative analysis of carbohydrates. Estimation of sugar by Dubois method. Determination of reducing sugars by DNS method. Determination of total carbohydrate by anthrone method. Protein estimation by Bradford method. Absorbance curve of two dyes. Qualitative analysis of amino acids. Titration of amino acids. Purification of acid phosphatase from mustard seedlings. Qualitative analysis of oils and fats. Estimation of saponification value of oils. Estimation of iodine number of oils/fats. Chromatography of photosynthetic pigments. Lipid analysis by thin layer chromatography. Total protein estimation by Lowry's method. Kinetics of alkaline phosphatase.

Suggested Readings

- Berg JM, Tymoczko JL and Stryer L (2007) Biochemistry, 7th Ed. Wiley Eastern Ltd. ISBN:0 7167-8724-5.
- Berg Jeremy M, Stryer Lubert, Tymoczko John, Gatto Gregory. Biochemistry.
- Buchanan Bob B, Gruissem Wilhelm and Jones Russell L. Biochemistry and Molecular Biology of Plants.
- Lehninger. Principles of Biochemistry –David L. Nelson and Michael M. Cox
- Plummer David T. An Introduction to Practical Biochemistry.
- Rao Beedu Sashidhar and Deshpande Vijay Experimental Biochemistry: A student companion.
- Sadasivam, S and Manickam A (2009) Biochemical Methods, 3rdEdn, New Age International.
- Thayumanavan B, Krishnaveni S and Parvathi K (2004) Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4.

- Voet Donald and Voet Judith. Biochemistry.
- Wilson K and Walker J M (2000) Principles and techniques of Practical Biochemistry

SOA/UG/FMN/51T – Research Methodology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/51T	Research Methodology	1	70	30	100

Aim of the Course

To inculcate the art of research and expose the students through various methodologies of data collection, processing, tabulation and interpretation

Theory

Role of research methodology - Induction and deduction, Sources of information - Review of literature, Identification of problem - Formulation of objectives and hypothesis - Scope of survey based research - Types of surveys- identification of research problem - Analysis of research problem, customer identification, categorization- Data collection, analysis and compilation of survey report - Types of data, concepts of population - Analysis of data, graphical and diagrammatic presentation - Measures of central tendencies- mean, median, mode- problems- Reliability and validity of measuring tools.- Reporting: Significance of report writing, steps in report writing- Processing Information in Research Methodology - Importance of Experiments in research - Interview studies in Research methodology -Solutions of research methodology.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/51P	Research Methodology	1	70	30	100

Practical

Research problem identification, objective and Hypothesis Formulation - Research design, Collection of data, Analysis of Data for the identified Problem- Hypothesis testing, interpretation and report writing for the identified problem- Application of Scales for measurement – Nominal and ordinal- Application of Scales for measurement –Interval and Ratio- Application of Scales for measurement – Likert and other scales- Identification of Primary and Secondary Data -Correlation - Simple and partial correlation - Correlation - Multiple correlation analysis - Regression – Simple and Multiple regression analysis- Dummy variable analysis - Construction of Index Numbers - Factor analysis - Cluster analysis.

Suggested Readings

- C.R. Kothari and Gaurav Garg (2023). Research Methodology: Methods and Techniques, New Age International Publishers.
- Ranjit Kumar (2005), Research Methodology: A Step-By-Step Guide for Beginners, SAGE Publications.
- R. Pannerselvam (2023), Research Methodology. PHI Learning.
- R. Cauvery, U.K. Sudha Nayak, M.Girija, R. Meenakashi (2003),Research Methodology, S. Chand & Company Ltd.

SOA/UG/FMN/52P – Statistical Packages for Data Analysis

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/52P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100

Aim of the Course

The art of data collection, processing, analysis and interpretation will be developed to the translate simple data in to scientific data

Practical
SYSTAT package – data entry and creation of a data file – importing an excel file, SPSS file, database file, BMDP file and SAS file in SYSTAT for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SYSTAT- SAS package – data entry and creation of data files in SAS – opening a file – importing an excel file, SYSTAT file, database file and SPSS file in SAS for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SAS- Data analysis using SYSTAT and SAS packages- Descriptive statistics- Cross tabulation – one way, two way and multi-way tables- Chi square test- Student's t test – comparing a single mean- Comparison of two means – independent t test- Comparison of two means – paired t test- One way ANOVA- Two way ANOVA- Correlation analysis- Spearman's rank correlation and Kendall's tau- Jaccard and tetra correlation coefficients- Complete regression analysis.
Suggested Readings
• Jayaraman, K. and Rugmini, P. (1990). Statistical techniques in forestry - Research and forestry. Kerala Forest Research Institute, Peechi, Thrissur. • Nigam A.K. and Gupta, V.K. (1979). Hand book on Analysis of Agricultural Experiments. IASRI Publication, New Delhi. • Panse, V. G. and Sukhatme, P.V. (1967). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India. • Petersen Roger G. (1994) Agricultural Field Experiments: Design and Analysis. Marcel Dekker, New York.

SOA/UG/FMN/53P – Internship with Forest Products and Technology-based Institutions /Industries

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/53P	Internship with Forest Products and Technology-based Institutions /Industries	2 (0+2)	70	30	100

Aim of the Course
To provide hands-on training and professional exposure to forest products processing, technology applications, and industrial operations, enabling students to understand production techniques, value addition, quality control, and sustainable management of forest-based products.
Practical
Field attachment to forest product processing units, wood-based industries, plywood/veneer plants, MDF/particle board units, paper and pulp industries, and NTFP processing centers**; hands-on observation and participation** in log handling, sawing, peeling, pressing, seasoning, kiln operations, chemical and natural preservation techniques, lamination, and value addition; **quality control and grading** of timber, NTFPs, and other forest products using standard parameters; **measurement and documentation** of production, yield, recovery rates, and material losses; exposure to **industrial machinery, processing equipment, and technology applications**; participation in **packaging, storage, and inventory management**; understanding **industrial workflow, safety protocols, and occupational health practices**; training in **post-harvest handling of NTFPs,** extraction of essential oils, resin tapping, and preparation of minor forest products for market; use of **basic tools for measurement, moisture determination, and product testing; market assessment** and documentation of value chain processes; preparation of **detailed internship report** including activities, observations, critical analysis, and recommendations; exposure to **environmental management practices** in

industries; understanding **traceability and certification requirements** where applicable**; teamwork and communication exercises** during industrial training.

V – Forest Resources Management and Utilization

SOA/UG/FMN/54T – RS and GIS Application for Forest Resource Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/54T	RS and GIS Application for Forest Resource Management	2	70	30	100

Aim of the Course

To impart the knowledge regarding the concept and application of Remote sensing and GIS in forest resource management

Theory

Remote sensing types, Digital data formats, Image processing techniques, Electromagnetic spectrum and its interaction with atmosphere and surface, Creation of False Color Composites (FCC). Geometric and Radiometric Errors of images, Geometric and Radiometric corrections: contrast enhancement, Linear contrast stretch, Histogram equalization, Filtering, Image fusion technique, Vegetation Indices, Supervised and Unsupervised Classification. GIS and its components, Raster and vector data models, Visual image interpretation, database management system(DBMS), Essential map elements, Coordinate System and Projection, Attribute data and thematic mapping. Geographical Positioning System (GPS), GPS accuracy, Segments of GPS.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/54P	RS and GIS Application for Forest Resource Management	1	70	30	100

Practical

Introduction to GIS Software, Satellite data handling, Geo-referencing. Creation of False Color Composite. Image processing techniques: Contrast enhancement, Linear contrast stretch, Histogram equalization, Filtering, Image fusion technique, Vegetation Indices. Projection of digital data. On screen digitization with QGIS. Spatial and attribute data in maps in DBMS. Handling GPS receiver.

Suggested Readings

- Campbell, J.B. (2002). Introduction to Remote Sensing-Third edition. Taylor and Francis, London
- Environment System Research Institute, (1999). GIS for Everyone. Redlands, CA: ESRI
- Jackson, M.J. (1992). Integrated Geographical Information Systems. International Journal of Remote Sensing, 13(6-7): 1343-1351
- Joseph, G. (2005). Fundamentals of Remote Sensing-Second edition. Universities Press
- Lillesand, T.M. and Kiefer, W. R. (1994). Remote sensing and Image Interpretation, Fourth edition. John Wiley and Sons, Inc., USA
- Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS and LUP, Nagpur.

SOA/UG/FMN/55T – Ecosystem Services and Valuation of Forest Resources

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/55T	Ecosystem Services and Valuation of Forest Resources	2	70	30	100

Aim of the Course

To impart the knowledge and skill regarding the concept of ecosyetm services and valuation of forest resources

Theory

Ecosystem Services (ES) basics, importance, history of ES and natural capital, Classification of ES-provisioning, regulating, supporting and cultural services and their status and changes, drivers of change of ecosystem services, international conventions and charters on ES-Inter-Governmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) and Millennium Ecosystem Services (MEA) assessment - an overview. Linkages among biodiversity, ecosystem services and human wellbeing. Quantification of ecosystem services-direct and indirect approaches. Ecological Economics: Valuation of ES, need for valuation. Use values and Non-Use values direct value, indirect value, optional value, bequest value, existence value. Valuation Methods-Market price-based approach such as stumpage value method, productivity and cost-based approaches such as replacement cost method and surrogate market and stated preference approaches such as stumpage value method, Hedonic Pricing Method, Contingent Valuation Method, Travel Cost Method, etc., Case studies in India and abroad. Challenges in valuation of ES. Governance and policy issues in ecosystem services, Payment for ecosystem services (PES), mechanisms of benefit sharing, eco-certification, Certification process in agro-forestry based carbon projects and carbon f inance. Geographic Indications, Forest Stewardship Council, Landscape labelling. National and International initiatives in PES and recent policy and programs.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/55P	Ecosystem Services and Valuation of Forest Resources	1	70	30	100

Practical

Valuation methods - direct and indirect methods, Valuation of standing timber, Case studies of PES in India and Abroad, Case studies on certification and geographical indications.

Suggested Readings

- Alavalapati JRR and D Evan Mercer. 2004 Valuing Agro-forestry Systems: Methods and Applications. Kluwer Academic Publishers.
- Huxley P. 1999. Tropical Agro-forestry. Blackwell.
- Jain SK and Singh P. 2000. Economic Analysis of Industrial Agro-forestry: Poplar (Populus deltoides) in Uttar Pradesh (India). Agro-forestry Systems.
- Jeffers JNR. 1978. An Introduction to System Analysis with Ecological Application. Edward Arnold.
- Jose S. 2009. Agro-forestry for Ecosystem Services and Environmental Benefits: An Overview. Agro-forestry Systems.
- Nair PKR. 1993. An Introduction to Agro-forestry. Kluwer, Netherlands.
- Paulo ELD and Nunes. 2014. Handbook on the Economics of Ecosystem and Biodiversity. E-book.
- Sander J, Nicolas D and Hans K. 2014. Ecosystem Services: Global Issues and Local Practices. First Edition. Elsevier Publications.
- Schroth G and Sinclair F. 2003. Tree Crops and Soil Fertility: Concepts and Research Methods, CABI, Wallingford, UK.
- Young A. 1997. Agro-forestry for Soil Management. Second edition. CABI, Wallingford, UK.

SOA/UG/FMN/56T – Entrepreneurship in Value Chain Improvement of Forest Resources

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/56T	Entrepreneurship in value chain improvement of Forest Resources	2	70	30	100

Aim of the Course

To provide students with knowledge and skills to develop forest resources as agri-business opportunities, focusing on value addition, market analysis, pricing, demand-supply forecasting, and entrepreneurship, with the goal of promoting sustainable forest-based livelihoods and rural development.

Theory

Forest resources as Agri-business option for rural development, SWOT analysis of forest resource entreprise, Demand and supply forecasts in forest resources, Price determination and price discovery in forest resources, Collection, processing and value addition of forest resources, Value chain analysis (VCA) of forest resources, market dynamics and trade mechanism in forest resources, Cost benefit considerations in forest resources production, Economics and marketing of forest resources, Cooperative societies, industries, NGOs and Government organizations in strengthening forest based livelihood.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/56P	Entrepreneurship in value chain improvement of Forest Resources	1	70	30	100

Practical

Field based value chain study of any important forest resource. Case study on entrepreneurship of any cooperative, NGO, society, industry.

Suggested Readings

- Charles W, Hill L and Steven L McShane, 2007, Principles of Management, Tata McGraw Hill, New Delhi.
- Girish B and S S Inamati. Forest Business Management by Shahapurmath. Satish Serial Publishing House
- Koontz H and Weihrich H, 2007, Principles of Management, Tata McGraw Hill, New Delhi.
- Massie J L, 1995, Essentials of Management, Prentice Hall of India Pvt. Ltd., New Delhi.
- Prasad L M, 2005, Principles and Practices of Management, Sultan Chand and Sons Educational Publishers, New Delhi.
- Rao V S B, and Narayana P S, 2004, Principles and Practices of Management, Konark Publishing Pvt. Ltd. New Delhi.

SOA/UG/FMN/57T – Joint Forest Planning and Management

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/57T	Joint Forest Planning and Management	1	70	30	100

Aim of the Course

To impart the knowledge and skill regarding the concept, legality, planning and implementation of JFM for sustainable forest management

Theory

Concept of JFM. Definition. Meaning what is your idea of JFM, CFM? Learn Definition of JFM in state and national JFM guidelines (latest versions): what is common to all? -what is different? -if different, why? -what is specific to your own state?

Concept-why from the conventional management of forests did JFM evolve? -what was the status of: protection, harvest and provision of benefits in: 1. conventional forest management 2. Social forestry.

JFM Key Principles What is management of resources? -what are the resources available to be managed in the forests? -why the resources are to be managed? -what is the difference of carrying capacity of forests with canopy? -visualize canopy wise availability of resources. (Between 0.1 and 0.4, more than 0.7) 1.2 what is joint management of resources.

Legal position-what are the criteria to identify target areas? Area coverage? Community? -what will be the time span to be earmarked for JFM? -Why? - Figure out stages of JFM program period. -what is the

functional role of FD and local people? - What is the legal frame that endorses the above identified factors? 1 hour Scope and limitations-what will be the measures to fill gaps? -what will be possible limitations? Community Forestry: Introduction to the concept of forestry as a common property resource– Definition,

Scope and necessity of community forestry. Forests and man: Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural Environment-NFP 1988 and the importance of people in forest conservation. Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups. Social Forestry for fodder production, fuel wood, production, leaf manure, timber production.

NTFPs Joint Forest management: concept, legislation, rules, importance Joint Forest management: concept, legislation, rules, importance. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation- problems and prospects, Micro plan Preparation. JFMS, FDCS. VFCS, CBOS. NGOS and co-operative societies Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS. Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation- problems and prospects, Micro plan Preparation. JFMs, FDCs, VFCs, CBOs, NGOs and co-operative societies.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/57P	Joint Forest Planning and Management	1	70	30	100

Practical

Joint Forest management: concept, legislation, rules, importance Joint Forest management: concept, legislation, rules, importance. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation- problems and prospects, Micro plan Preparation. JFMS, FDCS. VFCS, CBOS. NGOS and co-operative societies Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS. Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation- problems and prospects, Microplan Preparation. JFMs, FDCs, VFCs, CBOs, NGOs and co operative societies. Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups. Social Forestry for fodder production, fuel wood, production, leaf manure, timber production, PRA exercises. Visit to village to study the community forestry components- Community reserve, organizational set up and administrative procedures in a social forestry (SF) Range, Microplan Preparation- Field visit to a JFM operational area and conduct PRA surveys. Afforestation techniques and social forestry.

Suggested Readings

- Balakathiresan, S. (1986). Essentials of forest management, Nataraj Publishers, Dehradun.
- Bullock, R. C. L. and Hanna, K.S. (2012). Community Forestry Local Values, Conflict and Forest Governance. Cambridge University Press.
- FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasylva - No. 143, Published by FAO.
- Jha, L.K., Sen P. K. and Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDA MS, P. 386 p.
- Jalihal, K.A. and Veerabhadraiah, V. (2007), Fundamentals of Extension Education and Management in Extension, Concept Publishing Company.
- Gunter, J. (Ed.). (1973). The Community Forestry Guidebook (http://www.forrex.org/ sites/ default/ files/ forrex_series/FS15.pdf).
- Ojha, H.R., Timsina, N.P., Kumar, C., Banjade, M.R and Belcher, B. (2007). Communities, Forests and Governance: Policy and Institutional Innovations from Nepal. Adroit Publishers, New Delhi, India.
- Roy, S.B. and Chatterjee, M. (1994). Joint Forest Management. Inter India Publications Tiwari, K.M. (1983). Social forestry for rural development. International Book Distributors. Vyas, G. P.D. (2006). Community Forestry. Agrobios, India.

- Sim, H. and Hilmi A. (1987), Forestry Extension Methods, FAO Forestry Paper-80, P. 153.

SOA/UG/FMN/58T – Climate Change Mitigation

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/58T	Climate Change Mitigation	2	70	30	100

Aim of the Course

To understand the scenario of climate change and international treaties on climate change, for climate change mitigation and conservation of ecosystems

Theory

Global climate change - factors involved greenhouse gases, potential threats, global carbon cycle and C-budget, carbon sequestration. Forests and climate change. Forest responses and vulnerabilities to climate change mitigation. Status of forests in global climate change. Harnessing Forests for Climate Change Mitigation, International climate negotiation, UNFCCC, IPCC, CoP, LULUCF, REDD++ and CDM. National action plan for climate change - Green India mission- Indian Network for Climate Change Assessment (INCCA) - State Action Plan on Climate Change. Silviculture and sustainability- criteria and indicators for sustainable plantation forestry in India. CIFOR guidelines. Analog forestry for site productivity and carbon value. Disturbance- natural and anthropogenic, short- and long- term impacts and their implications. Fire loss estimation in forests. Deforestation and degradation trends at global, national and regional levels. Mega development projects, Road widening projects and conservation of native and threatened species, management and rehabilitation plans. Invasive – major invasive species in forests – area affected and methodology for mapping. Eradication methods- management. Restoration of invasive affected areas – types - methods approaches, strategies and opportunities. Role of canopy in regulating functional inputs to stand: canopy and forest continuum, Continuous Cover Expanding forest and tree cover area – TOF sector in India. Carbon sequestration potential of Trees Outside forests (TOFs), home gardens and urban forests.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/58P	Climate Change Mitigation	1	70	30	100

Practical

Study of national/international organisations IPCC etc. Study of greenhouse gases, potential threats. Estimation of carbon pools, C-budget, carbon sequestration. Forest vulnerabilities analysis to climate change mitigation. Status of forests in global climate change. Analysis of Forests for Climate Change Mitigation. International climate negotiation, UNFCCC, IPCC, CoP, LULUCF, REDD++ and CDM. National action plan for climate change - Green India mission- Indian Network for Climate Change Assessment (INCCA) - State Action Plan on Climate Change. Criteria and indicators for sustainable plantation forestry in India. Study of CIFOR guidelines. TOF sector in India- carbon sequestration potential of Trees Outside forests (TOFs), home gardens and urban forests.

Suggested Readings

- Anderson, P. and Palik, B. 2011. Silviculture for Climate Change. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center.
- Bravo, F., LeMay, V., Jandl, R., and Gadow, von K. (Eds). 2008. Managing Forest Ecosystems: T he Challenge of Climate Change. Springer publication. Pp 324.
- Claussen, Eileen, Cochran, Vicki, Arroyo, Davis, Debra, P. and Pew. 2001. Climate Change: Science, Strategies, and Solutions. Brill Academic Pub. Pp 393.
- Markham, Adam (Ed.). 2010. Potential Impacts of Climate Change on Tropical Forest Ecosystems. Amazon publishers.
- Streck, Charlotte, O'Sullivan, Robert, Tarasofsky, Richard, G., Janson-Smith, Toby. 2011. Climate Change and Forests: Emerging Policy and Market Opportunities. Brookings Institution Press.

SOA/UG/FMN/59T – Ecotourism

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/59T	Ecotourism	2	70	30	100

Aim of the Course

To develop knowledge, understanding, and appreciation of environmentally responsible travel to relatively undisturbed natural areas that promotes biodiversity conservation, has low negative visitor impact, and provides for socio-economic benefits to the local stakeholder communities

Theory

Ecotourism – Definition - History of tourism and evolution of ecotourism. Various forms of tourism - Dimensions of tourism and essential conditions for tourism to occur. Differences between tourism components. Mass tourism versus ecotourism. Organised tours and Free Independent Traveller – World Tourism Organization. Concept of ecotourism and flaws in real world. Problems with definition of ecotourism and criticisms. Dimensions of ecotourism and the criteria to qualify for ecotourism. Declaration – Different forms of ecotourism. Ecotourism indicators and conceptual differences between developing and developed countries. International organizations and NGOs promoting ecotourism. Ecotourism-its potential in developing countries- Poverty and biodiversity, Ecotourism as a rural development strategy in tropical countries Ecotourism as a land use- possibilities of integration – Ecotourism policies at national and local level. Environmental Impacts of ecotourism and its mitigation - Case studies from different parts of the world- Concept of "scale". The checks and controls and institutional mechanisms for controlling the environmental impacts, Mitigation of pollution. Social Impacts of ecotourism and precautionary principles to avoid ill effects Stories from different parts of the world narrating ecotourism development and its influence on society and their culture – The societal advantages and the negative impacts of ecotourism development – Ways forward to address the negative social impacts Indigenous people and ecotourism. Ecotourism economics and business – Investment of international agencies like World Bank in ecotourism projects Ecotourism economics at macro and micro economic level in developing countries Ecotourism as a green business and role of green consumerism – Business plans- unique selling points for marketing – Potential of internet in marketing ecotourism – Payments for Environmental services and role of ecotourism Multiplier effects, opportunity costs and leakage in ecotourism industry Sharing ecotourism revenues among stakeholders – Training in ecotourism to deliver quality service. Ecotourism as a vehicle for the conservation of common property resources – potentials and pitfalls, Dangers involved in management of common property resources Relations between the government and the private sector. Ecotourism and Protected Areas Changing paradigms in the Protected Area Management Support at international level for ecotourism Integrated Conservation Development Projects (ICDPS) and role of ecotourism Community based ecotourism programs. Planning and management of ecotourism – Ecotourism plans and management of visitors and other resources including human and natural resources – Quality control, codes of conduct etc. Use of GIS and ICT for effectively managing and planning ecotourism – Criteria and indicators for sustainable management and monitoring – Charter for Sustainable Tourism – Sustainability issues in ecotourism management and ecotourism certification. Ecotourism design – Role of socio-economic factors in decision making – Designing ecotourism products using local technologies – Carrying capacity considerations. – Use of GIS in ecotourism. Ecotourism markets and influences of climate change Existing ecotourism markets and ecotourism market segmentation – Paradigm shifts possible due to climate change and its potential influence of carbon economy on existing ecotourism markets.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/59P	Ecotourism	1	70	30	100

Practical

Preparation of a thematic compendium after extensive and original independent investigation about the chosen Protected Area. Be familiar with Government policy and legislation, the current policies regarding the component land uses of the study site. Stakeholder analysis and social Impacts Assessment. Identify different stakeholders at different levels. Based on this perform a stakeholder analysis and then conduct social surveys to gather the information required for assessing the impacts of current management and to explore the intervention needed in the chosen protected area. Ecological surveys including Environmental Impact

Assessment. Assess the ecological impacts of current human use using standard techniques in order to identify the intervention needed in the chosen protected area.
Suggested Readings
• Bhatt, S. and Liyakhat, S. 2014. Ecotourism Development in India: Communities, Capital and Conservation • Lindberg, K., Wood, M. E. and Engeldrum, D. 1998. Ecotourism- A guide for planners and managers (Environment and Development). Foundation Books. • Page, S. J. and Dowling, R. K. 2002. Ecotourism. Pearson Education Limited, Essex. The Ecotourism Society, Vermont. • Weaver, D. 2002. Ecotourism. Milton, Queensland, Australia: John Wiley and Sons Australia.

SOA/UG/FMN/60T – Restoration of Degraded Lands

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/60T	Restoration of Degraded Lands	2	70	30	100

Aim of the Course

To impart practical understanding about rejuvenation of forest with tree vegetation and to develop skills on tacking different problem soils with suitable vegetation

Theory

Degraded lands: Concept, classification, status, extent and causes of degraded lands/ wastelands, different types of degraded lands – physical, chemical and biological land degradation. Soil erosion- types, causes and mechanism, measures to control erosion, ravine and sand dune formation and their control measures. Salt affected soils- classes of salt affected soils, causes, extent and their effects on plant growth and afforestation /reclamation practices. Acid soils- definition, characteristics, causes and afforestation. Water logged areas explanation, impact on pant growth and Bio-drainage techniques. Afforestation and reclamation of denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas. Desertification- definition, impact and causes, prevention and counter measures (shelter belts and wind breaks). Soil pollution- types, effects and control measures through forestry techniques. National and state level programs on degraded lands/wasteland development. Role of Government agencies and NGO's in degraded lands/wasteland development program.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/60P	Restoration of Degraded Lands	1	70	30	100

Practical

Tree species suitable for different degraded lands. Identification and study of various degraded lands. Visit to nearby degraded lands (Eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas) and afforestation program.

Suggested Readings

- Hegde, N.G. 1987. Handbook of Wasteland Development. BAIF, Pune 102p. ICAR. 1977. Desertification and its Control.
- ICAR, New Delhi 358p. National Commission on Agriculture 1976. Report of the National Commission on Agriculture, Part ix.
- Imeson, A. 2012. Desertification, Land Degradation and Sustainability, John Wiley and Sons.
- Kumar, Anil and Pandey, R. N. 1989.Wastelands Management in India. Ashish Publishing House, New Delhi.

- Luna, R. K. 1989. Plantation Forestry in India, International book distributors, Dehra Dun. Forestry; Ministry of Agriculture and Irrigation, Govt. of India, New Delhi 457p.

SOA/UG/FMN/61T – Urban Ecology and Environment

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/61T	Urban Ecology and Environment	2	70	30	100

Aim of the Course

To understand urban ecology, biodiversity conservation and management for sustainable development To evaluate environmental and social impacts to deal with global challenges of climate change in cites

Theory

Concepts of urban ecology: Theories of urban ecology and linkages with sustainable urbanism, Concepts of Eco cities, smart cities, compact cities etc., Challenges and opportunities of urban, rural and peri-urban growth. Green Spaces, bio-diversity conservation and conflicts: Urban greens: challenges and choices for management, Human nature interactions and urban forest management, introduction to functional diversity and traits, Bio-diversity conservation conflicts, Spatial dimensions of urban ecology. Urban Environment: Introduction to urban morphology, Industrial ecology and symbiosis, Management of air quality and noise, Urban solid waste management, Urban water ecological challenges. Impact Analysis and Ecological Footprint Analysis: Environmental Impact Analysis 10 2, Social Impact Analysis and Strategic Environmental Assessment, Urban metabolism and Ecological Footprint Analysis. Ecological risk assessment framework (Definition, Problem formulation, Risk analysis, Risk characterization, Risk management), Climate change, mitigation and adaptation, Climate modifications and managing climate change challenges in cities, Adaptation and mitigation measures to make cities resilient, Ecosystem services and nature-based solution to address urban resilience.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/61P	Urban Ecology and Environment	1	70	30	100

Practical

Vegetation analysis and characterization of green spaces in nearby urban areas. Identifying challenges in soil waste management in nearby urban areas. Urban Risk assessment and mitigation in urban areas.

Suggested Readings

- Adler, F. R. and Tanner, C. J. 2013. Urban Ecosystems. Cambridge University Press.
- Cities and Bio-diversity Outlook. 2013. Action and Policy: A Global Assessment of the Links between Urbanization, Biodiversity, and Ecosystem Services, by Secretariat of the Convention on Biological Diversity.
- Dale, R. 2004. Evaluating Development Program and Project, Second Edition, Sage Publication.
- Keitaro Ito. 2021. Urban biodiversity and ecological design for sustainable cities. Springer.
- Mostafavi, M. and Doherty, G. 2010. Ecological urbanism, published by Baden: Harvard University Graduate School of Design.
- Morrison-Saunders, A. and Arts, J. (Eds) 2004. Assessing Impact: Handbook of EIA and SEA Follow-up, Earthscan James andJames, London.
- Parris, K. M. 2016. Ecology of urban environments. Chichester, West Sussex; Hoboken, Nj: John Wiley and Sons Ltd.
- Singhal, S. and Kapur, A. 2002. Industrial Estate Planning and Management in India – an Integrated Approach towards Industrial Ecology. Journal of Environmental Management, Elsevier Science Ltd., 66, 2002.
- Sivaramakrishnan, K. and Rademacher, A. 2013. Ecologies of Urbanism in India Metropolitan Civility and Sustainability. Hong Kong China: Hong Kong University Press, Baltimore.
- United Nations Human Settlements Program (UN-HABITAT). 2011. Global report on human settlements - Cities and Climate Change: Policy Directions

SOA/UG/FMN/62T – Plant Biochemistry

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/62T	Plant Biochemistry	1	70	30	100

Aim of the Course

To understand the basic scenario of biochemical action that happens in the plant system

Theory

Introduction to biomolecules. Chemistry of carbohydrates: Monosaccharides, classification, Configurations and conformations (Anomerism, epimersim, mutarotation, inversion); Disaccharides and polysaccharides (structural and storage); Glycosaminoglycans and glycoproteins. Chemistry of lipids: Lipid classification-Fatty acids, triacylglycerols, glycerophospholipids and sphingolipids. Amino acids of proteins – General properties, peptide bonds, classification and characteristics, acid base properties; Optical activity. Primary, secondary, tertiary and quaternary structure of proteins; f ibrous and globular proteins; protein stability and denaturation. Chemistry of nucleic acids: Bases, sugars, Nucleosides and nucleotides. Chemical structure and properties of DNA and RNA. Chemical catalysts vs. biological catalysts; substrate specificity-stereo, geometric specificities; Enzymes – nomenclature, classification, enzyme kinetics- rates of reactions; Lock and Key hypothesis and induced fit models; Enzyme assay, transition state theory, Michaelis Menten equation, Lineweaver Burk plot, enzyme inhibition-reversible (Competitive, uncompetitive and mixed) and irreversible, allosteric enzymes, Effect of pH and temperature on enzyme activity; Isozymes, coenzymes. Photosynthesis – light reactions, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3, C4 and CAM plants, CO2 fixation, regulation of photosynthesis. Metabolism of carbohydrates -glycolysis, TCA cycle, electron transport chain. Lipid metabolism – beta oxidation and fatty acid biosynthesis. Secondary metabolites- Classification and functions of phenolics, terpenoids and alkaloids.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/62P	Plant Biochemistry	1	70	30	100

Practical

Qualitative analysis of carbohydrates. Estimation of sugar by Dubois method. Determination of reducing sugars by DNS method. Determination of total carbohydrate by anthrone method. Protein estimation by Bradford method. Absorbance curve of two dyes. Qualitative analysis of amino acids. Titration of amino acids. Purification of acid phosphatase from mustard seedlings. Qualitative analysis of oils and fats. Estimation of saponification value of oils. Estimation of iodine number of oils/fats. Chromatography of photosynthetic pigments. Lipid analysis by thin layer chromatography. Total protein estimation by Lowry's method. Kinetics of alkaline phosphatase.

Suggested Readings

- Berg JM, Tymoczko JL and Stryer L (2007) Biochemistry, 7th Ed. Wiley Eastern Ltd. ISBN:0 7167-8724-5.
- Berg Jeremy M, Stryer Lubert, Tymoczko John, Gatto Gregory. Biochemistry.
- Buchanan Bob B, Gruissem Wilhelm and Jones Russell L. Biochemistry and Molecular Biology of Plants.
- Lehninger. Principles of Biochemistry –David L. Nelson and Michael M. Cox
- Plummer David T. An Introduction to Practical Biochemistry.
- Rao Beedu Sashidhar and Deshpande Vijay Experimental Biochemistry: A student companion.
- Sadasivam, S and Manickam A (2009) Biochemical Methods, 3rdEdn, New Age International.
- Thayumanavan B, Krishnaveni S and Parvathi K (2004) Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4.
- Voet Donald and Voet Judith. Biochemistry.
- Wilson K and Walker J M (2000) Principles and techniques of Practical Biochemistry

SOA/UG/FMN/63T – Research Methodology

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMN/63T	Research Methodology	1	70	30	100

Aim of the Course

To inculcate the art of research and expose the students through various methodologies of data collection, processing, tabulation and interpretation

Theory

Role of research methodology - Induction and deduction, Sources of information - Review of literature, Identification of problem - Formulation of objectives and hypothesis - Scope of survey based research - Types of surveys- identification of research problem - Analysis of research problem, customer identification, categorization- Data collection, analysis and compilation of survey report - Types of data, concepts of population - Analysis of data, graphical and diagrammatic presentation - Measures of central tendencies- mean, median, mode- problems- Reliability and validity of measuring tools.- Reporting: Significance of report writing, steps in report writing- Processing Information in Research Methodology - Importance of Experiments in research - Interview studies in Research methodology -Solutions of research methodology.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/63P	Research Methodology	1	70	30	100

Practical

Research problem identification, objective and Hypothesis Formulation - Research design, Collection of data, Analysis of Data for the identified Problem- Hypothesis testing, interpretation and report writing for the identified problem- Application of Scales for measurement – Nominal and ordinal- Application of Scales for measurement –Interval and Ratio- Application of Scales for measurement – Likert and other scales- Identification of Primary and Secondary Data -Correlation - Simple and partial correlation - Correlation - Multiple correlation analysis - Regression – Simple and Multiple regression analysis- Dummy variable analysis - Construction of Index Numbers - Factor analysis - Cluster analysis.

Suggested Readings

- C.R. Kothari and Gaurav Garg (2023). Research Methodology: Methods and Techniques, New Age International Publishers.
- Ranjit Kumar (2005), Research Methodology: A Step-By-Step Guide for Beginners, SAGE Publications.
- R. Pannerselvam (2023), Research Methodology. PHI Learning.
- R. Cauvery, U.K. Sudha Nayak, M.Girija, R. Meenakashi (2003),Research Methodology, S. Chand & Company Ltd.

SOA/UG/FMN/64P – Statistical Packages for Data Analysis

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/64P	Statistical Packages for Data Analysis	1 (0+1)	70	30	100

Aim of the Course

The art of data collection, processing, analysis and interpretation will be developed to the translate simple data in to scientific data

Practical

SYSTAT package – data entry and creation of a data file – importing an excel file, SPSS file, database file, BMDP file and SAS file in SYSTAT for analysis- Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SYSTAT- SAS package – data entry and creation of data files in SAS – opening a file – importing an excel file, SYSTAT file, database file and SPSS file in SAS for analysis-

Data manipulation – transformation – ranking, sorting, appending, merging and transposing of data in SAS- Data analysis using SYSTAT and SAS packages- Descriptive statistics- Cross tabulation – one way, two way and multi-way tables- Chi square test- Student's t test – comparing a single mean- Comparison of two means – independent t test- Comparison of two means – paired t test- One way ANOVA- Two way ANOVA- Correlation analysis- Spearman's rank correlation and Kendall's tau- Jaccard and tetra correlation coefficients- Complete regression analysis.
Suggested Readings
• Jayaraman, K. and Rugmini, P. (1990). Statistical techniques in forestry - Research and forestry. Kerala Forest Research Institute, Peechi, Thrissur. • Nigam A.K. and Gupta, V.K. (1979). Hand book on Analysis of Agricultural Experiments. IASRI Publication, New Delhi. • Panse, V. G. and Sukhatme, P.V. (1967). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India. • Petersen Roger G. (1994) Agricultural Field Experiments: Design and Analysis. Marcel Dekker, New York.

SOA/UG/FMN/65P – Internship with Forest Business Unit/RS-GIS Company or Organization

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/UG/FMN/65P	Internship with Forest Business Unit/RS-GIS Company or Organization	2 (0+2)	70	30	100
Aim of the Course					
To inculcate knowledge and skill in students to employ tools and technques of RS and GIS for effective planning, implementation, monitoring and evaluation of forest resource management.					
Practical					
Field attachment to RS-GIS company/organization. Attachment of students in RS-GIS institutes- IIRS, FSI, GSI, ICFRE, RS & GIS labs at state level. Learning exposure in GIS Software, Satellite data handling, Geo-referencing. Creation of False Color Composite. Image processing techniques: Contrast enhancement, Linear contrast stretch, Histogram equalization, Filtering, Image fusion technique, Vegetation Indices. Projection of digital data. On screen digitization with QGIS, ERDAS, ARC GIS. Spatial and attribute data in maps in DBMS. Handling GPS receiver. Preparation of base maps, thematic maps; Visual interpretation of satellite imagery; Forest cover mapping and land use mapping; Digital image processing; Exercises in viewing, editing, overlay. Using of QGIS Software to prepare different maps.					

SEMESTER - VIII

SOA/UG/FMJ/35P – Internship/Project/Students READY Programme

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
SOA/UG/FMJ/35P	Internship/Project/Students READY Programme	20 (0+20)	70	30	100

Aim of the Course

To provide students with hands-on, multidisciplinary training and experiential learning in forestry, wood-based industries, research, entrepreneurship, and field survival skills, preparing them for professional careers and enhancing practical knowledge, administrative abilities, and entrepreneurial competencies.

Practical

Training attachment in wood-based industry/ forest departments/ Police/ Special Task Force (STF)/ incubation centres/ KVKs or research Institutes/ NGO/ agribusiness entrepreneur, etc. (May be conducted in split manner in more than one industry/ institution/ organization).

Ideally it is recommended to have:

Internship with Forest Department (Administrative Skill) for 5 weeks

Internship with wood-based industries (Technical Skill) for 2 weeks

Internship with Police/ Special Task Force (STF) for Jungle survival for 1 week

Internship with incubation centres/KVKs/ research Institutes/ NGO/ agribusiness entrepreneur, etc. for 2 weeks.

Either project (R and D based, field study based) or entrepreneurship based (incubation/ experiential learning)

ONLINE COURSES

Course Code	Name of Subject	Credits	Marks		Total
			External	Internal	
*SOA/UG/MOOC/01	On-line courses (MOOC)	10 (non-Gradial)	-	-	(non-Gradial)

Aim of the Course

The objective is to enable students to cultivate their passion or enhance their knowledge and competency in any field beyond the prescribed courses.

On-line Courses

Students must complete a minimum of 10 credits of online courses (as per UGC guidelines for online courses) as a partial requirement for the B.Sc. (Forestry) program.

Online courses from any field in forestry can be accessed through NPTEL, MOOCs, edX, Coursera, SWAYAM, or any other relevant portal.

The courses will be non-gradial as separate certificates would be issued by institutes offering the courses. These can be taken any time during the 3rd and 4th years of the UG program. However, the University/ institute will keep a record of such courses registered and completed by each student. It will indicate the title of the (satisfactorily completed) courses in the final transcript issued to the student.

* These can be taken any time during the 3rd and 4th years of the UG program.

List of Suggestive Courses on SWAYAM/MOOC

Course title	Duration	Credits
Forests and their Management	12 Weeks	01
Wildlife Ecology	12 Weeks	01

Introduction to Biology: Ecology	04 Weeks	01
Introduction to Biology: Ecology, Evolution, and Biodiversity	17 Weeks	01
Introduction to Biology: Biodiversity	05 Weeks	01
Ecology: Ecosystem Dynamics and Conservation	05 Weeks	01
Fire Ecology	08 Weeks	01
Ecology and Society	12 Weeks	01
Environmental Studies	12 Weeks	01
Environmental Studies: A Global Perspective	06 Weeks	01
Toolbox for Environmental Management	05 Weeks	01
Environmental Protection and Sustainability	08 Weeks	01
Ecosystem and Natural Resources	12 Weeks	01
NGO'S and Sustainable Development	15 Weeks	01
Nanotechnology Applications in respective fields	08 Weeks	01
Personality Development and Communication Skills	08 Weeks	01
Personality Development	08 Weeks	01
Yoga Practices 1	12 Weeks	01
Yoga Practices 2	12 Weeks	01
Ethics: Theories and Applications	12 Weeks	01