

# DEPARTMENT OF FORESTRY

## COURSE CONTENT & SYLLABUS

w.e.f. Session 2024-25



Our Motto:

*Planting seeds for a better tomorrow*

**Dolphin (PG) Institute of Biomedical & Natural Sciences,  
Manduwala- Dehradun (An Autonomous Institute)**

## Introduction

The world of Forestry is changing rapidly. The multi-valuable nature of forests is gaining wider recognition, thus, leading to increased understanding of the linkage between forests and society. Forests are significant to the well being of society providing multiple services and products i.e. tangible and intangible. Moreover, in the present era of climate change, our forests are crucial not only for supplying various products and services but also for ensuring a healthy environment. From providing livelihood security to generating business ventures; from being sources of rich biodiversity to carbon resources, the usefulness of forests to humankind indeed is wide-ranging. Forest as a commodity is to be managed scientifically to enhance its production and productivity and protection of environment as well as sustenance of our agriculture. Higher Forestry education has an important role to play in the future of the world's forests. The future decision makers; the students of today; will need to possess adequate skills to be able to meet the future challenges. To produce high degree competence and skill oriented world class forestry professionals, Forestry education needs to be reoriented so as to meet the challenges of high forest productivity and global market along with eco-friendly environment. In India, Forestry education was introduced at the University level by starting M.Sc. Forestry in 1976 at Dr YS Parmar University of Horticulture and Forestry, Nauni (HP). Thereafter, many Agriculture Universities started UG, PG and Ph.D. programme in Forestry with the directive of MoEF and ICAR. Today, about 50 institutes of State/ Central/ Private University in 21 states of the country are offering different degree programmes in Forestry.

## Programme Offered

1. B. Sc. Forestry (4 year Programme)
2. M. Sc. Forestry (2 year Programme)

## B Sc Forestry

### Eligibility for Admission

10+2 / Intermediate with PCMB (Physics, Chemistry, Maths, Biology)/PCM/Agriculture from a recognized Board/University.

### Future Prospects & Job opportunity

#### **1. Technical Proficiency:**

- Graduates will demonstrate advanced technical proficiency in forestry principles, practices, and technologies relevant to industrial applications.

#### **2. Problem Solving and Decision Making:**

- Graduates will be proficient in analyzing complex forestry challenges, applying critical thinking, and making informed decisions to address industry-specific issues.

#### **3. Communication Skills:**

- Graduates will possess effective communication skills, enabling them to interact professionally with industry stakeholders, colleagues, and the public.

#### **4. Ethical Leadership**

- Graduates will exhibit ethical leadership in forestry practices, adhering to principles of sustainability, environmental stewardship, and social responsibility.

#### **5. Industry Collaboration**

- Graduates will collaborate effectively with forestry-related industries, fostering partnerships, and contributing to the development and implementation of sustainable forestry practices.

#### **6. Research and Innovation**

- Graduates will engage in applied research, contributing to innovations in industrial forestry practices, and demonstrating a commitment to continuous learning and improvement.

#### **7. Professionalism and Career Readiness**

- Graduates will be prepared for successful careers in the forestry industry, equipped with the skills, knowledge, and professional demeanor required by employers.

#### **8. Global Perspective**

- Graduates will understand the global context of forestry practices, recognizing and addressing international challenges and opportunities in the industry.

#### **9. Entrepreneurial Mindset:**

Graduates will cultivate an entrepreneurial mindset, demonstrating the ability to identify opportunities, develop business plans, and contribute to the growth of forestry enterprises.

- Nursery Enterprise
- Bamboo Crafting
- Forest based handicrafts
- Eco-tourism
- Wild Fruit etc produce based entrepreneurship

#### **10. Government sector opportunity:**

- Graduates will be prepared for successful careers in the government sector like:-

- UPSC – IFOs
- State PCS- ACF, RFO, Foresters, Safe Guard Specialists, Logging Officer, Resettlement Specialist, Bio-engineering expert, Environment Expert
- VAN Vigyan Kendra- SMS. Scientists, Coordinators
- ICAR- ASRB NET, ASRB Scientists
- ICFRE & MoEFCC- Plantation Officer, Technical Asstt., Scientists, JRF, SRF, RA
- Forest Survey of India- JTA
- UPCL- Forestry Expert
- Academics- Professor, TRP, Lab Asst.
- Banks- Field Officer, Specialist Officer
- UCOST-Scientists, JRF, SRF, RA
- WAPCOS- Consultant
- Tourism Deptt.- Forest Conservation Specialist
- UCADA- Land Acquisition Specialists
- IIRS-Variou Project designations
- State's Bamboo Board-
- WII, BSI, ZSI etc-Variou Project designations

#### **11. Private Sector & NGO's**

- HESCO- Consultant, JRF, SRF, RA

- WIMCO- Plantation Officer/Incharg
- Century Pulp & Paper- Plantation Officer/Incharge
- CEDAR- Consultant, JRF, SRF, RA
- Plywood & Solid Industry- Quality control officer & Production Manager
- HARC- Consultant, JRF, SRF, RA
- Pvt Academic Institutions- Astt Professor, Lab Astt. Etc.

#### **International/Global Opportunities:**

- RECOFTC
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)- Germany- Project / Field Biologists
- IUCN
- WWF
- World Bank
- SAF
- UNDP
- IUFRO
- CIFOR
- ICIMOD

### **Programme Objectives**

- The primary objective of the Department of Forestry is to provide high-quality education and training in forestry sciences.
- Equipping students with the knowledge, skills, and ethical values necessary for sustainable management of forest ecosystems.
- The department aims to produce competent professionals who can contribute to the conservation, restoration, and efficient utilization of forest resources while balancing environmental, economic, and social considerations.

### **Programme Core Values**

1. Professionalism: Upholding the highest standards of professional ethics, integrity, and accountability in forestry practices.
2. Environmental Stewardship: Promoting responsible and sustainable use of forest resources, prioritizing environmental protection and conservation.
3. Inclusivity and Diversity: Embracing diversity, fostering an inclusive environment, and respecting different perspectives and cultural values related to forestry.
4. Continuous Learning: Encouraging lifelong learning, professional development, and the pursuit of knowledge to stay updated with the latest advancements in forestry sciences.
5. Community Engagement: Establishing strong connections with local communities, understanding their needs, and collaborating to address forestry-related challenges while respecting traditional knowledge and practices.

#### **Program outcomes for B. Sc. Forestry course Students will be able to:**

PO1: Define & describe principles and practices of Silviculture, Forest mensuration, Forest Management, Agroforestry, Wildlife Biology & management, Tree Improvement, Forest Engineering, Wood Science and Soil Science.

PO2: Evaluate different forest parameter like Density, volume, crown parameters and age of individual tree & crop using instruments and formula.

PO3: Conduct participatory appraisal of forest dependent communities and infer the observations to point the gaps in management.

PO4: Practice & apply various forestry Principles as per the University's, Forest Department's & Industrial requirements.

PO5: Explain, Practice & apply English communication, environment education & entrepreneurship skills.

PO6: Practice ethical principles, teammanship to lead, manage & execute forestry practice in Industries, Forest departments and Research Institutions.

**B.Sc. (Hons) FORESTRY [Eight (8) Semester]  
SCHEME OF INSTRUCTIONS AND CREDITS  
COURSE CONTENTS**

**Semester-wise Courses  
Semester I**

S.No	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR-CC/101 T	Introduction to Forestry	2	70	30	100
2	FOR-CC/102T	Dendrology	2	70	30	100
	FOR-CC/102P	Dendrology	1	100	-	100
3	FOR-CC/103T	Geology and Soils	2	70	30	100
	FOR-CC/103p	Geology and Soils	1	100	-	100
4	FOR-CC/104T	Plant Biochemistry	2	70	30	100
	FOR-CC/104P	Plant Biochemistry	1	100	-	100
5	FOR-CC/105 P	Technique/field tour /(On sight Exposure)	2	100	-	100
<b>Ability Enhancement Course (AEC)</b>						
1	FOR-AEC101 T	Information and Communication Technology	2	70	30	100
	FOR-AEC101 P	Information and Communication Technology	1	100	-	100
<b>Multidisciplinary/Interdisciplinary Course</b>						
1	FOR-MD101 T	Introduction to Agronomy and Horticulture	1	70	30	100
	FOR-MD101 P	Introduction to Agronomy and Horticulture	1	100	-	100
2	FOR-ID102T	Forest Botany/Basic Maths	1	70	30	100
	FOR-ID102P	Forest Botany	1	100	-	100
<b>Skill Enhancement Course</b>						
1	SOA/SEC101T	Communication Skills and Personality Development	2	70	30	100
1	FOR-E101P	NCC-I/NSS-I*	1	-	-	-

\* Non Credit Course

**Total Credit to earn in the semester I**

Core	AEC	MDC/IDC	SEC	Elective	Total
13	2	4	2	-	21

### Semester II

S.No	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR-CC201T	Plant Physiology	2	70	30	100
	FOR-CC201P	Plant Physiology	1	100	-	100
2	FOR-CC202T	Plant Cytology and Genetics	2	70	30	100
	FOR-CC202P	Plant Cytology and Genetics	1	100	-	100
3	FOR-CC203T	Theory and Practice of Silviculture	2	70	30	100
	FOR-CC203P	Theory and Practice of Silviculture	1	100	-	100
4	FOR-CC204T	Forest Protection	2	70	30	100
	FOR-CC204P	Forest Protection	1	100	-	100
<b>Ability Enhancement Compulsory Course (AEC)</b>						
1	FOR-AEC201T	Statistical Methods & Experimental Designs	2	70	30	100
	FOR-AEC201P	Statistical Methods & Experimental Designs	1	100	-	100
<b>Multidisciplinary/Interdisciplinary Course</b>						
1	FOR-ID201T	Wood Anatomy	2	70	30	100
	FOR-ID201P	Wood Anatomy	1	100	-	100
2	FOR-ID202T	Environmental Studies and Disaster Management	2	70	30	100
	FOR-ID202P	Environmental Studies and Disaster Management	1	100	-	100
3	FOR/203P	NCC-II/NSS-II*	1	-	-	-

\* Non credit course

**Total Credit to earn in the semester II**

Core	AEC	MDC/IDC	SEC	Elective	Total
12	3	6	-	-	21

### Semester III

S.N	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR/CC301T	Forest Survey and Engineering	2	70	30	100
	FOR/CC301P	Forest Survey and Engineering	1	100	-	100
2	FOR/CC302T	Logging and Ergonomics	2	70	30	100
	FOR/CC302P	Logging and Ergonomics	1	100	-	100
3	FOR/CC303T	Soil Biology and Fertility	2	70	30	100
	FOR/CC303P	Soil Biology and Fertility	1	100	-	100
4	FOR/CC305T	Forest Mensuration	2	70	30	100
	FOR/CC305P	Forest Mensuration	1	100	-	100
<b>Ability Enhancement Compulsory Course (AEC)</b>						
1	FOR/AEC301T	Nursery Management and Commercial Forestry	2	70	30	100
	FOR/AEC301P	Nursery Management and Commercial Forestry	1	100	-	100
<b>Multidisciplinary/Interdisciplinary Course</b>						
1	FOR/MD301T	Wildlife Biology, Ornithology & Herpetology	2	70	30	100
	FOR/MD301P	Wildlife Biology, Ornithology & Herpetology	1	100	-	100
	FOR/MD302T	Climate Science	2	70	30	100
	FOR/MD302P	Climate Science	1	100	-	100
2	FOR/MD303T	Forest Extension & Community Forestry	1	70	30	100
	FOR/MD303P	Forest Extension & Community Forestry	1	100	-	100
<b>Skill Enhancement Course (SEC)/ Noncredit course</b>						
3	FOR/ESC301P	NCC-III/NSS-III*	1	-	-	-

\* Noncredit course

### Total Credit to earn in the Semester III

Core	AEC	MDC/IDC	TOTAL
12	3	8	23

### Semester IV

S.N	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR/CC401T	Forest Management	2	70	30	100
	FOR/CC401P	Forest Management	1	100	-	100
2	FOR/CC402T	Silviculture of Indian Trees	2	70	30	100
	FOR/CC402P	Silviculture of Indian Trees	1	100	-	100
3	FOR/CC403T	Wood Products & Utilization	2	70	30	100
	FOR/CC403P	Wood Products & Utilization	1	100	-	100
4	FOR/CC404T	Forest Ecology and Biodiversity	2	70	30	100
	FOR/CC404P	Forest Ecology and Biodiversity	1	100	-	100
5	FOR/CC405T	Silviculture Systems	2	70	30	100
<b>Skill Enhancement Course (SEC)</b>						
1	FOR/SEC401T	Ethnobotany, Medicinal and Aromatic Plants	2	70	30	100
	FOR/SEC401P	Ethnobotany, Medicinal and Aromatic Plants	1	100	-	100
2	FOR/SEC402T	Rangeland and Livestock Management	2	70	30	100
	FOR/SEC402P	Rangeland and Livestock Management	1	100	-	100
3	FOR/SEC403T	Forest Tribology Traditional Knowledge System	2	70	30	100
4	FOR/SEC403P	Study Tour of State Forest*	1	-	-	-

\* Noncredit course

### Total Credit to earn in the Semester IV

Core	AECC	SEC	TOTAL
14	0	8	22



### Semester V

S.No.	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR/CC501T	Principles of Agroforestry	2	70	30	100
	FOR/CC501P	Principles of Agroforestry	1	100	-	100
2	FOR/CC502T	Wood Science and Technology	2	70	30	100
	FOR/CC502P	Wood Science and Technology	1	100	-	100
3	FOR/CC503T	Tree Seed Technology	2	70	30	100
	FOR/CC503P	Tree Seed Technology	1	100	-	100
4	FOR/CC504 P	Experiential Learning - I	5	100	-	100
<b>Skill Enhancement Course (SEC)</b>						
1	FOR/SEC501T	Plantation Forestry	2	70	30	100
	FOR/SEC501P	Plantation Forestry	1	100	-	100
2	FOR/SEC502T	Entrepreneurship Development & Business Management	2	70	30	100
	FOR/SEC502P	Entrepreneurship Development & Business Management	1	100	-	100
3	FOR/SEC503T	Forest Hydrology and Watershed Management	1	70	30	100
	FOR/SEC503P	Forest Hydrology and Watershed Management	1	100	-	100
4	FOR/SEC504T	Forest Economics and Marketing	1	70	30	100
	FOR/SEC504P	Forest Economics and Marketing	1	100	-	100

**Total Credit to earn in the Semester V**

Core	AECC	SEC	TOTAL
14	0	10	24

**Semester VI**

S.No.	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR/CC601T	Forest Laws, Legislation and Policies	2	70	30	100
2	FOR/CC602T	Geomatics	2	70	30	100
	FOR/CC602P	Geomatics	1	100	-	100
3	FOR/CC603T	Restoration Ecology	2	70	30	100
	FOR/CC603P	Restoration Ecology	1	100	-	100
4	FOR/CC604P	Experiential Learning-II	5	100	-	100
<b>Skill Enhancement Course (SEC)</b>						
1	FOR/SEC601T	Tree Improvement	2	70	30	100
	FOR/SEC601P	Tree Improvement	1	100	-	100
2	FOR/SEC602T	Non-Timber Forest Products, Marketing & Trade	2	70	30	100
	FOR/SEC602P	Non-Timber Forest Products, Marketing & Trade	1	100	-	100
3	FOR/SEC603T	Certification of Forest Products	2	70	30	100
4	FOR/SEC604T	Recreation and Urban Forestry	1	70	30	100
	FOR/SEC604P	Recreation and Urban Forestry	1	100	-	100

**Total Credit to earn in the Semester VI**

<b>Core</b>	<b>AECC</b>	<b>SEC</b>	<b>TOTAL</b>
13	0	10	23



### Semester VII

S.N	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR/CC701T	Forest Inventory and Yield Prediction	1	70	30	100
	FOR/CC701P	Forest Inventory and Yield Prediction	1	100	-	100
2	FOR/CC702T	Forest Biotechnology	2	70	30	100
	FOR/CC702P	Forest Biotechnology	1	100	-	100
3	FOR/CC703T	Agroforestry Systems and Management	2	70	30	100
	FOR/CC703P	Agroforestry Systems and Management	1	100	-	100
4	FOR/SEC701T	Wildlife Management	2	70	30	100
	FOR/SEC701P	Wildlife Management	1	100	-	100
4	FOR/SEC702T	Agricultural Informatics	2	70	30	100
	FOR/SEC702P	Agricultural Informatics	1	100	-	100
<b>Skill Enhancement Course (SEC)</b>						
1	FOR/SEC703P	Project Work & Dissertation	10	100	-	100

#### Total Credit to earn in the Semester VII

Core	AECC	SEC	TOTAL
14	0	10	24

### Semester VIII Forestry Work Experience

S.No.	Course Code	Name of the Courses	Credits	Marks		Total
				External	Internal	
	<b>Core Course</b>					
1	FOR/CC801P	Orientation (10 days)	1	100	-	100
2	FOR/CC802P	Forest Range Training Program (50 days)	10	100	-	100
3	FOR/CC803P	Industrial Placement (20 days)	4	100	-	100
4	FOR/CC804P	Socio-Economic Survey and Village Attachment (20 days)	4	100	-	100
<b>Skill Enhancement Course (SEC)</b>						
1	FOR/SEC801P	Weapon Training and First Aid Training (5+3=8 days)	1	100	-	100
2	FOR/SEC802P	Report Writing and Presentation (12 days)	2	100	-	100
3	FOR/SEC803P	All India Tour*	3	-	-	-

\* Noncredit course

#### Total Credit to earn in the Semester VIII

Core	AECC	SEC	ELECTIVE	TOTAL
19	0	6	0	25

**B.Sc. (Hons) FORESTRY [Eight (8) Semester] CHOICE BASED CREDIT SYSTEM  
(CBCS)  
Detailed Syllabus**

**Semester-I**

**Introduction to Forestry (FOR-CC/101T)**

**Course outcome**

Student will be able to

CO1: Explain history and classification of Indian and global forests.

CO2: Describe basics of agroforestry and global warming and climate change.

CO3: Explain forestry practices around the world.

CO4: Enlist different wood based industries and important dates/events related to forest and environment as well as different organizations related to forest.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC/101T	Introduction to Forestry	2	70	30	100

**Unit I**

Theory - Forests - definitions, role, benefits - direct and indirect. History of Forestry - Definitions divisions and interrelationships. Classification of forests - High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests - even and uneven aged stands. Forest types of India- classification.

**Suggested Readings:**

- Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi, 473p.
- Champion, H, G and Seth, S.K. 1968. Forest types of India, a revised survey of forest types of India, GOI Press, New Delhi, 404p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit II**

Agroforestry, farm forestry, social forestry, joint forest management concepts, programmes and objectives. Important acts and policies related to Indian forests. Global warming - forestry options for mitigation and adaptation - carbon sequestration. Important events/dates related to forests and environment - themes and philosophy.

**Suggested Readings:**

- Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi, 473p.
- Champion, H, G and Seth, S.K. 1968. Forest types of India, a revised survey of forest types of India, GOI Press, New Delhi, 404p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit III**

Introduction to world forests - geographical distribution and their classification, factors influencing global forests distribution - productivity 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.

**Suggested Readings:**

- Persson, R. 1992. World forest resources. Periodical experts, New Delhi.
- Westoby, J. 1991. Introduction to World Forestry. Wiley, 240p.

• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit IV**

Forest/wood 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.

**Suggested Readings:**

- Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi, 473p.
- Champion, H, G and Seth, S.K. 1968. Forest types of India, a revised survey of forest types of India, GOI Press, New Delhi, 404p.

• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Reference Suggested Readings**

- Champion, H, G and Seth, S.K. 1968. Forest types of India, a revised survey of forest types of India, GOI Press, New Delhi, 404p.
- Grebner, D.L., Bettinger, P and Siry, J.P. 2012. Introduction to Forestry and Natural Resources. Academic Press. 508p (Google eBook).
- Mather, A.S. 1990. Global forest resources. Belhaven, London.
- Persson, R. 1992. World forest resources. Periodical experts, New Delhi.
- Westoby, J. 1991. Introduction to World Forestry. Wiley, 240p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Dendrology (FOR-CC/102T)**

**Course outcome**

Student will be able to gather knowledge, develop skills and apply as below :

CO1: Appraisal on principles and practices, theories and technical terminology needed for dendrodiagnostics of Forestry important species.

CO2: Phytogeographical entities of forest species of conservation value.

CO3: International trends in nomenclature, classification system pertinent at national level.

CO4: Development of region specific repositories on species of economic and environment importance.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC/102T	Dendrology	2	70	30	100

**Unit I**

Introduction – Importance and scope of dendrology, Principles and systems of plant classification. Detailed study of Bentham and Hooker natural system, its advantages and disadvantages. Plant Nomenclature – objectives, principles and International Code of Botanical Nomenclature.

**Suggested Reading**

- Ashok Kumar (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
- Brandis. D. Revised by R. D. Jakarti (2010). Indian Trees. Dehradun.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit II**

Role of vegetative morphology in identification of woody forest flora. Peculiarities of bole, general form of woody trunk and deviations like buttresses, flutes, etc. Morphology and description of barks of common trees. Characteristics of blaze, bark colour, exudations etc. Morphology of leaf, different types of leaves, colour of young and old leaves in some species as (regular) features of identification. Reproductive morphology of plants with reference to description and identification of reproductive parts.

**Suggested Reading**

- Ashok Kumar (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
- Brandis. D. Revised by R. D. Jakarti (2010). Indian Trees. Dehradun.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit III**

Detailed study of the families- diagnose the features-floral variations–distribution and economic importance-systematic position as per Bentham & Hooker System of classification-Magnoliaceae, Annonaceae, Clusiaceae, Dipterocarpaceae, Malvaceae, Sterculiaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardiaceae, Fabaceae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae, Bignoniaceae, Lamiaceae, Lauraceae, Euphorbiaceae, Santalaceae Orchidaceae, Palmae Arecaceae and Poaceae. Taxaceae, Casuarinaceae and Pinaceae.

**Suggested Reading**

- Ashok Kumar (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
- Brandis. D. Revised by R. D. Jakarti (2010). Indian Trees. Dehradun.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOO

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC/102 P	Dendrology	1	100	-	100

**Practical –**

Morphological description of plant parts and method of collection of plants. Techniques of preparing herbarium specimens. General study of herbarium. Dissection of flowers-making sketches-construction of floral diagrams of one species of the following families: Annonaceae and Clusiaceae, Dipterocarpaceae and Malvaceae, Sterculiaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae Anacardiaceae, Fabaceae - Papilionaceae- Mimosaceae–Caesalpiniaceae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae, Taxaceae, Casuarinaceae Bignoniaceae, Lamiaceae, Euphorbiaceae, Taxaceae and Casuarinaceae, Orchidaceae and Poaceae, Pinaceae.

**Reference Suggested Reading**

- Ashok Kumar (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
- Bor N. L. (1990). Manual of Indian Forest Botany. Periodical Expert Book Agency. New Delhi.
- Brandis. D. Revised by R. D. Jakarti (2010). Indian Trees. Dehradun.
- Charles McCann. (1966). 100 Beautiful Trees of India. D. B. Taraporevala Sons & C. Pvt. Ltd. Mumbai. (Available online PDF)
- Father H. Santapau. (1966). Common Trees. (Available online PDF)
- Gurucharan Singh. (2000). Plant Systematics. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- Hardin, W., Harrar, E.S., and White, F.M. (1995) Textbook of Dendrology (8th Edition). McGraw-Hill Companies, London
- Jain S. K. and R. R. Rao. (1977). Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers. New Delhi.
- Lawrence, G.H.M.(1967). Taxonomy of Vascular Plants. Oxford&IBH, New Delhi.
- Mishra. S.R.(2010). Textbook of Dendrology. Discovery Publishing House Pvt. Ltd. New Delhi.

- Naqshi. R. (1993). An Introduction to Botanical Nomenclature. Scientific Publishers. Jodhpur.
- Pandey S. N. and S. P. Mishra. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.
- Parker. R. N. (1933). Forty Common Indian Trees and How to know them. (Available online PDF)
- Randhawa. M. S. (1957). Flowering Trees in India. Sree Saraswati Press Ltd. Kolkatta.
- Sahni. K. C. (2000). The Book of Indian Trees. Bombay Natural History Society. Mumbai.
- Tewari D. N. (1992). Tropical Forestry in India. International Book Distributors, Dehradun.

### Geology and Soils (FOR-CC/103 T)

#### Course outcome

The students will be able to

CO1: Explain the concepts and fundamentals of soil science.

CO2: Define the rocks and minerals, their makeup, and the numerous soil types that are generated from various parent materials.

CO3: Recognize the function of soil-forming components and processes.

CO4: Perceive many physical, chemical, and biological characteristics of the soil and how they affect plant growth.

CO5: Understand the behavior of soils in crop production and management will be possible with the knowledge acquired in this course.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC/103 T	Geology and Soils	2	70	30	100

#### Theory

##### Unit-I

Introduction to geology - its significance, composition of earth's crust, soil as a natural body - major components by volume. Pedology -rocks- types – igneous, sedimentary and metamorphic, classification - soil forming minerals - definition, classification-silicates, oxides, carbonates, sulphides, phosphates-occurrence. Weathering of rocks and minerals -weathering factors -physical-chemical-biological agents involved, weathering indices.

##### Suggested Readings:

- Biswas, T.D. and Mukherjee, S. K. 1987. Test Book of Soil Science, Tata McGraw Hill Publishing Co., New Delhi
- Indian society of soil science (ISSS). 2002. Fundamentals of Soil Science. Published by Indian Society of Soil Science, IARI, New Delhi
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### Unit-II

Factors of soil formation- parent material, climate, organism, relief, time. Soil forming processes- eluviations and illuviation, formation of various soils. Physical parameters- texture-definition, methods of textural analysis, Stokes law, textural classes, use of textural triangle, absolute specific gravity-definition apparent specific gravity/bulk density-factors influencing-eld bulk density, relation between bulk density- particle density. Pore space-definition-factors affecting capillary and non capillary porosity- soil colour-definition-its significance - ficolour variable-hue, value, chroma, Munsell colour chart- factors influencing-parent material-soil moisture-organic matter. Soil structure-



definition- classification-clay- prism like structure-factors influencing genesis of soil structure, soil consistency, plasticity-Atterberg's constants. Soil air-composition, factors influencing-amount of air space. Soil temperature-sources and distribution of heat-factors influencing-measurement. Chemical properties -soil colloids organic- humus-inorganic-secondary silicate-clay-hydrous oxides.

**Suggested Readings:**

- Biswas, T.D. and Mukherjee, S. K. 1987. Test Book of Soil Science, Tata McGraw Hill Publishing Co., New Delhi
- Indian society of soil science (ISSS). 2002. Fundamentals of Soil Science. Published by Indian Society of Soil Science, IARI, New Delhi
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-III**

Soil organic matter decomposition - concept of pH - soil acidity -nutrient availability- soil buffering capacity – a brief overview of saline, sodic and calcareous soils. Soil water-forms- hygroscopic, capillary and gravitational-soil moisture constants-hygroscopic coefficient-wilting point-field capacity-moisture equivalent, maximum water holding capacity, energy concepts- pF scale measurement-gravimetric-electric and tensiometer methods-pressure plate and pressure membrane apparatus-Neutron probe-soil water movement-saturated and unsaturated infiltration and percolation. Elementary knowledge of soil classification – soil orders. Forest soils- characteristics- distinguishing features- changes in physical and chemical properties compared to agricultural soils.

**Suggested Readings:**

- Biswas, T.D. and Mukherjee, S. K. 1987. Test Book of Soil Science, Tata McGraw Hill Publishing Co., New Delhi
- Indian society of soil science (ISSS). 2002. Fundamentals of Soil Science. Published by Indian Society of Soil Science, IARI, New Delhi
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-CC/103P</b>	<b>Geology and Soils</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>

**Practical –**

Identification of rocks and minerals; Collection and preparation of soil samples; Soil analyses for moisture, colour, bulk density, organic matter, pH, EC; Textural analysis by hydrometer method; Study of soil profile; Study tour for identification of rocks and minerals and profile studies; Practicals on introduction to Tensiometer, pressure plate and neutron probe etc.

**Reference Suggested Reading**

- Biswas, T.D. and Mukherjee, S. K. 1987. Test Book of Soil Science, Tata McGraw Hill Publishing Co., New Delhi
- Brady, N. C. 1990. Nature and Properties of Soils. 10th ed., Macmillan Publishing Co. Inc., New York
- Foth, H.D. and Turk, L. M. 1972. Fundamental of Soil Science. 5th edn. Wiley Eastern Pvt. Ltd., New Delhi
- Gupta, P.K. 2007. Soil, Plant, Water and Fertilizer Analysis. Published by AGROBIOS (India), Jodpur
- Indian society of soil science (ISSS). 2002. Fundamentals of Soil Science. Published by Indian Society of Soil Science, IARI, New Delhi
- Jaiswal, P.C. 2006. Soil, Plant and Water Analysis. 2nd Edn. Kalyani Publishers, Ludhiana
- Pritchett and Fisher R, F. 1987. Properties and Management of Forest Soils. John Wiley, New York.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Plant Biochemistry (FOR-CC/104 T)

### Course outcome

Student will be able to

CO1: Understand the significance of Biochemistry.

CO2: Describe the chemistry of carbohydrates, lipids, proteins and amino acids. Describe the classification and structural organization of proteins.

CO3: Describe the mechanism of enzyme action and identify the classes of enzymes and factors affecting action.

CO4: Describe the catabolic reactions of carbohydrates, lipids and amino acids. Understand Concepts, principles and processes in plant biotechnology.

CO5: Identify the class and functions of secondary metabolites

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-CC/104 T</b>	<b>Plant Biochemistry</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>

### Theory

#### Unit-I

Chemistry of carbohydrates—classification, mono, di and poly saccharides, anomerism, epimerism, mutarotation, configuration of sugars and in version. Chemistry of lipids—classification, simple lipids and phospho lipids. Fatty acids and fat content, lipids of chloroplast, membrane lipids.

#### Suggested Readings:

- Mazur, A and Harrows, B.(1971). Text book of Biochemistry. W.B. Sanders Publications, New Delhi.
- William, H.E. and Daphne, C.E.(2005). Biochemistry and Molecular Biology, Oxford University Press.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit-II

Chemistry of amino acids, peptides and proteins, classification, levels of protein structure. Chemistry of nucleic acids—bases, sugars, Nuclease E nzymes —classification, enzyme kinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes. Metabolism of carbohydrates—glycolysis, TCA cycle, HMP shunt, glyoxylic acid cycle, electron transport chain. Lipids metabolism—beta oxidation and fatty acid biosynthesis

- Mazur, A and Harrows, B.(1971). Text book of Biochemistry. W.B. Sanders Publications, New Delhi.
- William, H.E. and Daphne, C.E.(2005). Biochemistry and Molecular Biology, Oxford University Press.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-CC/104P</b>	<b>Plant Biochemistry</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>

### Practical –

Preparation of solutions of different concentrations, pH and buffers. Qualitative tests for carbohydrates, Quantitative estimation of reducing sugars by DNS method, Quantitative test for total carbohydrates by Anthrone reagent, Qualitative tests for lipids, Determination of Saponification number of oils/fats, Determination of Iodine number of fatty acids, Qualitative tests for proteins/amino acids, Estimation of protein by Lowry's method, Determination of Michaelis constant of enzymes, Estimation of RNA.

### Reference Suggested Reading

- Conn, E.E. and Stumpf, P.K.(1989). Outlines of Biochemistry, Wiley Eastern Ltd., New Delhi
- Mazur, Aand Harrows, B.(1971). Text book of Biochemistry. W.B. Sanders Publications, New Delhi.
- William, H.E. and Daphne, C.E.(2005). Biochemistry and Molecular Biology, Oxford University Press.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Technique/field tour (FOR-CC/105 P)

#### Course outcome

Student will be able to

CO1: Students will learn a Forestry technique or will know the Forestry & allied Institutions.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-CC/105 P</b>	<b>Technique/field tour</b>	<b>2</b>	<b>100</b>	<b>-</b>	<b>100</b>
Student will be taken for 3 to 4 days field tour by concern class mentor and class teacher. (Cost of tour shall be borne by the students)					

### Communication Skills and Personality Development (FOR-AECC101 T)

#### Course outcome

Student will learn following:

CO1: Introduction to word classes; structure of the verb in English.

CO2: Uses of tenses. Study of voice. Use of conjunctions and prepositions. Sentence patterns in English.

CO3: Spoken English: conversations of different situations in everyday life. The concept of stress, stress shift in words and sentences.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-AECC101 T</b>	<b>Communication Skills and Personality Development</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>

#### Theory –

#### Unit-I

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences. Applied Grammar: Introduction to Word Classes. Structure of the Verb in English. Uses of Tenses. Study of Voice. Use of Conjunctions and Prepositions. Sentence Patterns in English. Spoken English: Conversations of Different Situations in Everyday Life. The Concept of Stress, Stress Shift in Words and Sentences. Words with Silent Letters and their Pronunciations. The Basic Intonation patterns.

#### Reference Suggested Reading

- Carroll, B.J. 1986. English for college, Macmillan India Ltd. New Delhi
- Hahn, "The Internet complete reference", TMH
- Hornby, A.S. 1975. Guide to patterns and usage in English. Oxford University, New Delhi.
- Qurik, R and Green baum, S 2002. A University grammar

### Introduction to Agronomy and Horticulture (FOR-ID101 T)

#### Course outcome

After completing this course, students are able to:

CO1: Define and describe Definition, importance, nutritive value

CO2: Classify horticultural crops viz., fruits, vegetables, flowers, medicinal and aromatic crops, spices

CO3: Explain planning and layout, management, planting systems of orchards.

CO4: Assess the principles and methods of training and pruning of fruit crops, Horticultural zones

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-ID101 T	Introduction to Agronomy and Horticulture	1	70	30	100

#### Theory-

##### Unit-I

Agronomy, scope and its role in crop production-Major Field crops of India – classification, area, distribution and productivity of major Field crops. Farming and cropping systems –mono, sole and multiple cropping, relay, sequential and inter cropping. Tillage- definition- objectives – types of tillage-tillage implements – tillth - characteristics of good tillth - Soil productivity and fertility- Crop nutrition – nutrients –classification – Nutrient sources- organic manures –fertilizers – biofertilizers- Integrated Nutrient Management-Importance of water in plant growth- Irrigation and drainage. Weed control – definition and characteristics of weeds, classification of weeds – damages due to weeds - benefits of weeds. -Control vs prevention of weeds – methods of weed control-Classification of herbicides– Integrated weed management.

##### Suggested Reading

Bose, T.K. 1985. Fruits of India- Tropical and subtropical. Naya Prakash, Calcutta

• Brady, N.C. and Well, R.R.2002. The Nature and Properties of Soils (13 th ed.). Pearson Education, Delhi.

• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### Unit-II

Definitions and importance of horticulture- Economic importance and classification of horticultural crops and their culture and nutritive value- area and production- exports and imports- fruit, vegetables, plantation and spice crops-soil and climate–principles-planning and layout- management of orchards-planting systems and planting densities- Principles and methods of pruning and training of fruit, plantation crops- use of growth regulators in horticulture crops-Horticultural zones of state and country.

##### Suggested Reading

Bose, T.K. 1985. Fruits of India- Tropical and subtropical. Naya Prakash, Calcutta

• Brady, N.C. and Well, R.R.2002. The Nature and Properties of Soils (13 th ed.). Pearson Education, Delhi.

• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-ID101 P	Introduction to Agronomy and Horticulture	1	100	-	100

Practical –

Identification of field crop and tillage implements. Preparation of seed beds, identification of fertilizers and manures – mixing chemical fertilizers – calculating fertilizer requirements. Identification of green manure plants. Identification of important weeds of the region with particular reference to forest plantations. Preparation of weed herbarium. Calculations of spray volume and herbicide concentrations. Methods of application of herbicides. Identification of horticultural crops-garden tools and implements. planning and layout of orchard and plantations.

Digging and filling of pits for fruit and plantation crops-planting systems, training and pruning of orchard trees-preparation and application of regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits-bearing habits and maturity standards, harvesting, grading, packaging and storage.

**Reference Suggested Reading**

- Agrawal, R.L.1980. Seed technology. Oxford & IBH Publishing Co., New Delhi
- Balasu bramaniyan, P and Palaniapan, S.P. 2001. Principles and Practices of Agronomy. Agro Bios (India)Ltd., Jodhpur.
- Bose, T.K. 1985. Fruits of India- Tropical and subtropical. Naya Prakash, Calcutta
- Brady, N.C. and Well, R.R.2002. The Nature and Properties of Soils (13 th ed.). Pearson Education, Delhi.
- De, G.C.1989. Fundamentals of Agronomy. Oxford & IBH Publishing Co., New Delhi
- Havlin, J. L., Beaton, J. D., Tisdale, S.L., and Nelson, W.L. 2006. Soil Fertility and Fertilizers: An Introduction to Nutrient Management(7th ed.). Pearson Education, Delhi.
- ICAR.2006. Hand book of Agriculture, ICAR, New Delhi.
- Nair, P.K.R.1979. Intensive multiple cropping with co conuts in India. Verlag Paul Pary, Berlin
- Palaniappan, S.P. 1988. Cropping systems in the tropics - Principles and management. Wiley Eastern Limited, New Delhi
- Randhawa, M.S.1982. History of agriculturein India, VolI, II&III. ICAR, New Delhi
- Reddy. T.Yand Reddy, G.H.S.1995. Principles of Agronomy, Kalyani Publishers, Ludhiana.
- Reddy, S.R.1999. Principles of Agronomy, Kalyani Publishers, Ludhiana.
- Sankaran, S. and Subbiah Mudaliar, V.T. 1991. Principles of Agronomy. The Bangalore Printing & Publishing Co., Bangalore
- Tisdale, S.L. etal.1985.Soil fertility and fertilizers. Macmillan Pub.Co., New York
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Information and Communication Technology (FOR-E102 T)**

**Course outcome**

Student will be able to

CO1: Recall the basics of Computers and compare and contrast the details of Software and Hardware.

CO2: Describe System software’s like Operating Systems DOS Windows and assess the application software’s like MS Office and Statistical Packages.

CO3: Illustrate FOSS for OSS, Spreadsheet, presentation and word- process.

CO4: Outline the basics of Internet and Intranet.

CO5: Analyze, classify and evaluate Audio Visual Aids.

CO6: Investigate the Communication Process and inspect the barrier in communication.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-E102 T</b>	<b>Information and Communication Technology</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>

<b>Theory- Unit-I</b>					
Introduction to computers, hard ware and soft ware, basic works of computer, operating systems. DOS, WINDOWS commands for managing files. Windows component like icons, desktop, My Computer, recycle bin, My Documents, task bar, start menu options. Familiarizing with MS OFFICE (MS Excel, MS Word, MS PowerPoint). Introductions to FOSS for OS and for work related to word processing, spreadsheet and presentation. Introduction to intra and internet and its application. Introduction to statistical packages and image processing software. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing. Communication process, Berlo' s model, feedback and barriers to communication.					
Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-E102 P</b>	<b>Information and Communication Technology</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>
<b>Practical –</b>					
Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of fisheries data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.					
<b>Reference Suggested Reading:</b>					
<ul style="list-style-type: none"> <li>• Norton Peter, “DOS Guide”, Prentice Hall of India</li> <li>• Norton Peter, “Introduction to Computers”, TMH</li> <li>• Rajaraman V, “Fundamentals of Computers”, PHI</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

### Forest Botany (FOR-ID102 T)

#### Course outcome

Students will be able to

CO1: Explain the distinguished features of Phanerogams, Cryptogams, Angiosperm, Gymnosperm.

CO2: Describe the Morphology of roots, shoots and flowers. Phyllotaxy, Venation, aestivation and inflorescence.

CO3: Discuss Basic structures of different kind of tissues.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-ID102 T</b>	<b>Forest Botany</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>
<b>Theory- Unit-I</b>					
Introduction to Allied and Applied Branches of Botany; General classification of plants – Phanerogams, Cryptogams, Angiosperms and Gymnosperms, Dicotyledons and Monocotyledons; General body organization and characters of Algae (e.g. Chlamydomonas), Fungi (Mucor), Bryophytes (Moss) and Pteridophytes (Nephrolepis);					
<b>Suggested Readings:</b>					
<ul style="list-style-type: none"> <li>• Ashok Kumar (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.</li> <li>• Dutta. C. (1998). Botany for Degree Students. (1998). Oxford University Press. India</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

**Unit-II**

Parts of flowering plants- Root system and Shoot system, typical structure of root, stem and leaf; Functions of root, stem and leaves; Basic Structure of Flower- Essential and Non essential parts of flower; Morphology of root, stem and leaves; Morphology of Flower with emphasis on Inflorescence; Types of Phyllotaxy and Venation in leaves, types of placentation and aestivation in flower; Basic types of tissues (Structure and Function) - Dermal, Vascular and Ground tissues; Parenchyma, Sclerenchyma, Collenchyma, Chlorenchyma, Aerenchyma, Cambium, Xylem and Phloem; Types of vascular bundles in flowering plants.

**Suggested Readings:**

- Ashok Kumar (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
- Dutta. C. (1998). Botany for Degree Students. (1998). Oxford University Press. India
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-ID102 P	Forest Botany	1	100	-	100

**Practical –**

Morphology of root, stem and leaves with special emphasis on underground and aerial modifications in root and stem; simple and compound leaves; types of phyllotaxy and venation (live specimens); typical structure of bisexual flower; types of inflorescence (live specimens); types of tissues with the aid of permanently mounted slides; Tissue organization in Dicot root, stem and leaves; Tissue organization in Monocot root, stem and leaves with the aid of permanent slides or study charts.

**Reference Suggested reading:**

- Ashok Bendre and Ashok Kumar. (1984). Textbook of Practical Botany. Vol. I and II. Rastogi Publications. Meerut. India. (Also available on Flipkart and Amazonbooks. Com)
- Ashok Bendre and P. C. Pande. (1996). Introductory Botany. Rastogi Publications. Meerut. India.
- Ashok Kumar (2001). Botany in Forestry and Environment. Kumar Media (P) Ltd. Gandhinagar, Gujarat.
- Dutta. C. (1998). Botany for Degree Students. (1998). Oxford University Press. India
- Dutta. C. (2000). Class Book of Botany. Oxford University Press. India
- Gurucharan Singh. (2000). Plant Systematics. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
- Pandey S. N. and S. P. Mishra. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.
- Pandey. P. (2012). Taxonomy of Angiosperms. S. Chand and Company Ltd. New Delhi.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Basics Mathematics (FOR- ID102 T)****Course outcome**

Students will be able to

CO1: Recall basic mathematical formulas and definitions relevant to forestry applications (e.g., growth rate formulas, statistical measures).

CO2: Recognize different types of mathematical functions and their graphical representations (e.g., linear equations, exponential growth curves).

CO3: Explain & interpret the underlying principles of mathematical concepts used in forestry (e.g., explain the concept of standard deviation in analyzing forest density data).

Course Code	Name of Subject	Credit	Marks	Total
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			<b>External</b>	<b>Internal</b>	
<b>FOR- ID102 T</b>	<b>Basics Mathematics</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>
<p><b>Theory-</b>            Elementary idea of complex number. Arithmetic and Geometric progressions. Elementary idea of permutation and combinations. Matrix of a system of linear equations. Binomial theorem for positive integral index, any index and their applications, addition and subtraction formulae. A, B and C, D formulae. Sine and Cosine formulae. Inverse Trigonometric functions, ratios and their interrelationships. Limit off unctions-differentiations and integrations simple applications- maxima and minima least square techniques- Introduction to matrices and determinants, special type of matrices, addition, subtraction and multiplication of matrices.</p> <p><b>Reference Suggested Readings</b></p> <ul style="list-style-type: none"> <li>• Chatterjee S. K. (1970). Mathematical Analysis. Oxford &amp; IBH.</li> <li>• Frank, A. (1962). Schaum’s Outline of Theory and Problems of Matrices. McGraw-Hill</li> <li>• Frank, A. 1967. Theory and Problems of Differential Equations. McGraw-Hill</li> <li>• Gentle JE. (2007). Matrix Algebra: Theory, Computations and Applications in Statistics. Springer</li> <li>• Narayan, S. (1953). A Text Book of Matrices. S. Chand and Company.</li> <li>• Parameswaran, S. (1976). An introduction to mathematics. Oxford &amp; IBH Publishing Co. 172p.</li> <li>• Walter R. (1976). Principles of Mathematical Analysis. McGraw-Hill.</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					
<p><b>NCC-I/NSS-I* (FOR-103P)</b>  <b>Course outcome</b>            CO1: It is aimed to Develop Character, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure, and Ideals of Selfless Service amongst the Youth of the Country</p>					
<b>Course Code</b>	<b>Name of Subject</b>	<b>Credit</b>	<b>Marks</b>		<b>Total</b>
			<b>External</b>	<b>Internal</b>	
<b>FOR-103P</b>	<b>NCC-I/NSS-I*</b>	<b>1</b>	-	-	-
<p><b>Theory-</b>            Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, armsdrill, shoulderarm, orderarm, presentarm, guard of honour, ceremonial drill.            NSS – Aims and objectives of NSS. NSS logo, mottoetc. Orientation of students in national problems, study of philosophy of NSS, funda mentals rights, directive principles of state policy, Village adoption.</p>					

\* Non credit course



## Semester-II

### Plant Physiology (FOR-CC201T)

#### Course outcome

Students of B.Sc. Forestry will achieve following outcomes:

CO1: Understanding of the basic principles of plant physiology, including the structure and function of plant cells, tissues, and organs and understanding of the processes that occur within plants, such as photosynthesis, respiration, and transpiration.

CO2: Understanding of the mechanisms by which plants respond to environmental factors, including light, temperature, water, and nutrients & able to apply physiological concepts to practical problems in forestry, such as tree growth and development, stress response, and adaptation to changing environmental conditions.

CO3: Understanding of the interactions between plants and other organisms, including pests, pathogens, and symbiotic microorganisms and familiar with techniques for studying plant physiology, such as microscopy, biochemical analysis, and experimental design.

CO4: Ability to communicate effectively about plant physiology concepts and research findings through oral presentations, written reports, and scientific publications and understand the ethical considerations involved in plant physiology research, including issues related to genetic engineering, biotechnology, and conservation.

CO5: Appreciation of the importance of plant physiology in addressing global challenges such as climate change, food security, and ecosystem restoration.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC201T	Plant Physiology	2	70	30	100

#### Theory-

##### Unit-I

Introduction to tree physiology. Photosynthesis - C<sub>3</sub>, C<sub>4</sub> and CAM plants – Photorespiration Factors affecting photosynthesis. Respiration - energetics of dark respiration. Plant-water relations: Concept of water potential, ascent of sap and water balance. Stomatal physiology : stomatal conductance – resistance.

##### Suggested Reading

- Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.
- Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons. New York
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### Unit-II

Mineral nutrition: macro and micro nutrients Arnon's criteria of essentiality – deficiency. Nutrient dynamics and plant growth – Nutrient cycling of C,N,P,S. Plant growth regulators – classification. Tree structure, growth and development, growth kinetics. Growth regulation and co-ordination- Plant growth analysis, Canopy studies.

##### Suggested Reading

- Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.
- Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons. New York
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### Unit-III

Forest Biomes. Light interactions, models of forest canopies - Sun plants and shade plants shade tolerance. Temperature influence on forest development, energy budgets, low and high temperature - Physiological adaptations for high temperature, chilling injury. Water stress - Mechanism of drought tolerance and drought resistances - Physiological basis of drought, avoidance and tolerance. Water relations of forest trees – Transpiration from forest canopies – Evapotranspiration models of forest

stands - Water use efficiency of forest stands. Salinity stress its effects on tree growth. Resistance to salinity. Forest and microclimate . Carbon balance and dry matter production in forest trees - Dry matter production and partitioning – source/ sink - . GPP and NPP of forest stands -Carbon cycling.

**Suggested Reading**

- Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.
- Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons. New York
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC201P	Plant Physiology	1	100	-	100

**Practical-** C 3 and C 4 leaf anatomy. Estimation of transpiration using porometer. Extraction and estimation of chlorophyll in plants. Estimation of stomatal index. Demonstration of plasmolysis. Estimation of water potential in plants using Plant water status console. Estimation of leaf area of plants. Plant growth analysis – RGR (Rotative growth rate), NAR (Net assimilation rate), and LAR (Long area ratio), SLA (specific leaf area) and leaf weight ratio (WR), Long area index (LAI), CGR – LAD etc... Measurement of moisture stress tolerance parameters in trees - membrane stability, chlorophyll stability, proline content, wax and cuticle thickness. Measurement of relative water content, leaf water potential, osmotic potential. Measurements of stomatal resistance/stomatal conductance under varying stress condition. Observation on tree architecture of important species

**Reference Suggested Reading**

- Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.
- Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons. New York
- Larcher, W. (2003). Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups. Springer Science & Business Media
- Lambert, Chapin, F.S. and Pons, T.L. (1998). Plant Physiological Ecology. Springer Scientific+ Business Media inc. Newyork.
- Landsberg, J.J (1986). Physiological Ecology of Forest Production. Academic Press Inc., London
- Landsberg, J.J and Gower, S.T (1997). Applications of Physiological Ecology to Forest Managment. Academic Press Inc., London.
- Nobel P. S. (2005). Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, Amsterdam
- Salisbury, F. B. and Ross,C. W. (2004) . Plant Physiology. Thomson Asia Ptd, Ltd. Singapore.
- Taiz, L. and Zeiger, E. (2010) 5th edition Plant Physiology. Sinauer Associates, Inc., Massachusetts
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Plant Cytology and Genetics (FOR-CC202T)**

**Course outcome**

Students are able to

CO1: Learn about basic cell structure and theory.

CO2: Describe the Mendel’s law.

CO3: explain Structure and role of DNA and RNA, chromosomes and genes.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC202T	Plant Cytology and Genetics	2	70	30	100

**Theory-**

**Unit-I**

History of genetics. Mendel's principles of inheritance – segregation – independent assortment. Cell – structure and functions. Cell organelles. Cell reproduction – mitosis – meiosis and its significance. Chromosome theory of inheritance. Modification to Mendelian inheritance – multiple alleles – co-dominance – gene interaction – epistasis – pleiotropy – polygenic inheritance penetrance and expressivity – cytoplasmic inheritance. Linkage and crossing over – cytological consequence of crossing over. Detection of linkage and linkage maps.

**Suggested Reading:**

- Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science, India (P.) Ltd., Daryaganj, New Delhi.
- Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Chromosomal aberrations- numerical and structural. Structure of DNA and types and its replication. Chromosomes – its structure and function. Fine structure of gene; Gene expression and their functions. RNA its structure function and types. Gene action – protein synthesis. Mutation, its classification and uses.

**Suggested Reading:**

- Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science, India (P.) Ltd., Daryaganj, New Delhi.
- Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-CC202P</b>	<b>Plant Cytology and Genetics</b>	1	100	-	100

**Practical –**

Study of fixatives and stains. Preparation of slides showing various stages of mitosis. Preparation of slides showing various stages of meiosis. Working out problems related to monohybrid cross, dihybrid cross, independent assortment, linkage, gene mapping, probability and chi-square, multiple alleles etc.

**Reference Suggested Reading:**

- Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science,
- Garner, E. J., Simmons, M. J. and Sunstad, P. D. (2008). Principles of Genetics (8th edn.).Wiley India (P.) Ltd., Daryaganj, New Delhi.
- Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut
- Strickberger, M.W. (1996). Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi.
- Tamarin, R. (2002). Principles of Genetic (7th Ed). Tata McGraw-Hill Education.
- White, T.L., Adams, W.T., and Neale, D.B. (2007). Forest Genetics. CABI
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Theory and Practice of Silviculture (FOR-CC203T)**

**Course outcome**

After completion the course, students are able to -

CO1: Use the knowledge of silviculture and its application.

CO2: Discuss the scope, opportunities and constraints of silviculture.

CO3: Identify the origin, importance, distribution, regarding to different locality factors.

CO4: Describe Tree's reproduction, care and conservation methods.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR-CC203T</b>	<b>Theory and Practice of Silviculture</b>	2	70	30	100

**Theory-**

**Unit-I**

**Definitions: Silviculture:** Objectives and scope of silviculture-relation with other branches of Forestry Silvics. Site factors - climatic, edaphic, physiographic, biotic and their interactions. Trees and their distinguishing features, growth and development. Root growth- fine root/functional root production-

Direct and indirect benefits- biophysical interactions- trees and buffering functions- C sequestration potential of forests. Silvicultural systems-definition, scope and classification. Systems of concentrated regeneration- systems of diffused regeneration- accessory systems- Clear felling systems- Shelterwood system - Selection system and its modifications- Coppice systems- Culm selection system in Bamboo, Canopy lifting system in Andaman. Silvicultural systems followed in other countries.

**Suggested Reading**

- Champion, H.G. and Trevor,G.1936. Handbook of Silviculture, Cosmo Publication, N e w Delhi
- Dwivedi. A.P. 1993. Text book of Silviculture. International Book Distributors.
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

**Regeneration of forests** – objectives - ecology of regeneration- natural, and artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment, requirement for natural regeneration, 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. Tree planting- Sowing v/s planting different kinds of pits- tending and cultural operations- weeding- kinds of weeding- release operations- singling, cleaning–liberation cutting.

**Suggested Reading**

- Champion, H.G. and Trevor,G.1936. Handbook of Silviculture, Cosmo Publication, N e w Delhi
- Dwivedi. A.P. 1993. Text book of Silviculture. International Book Distributors.
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC203T	Theory and Practice of Silviculture	1	100	-	100

**Practical –**

Acquaintance with modern silvicultural tools. Visits to different forest areas/types. Study of forest composition. Visiting plantations raised by forest department, Exercise on nursery practice- seed collection, seed pre-treatment- nursery stock preparation- field preparation- marking, alignment and stacking, pit making-planting, various tending operations- weeding, cleaning, singling, pruning, pollarding, lopping, and thinning- fertilization in trees- plant protection and sanitation measures.

**Reference Suggested Reading**

- Baker, F.S.1950. Principles of Silviculture, Mc Graw Hill, N . Y .
- Champion, H.G. and Trevor,G.1936. Handbook of Silviculture, Cosmo Publication, N e w Delhi
- Daniel, T.W., Helms,J.A., Baker, F.S. 1970. Principles of Silviculture, Mc Graw Hill, N.Y.
- Duryea, M.L. and Landis, T.D.(eds.)1984. Forest Nursery Manual: Production of bareroot seed lings. Martinus Nijhoff/Dr W. Junk Publishers. The Hague/Boston/Lancaster, 386p.
- Dwivedi. A.P. 1993. Text book of Silviculture. International Book Distributors.
- Evans, JE.1982. Plantation For estryinthe Tropics.The English Language Book Society and Clarend on Press– Oxford
- Gunter, S.,Weber, M,M Stimm, Band Mosandl, R. 2011. Silviculture inthe Tropics. Springer- Verlag- Berlin.
- Haig, I. T. Huberman, M. A. and Aung Din, U. 1986. Tropical Silviculture, Vol. I and II.
- Food andAgriculture Organization of the United Nations Rome and Periodical Experts BookAgency, D-42, Vivek Vihar,Delhi–110032.
- Khanna, L.S.1989. Principles and Practice of Silviculture. Khanna Bandhu, 7 Tilak Marg, Dehradun
- Kostler, J.1956. Silviculture. International Book Distributors, P.O. Box4. Dehradun

Lal, J.B.2003. Tropical Silviculture, New Imperatives: New Systems, International Book Distributors, P.O. Box 4. Dehradun

Smith, D.M.1986. The Practice of Silviculture, Edn8. New York, John Wiley.

- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Forest Protection (FOR-CC204T)

### Course outcome

Students will learn

CO1: About different insect/pest, diseases related to different parts of standing trees caused by biotic and abiotic entities and their control measures.

CO2: About the damages caused by animals and their control.

CO3: About Forest fire, encroachment and problems related to plantation

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC204T	Forest Protection	2	70	30	100

### Theory-

#### Unit-I

Introduction – Importance of protection in Indian Forestry – classification of injurious agencies. Injury to forest due to fires, causes and character of forest fires – fire prevention activity fire suppression – fire fighting equipments – fire control policy and objectives. Fire fighting in other countries. Injury to forest due to man- lopping – cutting for fuel wood – Encroachment- different types, control of encroachment illegal felling of trees- method of control legislation. Forest weeds and weed management, management of woody climbers, parasites and epiphytes.

#### Suggested Reading:

- Basher, A.E.S. (1983).Forest Fires and Their Control. Gulab Primlani Amerind Publishing, New
- Devasahayam, H.L. and Henry, L.D.C. (2009). Illustrated Plant Pathology- Basic Concepts. New India Publishing Agency
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit-II

Importance of Forest Pathology, tree disease classification, Principles of tree disease management, - Causes and symptoms- losses due to forest tree diseases, root diseases (wilt, root- and butt rot), stem diseases (heart rots, stem blisters, rusts, stem wilt, cankers, pink diseases, gummosis, water blister) and foliar diseases (rust, powdery mildew, leaf spot, leaf and twig blight, abnormal leaf fall, needle blight etc.) Etiology, symptoms, mode of spread, epidemiology and management, including chemical, biological, cultural and silvicultural practices. Nursery diseases and their management. Disease due to physiological causes. Abiotic diseases.

#### Suggested Reading:

- Basher, A.E.S. (1983).Forest Fires and Their Control. Gulab Primlani Amerind Publishing, New
- Devasahayam, H.L. and Henry, L.D.C. (2009). Illustrated Plant Pathology- Basic Concepts. New India Publishing Agency
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit-III

Forest Entomology in India. Methods and principles of pest control: Mechanical, physical, silvicultural, legal, biological and chemical. Principles and techniques of Integrated Pest Management in forests. Classification of forest pests: types of damages and symptoms; factors for outbreak of pests. Nature of damage and management: Insect pests of forest seeds, forest nursery and standing trees of timber yielding species of natural forest and Plantation forest species. Insect pests of freshly felled trees, finished timbers and their management.

#### Suggested Reading:

- Basher, A.E.S. (1983).Forest Fires and Their Control. Gulab Primlani Amerind Publishing, New
- Devasahayam, H.L. and Henry, L.D.C. (2009). Illustrated Plant Pathology- Basic Concepts. New India Publishing Agency

- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-CC204P	Forest Protection	1	100	-	100

**Practical –**

Visit to forest areas with fire damages, studying fire registers as records, studying encroachments and problems caused due to disturbance-visit to illegally felled areas- Visit to fire station, study and acquaint with machinery used for fire control, identification of weeds, parasites and epiphytes. Observation of symptoms in laboratory and in forests - examination of scrapings - host-parasite relationships - causal organisms of above forest diseases.

Examination of cultures of important pathogens. Visit to nurseries and plantations. Insect pests of forest seeds; forest nurseries; standing trees; freshly felled trees and finished products. Survey and identification of invertebrate fauna from forest areas. Methods of isolating soil invertebrate macro and micro fauna. Insecticides and their formulations, plant protection appliances.

**Reference Suggested Reading:**

- Agrios, G.N. (1997). Plant Pathology. 4thEdn, Horcourt Asia Pvt. Ltd., Singapore.
- Bakshi, B.K. (1976), Forest Pathology; Principles and Practices in Forestry. Pub. Comptroller of Publications, Delhi. 400p.
- Basher, A.E.S. (1983).Forest Fires and Their Control. Gulab Primlani Amerind Publishing, New
- Boyce, J.S. (1961). Forest Pathology, 3rd edition. McGraw-Hill. New York, New York. 572 pp
- Brown, A.A and Davis, K.P. (1973). Forest Fire Control and Use. Mc Graw Hill Book Co. New York. Delhi.159p.
- Devasahayam, H.L. and Henry, L.D.C. (2009). Illustrated Plant Pathology- Basic Concepts. New India Publishing Agency
- Elton, C. S. (2000). The Ecology of Invasions by Animals and Plants. University of Chicago Press.
- Fuller, M. (1991). Forest Fires. Wiley Nature Editions, New York.
- Ghadekar, S.R. (2003) Meteorology. Agromet Publishers, Nagpur
- Hal, R.B. (1990). Principles and Procedure of Range Management. International Book Distributors, Dehra Dun.
- Johnson, A.E and Miyanishi, K. (2001). Forest Fires: Behavior and Ecological Effects. Academic Press.
- Khanna, L.S. (1988). Forest Protection. Khanna Bandhu, Dehradun.206p.
- Lenka, D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi
- Luna, R.K. (2007). Principles and Practices of Forest Fire Control.International Book Distributors, Dehradun.466p.
- Mavi, H.S. (1994) Agrometeorology. Oxford &IBH, New Delhi
- Mohanan, C. (2011). Macro fungi of Kerala, KFRI, Peechi.p.597
- Negi, S.S. (1999). Handbook of Forest Protection. International Book Distributors.271p.
- Pathak, V.N., Khatri, N.K. and Manish Pathak. (2000). Fundamentals of Plant Pathology. Eds. Agribios (India), Jodpur. 356 p.
- Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,
- Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg
- Singh, R.S (2002).Introduction Principles of Plant Pathology. Oxford & IBH, New Delhi
- Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR, New Delhi
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Statistical Methods & Experimental Designs (FOR-AECC10`T)

### Course outcome

After completing this course, students are able to

CO1: Describe and explain variable Statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution, tables and diagrammatic as well as graphical presentation of data & to analyze and evaluate average, variation or dispersion for raw and grouped data,

CO2: Recall the basic concepts and laws of Probability and explain Theoretical distribution: binominal, poisson and normal distributions , outline of Sampling and sampling methods, basic concept of tests of significance: basic concepts,

CO3: Examine, apply, analyze and evaluate tests for equality mean, independent and paired t-tests, chi square tests for application of attributes and test for goodness to fit of mendalian ratios, & to discuss, examine and explain Correlation, correlation co- efficient and its properties, regression, fitting of sample linear regression, tests of significance of correlation and regression co- efficient,

CO4: Investigate the design of experiment- Basic principles of experimental design-replication, randomization and local control, layout, analysis, applications, advantages and limitations of completely randomized design, randomised block design and latin square designs,

CO5: Describe and explain analysis is of variance – assumptions- construction of ANOVA table – conclusions based on ANOVA. Comparisons based on means-critical difference, DMRT, the basics of transformations of data- square root, logarithmic and angular transformations

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-AECC10`T	Statistical Methods & Experimental Designs	2	70	30	100

### Theory-

#### Unit-I

Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution, tables –graphic presentation of data, simple, multiple component and percentage, bar diagram, pedia gram, histogram, frequency polygon and frequency curveave rage and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles for raw and grouped data. Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoretical distributions, binominal, poisson and normal distributions, sampling, basic concepts, sampling vs. Complete enumeration parameter and static, sampling methods, simple random sampling and stratified and om sampling.

#### Suggested Reading

- Cochran, W.G and Cox, G.M.(1958). Experimental designs. Wiley, New York
- Das, M.N. and Giri, N.C. (1986). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi. Federer, W.T.(1955), Experimental Design. Macmillan, New York.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit-II

Tests of significance: Basic concepts, tests fore quality mean, aninde pendet and paired t-tests, chisquare tests for application of attributes and test for goodness to fit of mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of sample linearreg ressession, tests of significance of correlation and regressionco-efficient. Introduction to design of experiment- Basic principles of experimental design-replication, randomization and local control. Analysis is of variance-assumptions- construction of ANOVA table–conclusions based on ANOVA.

Comparisons based on means-critical difference, DMRT. Transformations of data- square root, logarithmic and angulartrans for mations.

Completely randomized design-Layout, analysis, advantages and limitations. Randomised block design-



layout, analysis, choice of no. of blocks, advantages and limitations. Latin square designs-layout, analysis, applications, advantages and limitations.

**Suggested Reading**

- Cochran, W.G and Cox, G.M.(1958). Experimental designs. Wiley, New York
- Das, M.N. and Giri, N.C. (1986). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi. Federer, W.T.(1955), Experimental Design. Macmillan, New York.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-AECC101P	Statistical Methods & Experimental Designs	1	100	-	100

**Practical –**

Formation of frequency distribution. Diagrammatic and graphic representation. Calculation of different measures of central tendency. Computation of various measures of dispersion. Calculation of coefficient of variation-coefficients of skewness and kurtosis. Computation of product moment correlate on coefficient-rank correlation, coefficient-and coefficient of concordance. Fitting of linear egression models for prediction. Simple problems on probability- fitting of binomial distribution. Fitting of poisson distribution, problems on normal distribution. Selection of simple random sample – estimation of parameters – sample size determination. Selection of stratified and om sample–equal, proportional and Ney man’s allocation in stratified sampling. Large sample tests. Small sample tests, t and F tests, Chi –square test, test of goodness of fit – test of independence of attributes in a contingency table - computation of mean – square contingency. Analysis of variance-construction of ANOVA table of one-way classified data.

Analysis of variance-construction of ANOVA table of two-way classified data. Layout and analysis of CRD, Layout and anal ysis of RBD. Analysis of data from 2n factorial experiments in RBD. Formation of Yate's table-calculation of main effects and interaction effects. Layout and analysis of split-plot design.

**Reference Suggested Reading**

- Anderson, R.L. and Bancroft, T.A.(1952).Statistical Theory in Research. Mc. Graw Hill Book Co., New York.
- Cochran, W.G and Cox, G.M.(1958). Experimental designs. Wiley, New York
- Das, M.N. and Giri, N.C. (1986). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi. Federer, W.T.(1955), Experimental Design. Macmillan, New York.
- Gomez, K.A. and Gomez, A.A. (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons. New York. 680 p.
- Kempthorne, O. (1952). The design and analysis of experiments. Wiley, New York.
- Nigam A.K. and Gupta, V.K.(1979). Hand book on Analysis of Agricultural Experiments. IARI Publication, New Delhi.
- Panse, V. G. and P.V. Sukhatme. (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.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Wood Anatomy (FOR-E101T)**

**Course outcome**

Students are able to

CO1: List, explain and identify wood’s anatomical features.

CO2: Explain Woodcell wall structureCO3: Discuss secondary growth mechanism in wood.

CO4: Compare Gymnosperm and Angiosperm

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

FOR-E101T	Wood Anatomy	2	70	30	100
<p><b>Theory-</b></p> <p><b>Unit-I</b></p> <p>Introduction to wood anatomy. Kinds of woody plants- Gymnosperms versus angiosperms. 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. Secondary growth in woody plants. Mechanism of wood formation in general, and with 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, wood rays, etc. Sapwood versus heart wood, anatomical differences. Transformation of sapwood to heartwood; factors affecting transformation.</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Anoop, E. V., Antony, F., Bhat, K. V. Lisha, D. A. and Babu, L. C. 2005. Anatomical key for the identification of important timbers of Kerala. Kerala Agricultural University, Thrissur and Kerala State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala, India. 126p.</li> <li>• 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.</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul> <p><b>Unit-II</b></p> <p>Microscopic features of wood. Prosenchymatous elements, tracheids, vessels, fibers. Parenchymatous elements, parenchyma and rays, resin canals, gum canals, latex canals, infiltrants in wood. Three dimensional features of wood; transverse, tangential and radial surfaces. Elements of wood cell walls. The structure and arrangement of simple pit, bordered pits. Extractives in wood. Comparative anatomy of gymnosperms and angiosperms. Anatomical features of common Indian timbers; classification into porous and nonporous woods, ring porous and diffuse porous woods. Effect of growth rate on wood properties. Juvenile wood and mature wood.</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Anoop, E. V., Antony, F., Bhat, K. V. Lisha, D. A. and Babu, L. C. 2005. Anatomical key for the identification of important timbers of Kerala. Kerala Agricultural University, Thrissur and Kerala State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala, India. 126p.</li> <li>• 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.</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					
Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-E101P	Wood Anatomy	1	100	-	100
<p><b>Practical –</b></p> <p>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.</p> <p>Procedures for field identification of timbers. Study of physical features of wood. Study of gross features of wood. Study of anatomical features of wood, pores or vessels, different types. Study of soft tissue in timbers and their different types 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 Uttarakhand.</p> <p><b>Reference Suggested Reading</b></p>					

- Anoop, E. V., Antony, F., Bhat, K. V. Lisha, D. A. and Babu, L. C. 2005. Anatomical key for the identification of important timbers of Kerala. Kerala Agricultural University, Thrissur and Kerala State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala, India. 126p.
- Hoadley, B. 2000. Identifying wood-Accurate results with simple tools. Taunton Press, Newtown, USA. 223p.
- 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.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### **Environmental Studies and Disaster Management**

#### **Course outcome**

After completing this course, students are able to:

CO1: Enlist, define, describe scope, importance and basics of subject. And classify, compare & describe types of resources,.

CO2 Collect & Compile information about biodiversity and its conservation and evaluate different parameter like Environmental Pollution, Solid Waste Management, Social Issues, Environmental ethics, Wasteland reclamation.

CO3: Assess the impact of Wildlife Protection Act. & Forest Conservation Act. on Public awareness, Environment and human health

CO4: Prepare the report on Women and Child Welfare & Disaster Management.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-E102T	Environmental Studies and Disaster Management	2	70	30	100

#### **Theory- (Total Lecture- 32 Hrs)**

##### **Unit-I**

Environmental studies: definition, scope and importance. Natural Resources, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources. Ecosystems-Concept of an ecosystem, structure and function of an ecosystem. Biodiversity and its conservation, Value. Environmental Pollution, Solid Waste Management, Social Issues, Environmental ethics, Wasteland reclamation, Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness, Environment and human health, Women and Child Welfare, Natural Disasters, Climatic change, Man Made Disasters, Disaster Management.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-E102P	Environmental Studies and Disaster Management	1	100	-	100

#### **Practical – (Total Lecture- 16 Hrs)**

Field work: Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural, Study and documentation of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc. Assessing environmental issue of a area, town, institutional company etc.

#### **Suggested Reading:**

- Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.
- Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.



## NCC-II/NSS-II\* (FOR-E103P)

### Course outcome

CO1: It is aimed to Develop Character, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure, and Ideals of Selfless Service amongst the Youth of the Country

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR-E103P	NCC-II/NSS-II*	1	-	-	-
<b>Theory-</b> NCC-II- Weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush.					

### \* Non credit course

## Semester III

### Forest Survey and Engineering (SOA/FC110T)

#### Course outcome

After completing this course, students are able to:

CO1: Enlist, define & describe relevant terminology and basics of subject.

CO2: Classify, compare & describe types of surveying.

CO3: Practice and Apply mathematical relations & use of instruments like chain, ranging rod etc.

CO4: Evaluate different parameter like area, distance etc. and experiment with instruments in the field and infer the observations.

CO5: Find errors & measure that. prepare and report survey plan.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/FC110T	Forest Survey and Engineering	2	70	30	100

#### Theory-

##### UNIT-I

Forest survey, scope and types of surveying, chain surveying- types and instruments used- Traversing, triangulation, survey stations, base line, check and tie lines; ranging of survey lines; offsets and their types; chain of slopy grounds, chaining across obstacles; cross staff surveying,

#### Suggested Reading

- Masani, N.J. (2006). Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.
- Parkash, R. (1983). Forest Surveying, International Book Distributor.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### UNIT-II

Areas of irregularly bounded fields- different methods; Simpson's, trapezoidal rule; compass surveying, chain and compass traversing, magnetic and true bearing, prismatic compass, local attraction. Computation of interior angles and balancing of closed traverse. Plane table surveying:- plane table and its accessories, methods of plane table surveying. Leveling: terms used types of level.

#### Suggested Reading

- Masani, N.J. (2006). Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.

- Parkash, R. (1983). Forest Surveying, International Book Distributor.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### UNIT-III

Theodolite and its uses. Contour surveying. Buildings materials- types, strength and characteristics, site selection for building construction, forest roads- alignment, construction and drainage; retaining walls, breast wall, water ways and culverts, Bridges-types, selection of site, simple wooden beam bridge, check dams, spurs, farm ponds, earth dams.

#### Suggested Reading

- Masani, N.J. (2006). Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.
- Parkash, R. (1983). Forest Surveying, International Book Distributor.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/FC110P	Forest Survey and Engineering	1	100	-	100

#### Practical –

Chain surveying, compass traversing; plane table surveying, leveling, calculations of earth work for construction of forest, roads & earth dams; alignment of forest roads; preparation building plans; design of water ways; design of simple wooden beam bridge; design of retaining walls. Design of check dams.

#### Suggested Reading

- Kanetkar, T.P. and Kulkarni, S.V. (1989). Surveying and levelling. Vidyarthi Griha Prakashan, Pune.
- Masani, N.J. (2006). Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.
- Murthy, V.V.N. (1985). Land and water management engineering. Kalyani Publishers, New Delhi.
- Parkash, R. (1983). Forest Surveying, International Book Distributor.
- Punnia, B.G. (1987). Surveying Vol I. Laxmi Publishers, New Delhi.
- Sahani, P.B. (1979). Text Book of Surveying Vol. I & II. Oxford and IBH, New Delhi.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Logging and Ergonomics (FOR/CC302T)

### Course outcome

After completing this course, students are able to:

CO1- Define & describe the scope of logging, planning – execution and demarcation of the area for logging and estimation of produce available for extraction.

CO2- Illustrate the Implements (traditional and improved tools) used in logging operation.

CO3- Explain Felling rules, seasons and methods. Conversion & extraction of finished produce using various means of land, aerial and water transports.

CO4- Outline different Grading and Storage methods of timber in the depots for display and disposal. With their types, layout and management, and classify Systems of disposal/sale of timber.

CO5- Explain Ergonomics, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition., Recommend PPE, safety rules and first aids.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC302T	Logging and Ergonomics	2	70	30	100

### Theory-

#### UNIT-I

Definition and scope of logging, logging plan and execution. Location and demarcation of the area for logging and estimation of produce available for extraction. Implements used in logging operation; traditional and improved tools. Felling rules and methods, Work contracts related to felling and removing (contract system, convener systems) etc. Conversion, measurement and description of converted material.

Means of transport of timber; carts, dragging, skidding, overhead transport, ropeways, skylines. Transport by road and railways. Transport by water; floating, rafting and concept of booms. Non-destructive sampling methods of wood. Grading and storage of timber in the depots for display and disposal, temporary and final storage. Timber Depots; types, lay out and management. Systems of disposal of timber.

**Suggested Reading**

- FRI. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.
- Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**UNIT-II**

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

**Suggested Reading**

- FRI. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.
- Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC302P	Logging and Ergonomics	1	100	-	100

**Practical –**

Equipments and tools used in logging operations and their uses. Instructions regarding maintenance of various records and registers in logging operations; Conversion of felled trees into logs, poles, firewood, pulpwood. Visit to local saw mills to study the equipments used and process of conversion. Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers. Visit to local dumping yard (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; Preparation of ergonomic check lists. Familiarize the e-auctioning procedure of State Forest Department. Safety rules and first aids in forestry operations.

**Reference Suggested Reading**

- Brown, N. C. 2002. Principles and methods of harvesting of timber. Biotech books, Delhi. • 430p.
- Staaf, K.A.G. and Wiksten, N.A. (1984). Tree Harvesting Techniques. Martinus Nijhoff/DR • W. Junk Publishers, Netherlands.
- FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.
- GFC. [Guyana Forestry Commission]. 2002. Code of practice for timber harvest. 2nd Ed. Georgetown, Guayana. 42p.
- Hakkila, P. 1989. Utilization of residual forest biomass. Springer-verlag, Berlin. 567p.
- Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.
- Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.
- Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.
- Wakermann, A. E. 2002. Harvesting timber crops. Biotech books, Delhi. 433p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Soil Biology and Fertility (FOR/CC303T)

### Course outcome

Students will be able to

CO1: differentiate Forest soils vs. cultivated soils

CO2: Explain special features of forest soils, forest soil formation and vegetation.

CO3: Explain Pedogenic processes and Properties of soils under different forest ecosystems.

CO4: Describe types of humus and discuss Essential nutrient elements, nutrient deficiencies and visual symptoms, soil fertility and Site productivity and nutrient cycling in forest soils.

CO5: Explain Mineral transformations-carbon cycle with decomposition and humus formation,.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC303T	Soil Biology and Fertility	2	70	30	100

### Theory- UNIT-I

Introduction - forest soils vs. cultivated soils, special features of forest soils, forest soil formation and vegetation development. Pedogenic processes – Podzolization and Laterization. Properties of soils under different forest ecosystems. Forest floor – stratification – types of humus. Essential nutrient elements-occurrence, availability and their functions. Diagnosis of nutrient deficiencies-visual symptoms, soil fertility evaluation methods. Site productivity and nutrient cycling in forest soils. N, P and K, macro and micronutrient fertilizers and their uses. Forest soil-biology-distribution of various microorganisms in soil ecosystem and their interaction effects.

#### Suggested Reading

- Brady, NC. The Nature and Properties of Soils. Mac Millan Pub. Comp. New York.
- Burges, A. and Raw, F. 1967. Soil Biology. Acad. Press, New York
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### UNIT-II

Role of microorganisms in soil fertility. Mineral transformations-carbon cycle with reference to organic matter decomposition and humus formation, Microbial degradation of cellulose & lignin. Bio-fertilizers – their importance. Nitrogen fixation-Rhizobium-tree legume symbiosis, Frankia X non-legume symbiosis, asymbiotic and associative N<sub>2</sub> fixation. Nitrification and denitrification in forest ecosystems. Microbial transformation of phosphorous, sulphur, and micronutrients. Mycorrhizae: types, biology and importance with specific relevance to tree crops and mobilization of phosphorus and micro-nutrients. Rhizosphere and phyllosphere concept. Fertility management of forest soils.

#### Suggested Reading

- Brady, NC. The Nature and Properties of Soils. Mac Millan Pub. Comp. New York.
- Burges, A. and Raw, F. 1967. Soil Biology. Acad. Press, New York
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC303P	Soil Biology and Fertility	1	100	-	100

### Practical –

Study of forest soil profile; Estimation of pH and EC –Organic carbon – available N, P, K, Ca, Mg, S and micronutrients – Determination of CEC and exchangeable cations; Interpretation of soil and plant analysis data for fertilizer recommendation. Basic sterilization techniques; culturing and maintenance of micro organism occurring in soil; Staining methods; Study of decomposition of forest litter by CO<sub>2</sub> – evolution



method; Estimation of nitrification rate in soil; Isolation of legume bacteria and Azotobacter; Preparation and inoculation techniques for mycorrhizae and biofertilizers.

**Reference Suggested Reading**

- Brady, NC. The Nature and Properties of Soils. Mac Millan Pub. Comp. New York.
- Burges, A. and Raw, F. 1967. Soil Biology. Acad. Press, New York
- Mengel, K. and Kirkby, A. 1978. Principles of Plant Nutrition. International Potash Institute, Switzerland
- Pritchett and Fisher RF 1987. Properties and Management of Forest Soils. John Wiley, New York.
- Tisdale, L. S. Nelson, L.W. and Beaton, J. D. 1985. Soil Fertility and Fertilisers. Macmillan Publishing Company, New York
- Young, A. 1989. Agroforestry for Soil Conservation. CAB International, U.K.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Forest Mensuration (FOR/CC305T)**

**Course outcome**

After completing this course, students are able to:

CO1: Enlist, define & describe relevant terminology and basics of subject. & explain different parameter like diameter, height etc. of individual tree & crop and collect data for that..

CO2: Practice and apply mathematical relations & use of instruments like tree caliper, altimeter etc.

CO3: Evaluate different parameter like volume , age etc. of individual tree & crop and experiment with instruments in the field and infer the observations.

CO4: Find errors & measure that prepare and plan for forest inventory.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC305T	Forest Mensuration	2	70	30	100

**Theory-**

**Unit-I**

Forest Mensuration - Definition and objectives, Scales of measurement, Units of measurements, Precision, bias and accuracy, 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 measurements- leaning trees. Tree stem form-Metzgr's theory –form factor- types of form factor, form height for quotient, form class.

**Suggested Reading**

- Chaturvedi, A.N and L.S. Khanna. 2011. Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.
- Forest mensuration: A Handbook for Practitioners. 2006. Forestry Commission Publications. 330 pp.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Volume measurements of standing trees, logs, branch wood- formulae- involved, definitions, volume tables-preparation of volume tables-graphical method-regression method- Determination of growth of trees- Increment-CAI & MAI- increment percent-increment borer- Stump analysis- Stem analysis. Measurement of tree crops-objects-crop diameter-crop height-crop age-crop volume.

**Suggested Reading**

- Chaturvedi, A.N and L.S. Khanna. 2011. Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.
- Forest mensuration: A Handbook for Practitioners. 2006. Forestry Commission Publications. 330 pp.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

FOR/CC305P	Forest Mensuration	1	100	-	100
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**Practical –**

Determination of pace 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- Preparation and use of simple height measuring instruments- Christens Hypsometer-Smithies Hypsometer- Modified Smithies Hypsometer-Measurement of tree height using instrumental methods- Abneys level-Haga altimeter- Relaskop- Clinometer- Blumeleiss Hypsometer-Laser Hypsometer- Volume determination of standing and felled trees. Exercise on Stump analysis. Exercise on stem analysis-Annual ring counting using ring borer. Preparation of volume tables- local volume table.

**Suggested Reading**

- Chaturvedi, A.N and L.S. Khanna. 2011. Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.
- Forest mensuration: A Handbook for Practitioners. 2006. Forestry Commission Publications. 330 pp.
- Husch, B., Beers, T.W. and Kershaw, J. J.A. 2002. Forest Mensuration (4th edition). John Wiley & Sons, Nature. 456 pp.
- Laar, V. A. and Akca, A. 2007. Forest Mensuration. Managing Forest Ecosystems. Vol.13. Springer.384pp.
- Manikandan, K. and Prabhu, S. 2012. Indian Forestry. Jain Brothers. New Delhi. 590 pp.
- West, P.W. 2009. Tree and Forest Measurement (2nd edition). Springer. 192pp.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Nursery Management and Commercial Forestry (SOA/FSEC102T)**

**Course outcome**

After completion the course, students are able to -

- CO1: Explore about the need and importance of a nursery.
- CO2: Explain types of nurseries and the intercultural operation.
- CO3: Describe Macro and micro propagation.
- CO4: Assess the plant protection measures in nursery.
- CO5: inspect the important tree species and their nursery practices.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/FSEC102T	Nursery Management and Commercial Forestry	2	70	30	100

**Theory-**

**Unit-I**

Propagation concept, definition, methods and importance. Site selection, planning and layout of nursery area. Types of nursery, types of nursery beds, preparation of beds. Pre-sowing treatments. Methods of seed sowing. Pricking, watering methods, weeding, hoeing, fertilization, shading, root culturing techniques, lifting, winnows, grading, packaging. Storing and transportation. Type and size of containers. Merits and demerits of containerized nursery. Preparation of ingredient mixture.

**Suggested Reading**

- Vinod Kumar, Nursery & Plantation Practices in Forestry, Scientific Pub., India
- Luna R.K., Plantation Forestry in India
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Vegetative propagation techniques-macro and micropropagation. Study of important nursery pests and diseases and their control measures. Nursery practices for some important tree species.

<b>Suggested Reading</b>					
<ul style="list-style-type: none"> <li>• Vinod Kumar, Nursery &amp; Plantation Practices in Forestry, Scientific Pub., India</li> <li>• Luna R.K., Plantation Forestry in India</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					
Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/FSEC102P	Nursery Management and Commercial Forestry	1	100	-	100
<p><b>Practical –</b> 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. Pricking and transplanting of pricked out stock within nursery 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.</p> <p><b>Reference Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Vinod Kumar, Nursery &amp; Plantation Practices in Forestry, Scientific Pub., India</li> <li>• Luna R.K., Plantation Forestry in India</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

### Wildlife Biology, Ornithology & Herpetology

**Course outcome**

Students will be able to

CO1: Explain faunal diversity including different mammal, birds and reptile species.

CO2: create awareness regarding the importance of wildlife as equal to tree resource.

CO3: Describe morphology of birds, their distinctive features for identification, anatomy, role in ecosystem.

CO4: Describe Amphibians and reptiles morphology, feeding behavior, locomotion.

CO5: Define & describe Wetlands and Ramsar sites with their conservation objectives

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/FE109T	Wildlife Biology, Ornithology & Herpetology	2	70	30	100

**Theory-**

**Unit- I.** History of Wildlife studies in India; Classification of Indian Mammals, 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; Wildlife Habitat: Niche, Territory, Home Range, Territoriality, Edge, Cruising Radius, Carrying Capacity; Animal behavior and adaptation; Habitat Improvement: Food, Water, Shelter improvement.

**Suggested Reading**

- Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.
- Daniel, J C. 2002. The Book of Indian Reptiles. Bombay Natural History Society, Bombay, 141pp.
- Das, I. 1995. Turtles and Tortoises of India. Oxford University Press. Bombay. 176pp.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit - II.** Introduction. History of ornithology in India. A brief knowledge of bird anatomy, morphology and physiology, digestive, skeletal, respiratory, excretory systems of birds. Skeleton, feathers, skin, beak

and taxidermy. Thermoregulation in birds. Bird ecology and behaviour; migration and territorial behaviour, feeding, song and nests. Water birds, scavenger birds, frugivorous birds, pest birds, pet birds and pollinator birds. Importance of birds to different ecosystems. Birds and man. Bird watching, Bird conservation and management in India. Important Bird areas of India, Red Data Book birds of India. Wetland conservation, Ramsar sites of India.

**Suggested Reading**

- Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.
- Daniel, J C. 2002. The Book of Indian Reptiles. Bombay Natural History Society, Bombay, 141pp.
- Das, I. 1995. Turtles and Tortoises of India. Oxford University Press. Bombay. 176pp.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-III. Amphibians and Reptiles and - Distinctive features of identification of snake, crocodile, turtle and tortoise. Class Amphibia - evolution, Salient features. Nutrition, Respiration. Locomotion and Reproduction. Class Reptilia - Evolution and salient features, Nutrition, Respiration, Locomotion and Reproduction. Turtle, Tortoise, Terrapins, Indian Lizards, Sphenodon, Indian Snakes Crocodiles.**

**Suggested Reading**

- Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.
- Daniel, J C. 2002. The Book of Indian Reptiles. Bombay Natural History Society, Bombay, 141pp.
- Das, I. 1995. Turtles and Tortoises of India. Oxford University Press. Bombay. 176pp.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
SOA/FE109P	Wildlife Biology, Ornithology & Herpetology	1	100	-	100

**Practical –**

**Unit-I.** Visit to various protected areas and observations on the morphological, behavioral, 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.

**Unit-II.** Field identification of major birds of India. Bird watching and drawings. Study of feathers, beak and leg types of different groups of birds. Study of the nest and eggs of birds. Mist netting and tagging/marketing of birds for the bird migration studies. Bird census techniques. Visit to different bird habitats.

**Unit-II.** Identifications of amphibians of Uttarakhand. Sexual Dimorphism in amphibians. Identification of Reptiles. Handling of Reptiles (Indian snakes and others)

**Suggested Reading**

- Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.
- Daniel, J C. 2002. The Book of Indian Reptiles. Bombay Natural History Society, Bombay, 141pp.
- Das, I. 1995. Turtles and Tortoises of India. Oxford University Press. Bombay. 176pp.
- Das, I. 2002. A photographic guide to Snakes and other reptiles of India. New Holland Publishers (UK) Ltd.
- Grimmet, R. Inskipp T and Inskipp, I. 2003. Handbook of Birds of Indian subcontinent. Oxford University press
- Grimmet, R. Inskipp, T and Nameer, P.O. 2007. Birds of southern India, BNHS series.

- Gururaja KV. 2012. Pictorial Guide to frogs and toads of the Western Ghats. IISc. Bangalore.
- Kazmierczak, K. and van Perlo B. 2000. A field guide to the birds of the Indian subcontinent, Yale University Press, New Haven. CT.
- Kentwood D. Wells. 2007. The Ecology and Behavior of Amphibians. The University of Chicago Press, Chicago.
- Sukumar, R. Asian Elephant. Ecology and Management. Oxford University Press Cambridge. Dasmann, R.F. 1982. Wildlife Biology. Wiley Eastern Ltd. New Delhi.
- 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
- Johnsingh, A.J.T. and N. Manjrekar. 2014. Mammals of South Asia. Vol. I. University Press, 614p
- John Singh, A.J.T. and N. Manjrekar. 2015. Mammals of South Asia. II. University Press, 739p
- Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press
- Mathur R. 1985. Animal Behaviour. Oxford University Press
- Menon V. 2014. Indian Mammals: A field guide. Hachette. 528p.
- Vidyarathi, L.P. and Rai, B.K. 1985. The tribal culture of India. Concept Publ. Co., New Delhi.
- Rasmussen P C and John C. Anderton. 2012. Birds of South Asia: The Ripley guide. Vol. I and II, Smithsonian Institution and Lynx Edicions, Washington DC and Barcelona.
- Wallace GJ and HD Mahan. 2005. An Introduction to Ornithology. 3rd Ed. McMillion publishing company. New York.
- Whitaker, R. and Captain, A. 2004. Snakes of India. The Field Guide. Draco Books. Chengalpattu, Tamil Nadu, xiv+479, pls, text-figs.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### **Climate Science (FOR/MD302T)**

#### **Course outcome**

Students will be able to

CO1: Define & describe aim & scope of Agrometeorology and describe the Factors and elements of weather and climate, Composition and structure of atmosphere.

CO2: Describe air and soil temperature regimes, atmospheric & enlist types of clouds and precipitation

CO3: Discuss cyclones, anticyclones and thunder storms & explain the effect of Solar radiation components, weather and climate effect on plant growth. Climatic normals for crops and trees.

CO4: Describe agro climatic zones of India and discuss the Climate change, its consequences and various conventions on climate change.

CO5: Explain Forests Vulnerability and adaptability towards climate change and climate resilient systems like agroforestry.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/MD302T</b>	<b>Climate Science</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>

#### **Theory-**

#### **Unit-I**

Agrometeorology – definition, aim and scope. Factors and elements of weather and climate. Composition and structure of atmosphere. Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost. Cyclones, anticyclones and thunder storms. Solar radiation components and effect on plant growth. Effect of weather and climate on the growth and development of crops. Climatic normals for crops and trees. Agro climatic zones of India. Evaporation and transpiration.

#### **Suggested Reading**

- Lenka, D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi
- Mavi, H.S. (1994) Agrometeorology . Oxford & IBH, New Delhi
- Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi.

- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Unit-II

Climate change: Understanding climate change and its consequences. Global warming and its effects on Forest. Forest and climate change: Vulnerability and adaptability - Evidence of forest disturbance due to climate change –Climate change influence on agro-forestry- Climate resilient forestry. Economic worth of carbon storage in forest – Forest and UN convention on climate change - NATCOM initiatives – Decision making in emission of Green House Gases (GHG). Kyoto protocol, awareness about climate change. National action plan for climate change – Green India mission- Indian Network for Climate Change. Assessment (INCCA) - State Action Plans on Climate Change.

### Suggested Reading

- Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi
- Mavi, H.S. (1994) Agrometeorology . Oxford &IBH, New Delhi
- Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/MD302P	Climate Science	1	100	-	100

### Practical –

Study of temperature instruments, pressure instruments, humidity instruments, wind instruments, rain instrument and wind rose. Solar radiation instruments with pyranometer. Layout of an agromet observatory and types. Measurement of wind and evaporation. Measurement of sunshine hours. Measurement of soil temperature and dew. Estimation of green house gases into atmosphere.

### Reference Suggested Reading

- Ghadekar, S.R. (2003) Meteorology. Agromet Publishers, Nagpur
- Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi
- Mavi, H.S. (1994) Agrometeorology . Oxford &IBH, New Delhi
- Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,
- Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg
- Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Forest Extension & Community Forestry

### Course outcome

Student will be able to

CO1: Describe Human behaviour & psychology and define & explain the objectives & types of extension education, forestry extension education & rural development. And explain the need & importance of People’s participation in Forestry programmes

CO2: Describe transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Van Vigyan Kendras, Technology Assessment and Refinement Programme (TARP) of ICAR/ ICFRE.

CO3: Define the communication & explain the various means of communication. And explain Programming planning process & Evaluation.

CO4: Describe PRA process and describe & discuss policies, rules & importance of community Forestry, problems & prospects of its implementation with the help of case studies.

CO5: Discuss about JFMs, FDCs, VFCs, CBOs, NGOs a

Course Code	Name of Subject	Credit	Marks	Total
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			<b>External</b>	<b>Internal</b>	
<b>FOR/MD303T</b>	<b>Forest Extension &amp; Community Forestry</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>

### Theory-

#### Unit-I

**Forest Extension:** Introduction- human behaviour and psychology. Concept, scope, principles, philosophy and objectives of extension education and forestry extension education. Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Forestry extension: process, principles and types of education, Formal, informal non-formal education. People's participation in Forestry programmes. Elements of extension education, man himself man's environment and man's created devices. Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Van Vigyan Kendras, Technology Assessment and Refinement Programme (TARP) of ICAR/ICFRE. Communication: meaning, definition, elements and selected models. Audio-visual aids: importance, classification and selection. 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.

#### Suggested Reading

- FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasylva - No. 143, Published by FAO.
- L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit-II

**Community Forestry:** Legislation, rules, importance. Case studies of JFM,FDA, JICCA, CAMPA, Haryali Yojana, Integrated Watershed Management implementation- problems and prospects, Microplan Preparation. JFMs, FDCs, VFCs, CBOs, NGOs and co-operative societies.

#### Suggested Reading

- FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasylva - No. 143, Published by FAO.
- L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/MD303P</b>	<b>Forest Extension &amp; Community Forestry</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>

### 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. 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.

#### Reference Suggested Reading

- FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries,

Unasylva - No. 143, Published by FAO.

- L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.
- D. Sim, H. A. Hilmi (1987), Forestry Extension Methods, FAO Forestry Paper-80, P. 153.
- Jalihal, K.A. Veerabhadraiah, V. (2007), Fundamentals of Extension Education and Management in Extension, Concept Publishing Company.
- 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.
- Gunter, J. (Ed.). (1973). The Community Forestry Guidebook ([http://www.forrex.org/sites/default/files/forrex\\_series/FS15.pdf](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.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### NCC-III/NSS-III\* (FOR/SEC301P)

**Course outcome**

CO1: It is aimed to Develop Character, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure, and Ideals of Selfless Service amongst the Youth of the Country

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/SEC301P</b>	<b>NCC-III/NSS-III*</b>	<b>1</b>	-	-	-

**Theory-**

NCC-III Field engineering, map reading, conventional signs, grid systems, use of service protractor, prismatic compass and its use, self defence, general principles, precautions and training, attacks and counterattacks, marching and searching, first aid, hygiene and sanitation, civil defence, leadership and NCC song.

NSS-III- Awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition, village adoption- continued.

### Semester IV

#### Forest Management (FOR/CC401T)

**Course outcome**

**Students are able to:**

CO1: Understand the forest yield regulation involving the monitoring and assessing forest growth, health, and productivity, and making adjustments to management practices as needed & monitor and evaluate forestry practices to ensure which are precise meeting the goals of sustainability and having a positive impact on the environment and local communities.

CO2: Understand the role of policy and governance in sustainable forest management and the importance of international agreements, national policies, and local regulations.

CO3: Understand working plan and understand importance of sustainable forest management for maintaining the health of ecosystems and the well-being of human communities.



CO4: Analyze major policies and legislation related to forest management at the local, national, and international levels, and assess their impacts on forest ecosystems and society.

CO5: Explain sustainable forestry practices, including afforestation, reforestation, agroforestry, and forest conservation & explain the vital role of forests in environmental conservation and to integrate conservation practices into forest management.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/CC401T</b>	<b>Forest Management</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>

**Theory-**

**Unit I.** Definition, scope, objective and principles of forest management, organization of state forests- sustained yield-definition, principles and limitations. 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 stands.

**Suggested Reading**

- Balakathiresan, S (1986). Essentials of Forest Management, Nataraj Publishers, Dehradun. Bhatta charya P.,Kandya A.K. and Krishna Kumar (2008).Joint Forest Management in India, Aavishkar Publisher, Jaipur.
- Desai, V.(1991). Forest Management in India–Issues and Problems. Himalaya Pub. House, Bombay. Edmunds, Dand Wollen berg, E(2003). Essentials of Forest Management, Natraj Publishers, Dehradun.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit II.** Working plan-preparations- objectives and uses-forest maps and their uses. Joint forest management-concept and principles- Modern tools in forest management. Introduction to the concept of forestry as a common property resource– Definition, Scope and necessity of community forestry.

**Suggested Reading**

- Balakathiresan, S (1986). Essentials of Forest Management, Nataraj Publishers, Dehradun. Bhatta charya P.,Kandya A.K. and Krishna Kumar (2008).Joint Forest Management in India, Aavishkar Publisher, Jaipur.
- Desai, V.(1991). Forest Management in India–Issues and Problems. Himalaya Pub. House, Bombay. Edmunds, Dand Wollen berg, E(2003). Essentials of Forest Management, Natraj Publishers, Dehradun.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit III.** 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- Gender dimensions in Community forest management.

**Suggested Reading**

- Balakathiresan, S (1986). Essentials of Forest Management, Nataraj Publishers, Dehradun. Bhatta charya P.,Kandya A.K. and Krishna Kumar (2008).Joint Forest Management in India, Aavishkar Publisher, Jaipur.
- Desai, V.(1991). Forest Management in India–Issues and Problems. Himalaya Pub. House, Bombay. Edmunds, Dand Wollen berg, E(2003). Essentials of Forest Management, Natraj Publishers, Dehradun.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit IV.** Social Forestry- definition –NCA report of 1976- need and purpose- Social Forestry for – fodder production – fuel wood – leaf manure–timber production. Integrated rural development approach – with proper marketing facility – employment generation in raising, tending and harvesting of tree crops. Place of social forestry in the national forest policy of India-role of forest department.

**Suggested Reading**

- Balakathiresan, S (1986). Essentials of Forest Management, Nataraj Publishers, Dehradun. Bhatta charya

P.,Kandya A.K. and Krishna Kumar (2008).Joint Forest Management in India, Aavishkar Publisher, Jaipur.

• Desai, V.(1991). Forest Management in India–Issues and Problems. Himalaya Pub. House, Bombay. Edmunds, Dand Wollen berg, E(2003). Essentials of Forest Management, Natraj Publishers, Dehradun.

• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/CC401P</b>	<b>Forest Management</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>

**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 and volume. Field visit to JFM operational areas. Study the different field exercises for data collection for working plan.

**Reference Suggested Reading**

• Balakathiresan, S (1986). Essentials of Forest Management, Nataraj Publishers, Dehradun. Bhatta charya P.,Kandya A.K. and Krishna Kumar (2008).Joint Forest Management in India, Aavishkar Publisher, Jaipur.

• Desai, V.(1991). Forest Management in India–Issues and Problems. Himalaya Pub. House, Bombay. Edmunds, Dand Wollen berg, E(2003). Essentials of Forest Management, Natraj Publishers, Dehradun.

• Jerome L Cutteretal. (1983). Timber Management: A Quantitative Approach.John Wiley and Sons

• National Working Plan Code(2014). Mo EF, New Delhi. Ramprakash, (1986).Forest Management, IBD, Dehradun.

• Recknagel, Aand Bentley.J. (1988). Forest Management. IBD, Dehradun.

• Trivedi, P, Rand Sudarshan, K,N. (1996). Forest Management. Discovery publications, New Delhi.

• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Silviculture of Indian Trees (FOR/CC402T)**

**Course outcome**

After completing this course, students are able to:

CO 1: Describe & examine the Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices pest and diseases and economic importance of important tree species of India.

CO 2: Explain the morphological description and field identification characteristics of trees, seeds and seedling & examine the Phenology, Collection of seeds. Planting and stand management practices of important tree species of India.

CO 3: Evaluate the trees in response to light, fire, drought, frost, root suckering, coppicing and pollarding, etc.

CO 5: Examine various problem areas and study on species suitability.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/CC402T</b>	<b>Silviculture of Indian Trees</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>

**Theory-**

**Unit I.**Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices pest and diseases and economic importance of the following tree species of India. Broadleaved species: Tectona grandis, Shorea robusta, Dalbergia latifolia,

Dalbergia sissoo, Anogeissus spp, Terminalia spp., Santalum album, Swietenia macrophylla, Albizia spp, Pterocarpus marsupium, Gmelina arborea, Pterocarpus santalinus, Azadirachta indica, Hopea parviflora, Lagerstroemia microcarpa, Bamboos, reeds and rattan, Quercus spp.

**Suggested Reading**

- Troup, RS 1922. Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest Research Institute and Colleges, Dehra Dun, 1975.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit -II.** Conifers: Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii, Pinus wallichiana. Fast growing MPTs: Tropical pines, Eucalyptus spp, Casuarina equisetifolia, Leucaena leucocephala, Ailanthus triphysa, Grevillea robusta, Pongamia pinnata, Melia dubia, Acacia spp, Populus spp.

**Suggested Reading**

- Troup, RS 1922. Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest Research Institute and Colleges, Dehra Dun, 1975.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC402P	Silviculture of Indian Trees	1	100	-	100

**Practical –**

Study the morphological description and field identification characteristics of trees, seeds and seedlings. Phenology, Collection of seeds. Planting and stand management practices of Tectona grandis, Dalbergia latifolia, Santalum album, Swietenia macrophylla, eucalypts, acacias, bamboos, fast growing MPTs etc. Study the silviculture of trees in response to light, fire, drought, frost, root suckering, coppicing and pollarding, etc. Visit various problem areas and study on species suitability. Visit forest plantations and other woodlots. Study the planting density and stand management regimes for various end uses such as timber, pulpwood, plywood, cottage industries etc.

**Reference Suggested Reading**

- Troup, RS 1922. Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest Research Institute and Colleges, Dehra Dun, 1975.
- Khanna, L.S., Silviculture of Trees, Khanna Bandhu Pub., Dehradun
- Bebarta, 1999. Teak: Ecology, Silviculture, Management and profitability, IBD, Dehra Dun
- Champion, H.G. and A.L. Griffith. 1989. Manual for General Silviculture for India ICFRE booklets on tree species
- Kadambi, K. 1993. Silviculture and Management of teak. Nataraj Publishers, Dehra Dun. p.137.
- Lamprecht H 1989. Silviculture in the Tropics. GTZ, GmbH, FRG
- Renuka, C., Pandalai, R.C. and Mohanan, C. 2002 Nursery and silvicultural techniques for rattan, Kerala Forest research Institute.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Wood Products & Utilization (FOR/CC403T)**

**Course outcome**

Course aim to

CO1: Develop skills for general Wood Products & Utilization techniques and introduction to wood based industries.

CO2: Create understanding on fundamentals of manufacture, properties and uses of Composite wood – plywood, fiberboard, particleboard and hard board.

CO3: Acquire knowledge of intracellular compartmentalization of cell, plasma membrane, cell signalling, cell cycle, cell division and cell death pathways. Understand the concepts of Molecular biology and microbial genetics.

CO4: Introduce essentials of nanotechnology, industrial technique and to learn the basic aspects of Adhesives used in manufacture of composite wood Improved wood-definition, types (impregnated wood, heat stabilized wood, compressed wood, and chemically modified wood).

CO5: explain destructive distillation of wood and Scarification of wood and to describe wood product markets

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC403T	Wood Products & Utilization	2	70	30	100

#### Unit I

Uses of wood. Growth of wood based industry in India, effect of globalization. Importance of forest based industries in relation to Indian economy. Wood as a source of energy and chemicals, wood as raw material for industries like pulp, paper, rayon, composite woods and improved woods.

#### Suggested Reading

- Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2<sup>nd</sup> Ed. Miller and Freeman Publication, Inc. USA.388p.
- FRI.1976.Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun.941p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit II.

Description of different forest based industries - paper and pulp, furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes. Structural uses of Timber – bridges and other super structures. Decorative uses of wood. Introduction to wood modification, its need and scope, chemical modification of wood (acetylation, reaction with isocyanates, acetates, ethers, epoxides etc.). Primary conversion; sawing and veneering.

#### Suggested Reading

- Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2<sup>nd</sup> Ed. Miller and Freeman Publication, Inc. USA.388p.
- FRI.1976.Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun.941p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit III.

Composite wood; plywood, laminated wood, core board, sandwich board, fibre board, particle board; manufacturing process, uses and properties. Adhesives used in manufacture of composite wood. Improved wood; compressed wood, impregnated wood etc.; manufacturing process, uses and properties.

#### Suggested Reading

- Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2<sup>nd</sup> Ed. Miller and Freeman Publication, Inc. USA.388p.
- FRI.1976.Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun.941p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit IV.

Nano technology in wood. Manufacture of rayon and match. Wood carving and handicrafts. Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast. Biochar, technology, bioenergy concepts - short rotation crops as raw materials.

#### Suggested Reading

- Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2<sup>nd</sup> Ed. Miller and Freeman Publication, Inc. USA.388p.

<ul style="list-style-type: none"> <li>FRI.1976.Indian forest utilization.Volume I and II.ForestResearch Institute and colleges, Dehradun.941p.</li> <li>ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					
Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC403P	Wood Products & Utilization	1	100	-	100
<p><b>Practical –</b>            Estimation of specific gravity and calorific value of wood specimens. Maceration techniques and determination of sizes of fibres, vessels etc. Visits to various wood based industries like, plywood, packing case, match, tannins, furniture, saw mills etc. to study the manufacturing process. Visit to saw mill to study veneering and different kinds of sawing. Handicraft manufacturing unit. Visit to wood distillation unit. Visit to nearby industrial plantations.</p> <p><b>Reference Suggested Reading</b></p> <ul style="list-style-type: none"> <li>Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2<sup>nd</sup> Ed. Miller and Freeman Publication, Inc. USA.388p.</li> <li>FRI.1976.Indian forest utilization.Volume I and II.ForestResearch Institute and colleges, Dehradun.941p.</li> <li>Hoadley, B. 2000. Understanding Wood: A Craftsman’s guide to wood technology. Taunton Press. Newtown, USA.223p.</li> <li>ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

### Forest Ecology and Biodiversity (FOR/CC404T)

**Course outcome**

The students will be able

CO1: To understand how the environment influences plant growth and tree yields, and ways to modify the environment to improve plant growth and yields.

CO2: To have a greater knowledge of how wildlife conservation and management relates to the economy and environment, both currently and in the future.

CO3: To critically evaluate current events and public information related to biodiversity conservation and management as being scientifically-based or opinion-based and contribute to the knowledge base of information.

CO4: To understand the general principles of ecology as how they related to terrestrial and/or aquatic plant and animal conservation and management.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC404T	Forest Ecology and Biodiversity	2	70	30	100

**Theory-  
Unit I**

Historical development of ecology as a science. Levels of biological organization. Major forest Ecosystem. Forest environment- major abiotic and biotic components and their interaction, Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow. Population ecology - definition, population dynamics and carrying capacity, life table and its importance in forest management. Community ecology- species interactions, ecological succession, terminology, basic concepts, theories of succession- climax vegetation types, forest management and succession.

**Suggested Reading**

- OdumEP1983. Basic Ecology. Saunders College Publishing, Philadelphiaetc.613p

- MisraKC1974.Manual of Plant Ecology. Oxford & IBH PubCo. New Delhi etc.491p
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Unit II

Island Biogeography. Autecology of important tree species. Perturbation ecology- Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices. Principles of conservation biology, Ex-situ and In-situ methods of conservation, Genetic and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide.

### Suggested Reading

- OdumEP1983. Basic Ecology. Saunders College Publishing, Philadelphiaetc.613p
- MisraKC1974.Manual of Plant Ecology. Oxford & IBH PubCo. New Delhi etc.491p
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC404P	Forest Ecology and Biodiversity	1	100	-	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; Study of succession in field and water bodies; Visit to different ecosystems.

### Reference Suggested Reading

- OdumEP1983. Basic Ecology. Saunders College Publishing, Philadelphiaetc.613p
- MisraKC1974.Manual of Plant Ecology. Oxford & IBH PubCo. New Delhi etc.491p
- MichaelP.1984.EcologicalMethodsforFieldandLaboratoryInvestigations.TataMcGraw- Hill Pub. Co. New Delhi,404p
- Montagnini,FandJordan,C.F.2005.Tropical ForestEcology:TheBasisfor Conservationand Management. Springer.295p.
- Frankel,O.H.,Brown,A.H.D.,Burdon,J.J.1995.TheConservationofPlantBiodiversity. Cambridge University Press. Cambridge. 299p
  - Sagwal,S.S.1995.ForestEcologyofIndia.PioneerPublishers,India.368p
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Silviculture Systems (FOR/CC405T)

### Course outcome

Students will be able to

CO1: Explain scope/need of silvicultural systems

CO2: Classify & Describe various silvicultural systems.

CO3: Explain tending operations used in forests

CO4: Explain conversion technique

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC405T	Silviculture Systems	2	70	30	100

**Theory-  
UNIT-I**

Silvicultural system - definition, scope and classification. Even aged and uneven aged forests and their crown classes. Detailed study of the silvicultural systems: Clear felling systems including clear strip, alternate and progressive strip systems. Shelterwood system – Uniform system, Group system, Shelterwood strip system, Wedge system, Strip and group system, Irregular shelterwood system, Indian irregular shelterwood system. Seed tree method. Selection system and its modifications.

**Suggested Reading**

- Khanna, L.S. Theory and Practices of Silvicultural Systems. Khanna Bandhu, Dehradun
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Ethnobotany, Medicinal and Aromatic Plants****Course outcome**

After completing this course, students are able to:

CO 1: Describing the important terminology related to ethnobotany and relation with man and domestic animals.

CO 2: Explain the role of ethnic groups in ethnobotanical knowledge and medicinal plants.

CO 3: Explain different use of medicinal plants related to different families and their cultivation practices.

CO 4: Examine the role and benefits of medicinal and aromatic plants in economy of rural people as well as in country level & to identify the important MAP plants of Uttarakhand.

CO 6: Assess knowledge related to post harvest management of various MAP plants.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC401T	Ethnobotany, Medicinal and Aromatic Plants	2	70	30	100

**Theory-  
Unit-I**

Definition and scope of ethnobotany. 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 North India. Traditional Botanical Knowledge- concepts. Ethnobotany of the 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.

**Suggested Reading:**

- 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.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Definition - role of medicinal and aromatic plants in Indian economy - Important essential oil yielding plants in India - Detailed study of Aromatic Plants - lemon grass, citronella, palmarosa, vetiver, japanese mint, eucalyptus, jasmine, patchouli and geranium - botany, climate and soil requirements, Production Technology, Post Harvest Management and extraction of essential oils. Medicinal plants in India and Uttarakhand - history, origin, area and distribution, production technology, Post Harvest Management extraction of active principles and their uses - uses of different medicinal plants like Atropa, Cinchona,

Rauvolfia, Opium, Acorus, Digitalis, Strychnos nux-vomica, Aconitum, Picrorrhiza, Chirayita, Neem, Dioscorea, Costus. Cultivation practices of medicinal plants like Adhathoda zylanica, Sida cordifolia, Sterospermum colais, Plumbago zylanica, Tinospora, cordifolia, Kaemferia glanga, Indigofera tinctoria. Trade, Policies and Conservation of Kapoorkachri, Valeriana, Tejpatta, Timur medicinal plants collected in wild.

**Suggested Reading:**

- 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.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC401P	Ethnobotany, Medicinal and Aromatic Plants	1	100	-	100

**Practical –**

Field visit to different tribal regions to gain ethnobotanical 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: cultivation technologies 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/aromatic plants/Herbal mandis/collection & study of seeds of some medicinal plants and Aromatic Plants.

**Reference Suggested Reading:**

- 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 & 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 Ed). Scientific Publishers, India, 242p.
- Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers, Jodhpur, India, 672p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Rangeland and Livestock Management**

**Course outcome**

Students will be able to

CO1: Define & explain cattle and fodder resources of India, grassland, Carrying capacity, Livestock management, Rotation & enlist types of grasslands in India and explain their ecological distribution

CO2: Describe establishment and management of grasslands and enlist & explain Fodder trees and shrubs, and Storage of fodder



CO3: Define and discuss the importance of Livestock management, important breeds of important livestock eg. Cattle, buffalo, sheep and goat. Breeding and reproductive management for higher productivity and feeding management

CO4: Describe cattle diseases, their prevention & control.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC402T	Rangeland and Livestock Management	2	70	30	100

**Theory-  
Unit-I**

Definition, scope and importance – cattle and fodder resources of India, grassland types of India and their distribution – ecological status of Indian grasslands – principles of grassland management for maximizing forage yield and quality. Feeding habit and grazing behavior of range animals. Carrying capacity – definition, method of calculation. Establishment and management of grasslands – selection of species, planting, cultural practices – liming, fertilizer application, burning, weed control, grazing and cutting intensity. Storage of fodder – silage and hay – methods of preparation – hay banks, Fodder trees and shrubs,

**Suggested Reading**

- Holechek J.L. et al. 1989. Range Management. Prentice Hall, New Jersey
- Sastry, N.S.R. and C.K. Thomas. 2005. Livestock Production Management, Kalyani Publishers, NewDelhi.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Forest grazing. Definition and importance of Livestock management. Important breeds of important livestock eg. Cattle, buffalo, sheep and goat. Breeding and reproductive management for higher productivity. Feeding management – types of feedstuffs available for feeding livestock, methods of feeding. Assessing nutritive value of feed and fodder, estimation of digestible nutrients and energy in feedstuffs. Principles of rationing. Prevention and control of diseases.

**Suggested Reading**

- Holechek J.L. et al. 1989. Range Management. Prentice Hall, New Jersey
- Sastry, N.S.R. and C.K. Thomas. 2005. Livestock Production Management, Kalyani Publishers, NewDelhi.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC402P	Rangeland and Livestock Management	1	100	-	100

**Practical –**

Study of grassland and rangelands in the area. Different tools/instruments used in livestock management; Routine management practices followed on livestock farms; Identification of feedstuffs and their nutritive value; Nutritive requirement animals; Study of housing systems and requirements; Preservation of fodder as hay, silage and leaf meal.

**Reference Suggested Reading**

- Banerjee, G.C. 2010. A text book on Animal Husbandry, 8th Edition, Oxford and IBH New Delhi.
- Holechek J.L. et al. 1989. Range Management. Prentice Hall, New Jersey

- Sastry, N.S.R. and C.K. Thomas. 2005. Livestock Production Management, Kalyani Publishers, NewDelhi.
- Singh R.V. 1982. Fodder trees of India. Oxford and IBH New Delhi.
- Ward H.M. 1980. Grasses. A handbook for use in the field and laboratory, Scientific Pub., Jodhpur
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### **Forest Tribology & Traditional Knowledge System (FOR/SEC403T)**

#### **Course outcome**

After completing this course, students are able to:

CO1: Enlist, define & describe relevant terminology and basics of subject.

CO2: Classify, compare & describe types of Anthropology and discuss chronological development of human evolution, especially tribal community.

CO3: Apply the concept of Traditional knowledge & Forest laws to examine the status of livelihood & welfare of tribal.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC403T	Forest Tribology & Traditional Knowledge System	2	70	30	100

#### **Theory-**

##### **Unit -I**

Meaning, scope and development of Anthropology. Relationships with other disciplines. Main branches of Anthropology, their scope and relevance. Human Evolution and emergence of Man. Phylogenetic status, characteristics and geographical distribution. Principles of Prehistoric Archaeology. Chronology: Relative and Absolute Dating methods. Culture, Society, Marriage, Family, Kinship, Economic and Political Organization, Social Control, Religion, Anthropological theories, Language and Communication, Research Methods in Anthropology. Race and Racism. Applications of Anthropology. Ethno-archaeology in India.

##### **Suggested reading:**

- Sharma, R. N., Sharma, R.K. 1997. Anthropology. Atlantic Publishers & Distributors.
- Thakur, D. 1986. Socio-economic development of tribes in India. Deep and Deep Publications, New Delhi
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### **Unit -II**

Demographic profile of India. The structure and nature of traditional Indian social system. Caste system in India 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.

##### **Suggested reading:**

- Sharma, R. N., Sharma, R.K. 1997. Anthropology. Atlantic Publishers & Distributors.
- Thakur, D. 1986. Socio-economic development of tribes in India. Deep and Deep Publications, New Delhi
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### **Reference Suggested reading:**

- Furer-Haimendorf, C.V. 1985. Tribes of India - the struggle for survival. OUP. New Delhi

- Hasnain, N. 2007. Tribal India. New Royal Book Company
- Hasnain, N. 2011. Indian Anthropology. Palaka Prakashan
- Sharma, R.N. and Bakshi, S. 1984. Tribes and tribal development. Uppal Publ. House, New Delhi
- Sharma, R. N., Sharma, R.K. 1997. Anthropology. Atlantic Publishers & Distributors.
- Thakur, D. 1986. Socio-economic development of tribes in India. Deep and Deep Publications, New Delhi
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Study Tour of State Forest\*

#### Course outcome

Students will experience

CO1: The fauna, flora and other research activities going on research institute, forest industries, Govt. and private organizations of different parts of Uttarakhand.

CO2: Various national / heritage monuments as part of national integration activity situated in Uttarakhand

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC403P	Study Tour of State Forest*	1	-	-	-

#### Theory-

Study tour of one week duration in the respective States/part of India. To familiarize the students with the fauna, flora and other research activities research institute, forest industries, Govt. and private organizations of different parts of respective states/ part of India. To expose the students to various national / heritage monuments as part of national integration activity.

### Semester-V

#### Principles of Agroforestry (FOR/CC501T)

#### Course outcome

Students will be able to

CO1: Explain structure & constraints of Indian agriculture & concept & Potential of agroforestry.

CO2: Classify and describe agroforestry systems.

CO3: Discuss the role of agroforestry in soil, water, nutrient conservation & climate change mitigation.

CO4: Enlist MPTs and their characters & describe Diagnosis & design methodology.

CO5: Calculate economics of agroforestry systems.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC501T	Principles of Agroforestry	2	70	30	100

#### Theory-

#### Unit-I

Overview of the Agriculture scenario – its structure and constraints. Concept of sustainable agriculture and land use management. Paradigm shift in Agriculture development- impacts of green revolution, Agrobiodiversity, significance, threats and conservation strategies. Agroforestry definition and scope – rising demands of fuel wood, fodder and timber. Social, ecological, and economic reasons for

agroforestry. History of agroforestry. Components of Agroforestry- provisioning and regulator services of agroforestry.

**Suggested reading:**

- Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
- Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Nutrient cycling, Soil improvement, Increased production and productivity, Microclimate amelioration and carbon sequestration Tree-crop interaction in agroforestry– Definition, kind of interaction – Positive interactions- complimentarity - compatibility - mutualism, commensalism - Negative interactions – allelopathy and competition-Interaction management - Aboveground and belowground interactions- Manipulation of density, space, crown and roots.

**Suggested reading:**

- Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
- Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-III**

Tree Management – structure and growth of trees, crown and root architecture, agroforestry practices to minimize negative interaction – coppicing, thinning, pollarding and pruning – Crop planning and management –selection of suitable crops –management of nutrients, water and weeds – Classification of agroforestry systems – National Agroforestry Policy 2014—National and International organizations in Agroforestry. MPTs & N<sub>2</sub> Fixing trees in Agroforestry, Diagnosis & Design in Agroforestry land capability classification.

**Suggested reading:**

- Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
- Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC501P	Principles of Agroforestry	1	100	-	100

**Practical –**

Traditional agroforestry systems in the country and visits to some of the local agroforestry systems. Agroforestry systems in different agroecological zones- their structural and functional features. Visit to on farm agroforestry models. Studies on fodder banks and live fences. Studies on light and below ground interactions in agroforestry systems- MPTs and Nitrogen fixing trees in agroforestry- Studies on allelopathy- Design & Diagnostics exercise in agroforestry- land capability classification of various topographic regions- Visit to industrial plantations.

**Reference Suggested Reading**

- Huxley, P.A. 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.
- Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.
- Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p
- Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub.Co. New Delhi.
- Nair, P.K.R, Rao MR, and Buck, L.E (eds), 2004. New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry, Kluwer, Dordrecht, The Netherlands.
- Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
- Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. J. Plant Nutr. Soil Sci. 172: 10–23.
- Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Wood Science and Technology

### Course outcome

Student will be able to

CO1: Explain kinds of wood that can be used as industrial raw material

CO2: Describe physical, mechanical and electrical properties of wood with respect to wood utilization.

CO3: Describe wood-water relationship and processes involved.

CO5: List and describe wood seasoning processes, wood preservation processes and wood machining methods.

CO6: classify woods based on refractory nature and durability

CO5: Assess and compare wood's moisture content, air & kiln dried wood's properties. & use of wood preservative treatments.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC502T	Wood Science and Technology	2	70	30	100

### Theory-

#### Unit-I

Kinds of woods; hardwood, softwood, bamboos and palms, merits and demerits of wood as a raw material, the physical features of 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. Suitability of wood for various uses based on mechanical and physical properties. Wood water relationship; shrinkage, swelling, movement, fibre saturation, equilibrium moisture content. Wood seasoning; merits, principles and types; air seasoning, kiln seasoning and chemical seasoning. Refractory classes of timbers, kiln schedules. Seasoning defects and their control.

#### Suggested Reading:

- FRI.1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.
- Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Classification of timbers based on durability. Wood preservation; principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.). General idea about fire retardants and their usage. Non-pressure methods; steeping, dipping, soaking open tank process, Boucherie process. Pressure methods; full cell process, empty cell process (Lowry and Rueping). Wood machining. Sawing; techniques, kinds of saws; cross cut, edging, cudless, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Various stages in wood working. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

**Suggested Reading:**

- FRI.1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.
- Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC502P	Wood Science and Technology	1	100	-	100

**Practical –**

Mechanical tests on timber. Static bending, impact bending, 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.

**Suggested Reading:**

- Bowyer J. L., Shmulsky, R. and Haygreen, J. G. 2007. Forest products and wood science: An introduction. 5th Ed. Blackwell publishing, Ames, IA. 496p.
- Brown, H. P. 1985. Manual of Indian wood technology. International books and periodicals supply service, New Delhi. 121 p.
- FRI.1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.
- Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.
- 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.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Tree Seed Technology (FOR/CC503T)****Course outcome**

After completing this course, students are able to:

CO1- Define & describe Seed, its importance & role of seed technology in nursery stock & quality seed production.

CO2- Describe SPA-seed orchards, Enlist, define & describe relevant terminology and basics of subject.

CO3- Illustrate various methods and steps for selection of seed tree & collection of Seed, including its planning, organization etc.

CO4- Categorized Seed maturity, processing, storage, seed testing (moisture, purity, viability, dormancy, health etc).

CO5- Classify tree seeds w.r.t. storability/longevity & inspect seed certification and its procedure.

Course Code	Name of Subject	Credit	Marks	Total
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			<b>External</b>	<b>Internal</b>	
<b>FOR/CC503T</b>	<b>Tree Seed Technology</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>
<p><b>Theory-</b></p> <p><b>Unit-I</b></p> <p>Importance of seed in present day forestry, seed and fruit development, seed dispersal. Planning seed collection-Collection of immature fruits - Methods of seed collection. Fruit and seed handling – maintaining viability and identity- special precautions for recalcitrant seeds. Seed processing- operations prior to extraction- pre-cleaning, methods of extraction- operations after extraction- cleaning, grading and control of moisture level- factors affecting drying of orthodox seeds.</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Agrawal, R.L. 1986. Seed Technology. Oxford - IBH Publishing Co. New Delhi</li> <li>• Khullar, P. et. al. 1992. Forest Seed. ICFRE, New Forest, Dehra Dun</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul> <p><b>Unit-II</b></p> <p>Seed storage- definition- purpose, recalcitrant seeds- Harrington’s rule of thumb, seed maturity- parental and annual effects. Storage condition and ageing of seeds. Storage methods Storage containers. Seed dormancy- types of dormancy, treatments for breaking exogenous and endogenous dormancy. Seed dressing and pelleting. Seed testing - definition- ISTA rules. Sampling- seed weight- moisture- authenticity- seed health. Germination testing- germination equipment- conditions for selected species. Germination evaluation- germination testing in nursery. Indirect tests of viability. Seed Act and Seed Certification</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Agrawal, R.L. 1986. Seed Technology. Oxford - IBH Publishing Co. New Delhi</li> <li>• Khullar, P. et. al. 1992. Forest Seed. ICFRE, New Forest, Dehra Dun</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					
<b>Course Code</b>	<b>Name of Subject</b>	<b>Credit</b>	<b>Marks</b>		<b>Total</b>
			<b>External</b>	<b>Internal</b>	
<b>FOR/CC503P</b>	<b>Tree Seed Technology</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>
<p><b>Practical –</b></p> <p>Identification of seeds of tree species; Seed maturity tests; Physical purity analysis; Determination of seed moisture; Seed germination test; Hydrogen peroxide test; Tetrazolium test for viability; Seed vigour and its measurements; Methods of breaking dormancy in tree seeds; Study of seed collection and equipments; Planning of seed collection; Seed collection; Seed extraction; Visit to seed production area and seed orchard; Visit to seed processing unit/testing laboratory; Study of seed sampling equipments.</p> <p><b>Reference Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Agrawal, R.L. 1986. Seed Technology. Oxford - IBH Publishing Co. New Delhi</li> <li>• Ahuja, P.S. et al. 1989. Towards developing “Artificial Seeds” by shoot and root encapsulation. In: Tissue Culture and Biotechnology of Medicinal and Aromatic Plants. CIMAP, Lucknow, India, P. 22-28.</li> <li>• Chin, H.F. and Roberts, E.H. 1980. Recalcitrant Crop Seeds. Tropical Press Sdn. Bhd. Kuala Lumpur - 22-03, Malaysia</li> <li>• ISTA. 1993. International Rules for Seed Testing Rules. International Seed Testing Association, Zurich, Switzerland, 1993.</li> <li>• Khullar, P. et. al. 1992. Forest Seed. ICFRE, New Forest, Dehra Dun</li> <li>• Leadem, C.L. 1984. Quick Tests for Tree Seed Viability. B.C. Ministry of Forests and Lands, Canada.</li> </ul>					

- May, J.T., Belcher, Jr. E. W., Cordell, C.E., Filer, Jr. T. H., David South, and Lantz. C. W. 1985.
- Schmidt, L. 2000. Guide to Handling Tropical and Subtropical Forest Seed. Danida
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Experiential Learning – I (FOR/CC504 P)

#### Course outcome

CO3 - Applying: Participate in practical activities relevant to the specific course topic Apply relevant tools, techniques, and safety protocols during field exercises. Collect and analyze data generated from experiential activities. Implement best practices related to the course topic in simulated or real-world settings.

CO4 – Analyzing: Evaluate the effectiveness of various approaches encountered during experiential learning. Analyze the relationships between theoretical concepts and practical observations made during field experiences. Identify potential challenges and opportunities related to the course topic based on their hands-on involvement. Compare and contrast different methods or practices observed in the field, considering their economic, social, and environmental impacts.

CO5 – Evaluating: Critique existing practices observed during experiential learning activities, considering their sustainability and potential for improvement. Develop and justify recommendations for optimizing practices based on their field experiences. Reflect on their learning process and identify areas for improvement in their relevant skills.

Formulate a plan for integrating their learning from experiential activities into their future forestry careers.

CO6 – Creating: Design and implement a small-scale project related to the course topic, showcasing their acquired knowledge and skills. Develop educational materials or outreach programs to raise awareness about the importance of the course topic. Propose strategies for collaborating with stakeholders to improve practices related to the course topic. Communicate the significance of experiential learning within the specific forestry discipline to diverse audiences (e.g., forestry professionals, policymakers, the public).

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC504 P	Experimental Learning - I	5	100	-	100

#### Practical -

- Production and Marketing of high value forest produce (0+5) (FP)
- Raising Quality Planting Materials for forest regeneration (0+5) (SA/FB)
- Apiculture/Sericulture (0+5) (FB/NR/WL)
- Ecotourism (0+5)(BS/WL)
- Wild Animal Health Management (0+5) –WL

#### 1 Production and Marketing of high value forest produce 5(0 +5)

Project formulation, Market survey and prioritization of species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to timber markets, saw mills, forest depots etc. Lesser known, but highly utilizable indigenous species of timbers will be given priority. Fast rotation timber species raised under various trials of the University will also be included to the extent possible. Potential of different species for various end uses will be determined. Timber samples have to be converted into sticks / smaller sizes / macerated through appropriate procedures such as sawing and sizing in a saw mill or maceration in a laboratory. Mechanical tests: Static bending, compressive tests-across and along the grain. Finding out safe working stresses of lesser known or exotic/new species. Wood database currently available in the department will be updated based on the test results. Project report preparation and presentation, final examination. Wood



conversion in an integrated saw mill, turnery for handicrafts, joineries and furniture making. Data analysis, project report writing, presentation and final examination.

**2 Raising Quality Planting Materials for forest regeneration 5(0+5)**

Project formulation, Identification of species (grasses, trees, medicinal plants & wild fruits) for nursery raising, time of collection of plant material from selected seed sources, quantity of seed/plant material required, nursery area (open and protected), inputs required, Schedule for intercultural operation-seed treatment, sowing, weeding, fertigation, root hardening treatments. Assessment of demand in local/potential markets and institutions. Collection, Handling, Processing and Storage of planting material. Identification of superior seed sources, seed collection, treatment and storage. Vegetative propagati on under controlled and ambient conditions. Collection of vegetative propagules. Treatment and processing of bare root and containerized seedlings. Project Report and Presentation, Final examination

**(3) Apiculture 5(0+5)**

Project for mulation, Apiculture-Scope and importance of beekeeping–Bees classification– Hives – Social organization–extraction of honey and other products. Marketing of honey and bee wax and their value addition. Cost Benefit analysis, Project Report and Presentation, Final examination.

**(4) Ecotourism 5(0+5)**

Socio- economic feasibility analysis for initiating ecotourism projects. Tour planning and site development. Social engineering and natural resource management. Study of environmental and social impacts of ecotourism and mitigation strategies. Potential of ecotourism as a business..

**(5) Wild Animal Health Management 5(0+5)**

Basic concepts of disease and health conditions. Review of major diseases of Indian wild mammals, birds, amphibians and reptiles. Epidemiology of disease. Disease and population dynamics. Disease transmission between domestic and wild populations. Malnutrition, starvation, dehydration as disease syndromes. Condition, health and nutritional assessment in free-ranging populations. Control of disease planning and management of wildlife health programmes. Zoonoses.

**Plantation Forestry (FOR/SEC501T)**

**Course outcome**

Students are able to

CO1: Define Plantations and explain its scope. explain the history of development of plantation forestry, plantation organization and structure, discuss the concept national and regional planning for plantation, project appraisal and project implementation feasibility.

CO2: Describe the process of Plantation i.e. Choice of species, plantation establishment techniques, major pest and disease control measures, perform the Dynamics study of stand growth i.e. CCF-MCA- stand density management in plantations- thinning regimes-improvement fellings.

CO3: Evaluate Site quality, stand basal area- site index concept, plantation productivity assessment- growing stock assessment- MAI, sustainability of plantations, prepare plantation records journal.

CO4: Describe Industrial plantations- paper and pulp wood- match wood, plywood plantations- Plantations yielding NTFPs, explain Energy plantation- high density short rotation plantations- petro crops, avenue plantations, plantations as potential carbon sinks.

CO5: Discuss economic factors in plantation development considering social and cultural conditions.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

<b>FOR/SEC501T</b>	<b>Plantation Forestry</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>
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**Theory-**

**Unit-I**

Plantations-definition and scope. History of plantations, Development of plantation forestry, Plantation organization and structure, Land and plantation development. Plantation planning- national and regional planning-project appraisal and project implementation- feasibility studies. Plantation silviculture - Choice of species, plantation establishment- plantation maintenance- nutrition in plantations, use of fertilizers, major pest and disease in plantations, sanitation and control measures.

**Suggested Reading**

- Evans, J. 1992. Plantation Forestry in the Tropics, 2nd edition. Oxford, UK, Clarendon Press.
- Nambiar, E.K.S. and Brown, A.G. 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for Internat. Agricultural Research. 571p.
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Dynamics of stand growth- CCF-MCA- stand density management in plantations- thinning regimes-improvement fellings. Site quality evaluation, stand basal area- site index concept in plantation forestry- plantation productivity assessment- growing stock assessment- MAI, sustainability of plantations. Plantation records- plantation journal. Industrial plantations- paper and pulp wood- match wood, plywood plantations- Plantations yielding NTFPs. Energy plantation- high density short rotation plantations- petro crops, avenue plantations, plantations as potential carbon sinks. Economic factors in plantation development- social and cultural considerations.

**Suggested Reading**

- Evans, J. 1992. Plantation Forestry in the Tropics, 2nd edition. Oxford, UK, Clarendon Press.
  - Nambiar, E.K.S. and Brown, A.G. 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for Internat. Agricultural Research. 571p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

<b>Course Code</b>	<b>Name of Subject</b>	<b>Credit</b>	<b>Marks</b>		<b>Total</b>
			<b>External</b>	<b>Internal</b>	
<b>FOR/SEC501P</b>	<b>Plantation Forestry</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>

**Practical –**

Study the tools and materials for plantation establishment- Visit small and large plantations- study their management and functioning- Exposure to plantation project preparation- economic evaluation and feasibility studies of plantation projects. Study of planting operations- study of tending techniques- Planting methods and techniques fo different types of plantations including energy plantations, canal bank plantations - pulp wood plantations- study of Forest Development Corporation plantations-road side plantations plantation planning- Plantation journal- Choice of species for plantations-economic considerations in plantation. Study of govt vs. pvt. Plantations.

**Reference Suggested Reading**

- Bowen, G.D., E. K. S. Nambiar, E.K.S 1984. Nutrition on Plantation Forests. Academic Press, 1984 - Nature - 516 pages
- Evans, J. 1992. Plantation Forestry in the Tropics, 2nd edition. Oxford, UK, Clarendon Press.
- Evans, J. and Turnbull, J.W. 2004. Plantation Forestry in the Tropics: The Role, Silviculture and Use of Planted Forests for Industrial, Social, Environmental and Agroforestry Purposes. OUP Oxford, 467p.
- Krishnapillay.B. 2000. Silviculture and Management of teak plantations. Unasylva. 201. Vol 51. 14-21p
- Nambiar, E.K.S. and Brown, A.G. 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for Internat. Agricultural Research. 571p.
- Nambiar, E.K.S., Cossalter, C and Tiarks.A. 1998. Site Management and Productivity in Tropical Plantation Forests. Workshop Proceedings, South Africa.

- Suzuki, K., Ishii, K., Sakurai, S. and Sasaki, S. 2006. Plantation Forestry in the Tropics. Springer Tokyo.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## **Entrepreneurship Development & Business Management (FOR/SEC502T)**

### **Course outcome**

Students will be able to

CO1: Describe entrepreneurship development in the Indian economy & discuss the overview of Indian social, political and economic systems and their implications for decision making by entrepreneurs.

CO2: Apply concept of entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs

CO3: Describe SWOT analysis for Generation, incubation and commercialization of ideas and innovations & explain government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to forestry sector.

CO4: Explain Contract farming and joint ventures, public-private partnerships.

CO7: Explain Indian forestry processing and export industry, Social Responsibility of Business in Indian Overview.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC502T	<b>Entrepreneurship Development &amp; Business Management</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>

### **Theory- Unit-I**

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations.

#### **Suggested Reading:**

- Maslow, A.H 1970 Motivation and personality. Harper and Row publishers , New York.
- Perelson, B and Steiner, G 1964 Human behaviour. Harcourt Brace Jovanovich , New York.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### **Unit-II**

Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to forestry sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of forestry inputs industry. Characteristics of Indian forestry processing and export industry. Social Responsibility of Business.

#### **Suggested Reading:**

- Maslow, A.H 1970 Motivation and personality. Harper and Row publishers , New York.
- Perelson, B and Steiner, G 1964 Human behaviour. Harcourt Brace Jovanovich , New York.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks	Total
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			<b>External</b>	<b>Internal</b>	
<b>FOR/SEC502P</b>	<b>Entrepreneurship Development &amp; Business Management</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>
<p><b>Practical –</b>  Practical –  SWOT analysis, developing leadership skills, developing managerial skills, problem solving skill, supply chain management and total quality management, project planning formulation and report preparation.</p> <p><b>Reference Suggested Reading:</b></p> <ul style="list-style-type: none"> <li>• Maslow, A.H 1970 Motivation and personality. Harper and Row publishers , New York.</li> <li>• Perelson, B and Steiner, G 1964 Human behaviour. Harcourt Brace Jovanovich , New York.</li> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

### **Forest Hydrology and Watershed Management (FOR/SEC503T)**

#### **Course outcome**

Students will be able to

CO1: Define & explain Hydrology, Hydrological cycle, Energy and water balance equations, precipitation- rain and snow hydrology, Interception, infiltration, evaporation and transpiration, surface water, run off processes and hydrograph.

CO2: Describe the soil water energy concept, movement, availability and measurement.

CO3: Explain Watershed management & enlist & describe methods for water conservation & harvesting techniques.

CO4: Discuss the role of trees & forests in water conservation.

CO5: Acquainted with application of GIS in watershed delineation.

<b>Course Code</b>	<b>Name of Subject</b>	<b>Credit</b>	<b>Marks</b>		<b>Total</b>
			<b>External</b>	<b>Internal</b>	
<b>FOR/SEC503T</b>	<b>Forest Hydrology and Watershed Management</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>

#### **Theory-**

##### **Unit-I**

Importance and scope of Hydrology. Definitions. Hydrological cycle. Energy and water balance equations precipitation- rain and snow hydrology. Interception, infiltration, evaporation and transpiration- paired water sheds, surface water, run off processes and hydrograph. Soil water energy concept, movement, availability and measurement.

##### **Suggested Reading**

- Dhruva Narayana V. V. 1993. Soil and Water Conservation Research in India, ICAR, New Delhi
- Dhruva Narayana V. V., G. Sastry and U. S. Patnaik. 1997. Watershed Management. Indian Council of Agricultural Research, New Delhi, 176 p

- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

##### **Unit-II**

Watershed management- an approach for sustainable productivity-principles and practices- Methods for water conservation- water harvesting techniques. Role of trees in water conservation- natural terracing- species suitability- Recharging of water springs. Forest treatment and water yield. Application of GIS in watershed delineation.

Dhruva Narayana V. V. 1993. Soil and Water Conservation Research in India, ICAR, New Delhi

- Dhruva Narayana V. V., G. Sastry and U. S. Patnaik. 1997. Watershed Management. Indian Council of

Agricultural Research, New Delhi, 176 p					
<ul style="list-style-type: none"> <li>ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					
Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/SEC503P</b>	<b>Forest Hydrology and Watershed Management</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>
<p><b>Practical –</b>  Study of hydrological equipment; Measurement and analysis of rainfall data; Estimation of runoff using rational formula; Preparation, use and analysis of hydrograph; Measurement of evaporation by different methods; Visit to forest watersheds to study the effect of forest treatment on hydrological properties. Assesment of the impact of watershed treatments such as afforestation/restocking, assisted regeneration etc. on the watershed functioning- field layout- regeneration assessment- interpretation of results.</p> <p><b>Reference Suggested Reading</b></p> <ul style="list-style-type: none"> <li>Bennet, H. H. 1965. Elements of Soil conservation. Mc Graw Hill Book Co. Inc. New York</li> <li>Dhruva Narayana V. V. 1993. Soil and Water Conservation Research in India, ICAR, New Delhi</li> <li>Dhruva Narayana V. V., G. Sastry and U. S. Patnaik. 1997. Watershed Management. Indian Council of Agricultural Research, New Delhi, 176 p</li> <li>Gurmail Singh et al., 1988. Manual of Soil and Water Conservation. Oxford IBH Publishing Co. New Delhi</li> <li>Hamilton L. S. 1983. Tropical Forested Watersheds: hydrologic and soils response to major uses or conversions. International Book Distributors, Dehra Dun</li> <li>Hamilton, L.S. (ed.). 1983. Forest and Watershed Development and Conservation in Asia and the Pacific. International Book Distributors, Dehra Dun</li> <li>Hewlett, JD and Nutter, WL 1969. An Outline of Forest Hydrology. University of Georgia Press, Athens 132p</li> <li>Hudson, N. 1981. Soil Conservation. BT Batsford Limited, London 324 p.</li> <li>Lal R. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, London</li> <li>ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

### **Forest Economics and Marketing (FOR/SEC504T)**

#### **Course outcome**

Student will be able to

CO1: Define economics, Forest economics & describe its scope and relationship with other sciences, state the various theories related to consumer behavior such as equi-marginal utility, indifference curve, diminishing marginal utility.

CO2: Define & explain law of demand and understand the concept of price, income and cross elasticity's, factors of production i.e. land, labour, capital and enterprise and theories of rent, wage, interest & profit.

CO3: Describe Law of diminishing marginal returns and law of supply, understand the concepts of Price determination and forecasting under various market structures., discuss the concepts of National Income, the concept and types of inflation.

CO4: Apply business principles to forestry, utilize economic principles to address private and public policy issues related to allocating natural resources and environmental amenities, describe the role of markets and market failure with regards to the allocation of natural resources and environmental amenities.

CO5: Explain the role of market channels for distribution of forest resources & concept of different types of market, describe & perform SWOT analysis for crisis management

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC504T	Forest Economics and Marketing	1	70	30	100

### Theory-

#### Unit-I

Economics- meaning, definition, subject matter. Divisions of economics. Importance of economics- Forest Economics- meaning, definition. Basic concepts-Goods, service, utility, value, price, wealth, welfare-Wants- Meaning, characteristics, classifications of wants, importance. Theory of consumption-law of diminishing marginal utility, meaning, definition, assumption, illustration, limitations, law of equi-marginal utility. Importance. Consumer surplus- meaning, definition, importance. Demand-meaning, definition, kinds of demand, demand schedule, demand curve, law of demand, extension and contraction vs increase and decrease in demand. Elasticity of demand- types of elasticity of demand, degrees of price elasticity of demand, methods of measuring elasticity, factors in influencing demand, elasticity of demand, importance of elasticity of demand- supply- meaning, supply function-law of supply-factors in influencing supply-pricing of timber and non-timber products-Economics of timber and non-timber forest products. Forest planning-forest policy and development.

Production-meaning, factors of production-land, labour, capital, organization, entrepreneurship-Distribution-rent, wages, interest, profit-National Income-definition and concepts-Public finance-meaning- Public resource- meaning- sources. Taxation-types. Public expenditure-meaning, principles. Money-meaning-evolution- Inflation. definition, types of inflation. Welfare economics-meaning and basic concepts.

#### Suggested Readings

- Dewett, K. K. 2005. Modern Economic Theory. S. Chand, New Delhi.
- Dewett, K. K., Verma. 2004. Elementary Economic Theory, S. Chand, New Delhi
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit-II

Marketing- definition, Marketing Process – Need for marketing, Role of marketing, Marketing functions, Classification of markets Marketing of various channels, Price spread, Marketing Efficiency, Integration, Constraints in marketing of agricultural produce. Market intelligence, Basic guidelines for preparation of project reports Bank norms – Insurance – SWOT analysis – Crisis management.

#### Suggested Readings

- Dewett, K. K. 2005. Modern Economic Theory. S. Chand, New Delhi.
- Dewett, K. K., Verma. 2004. Elementary Economic Theory, S. Chand, New Delhi
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC504P	Forest Economics and Marketing	1	100	-	100

### Practical –

Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Identification of marketing channel- Calculation of price Spread, Identification of Market Structure – Visit to different Markets.

#### Reference Suggested Readings

- Dewett, K. K. 2005. Modern Economic Theory. S. Chand, New Delhi.
- Dewett, K. K., Verma. 2004. Elementary Economic Theory, S. Chand, New Delhi
- Jhingan, M. L. 2012. Macro Economic Theory. Vrindapublishers, New Delhi.
- Reddy, S.S., Raghuram, P., Neelakanta Sastry, T.V., Bhavani, D.I. 2004. Agricultural Economics. Oxford and IBH Publishers, New Delhi.

## Semester-VI

### Forest Laws, Legislation and Policies (FOR/CC601T)

#### Course outcome

Student will be able to

CO1: Enlist Forest policies & laws.

CO2: Define legal terms  
CO3: Explain National forest policies, Forest related Acts & Laws of regional, national and international significance

CO4: Compare all forest policies

CO5: Describe Indian judicial system and application of penal code to forests, general principles of criminal law, legal principles of punishment, criminal procedure code, the law of evidence and the Indian Evidence Act, 1872 as applied to forestry matters.

CO6: Discuss some important court verdicts on issues of utmost importance to conservation.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC601T	Forest Laws, Legislation and Policies	2	70	30	100

#### Theory-

National forest policies-scope and importance- comparative analysis of all forest policies -Indian judicial system- Legal definitions, application of penal code to forests, general principles of criminal law, legal principles of punishment, criminal procedure code, the law of evidence and the Indian Evidence Act, 1872 as applied to forestry matters. Indian Forest Act, 1927 general provisions, Code of Civil procedure, 1908. Forest (Conservation) Act, 1980. Brief description about other major forest laws of regional, national and international significance. Detailed study of KFA 1961. Biological Diversity Act, Van Panchayat Policy, Uttarakhand Forest Policy, Court verdicts on issues of utmost importance to conservation.

#### Reference Suggested Readings

- Dutta, R. and Yadav, B. (2012). Supreme Court on Forest Conservation. Universal Law Publishing Co., New Delhi, India
- Joy, P. P. (2012). Set up your criminal practice. Swamy Law House, Ernakulam
- Shetty, B. J. (1985), A Manual of Law for Forest Officers, Sharda Press, Mangalore
- Takwani, C. K. T and Thakker, M. C. (2012). Takwani Criminal Procedure. Lexis Nexis Butterwarths Wadhwa, Nagpur
- Varghese, M. I. (2012). Treatise on Forest Laws of Kerala. Swamy Law house, Ernakulam.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Geomatics (FOR/CC602T)

#### Course outcome

Students will be able to

CO1: Define & classify Remote sensing & Aerial photographs, Microwave remote sensing, GIS, conventional cartography, Spatial and non-spatial data, interaction of electromagnetic radiation with atmosphere and earth surface  
 CO2: Interpret aerial photographs, explain Satellite remote sensing platforms and sensors & satellite systems, discuss Indian Remote Sensing Programme; visual and digital image processing;  
 CO3: Describe application of remote sensing techniques in Forest vegetation mapping (NDVI); Forest cover monitoring and damage assessment, explain Integration of attribute data with spatial data. explain application of GIS in forestry  
 CO4: Use maps by its projection on Toposheet and Map reading, explain Global Positioning System's (GPS) applications in resource inventory, Global Navigation Satellite System, Galileo, GLONASS, QZSS, Compass, IRNSS etc., GAGAN  
 CO5: Explain the use of GIS software ARC GIS, ARC MAP,ARC INFO, ERDAS, GEOMEDIA, Q-GIS.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC602T	Geomatics	2	70	30	100

**Theory-**

**Unit-I**

Remote sensing - classification based on source: active and passive remote sensing; aerial and space remote sensing; interaction of electromagnetic radiation with atmosphere and earth surface, Aerial photographs – types; photo interpretation, Satellite remote sensing - platforms and sensors; satellite systems. Indian Remote Sensing Programme; visual and digital image processing; application of satellite based remote sensing techniques in forestry - vegetation mapping using satellite imagery-NDVI; Forest cover monitoring and damage assessment, Microwave remote sensing. Introduction to GIS. 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.

**Suggested Reading**

- Campbell, J.B. (2002). Introduction to Remote Sensing-Third edition. Taylor and Francis, London
- Joseph, G. (2005). Fundamentals of Remote Sensing-Second edition. Universities Press
- Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS & LUP, Nagpur.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

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, GLONASS, QZSS, Compass, IRNSS etc., GAGAN, Brief study of GIS software ARC GIS, ARC MAP,ARC INFO, ERDAS, GEOMEDIA, Q-GIS.

**Suggested Reading**

- Campbell, J.B. (2002). Introduction to Remote Sensing-Third edition. Taylor and Francis, London
- Joseph, G. (2005). Fundamentals of Remote Sensing-Second edition. Universities Press
- Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS & LUP, Nagpur.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC602P	Geomatics	1	100	-	100

**Practical –**

Preparation maps; visual interpretation of satellite imagery; forest cover mapping and land use mapping. Digital image processing. Introduction to various GIS software – Q-GIS, ERDAS, Arc GIS etc. Exercises in



viewing, editing, overlay. Visit to the GIS labs at State level.

**Reference Suggested Reading**

- 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 & Sons, Inc., USA
- Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS & LUP, Nagpur.
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Restoration Ecology (FOR/CC603T)**

**Course outcome**

Students are able to

CO1: Identify the various 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)

CO2: Select tree species suitable for different degraded lands.

CO3: Prepare restoration plan for a degraded land.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC603T	Restoration Ecology	2	70	30	100

**Theory-**

**Unit-I**

Degraded lands: concept, classification, status, extent and causes of degradation/ 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.

**Suggested Reading:**

- Anil kumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi

Development In India. Concept Publishing Co. New Delhi-59, 488p

- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

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 programmes on degraded lands/wasteland development. Role of Government agencies and NGO’s in degraded lands/wasteland development programme.

**Suggested Reading:**

- Anil kumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi

Development In India. Concept Publishing Co. New Delhi-59, 488p

• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC					
Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC603P	Restoration Ecology	1	100	-	100
<p><b>Practical –</b>            Selection criteria 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 programme. Preparation restoration plan for a piece of degraded land.</p> <p><b>Reference Suggested Reading:</b></p> <ul style="list-style-type: none"> <li>• Anil kumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi</li> <li>• Buol, S.W., Kole, F.D. and McGracken, R.J. 1975. Soil Genesis and Classification. Oxford and IBH Publ. New Delhi.</li> <li>• Butler, B.E. 1980. Soil Classification for Soil Survey. Clerneder Press-Oxford Publ. Co., London.</li> <li>• Gregersen, H. Draper, S. and Elz. D.(eds.) 1989. People and Trees- The Role of Social Forestry in Sustainable Development EDI Seminar Series, The World Bank, Washington, D. C. 273p</li> <li>• Hegde NG 1987. Handbook of Wasteland Development. BAIF, Pune 102p.</li> </ul> <p>Hegde NG and Abhyankar 1986 (eds). The Greening of Wastelands. BAIF, Pune 204p            IARI 1960. Soil Survey Manuel, IARI. New Delhi.            ICAR 1977. Desertification and its Control. ICAR, New Delhi 358p.            National Commission on Agriculture 1976. Report of the National Commission on Agriculture, Part ix, Prasad, V. N. 1985. Principles and Practices of Social-Cum-Community Forestry. International Book Distributors, Dehradun, 108p            Shah, S. A. 1988. Forestry for People. ICAR, New Delhi, 147p            Sharma, S. C., Chaturvedi R. B and Mishra O. P 1990. Utilization of Wastelands for Sustainable Development In India. Concept Publishing Co. New Delhi-59, 488p</p> <ul style="list-style-type: none"> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

### Experiential Learning-II (FOR/CC604P)

#### Course outcome

CO3 - Applying: Participate in practical activities relevant to the specific course topic Apply relevant tools, techniques, and safety protocols during field exercises. Collect and analyze data generated from experiential activities. Implement best practices related to the course topic in simulated or real-world settings.

CO4 – Analyzing: Evaluate the effectiveness of various approaches encountered during experiential learning. Analyze the relationships between theoretical concepts and practical observations made during field experiences. Identify potential challenges and opportunities related to the course topic based on their hands-on involvement. Compare and contrast different methods or practices observed in the field, considering their economic, social, and environmental impacts.

CO5 – Evaluating: Critique existing practices observed during experiential learning activities, considering their sustainability and potential for improvement. Develop and justify recommendations for optimizing practices based on their field experiences. Reflect on their learning process and identify areas for improvement in their relevant skills.

Formulate a plan for integrating their learning from experiential activities into their future forestry careers.

CO6 – Creating: Design and implement a small-scale project related to the course topic, showcasing their acquired knowledge and skills. Develop educational materials or outreach programs to raise awareness about the importance of the course topic. Propose strategies for collaborating with stakeholders to improve practices related to the course topic. Communicate the significance of experiential learning within the specific forestry discipline to diverse audiences (e.g., forestry professionals, policymakers, the public).

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC604P	Experiential Learning-II	5	100	-	100

**Practical -**

**1 (1) Production and Marketing of High Value Forest Produce 5(0+5)**

Project formulation, Market survey and prioritization of species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to timber markets, saw mills, forest depots etc. Lesser known, but highly utilizable indigenous species of timbers will be given priority. Fast rotation timber species raised under various trials of the University will also be included to the extent possible. Potential of different species for various end uses will be determined. Timber samples have to be converted into sticks / smaller sizes / macerated through appropriate procedures such as sawing and sizing in a saw mill or maceration in a laboratory. Mechanical tests: Static bending, compressive tests-across and along the grain. Finding out safe working stresses of lesser known or exotic/new species. Wood database currently available in the department will be updated based on the test results. Project report preparation and presentation, final examination. Wood conversion in an integrated saw mill, turnery for handicrafts, joineries and furniture making. Data analysis, project report writing, presentation and final examination.

**(2) Raising Quality Planting Materials for Forest Regeneration 5(0+5)**

Project for mulation, Identification of species (grasses, trees, medicinal plants & wild fruits) for nursery raising, time of collection of plant material from selected seed sources, quantity of seed/plant material required, nursery area (open and protected), inputs required, Schedule for intercultural operation-seed treatment, sowing, weeding, fertigation, root hardening treatments. Assessment of demand in local/potential markets and institutions. Collection, Handling, Processing and Storage of planting material. Identification of superior seed sources, seed collection, treatment and storage. Vegetative propagation under controlled and ambient conditions. Collection of vegetative propagules. Treatment and processing of bare root and containerized seed lings. Project Report and Presentation, Final examination.

**(3) Apiculture 5(0+5)**

Project for mulation, Apiculture-Scope and importance of beekeeping–Bees classification– Hives – Social organization –extraction of honey and other products. Marketing of honey and bee wax and their value addition. Cost Benefit analysis,Project Report and Presentation, Final examination.

**(4) Ecotourism 5(0+5)**

Socio- economic feasibility analysis for initiating ecotourism projects. Tour planning and site

development. Social engineering and natural resource management. Study of environmental and social impacts of ecotourism and mitigation strategies. Potential of ecotourism as a business.

**(5) Wild Animal Health Management 5(0+5)**

Basic concepts of disease and health conditions. Review of major diseases of Indian wild mammals, birds, amphibians and reptiles. Epidemiology of disease. Disease and population dynamics. Disease transmission between domestic and wild populations. Malnutrition, starvation, dehydration as disease syndromes. Condition, health and nutritional assessment in free-ranging populations. Control of disease planning and management of wildlife health programmes. Zoonoses.

**Tree Improvement (FOR/SEC601T)**

**Course outcome**

**Students are able to:**

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2- Explain forest genetics, tree breeding and improvement including its history, justification for tree improvement programme, its relation with other disciplines of forest management activities & able to outline advantage and limitation of tree improvement..

CO3- Identify the methods of forest reproduction: sexual and asexual reproduction and their consequences,.

CO4- able to identify the Selection procedures and techniques of species and provenance & Plus tree in tree improvement followed by progeny trials,

CO5- Able to perform the techniques of vegetative propagation of tree

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC601T	Tree Improvement	2	70	30	100

**Theory-**

**Unit-I**

Introduction – history and development of tree improvement – its relation to other disciplines of forestry. Reproduction in forest trees. Anthesis and pollination – their importance in tree breeding. Incompatibility and sterility. Quantitative inheritance. Relevance in forestry. Natural variability in trees – types and importance.- forces that change variability. Genetic, environmental and interaction components of variation - heritability and genetic advance. Genetic basis of tree breeding. Exotic forestry. Provenance testing. Selection- Seed production areas–seed orchards. Progeny trial and improvement of seed orchards. Combining ability and genetic gain – Hybridization in trees – back cross breeding, heterosis breeding. Breeding for resistance to insect pest’s diseases, air pollution and for wood properties. Vegetative propagation and clonal forestry. Conservation of forest tree germplasm. Recent techniques in tree improvement.

**Suggested Reading:**

- Surendran,C., Sehgal, R.N.and Parmathma,M.( Eds.)(2003).A textbook of Forest Tree Breeding. ICAR, NewDelhi.
- Zobel, B.and Talbert,J.(2003).Applied Forest Tree Improvement. Blackburn Press.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Mutation breeding; Ploidy breeding. Breeding objectives and concepts of breeding in self polinated, cross pollinated and vegetatively propagated crops. Breeding of important tree species. Breeding procedures for development of hybrids, / varieties of various crops. DUS testing, Concepts of Geographical indications. Artificial hybrids in trees-crossing in trees-problems and perspectives-crossing

hybrids and hybrid breakdown. Hybrid nomenclature in trees- Future of hybrid in applied tree improvement.

**Suggested Reading:**

- Surendran,C., Sehgal, R.N.and Parmathma,M.( Eds.)(2003).A textbook of Forest Tree Breeding. ICAR, NewDelhi.
- Zobel, B.and Talbert,J.(2003).Applied Forest Tree Improvement. BlackburnPress.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC601P	Tree Improvement	1	100	-	100

**Practical –**

Floral biology and phenological observations in some important species. Pollen morphology. Estimation of pollen sterility and viability. Emasculation and hybridization in forest tree species. Different breeding methods – flow chart. Recording observations in provenance trial. Estimation of phenotypic and genotypic coefficient of variation. Estimation of genetic advance, heritability and GCA. Exercise in plus tree selection – recording data – design and observation in teak, eucalyptus seed orchard.

**Reference Suggested Reading:**

- Allied T.L.White and Adams(2010).Forest Genetics.
- Bedell P.E.(2007).Tree Breeding for Genetic Improvement of Tropical Tree Species (1stEd).
- Surendran,C., Sehgal, R.N.and Parmathma,M.( Eds.)(2003).A textbook of Forest Tree Breeding. ICAR, NewDelhi.
- Wright, J. (2012). Introduction to Forest Genetics. Elsevier.
- Zobel, B.and Talbert,J.(2003).Applied Forest Tree Improvement. BlackburnPress.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Non-Timber Forest Products, Marketing & Trade(FOR/SEC602T)**

**Course outcome**

After completing this course, students are able to:

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2: Describe types of markets for timber and non-timber forest produce, market locations and their features.

CO3: Explain demand forecasts & Price determination in timber and non-timber forest produce.

CO4: Discuss economic features of specialized markets in terms of

degree and type of competition for bamboo, canes, lac, gums, resins, hides and skins. Essential oil, Seed oil, fibers Hosses, Tans dyes wild edible nuts, pulp & paper.

CO5: Determine economics of gathering & processing of medicinal plants from forests.

CO6: Discuss domestic and international demand and trade in timber and non-timber forest products.

CO7: Explain market inefficiencies in timber, non-timber forest produce and measures to check inefficiencies with th help of cooperative societies.

CO8: Discuss economic policy and regulations of international timber trade and basics of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and timber certification.

Course Code	Name of Subject	Credit	Marks	Total
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			<b>External</b>	<b>Internal</b>	
<b>FOR/SEC602T</b>	<b>Non-Timber Forest Products, Marketing &amp; Trade</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>
<p><b>Theory-</b>  <b>Unit-I</b>  Types of markets for timber and non-timber forest produce, market locations of timber and non-timber forest produce and their features. Demand forecasts. Price determination in timber and non-timber forest produce. Economic features of specialized markets in terms of degree and type of competition for bamboo, canes, lac, gums, resins, hides and skins. Essential oil. Seed oil, fibers Floosses, Tans dyes wild edible nuts, pulp &amp; paper. Economics of gathering medicinal plants from forests, economics of processing medicinal plants.</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• ITTO. 1993. The economic linkages between international trade in tropical timber and sustainable management of tropical forests. London environmental economic centre, International Institute for Environment and Development, London, UK. 330p.</li> <li>• Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers &amp; Publishers), Dehradun, India. 140p. <ul style="list-style-type: none"> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul> </li> </ul> <p><b>Unit-II</b>  Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce. Market inefficiencies in timber, non-timber forest produce and measures to check inefficiencies, role of cooperative societies in marketing of timber and non-timber forest produce. Economic policy and regulations of international timber trade. Essentials of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and timber certification.</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• ITTO. 1993. The economic linkages between international trade in tropical timber and sustainable management of tropical forests. London environmental economic centre, International Institute for Environment and Development, London, UK. 330p.</li> <li>• Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers &amp; Publishers), Dehradun, India. 140p. <ul style="list-style-type: none"> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul> </li> </ul>					
<b>Course Code</b>	<b>Name of Subject</b>	<b>Credit</b>	<b>Marks</b>		<b>Total</b>
			<b>External</b>	<b>Internal</b>	
<b>FOR/SEC602P</b>	<b>Non-Timber Forest Products, Marketing &amp; Trade</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>
<p><b>Practical –</b>  Library review of studies on marketing and trade of timber forest produce (teak, sal, rosewood, Terminalia spp. Pterocarpus and other important timber of national importance etc.); Non- Timber Forest Produce (NTFP such as bamboo, canes etc.); forest based medicinal and aromatic plants. Visits to timber produce and NTFP markets to collect price data and quantity sold and to observe auctions and competitions. Analysis of price and quantitative data of timber forest produce, NTFP for examining trend; seasonal, cyclical variations. Visit to markets of forest based medicinal plants. Study of buy back arrangements in forest based medicinal plants trade. Valuation of timber and NTFP (existence value, use and option values, intrinsic value etc). Development of hypotheses to study the marketing of forest produce. Presentation of results on analysis of price and quantity. Economics of processing pulp to paper/poly fiber; wood to plywood/veneers.</p> <p><b>Reference Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Gray, J. W. 1993. Forest resource systems in developing countries. Food and agricultural organization. Rome. 259p.</li> </ul>					

- ITTO. 1993. The economic linkages between international trade in tropical timber and sustainable management of tropical forests. London environmental economic centre, International Institute for Environment and Development, London, UK. 330p.
- ITTO. 2012. Annual review and assessment of the world timber situation, Yogyakarta, Indonesia. 182p.
- 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 & Publishers), Dehradun, India. 140p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### **Certification of Forest Products (FOR/SEC603T)**

**Course outcome**

Students will be able to

CO1: Define forest certification.

CO2: Describe principal stages in the process of certification, Producer’s motivation for supplying certified forest products, Key aspects of certification, Indian scenario in certification & Pros and cons of certification.

CO3: Explain Principles of sustainable forest management.

CO4: Explain origin of certification & Organizations responsible for certification. Legislations and policies of importance.

CO5: Explain the Certification schemes in operation: Forest Stewardship Council (FSC), Programme for Endorsement of Forest Certification Schemes (PEFC) etc. CIFOR certification tool kit.

CO6: Discuss International trade in tropical logs and sawn wood, Potential for certifying forests and forest products of India & Tracing of illegal logging.

CO7: Explain the species and region of origin of species identification using genetic methods and analysis of stable isotope ratios.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/SEC603T</b>	<b>Certification of Forest Products</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>

**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), Programme 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. Introducing forest certification. 1996. 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.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### **Recreation and Urban Forestry (FOR/SEC604T)**

#### **Course outcome**

Students will be able to

CO1: Define Forest recreation, landscaping & Urban Forestry.

CO2: Explain scope, social and environmental aspects of recreation, components, new approaches in forest recreation.

CO3: Enlist & explain the types of landscape designs, Landscape components.

CO4: Explain the tools and implements for landscaping.

CO5: Explain & Plan Specialised gardens in institutional and industrial complexes, roads, bridges, parking area and other structures. CO5: Describe uses, Management & Impact of urban forestry, enlist the Species suitable for urban forests and their criteria of suitability.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/SEC604T</b>	<b>Recreation and Urban Forestry</b>	<b>1</b>	<b>70</b>	<b>30</b>	<b>100</b>

#### **Theory-**

Forest recreation – definition and scope, social and environmental aspects of recreation, components, new approaches in forest recreation. Principles and elements of landscaping -types of landscape designs formal-Persian and Mughal designs, and informal- British and Japanese. Landscape components- plant and other components- lawn, pergolas, hedges, edges, topiary, baloon, arbours, carpet beds, trees, flower 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 programmes in institutional and industrial complexes, roads, bridges, parking area and other structures. Urban forestry – definition and scope – uses of urban forests, Management of urban forest-Arbiculture and its importance in urban forestry. Impact of urban forestry. Species suitable for urban forests, criteria of suitability.

#### **Suggested Reading**

- Miller, R.W.(1988). Urban Forestry. Prentice Hall International Ltd. London
- Singh, S.P. (1986). Planting of Trees. B.R. Publishing Corporation, Delhi.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/SEC604P</b>	<b>Recreation and Urban Forestry</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>

#### **Practical –**

Preparation, planning and designing the planting pattern for parks, sanctuaries, industrial complexes and avenues in cities – familiarise with the components of landscaping – studies on the features of flowering and foliage trees suitable for avenue planting – visit to landscaped areas, parks tourist spots and centres, national parks and sanctuaries., practice planting methods.



**Reference Suggested Reading**

- Douglar, J. Hort, R. A and Ranganadhan, S. (1982). Forest Farming. Natraj Publications, Dehradun.
- Gopikumar K. (2008). Arboriculture Principles and Practices. Published by Khanna Bandhu, Dehradun
- Hamm, W.E and Cale, D.N.(1987). Wild Land Recreation, John Wiley and Sons, New York .
- Miller, R.W.(1988). Urban Forestry. Prentice Hall International Ltd. London
- Singh, S.P. (1986). Planting of Trees. B.R. Publishing Corporation, Delhi.
- Urban Forestry and Urban Greening. An International Journal aimed at presenting high- quality research with urban and peri-urban woody and non-woody vegetation and its use, planning, design, Elsevier Publications.
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Semester-VII****Forest Inventory and Yield Prediction (FOR/CC701T)****Course outcome**

Students will be able to

CO1: Define & explain growth, yield, Forest Inventory, sampling, stands, stand density, canopy density & stand table. estimate growth and Yield of stands, enlist & explain kinds of enumeration (tree assessment techniques).

CO2: Measure wood volume, tree volume & tree volume tables, enlist & describe kinds of sampling, sampling units, Sampling design, sampling intensity, Inventory designs used in India, Sampling errors and non sampling errors.

CO3: Organise field work and conduct enumeration, explain point sampling- concept of horizontal point sampling.

CO4. Describe estimation of growth and yield prediction in forest stands.

CO5: Explain methods of predicting future growth of stands in particular stand density, canopy density & Crown competition factor, describe Yield tables Preparation, application and use.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC701T	Forest Inventory and Yield Prediction	1	70	30	100

**Theory-****Unit-I**

Yield - in regular forests-in Irregular forests. Estimation of growth and Yield of stands, Forest Inventory, Point sampling. Forest Inventory - definition-objectives- Kinds of enumeration- tree assessment techniques. Measurement of wood volume, tree volume & tree volume tables. Kinds of sampling, Sampling design. Kinds of sampling units- fixed area and point sampling units. Plots, strips, topographical units - sampling intensity,

**Suggested Readings**

• Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.

Spurr, H.S.(1952).Forest Inventory. John Wiley and Sons, New York, 476p.

- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Unit-II**

Inventory designs used in India, Sampling errors and non sampling errors. Organisation of field work and conduct of enumeration, Point sampling- concept of horizontal point sampling. Estimation of growth and yield prediction in forest stands- stand structure - growth of stand. Methods of predicting future growth of stands – stand density - canopy density, Crown competition factor. Yield tables- definition, Preparation of yield table, application and use of yield tables, stand table-definition and use.

**Suggested Readings**

- Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.
- Spurr, H.S.(1952).Forest Inventory. John Wiley and Sons, New York, 476p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC701T	Forest Inventory and Yield Prediction	1	100	-	100

**Practical –**

Study the demarcation and alignment of plots, strips etc. Field exercise on horizontal field demonstration of various sampling techniques- simple, stratified, multi stage, multiphase, non- random sampling techniques. Visit forest areas for forest enumerations- point sampling- use of wedge prism and Relaskop - Field exercise on the determination of site quality -Visit to local forest divisions and study the methods of preparation and use of yield tables. Method/demonstration on the use of aerial photographs in forest inventory

**Reference Suggested Readings**

- Chapman, H.H and Meyer, W.H. (2008).Manual of Forest Mensuration: Methods and Techniques. Asiatic Publishing House, New Delhi, 522p.
- Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.
- Heindjik, D. (1975). Forest Assessment. International Book Distributors, Dehradun, 349p
- Husch, B., Beers, T.W. and Kershaw,Jr. J.A.(2002). Forest Mensuration (4th edition). John Wiley & Sons, Nature.456 pp.
- Kangas, A. and Maltamo, M. (2006). Forest Inventory: Methodology and Applications. Managing Forest Ecosystems (Vol.10).Springer.340pp.
- Philip, M.S.(1994). Measuring Trees and Forest. AB International, UK,310p
- Scott,C.T and Gove, J.H. (2002). Forest Inventory. Encyclopedia of Environmetrics (Vol 2), John Wiley & Sons. pp 814–820
- Shiver, B.D and Borders, B.E.(1996). Sampling Techniques for Forest Resource Inventory. John Wiley and Sons, New York, 356p
- Spurr, H.S.(1952).Forest Inventory. John Wiley and Sons, New York, 476p.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

**Forest Biotechnology (FOR/CC702T)**

**Course outcome**

Students will be able to

CO1: Explain the concepts and history of plant biotechnology and its scope and importance in tree improvement, define & Explain totipotency and morphogenesis.

CO2: Describe the techniques of in- vitro cultures i.e. micro propagation, anther culture, pollen culture, ovule culture, embryo culture, test tube fertilization, endosperm culture, their nutritional requirements & factors affecting.

CO3: Explain the somaclonal variation, its types, define Somatic embryogenesis, synthetic seed production technology, Protoplast isolation, culture, manipulation and fusion; Products of somatic hybrids and cybrids, describe applications in tree improvement i.e., Genetic engineering, Restriction enzymes, Vectors for gene transfer – gene cloning, Direct and indirect method of gene transfer.

CO4: Describe transgenic plants, their applications , achievements and biosafety regulations.

CO5. Explain blotting techniques – DNA finger printing and bar coding, DNA based markers – RFLP, AFLP, RAPD, SSR , VNTRS,CAPS, SNPs, ESTs and DNA probes – mapping QTL – future prospects. MAS, and its application in tree improvement.

Course Code	Name of Subject	Credit	Marks	Total
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			<b>External</b>	<b>Internal</b>	
<b>FOR/CC702T</b>	<b>Forest Biotechnology</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>
<p><b>Theory-</b>  <b>Unit-I</b>  Concepts and history of plant biotechnology: scope and importance in tree improvement: Totipotency and morphogenesis, nutritional requirements of in-vitro cultures; techniques of in- vitro cultures, micro propagation, anther culture, pollen culture, ovule culture, embryo culture, test tube fertilization, endosperm culture, factors affecting above in-vitro culture, Applications and Achievements, somaclonal variation-types, reasons: Somatic embryogenesis and synthetic seed production technology, Protoplast isolation, culture, manipulation and fusion; Products of somatic hybrids and cybrids.</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Bajaj, Y.P.S. (Ed) (1988). Biotechnology in Agriculture and Forestry 2. Crops 1. Springer- Verlag, Berlin.</li> <li>• Dhawan, V (2012) Applications of Biotechnology in Forestry and Horticulture. Springer US</li> <li>•ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul> <p><b>Unit-II</b>  Applications in tree improvement. Genetic engineering, Restriction enzymes, Vectors for gene transfer – gene cloning, Direct and indirect method of gene transfer. Transgenic plants, their applications , achievements and biosafety regulations, Blotting techniques – DNA finger printing and bar coding, DNA based markers – RFLP, AFLP, RAPD, SSR , VNTRS,CAPS, SNPs, ESTs and DNA probes – mapping QTL – future prospects. MAS, and its application in tree improvement.</p> <p><b>Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Bajaj, Y.P.S. (Ed) (1988). Biotechnology in Agriculture and Forestry 2. Crops 1. Springer- Verlag, Berlin.</li> <li>• Dhawan, V (2012) Applications of Biotechnology in Forestry and Horticulture. Springer US</li> <li>•ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					
<b>Course Code</b>	<b>Name of Subject</b>	<b>Credit</b>	<b>Marks</b>		<b>Total</b>
			<b>External</b>	<b>Internal</b>	
<b>FOR/CC702P</b>	<b>Forest Biotechnology</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>
<p><b>Practical –</b>  Requirements for plant tissue culture laboratory. Techniques in plant tissue culture; media components and preparations; sterilization techniques and inoculation of various explants; aseptic manipulation of various explants; callus induction and plant regeneration, Micro propagation of important crops-anther, embryo and endosperm culture. Hardening / Acclimatization of regenerated plants. Somatic embryogenesis and synthetic seed production. Isolation of protoplast; demonstration of culturing of protoplast. Demonstration of Isolation of DNA. Demonstration of gene transfer techniques, direct methods. Demonstration of confirmation of genetic transformation. Demonstration of gel- electrophoresis technique</p> <p><b>Reference Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Bajaj, Y.P.S. (Ed) (1988). Biotechnology in Agriculture and Forestry 2. Crops 1. Springer- Verlag, Berlin.</li> <li>• Dhawan, V (2012) Applications of Biotechnology in Forestry and Horticulture. Springer US</li> <li>• Guptha, P.K. (2000). Elements of Biotechnology. Rastogi publications, Meerut.</li> <li>• Neumann, K.H., Kumar, A., and Sopory, S.K. (2008) Recent Advances in Plant Biotechnology and Its Applications. I. K. International Pvt Ltd</li> <li>• Punia, M.S. (1998). Plant Biotechnology and Molecular Biology. A laboratory manual. • Scientific</li> </ul>					

Publishers, Jodhpur

• Thieman, W.J. and Palladino, M.A. (2009). Introduction to Biotechnology, Second Edition. Pearson Benjamin Cummings, San Fransis

- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Agroforestry Systems and Management (FOR/CC703T)

#### Course outcome

Learner will gain knowledge of

CO1. Concept of agroforestry as sustainable landuse system

CO2. Classification of Agroforestry systems

CO3. Planning & management of agroforestry systems

CO4. D&D methodology for agroforestry research

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC703T	Agroforestry Systems and Management	2	70	30	100

#### Theory- Unit-i

Land use and land capability classification- overview of agroforestry around the world – agroforestry systems in India. Classification of agroforestry systems – structural, functional, agroecological, socio-economic and physiognomic basis. Agrosilvicultural systems – improved fallows in shifting cultivation – soil dynamics in shifting cultivation, taungya systems, Alley cropping –structural and functional attributes. Multipurpose trees and shrubs on farmlands, agricultural fields, plantation crop combinations- commercial crops under shade of planted trees and natural forests- Windbreaks & Shelterbelts. Silvopastoral systems – protein banks, live fence of fodder trees and hedges, trees and shrubs in pastures. Pastoral silviculture systems- grassland and tree management in the humid, arid and semi- arid regions. Agrosilvopastoral systems – tropical home gardens –structural and functional attributes. Other systems – apiculture, sericulture and mixed woodlots.

#### Suggested Reading

- Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.
- Nair, PKR 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

#### Unit-ii

Major Agroforestry practices in different agroecological zones of India- arid and semi arid regions- agroforestry practices for wasteland reclamation. Agroforestry practices for salt affected soils, agroforestry practices for wetlands and waterlogged areas. Non-wood forest products based agroforestry. Soil fertility improvement and water conservation through agroforestry. Socio-economic analysis of various agroforestry systems. Diagnosis and design of Agroforestry

#### Suggested Reading

- Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.
- Nair, PKR 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	

<b>FOR/CC703P</b>	<b>Agroforestry Systems and Management</b>	<b>1</b>	<b>100</b>	<b>-</b>	<b>100</b>
<p><b>Practical –</b>  Study the desirable characteristics of trees/shrubs/grasses for various agroforestry programmes. Assessment of standing stock of tree species in various agroforestry systems such as homegardens. Survey of agroforestry practices in local/adjoining areas. Field observations to characterize the structural, functional and economic attributes of the following agroforestry systems and practices- agrosilviculture systems, silvopastoral systems, pastoral silviculture systems, agrosilvopastoral systems, shelterbelts and windbreaks, live fences; fodder trees and protein banks. Exercise on diagnosis and design of agroforestry systems and practices. Assessment of productivity of tree crop combinations. Studying resource partitioning in agroforestry systems - water, light and nutrients. Analysis of soil and plant samples for water holding capacity, organic carbon N, P and K.</p> <p><b>Reference Suggested Reading</b></p> <ul style="list-style-type: none"> <li>• Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.</li> <li>• Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p</li> <li>Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub. Co. New Delhi.</li> <li>Nair, P.K.R, Rao MR, and Buck LE (eds), 2004. New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry, Kluwer, Dordrecht, The Netherlands.</li> <li>Nair, PKR 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.</li> <li>Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.</li> <li>Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. J. Plant Nutr. Soil Sci. 172: 10–23.</li> <li>Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.</li> </ul> <ul style="list-style-type: none"> <li>• ERP Notes/NPTL/SWAYAM/NLIST/ MOOC</li> </ul>					

### **Wildlife Management (FOR/SEC701T)**

**Course outcome**

After completing the course, students are able to-

CO1: Discuss the definition , management and conservation of wildlife and its values.

CO2: Explore classification of zoogeographic regions, Biomes of the world and Biogeographic region of India.

CO3: Use of different IUCN Category of threats in animal and plant diversity, Various methods of wildlife census.

CO4: Explore different conservation and management practices of wildlife and legal regulation of wildlife conservation.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
<b>FOR/SEC701T</b>	<b>Wildlife Management</b>	<b>2</b>	<b>70</b>	<b>30</b>	<b>100</b>

**Theory-**

**Theory-**

**Unit-I**

Definition, History of wildlife management and conservation in India, Values of wildlife – aesthetic, recreational, scientific, educational, commercial, farming, technological and ecological values. Zoogeographic regions of the world – Palearctic region, nearctic region, oriental region, Ethiopian region, Neotropical region, Australasian region. Major biomes of the world – polar region, coniferous forests, temperate forests, tropical forests, grasslands, deserts, mountains, inland waters, oceans and oceanic islands. Biogeographic zones of India

- trans-Himalayan, Himalayan, Indian desert, semi-arid, Western Ghats, Deccan peninsula, Gangetic plain, North East India, islands, coasts. Habitat requirements of animals. Red Data Book and redlisting, IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned.

### Suggested Reading

- Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.
- Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

### Unit-II

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- statistical analysis. Telemetry- transmitters, receivers, analysis of data, visual tagging and marking. Captive wildlife: Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife (Protection) Act, 1972. Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Introduction and reintroduction of species. Wildlife corridors. MAB, CITES. Wildlife Damage - appraisal, control and management. Healthcare, disease management and nutrition in Wild animals Protected areas concept, wildlife sanctuaries and national parks, biosphere reserves, major protected areas of India.

### Suggested Reading

- Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.
- Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC701T	Wildlife Management	1	100	-	100

### Practical –

Exercise on the census methods - direct method - total count, block count, water hole count, capture – recapture method, point transect, and line transect method – use of soft ware for analysis. Exercise on the census methods - 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. Direct and indirect methods of studying food habits of different wildlife. Studying habitat management and manipulation techniques. Wildlife damage and control: Questionnaire survey. Wildlife photography.

### Reference Suggested Reading

- 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
- Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press
- Lever, C. 1985. Naturalised mammals of the world. John Wiley, London
- Mills, L.S. 2013. Conservation of Wildlife Populations Demography, Genetics and Management (Ed.2). Wiley-Blackwell.
- Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.
- Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun
- Wildlife Institute of India (2004) Compendium on the notes on the course Captive management of Endangered Species. Wildlife Institute of India. Dehra Dun
- Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England
- Zoos Print and Zoo Zen, Published by Zoo Outreaches Organization, Coimbatore
  - ERP Notes/NPTL/SWAYAM/NLIST/ MOOC

## Agricultural Informatics (FOR/SEC702T)

### Course outcome

Students will be able to

CO1: Explain Computer Programming Concepts, documentation and program maintenance, debugging programs, errors. explain visual basic, java, fortran, C/ C++, etc, concepts and standard input/output operations, Variables and Constants, Operators and Expressions, Flow of control, Inbuilt and User defined functions, programming techniques for agriculture/forestry.

CO2: Define & explain e-Agriculture, its concepts, design and development, discuss application of innovative ways to use information and communication technologies (IT) in agriculture/forestry, use ICT for Data Collection, formation of development programmes, monitoring and evaluation of Programmes.

CO3: Use computer models in agriculture/forestry: 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.

CO4: Discuss IT application for computation of water and nutrient requirement of crops, explain the Computer-controlled devices (automated systems) for Agri-input management. Smartphone mobile apps in agriculture for farm advises, market price, postharvest management etc, Geospatial technology- concepts, techniques, components and uses for generating valuable agri-information.

CO5: Explain the decision support systems-taxonomy, components, framework, classification and applications in agriculture/forestry, DSS, agriculture information/ expert system, soil information Systems etc for supporting farm decisions, explain the preparation of contingent crop-planning and crop calendars using IT tools.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC702T	Agricultural Informatics	2	70	30	100

### Theory-

#### Unit-I

Computer Programming-General Concepts, documentation and program maintenance, debugging programs, errors. Introduction to visual basic, java, fortran, C/ C++, etc, concepts and standard input/output operations, Variables and Constants, Operators and Expressions, Flow of control, Inbuilt and User defined functions, programming techniques for agriculture/forestry. e-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in agriculture/forestry.

#### Unit-II

ICT for Data Collection, formation of development programmes, monitoring and evaluation of Programmes. Computer models in agriculture/forestry: 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 application for computation of water and nutrient requirement of crops.

#### Unit-II

Computer-controlled devices (automated systems) for Agri-input management. Smartphone mobile apps in agriculture for farm advises, market price, postharvest management etc, Geospatial technology- concepts, techniques, components and uses for generating valuable agri-information. Decision support systems-taxonomy, components, framework, classification and applications in agriculture/forestry, DSS, agriculture information/ expert system, soil information Systems etc for supporting farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC702P	Agricultural Informatics	1	100	•	100

### Practical –

**Practical-** Study of Computer components, accessories, practice of important DOS commands. Introduction of different operating systems such as windows, Unix, Linux, Creating, Files & Folders, File

Management. Use of MS-WORD and MS Power point for document, handling of tabular data, animation, video tools, art tool, graphics, template & 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, demonstration of Agri-information system. Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Introduction of various programming languages such as Visual Basic, Java, Fortran, C, C++, and their components Hands on practice on writing small programmes. Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/CropSyst/Wofost. Preparation of Inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools. Use of smart phones and other devices in agro-advisory and dissemination of market information. Introduction of Geospatial Technology, demonstration of generating information important for Agriculture. Hands on practice on preparation of Decision Support System.

### **Project Work & Dissertation (Project Work & Dissertation)**

#### **Course outcome**

Students will be able to

CO1: Conduct exercises on the recent trends in the field of forestry in Institutional level, Forest department level & Industrial level.

CO2: Compile & analyse survey data.

CO3: Synthesize report on the basis of analysed data

CO4: Prepare presentation of the work done.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC703P	<b>Project Work &amp; Dissertation</b>	<b>10</b>	<b>100</b>	-	<b>100</b>

#### **Theory-**

This course shall provide the B.Sc. (Hons) Forestry students an understanding of the principles and procedures of the experimental design, layout, analysis and interpretation of data and technical writing. Each student shall work on a specific research project to be identified with the help of the supervising teacher. They shall also prepare and present a proposed plan of work (PPW) specifying the objectives and procedures of the study and present the same before an audience consisting of faculty and students. The research work will be conducted leading to the preparation of a project report in the format and style of M.Sc. thesis. Evaluation will be done based on the quality of work, quality of report and its presentation before an audience consisting of faculty and students. (Project shall be small on which can be completed within 90 days of the semester duration).

### **Semester-VII Forestry Work Experience**

#### **A. Orientation**

##### **Course outcome**

Students will be able to

CO1: Conduct exercises on the recent trends in the field of forestry in Institutional level, Forest department level & Industrial level.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC801P	<b>Orientation (10 days)</b>	<b>1</b>	<b>100</b>	-	<b>100</b>

**Practical –**



Conducting various exercises for exposing the students on the recent trends in the field of forestry, transactional analysis, personality development, soft skills etc. Various fields of forestry and environment for placement, internship and to prepare students for the rigours of professional life after completing B.Sc. Forestry programme.

## B. Forest Range Training Programme (FOR/CC802P)

### Course outcome

#### Student will be able to

CO1: Describe the working of State Forest Department for various activities i.e. use of forestry equipments, nursery preparation for plantation activities, plantation work, management of degraded sites, working plan preparation and valuation of forests.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC802P	Forest Range Training Program (50 days)	12	100	-	100

#### Practical –

Visit to modern forest nurseries, herbal gardens and watersheds, study the felling and logging operations, timber lots and important industrial products, study or working plan, enumeration, volume and yield calculation & compartment history files, study the ‘CAT’ (Catchment Area Treatment Plan) and FDA (Forest Development Agencies). Use of forestry equipments/ instruments. Study the regeneration and management of important forestry tree species. Sample plots, layout studies, stump analysis, preparation of local volume tables. Study the working of other Forestry related organizations/industries.

At the Wild life Sanctuaries/National Parks/Tiger Reserves, the students are expected to learn about the aspects related with the preparation of the management plans/conservation plans, to undertake and familiarize the various wildlife population enumeration techniques and the biodiversity assessment techniques. To undertake pilot studies on the man-animal conflict and other issues in the forest areas etc.

## C. Industrial Placement

### Course outcome

Students will be able to:

CO1: Explain nature & structure of industrial and business organizations

CO2: Explain the collection and processing of raw-material in Forest Based Industries like Wood Workshop, Saw Mills, Wood Seasoning and Preservation Treatment Plants, Pulp and Paper Industries, Aromatic and Medicinal Plant Units Carpentry, bamboo and reed crafts, other Wood Products Industries, rubber, NWFP.

CO3: Explain & apply the production and management process, marketing and financial management in Wood Workshop, Saw Mills, Wood Seasoning and Preservation Treatment Plants, Pulp and Paper Industries, Aromatic and Medicinal Plant Units Carpentry, bamboo and reed crafts, other Wood Products Industries, rubber, NWFP etc.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC803P	Industrial Placement (20 days)	3	100	-	100

#### Practical –

Attachment with Forest Based Industries like Wood Workshop, Saw Mills, Wood Seasoning and Preservation Treatment Plants, Pulp and Paper Industries, Aromatic and Medicinal Plant Units Carpentry, bamboo and reed crafts, other Wood Products Industries, rubber, NWFP etc. Works to be under taken includes study the nature of industrial and business organization–structure, raw material–

collection and processing of raw-material, hands on practicals, production and management process, marketing and financial management.

#### D. Socio Economic Surveys and Village Attachment (FOR/CC804P)

##### Course outcome

Students will be able to

CO1: Prepare survey questionnaire for socio-economic survey.

CO2: Conduct the socio-economic surveys for data collection of relevance and analysis of collected information

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/CC804P	Socio-Economic Survey and Village Attachment (20 days)	3	100	-	100

##### Practical –

Data collection, use of PRA techniques with respect to village profile including socio- economic and cultural status, farm technology used, homesteads, agro forestry, biodiversity etc., Bench Mark survey of plant resources (cropping pattern, homesteads, agro forestry, biodiversity, yield system etc.), Schedule development, tabulation, analysis and preparing plan of work. Understanding local forestry and other village level institutions(Panchayat,Village Forest Committees, cooperations, youth/women groups etc.), People's participation in developmental programmes with special reference to forestry. Exercises on the use of extension methods and teaching aids for transfer of technology.

#### Weapon Training and First Aid Training (5+3=8 days) (FOR/SEC801P)

##### Course outcome

Students will be able to

CO1: Handle various kinds of weapons.

CO2: Use different first aid practices which are required in case of field emergencies, like snakebite, animal attack, poachers and accidents.

CO2: Explain the first aid to be given to wild animals in distress.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC801P	Weapon Training and First Aid Training (5+3=8 days)	1	100	-	100

##### Practical –

Hands on training in the handling of various kinds of weapons and their operation, limitations and precautions during their use. Getting basic know ledge on different first aid practices which are required in case of field emergencies, like snakebite, animal attack, poachers and accidents. Also to learn about the first aid to be given to wild animals in distress and volunteering in rural health services.

#### Report Writing and Presentation (12 days) (FOR/SEC802P)

##### Course outcome

Students will be able to

- CO1: Compile & analyse survey data.  
 CO2: Synthesize report on the basis of analysed data  
 CO3: Prepare presentation of the work done.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/ SEC802P	Report Writing and Presentation (12 days)	2	100	-	100

**Practical –**

Compilation of the work/experience detailing the objectives, places and persons visited, work done, experiences/skills gained and suggestions for improvement of training. (Photographs/statics) Presentation of the report before faculty. The assessment will be based on Project Report evaluation and viva-voce.

**All India Tour\* (FOR/SEC803P)**

**Course outcome**

Students will experience

CO1: The fauna, flora and other research activities going on research institute, forest industries, Govt. and private organizations of different parts of country.

CO2: Various national / heritage monuments as part of national integration activity situated in India.

Course Code	Name of Subject	Credit	Marks		Total
			External	Internal	
FOR/SEC803P	All India Tour*	3	-	-	-

**Practical –**

**Three weeks' duration**

To familiarize the students with the flora , fauna and other research activities of forestry faculty in university, research institutes, forest industries, govt. and private organization of different parts of India. To expose the students to various national / heritage monuments as part of national integration activity.

**\* Non credit course**

# DEPARTMENT OF FORESTRY

## M. Sc. Forestry in SILVICULTURE & AGROFORESTRY

### COURSE CONTENT & SYLLABUS w.e.f. Session 2024-25



Our Motto:  
*Planting seeds for a better tomorrow*

**Dolphin (PG) Institute of Biomedical & Natural Sciences,  
Manduwala- Dehradun (An Autonomous Institute)**



**Syllabus of PG Programme**  
**M.Sc. FORESTRY IN SILVICULTURE AND AGROFORESTRY**

**Course Contents**

<b>Semester 1</b>						
<b>Code</b>	<b>Title</b>	<b>Theory External</b>	<b>Internal</b>	<b>Practical/ Term Paper</b>	<b>Total Marks</b>	<b>Credit</b>
<b>Major Courses</b>						
FOR-MC-901	Silviculture	60	20	20	100	2+1
FOR-MC-902	Forest Biometry	60	20	20	100	1+1
FOR-MC-903	Silvicultural Practices	60	20	20	100	1+1
FOR-MC-904	Agroforestry System	60	20	20	100	2+1
<b>Interdisciplinary Course</b>						
FOR-IDC-901	General Statistical Methods & Computer Application	60	20	20	100	2+1
<b>Ability Enhancement Course</b>						
FOR-AEC-901	Intellectual Property & Its Management in Agriculture	60	40	-	100	1+0
FOR-AEC-902	Basic Concepts in Laboratory Techniques	-	40	60	100	0+1
<b>Skill Enhancement Course</b>						
FOR-SEC-901	Agriculture Research, Research Ethics & Rural Development Programmes	60	40	-	100	1+0
FOR-SEC-902	Disaster management	60	40	-	100	1+0
<b>Total Marks and Credits</b>					<b>900</b>	<b>17</b>
<b>Semester II</b>						
<b>Major Courses</b>						
FOR-MC-905	Interactions in Agroforestry Systems	60	20	20	100	1+1
FOR-MC-906	Modern Nursery & Plantation Technology	60	20	20	100	2+1
FOR-MC-907	Tree and Shrubs for Agroforestry	60	20	20	100	1+1
<b>Interdisciplinary Course</b>						
FOR-IDC-902	Applied Forest Tree Improvement	60	20	20	100	2+1
FOR-IDC-903	Agro-techniques of Medicinal and Aromatic Crops	60	20	20	100	2+1
FOR-IDC-904	Experimental Designs	60	20	20	100	2+1
<b>Ability Enhancement Course</b>						
FOR-AEC-903	Library and Information Services	-	40	60	100	0+1
<b>Skill Enhancement Course</b>						

FOR-SEC-903	Technical Writing & Communication Skills	-	40	60	100	0+1
		<b>Total Marks and Credits</b>			<b>800</b>	<b>18</b>
<b>Semester III</b>						
<b>Major Courses</b>						
FOR-MC-908	Climate Change and Conservation Silviculture	60	20	20	100	2+0
FOR-MC-909	Economics of Agroforestry System	60	20	20	100	2+1
FOR-MC-910	Industrial Agroforestry	60	20	20	100	1+1
FOR-MC-911A	Master's Research Review (Thesis)	-	-	100	100	0+8
<b>Interdisciplinary Course</b>						
FOR-IDC-905	Pulp & Paper Technology	60	20	20	100	2+1
<b>Skill Enhancement Course</b>						
FOR-SEC-904	Master's Seminar	-	-	100	100	0+1
		<b>Total Marks and Credits</b>			<b>600</b>	<b>19</b>
<b>Semester IV</b>						
<b>Major Courses</b>						
FOR-MC-912	Nutrient and Weed Management in Production Forestry	60	20	20	100	1+1
FOR-MC-911B	Master's Research (Thesis)	-	-	100	100	0+22
		<b>Total Marks and Credits</b>			<b>200</b>	<b>24</b>



## Syllabus of PG Programme

### M.Sc. FORESTRY IN SILVICULTURE AND AGROFORESTRY

#### Semester I

##### FOR-MC-901 Silviculture

CO1: Explain the forest characters and forest types with relation to different ecosystems.

CO2: Assess the stand growth, development and application of silvicultural principles for the production and protection benefits from the forests.

CO3: Classify different vegetation form in India and of world.

CO4: Identify different site factors in different forests and use of different silvicultural treatments for better growth and development of a forest.

I – Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Silviculture	FOR-MC-901	2+1	60	20	20	100

#### IV – Aim of the Course

To understand stand growth, development and provide knowledge regarding the application of silvicultural principles for the production and protection benefits from the forests.

#### V – Theory (Total Lecture: 32)

##### Unit I

Forest ecosystems- Introduction to tropical/ temperate silviculture. Role of silviculture in forest and wild land management, major forest formations classification, distribution, composition and structure. Vegetation dynamics- species richness-diversity indices. Vegetation forms of India and their productivity. Forest ecosystem- structure and functioning, community development, competitive interactions in forest communities, forest succession, concepts and models of succession-Connell-Slatyer models, climax theories, tolerance.

##### Unit II

Ecophysiology of tree growth- effect of radiation and water relationship, mineral nutrients and temperature. Forest stand development – stand development, evenaged and uneven-aged stands, age and site quality. Tree architecture and its role in stand management.

##### Unit III

Stand density determination-stand density indices-stand density management density management diagram, silvicultural treatments involved- thinning as a stand management tool, objectives of thinning, effects on growth and yield, thinning effect on economic yield of stands. Forest site quality evaluation-direct and indirect methods.

##### Unit IV

Treatment analysis-silvicultural regimes- factors influencing choice of regimes, use of system analysis to determine regimes, models for evaluating silvicultural alternatives, development of silvicultural regimes to suit management objectives, optimum management strategies, silvicultural prescriptions for maximum production regime.

#### VI – Practical (Total Lecture: 16)

- Visit to forest areas to study forest composition, classification, factors of locality, site quality, form and growth of forest trees.
- Study plant succession- study stand density, changes on productivity- thinning effects

## VII – Suggested Reading

- . Daniel TW, Helms JA and Baker FS. 1979. Principles of Silviculture. McGraw-Hill Book Company.
- . Julius E. 1992. Plantation Forestry in the Tropics. Oxford University Press.
- . Khanna LS. 1996. Principle and Practice of Silviculture. International Book Distributors.
- . Khanna LS. 2015. Theory and Practice of Indian Silviculture Systems. Bio-Green Publisher.
- . Lamprecht. 1986. Silviculture in the Tropics. Verlag Paul Parey, Hamburg und Berlin.
- . Nyland RD, Laura S, Kenefic, Kimberly K, Bohn and Susan LS.2016 Silviculture: Concepts and Applications (III edition), Kindle Edition, USA.
- . Pascal. 1988. Wet Evergreen Forests of the Western Ghats.
- . Shepherd KR. 1986. Plantation Silviculture. Springer.
- . Smith DM, Larson BC, Ketty MJ and Ashton PMS. 1997. The Practices of Silviculture- Applied Forest Ecology. John Wiley & Sons.

## FOR-MC-902 FOREST BIOMETRY

CO1: Enlist, define & describe relevant terminology and basics of subject, explain different parameter like diameter, height, determination of tree age and dendrochronology for growth history and climate change studies.

CO2: Practice and apply different parameters like estimation of volume, growth and yield of individual tree and forest stands.

CO3: Evaluate Forest inventory, sampling methods adopted in forestry and Use of GIS in forest experiment in the field and infer the observations. Find errors & measure quantification of regeneration and stand establishment. measurement of crown density and crown ratios

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Forest Biometry	FOR-MC-902	1+1	60	20	20	100

## IV – Aim of the Course

To develop understanding of students about tree and stand measurements, forest inventory and yield concepts.

## V – Theory (Total Lecture: 16)

### Unit I

Measurement of tree parameters. Determination of tree age and dendrochronology for growth history and climate change studies.

### Unit II

Estimation of volume, growth and yield of individual tree and forest stands. Preparation of volume tables. Application of yield and stand tables.

### Unit III

Forest inventory, sampling methods adopted in forestry, Use of GIS in forest inventory. Quantification of regeneration and stand establishment. Measurement of crown density and crown ratios. Simulation techniques. Growth and yield prediction models – their preparation and applications.

## VI – Practical (Total Lecture: 16)

- Calculations of volume of felled as well as standing trees;
- Volume table preparation;
- Application of different sampling methods;
- Preparation of yield and stand table;
- Quantification of regeneration and stand establishment;
- Measurement of crown density and crown ratios;
- Crown profiling of trees and stand;
- Dendrochronological studies.

## VII - Suggested Reading

- Chaturvedi AN and Khanna LS. 1994. Forest Mensuration. International Book Distributor.
- Ram Parkash 1983. Forest Surveying. International Book Distributor.
- Sharpe GW, Hendee CW and Sharpe WE. 1986. Introduction to Forestry. McGraw-Hill.
- Simmons CE. 1980. A Manual of Forest Mensuration. Bishen Singh Mahender Pal Singh, Dehradun.

## FOR-MC-903 – SILVICULTURAL PRACTICES

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2: Describe key ecological concepts surrounding the development of forest stands and how forest vegetation reacts to forestry activities.

CO3: Prepared to diagnose and quantify current conditions in a given inventory information, describe the desired conditions given landowner objectives, and to prescribe silvicultural treatments that will move current stand towards desired conditions.

CO4: Develop the forest management prescriptions to achieve the identified property goals, suggest alternative forest management treatments that may result in desirable conditions at the stand and landscape level, and achieve the goals compared to economics and effectiveness in Silvicultural practice.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Silvicultural Practices	FOR-MC-903	1+1	60	20	20	100

## IV – Aim of the Course

To acquaint the students with the advanced silvicultural practices in forestry with particular reference to commercial and short rotation forestry.

## V – Theory (Total Lecture: 17)

### Unit I

Silviculture under changing context of forestry- silviculture and ecosystem management, stand dynamics, silvicultural practices for pure and mixed stand, even aged and uneven aged stand – silvicultural practices for changing climatic conditions.

### Unit II

Silvicultural practices for natural and artificial regeneration – Ecology of regeneration, forest site management- enrichment of site – quality classes and site index models – stand density – spacing and tree growth – forest vegetation management – techniques for early stand growth- tending operations. Biomass allocation: belowground and aboveground. Changing trends in adoption of silvicultural systems.

### Unit III

Stand development – stages- crown dynamics, Crown Competition factor, Maximum crown area, thinning – pruning – response of trees and impact on wood quality, salvage cutting – improvement felling and enrichment planting – management of weeds, Invasive weeds in forests, Silvicultural practices for short rotation forestry, coppice forestry, Continuous cover forestry.

**Unit IV**

Site specific selection of tree species. Precision silviculture –silvicultural practices for important fast growing trees and bamboos of India- *Populus* species, *Neolamarkia cadamba*, *Eucalyptus sp.*, *Casuarina sp.*, *Tectona grandis*, *Melia dubia*, *Dalbergiasissoo*, *Gmelina arborea*, *Leucaena leucocephala*, *Ailanthus excelsa*, *Azadirachta indica*, *Swietenia macrophylla*, *Dendrocalamus sp.*, *Bambusa sp.*, – Mechanization of silvicultural practices.

**VI – Practical (Total Lecture: 16)**

- Visit to different forest sites to study the influence of site factors on composition;
- Determination of site quality;
- Studies on stand structure and composition of different forest types;
- Practicing pruning and its impact on wood quality;
- Characterizing methods of thinning;
- Working out intensity of thinning;
- Study of stand densities in natural forest stand and plantation stand;
- Afforestation techniques, Wood management techniques for forest tree crops;
- Planning and designing a tree planting programme;
- Exercise on precision silviculture practices;
- Exercise on mechanized silvicultural practices.

**VII – Suggested Reading**

- . Daniel TW, Helms JA and Baker FS. 1979. Principles of Silviculture. McGraw-Hill Book Company.
- . Julius E. 1992. Plantation Forestry in the Tropics. Oxford University Press.
- . Khanna LS. 1996. Principle and Practice of Silviculture. International Book Distributors.
- . Khanna LS. 2015. Theory and Practice of Indian Silviculture Systems. Bio-Green Publisher.
- . Lamprecht. 1986. Silviculture in the Tropics-Verlag Paul Parey, Hamburg und Berlin.
- . Nyland RD, Laura S, Kenefic, Kimberly K, Bohn and Susan LS.2016 Silviculture: Concepts and Applications (III edition), Kindle Edition, USA.
- . Shepherd KR. 1986. Plantation Silviculture. Springer.
- . Smith DM, Larson BC, Ketty MJ and Ashton PMS. 1997. The Practices of Silviculture- Applied Forest Ecology. John Wiley & Sons.

**FOR-MC-904 – AGROFORESTRY SYSTEMS**

CO1: To understand the concept of agroforestry.

CO2: To study structure & function of different agroforestry systems

CO3: To understand the role of agroforestry trees in soil, water, nutrient conservation & climate change mitigation.

CO4: To define social and community forestry.

CO5: To study global trends in agroforestry research and learn Diagnosis & design methodology

CO5: To explain agroforestry’s role in mitigation of climate change

I – Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Agroforestry Systems	FOR-MC-904	2+1	60	20	20	100

#### **IV – Aim of the Course**

To impart knowledge on the concept of agroforestry as a sustainable land use including diagnosis and design methodologies; overview of agroforestry and case studies.

#### **V – Theory (Total Lecture: 32)**

##### **Unit I**

Agroforestry: objectives, importance, potentials and limitations for implementations. Land capability classification and land evaluation. Basis of classification of agroforestry systems and principles, indigenous vs. exotic, intraspecific variations, crown architecture of tropical/ temperate trees. Ideotype concept for selection of multipurpose trees. Nitrogen fixing trees. Overview and case studies of different agroforestry systems.

##### **Unit II**

Structural and functional attributes of agroforestry systems, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, silvopastoral systems, shelter-belts and windbreaks, energy plantations and home gardens.

##### **Unit III**

Role of trees in soil productivity and conservation– micro-site enrichment- litter and fine root dynamics, Nitrogen fixation and nutrient pumping. Soil productivity and management in agroforestry.

##### **Unit IV**

Community forestry and social forestry, linear strip plantations.

##### **Unit V**

Trends in agroforestry systems research and development, Diagnosis and Design –PRA-RRA tools in agroforestry problem diagnosis.

##### **Unit VI**

Climate Change mitigation and adaptation through agroforestry- climate negotiations- LULUCF-agroforestry options.

#### **VI – Practical (Total Lecture: 16)**

- Survey and analysis of land use systems in the adjoining areas
- Study of tree crown architecture;
- Design and plan of suitable models for improvement
- PRA-RRA tools in agroforestry problem diagnosis.

#### **VII – Suggested Reading**

- . Buck LE, Lassoie, Fernandes ECM 1999. Agroforestry in Sustainable Agri. Systems. CRC Press.
- . Kumar BM and Nair PKR. 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Springer publication.
- . Kumar BM and Nair PKR. 2013. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and Challenges (Advances in Agroforestry). Springer publication.
- . Nair PKR and Latt 1998. Directions in Tropical Agroforestry Research. Kluwer.
- . Nair PKR, Rai MR and Buck LE. 2004. New Vistas in Agroforestry. Kluwer
- . Nair PKR. 1993. An Introduction to Agroforestry. Kluwer Academic Pub.
- . Ong CK and Huxley PK. 1996. Tree Crop Interactions – A Physiological Approach. ICRAF.
- . Peter Huxley. 1999. Multiple Cropping with Woody and Non-Woody Plants. John Wiley and Sons Ltd, Oxford, United Kingdom.
- . Tejwani KG. 1994. Agroforestry in India. Oxford & IBH Publishing Co. Pvt Ltd.
- . Thampan PK. 1993. Trees and Tree Farming. Peekay Tree Crops Development Foundation.
- . Young A. 1997. Agroforestry for Soil Management. CABI.

## INTERDISCIPLINARY COURSE

### FOR-IDC-901 – GENERAL STATISTICAL METHODS & COMPUTER APPLICATION

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2: Illustrate the concepts of general statistical methods and statistical inference that would help in understanding the importance of statistical methodology.

CO3: Prepare the concepts involved in data presentation, analysis and interpretation of results, develop design CRD, RBD.LSD solved and interpreted the practical real life problem.

CO4: Apply basic probability principal to solved real life problems

CO5: Understand & explain the t, F and chi- square distribution and to indentify the main characteristics of these distribution.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
General Statistical Methods and Computer Applications	FOR-IDC-901	2+1	60	20	20	100

#### IV – Aim of the Course

This course is meant for students who do not have sufficient background of statistical methods. The students would be exposed to concepts of general statistical methods and statistical inference that would help them in understanding the importance of statistical methodology. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation of results.

#### V – Theory (Total Lecture: 32)

##### Unit I

Review of probability. Random variable and mathematical expectation. Discrete and continuous probability distributions, viz., Binomial, Poisson and Normal distributions.

##### Unit II

Correlation and regression, Rank correlation, Non-linear regression, Partial and multiple correlation coefficient, Intra class correlation, Multiple linear regression.

##### Unit III

Introduction to theory of estimation, Testing of statistical hypothesis: chi-square, t and F distributions. Tests of significance based on chi-square, t and F tests. Large sample tests, Fisher Z transformation.

##### Unit IV

Analysis of variance: One way and two-way classification.

##### Unit V

MS Excel, introduction to computer softwares

#### VI – Practical (Total Lecture: 16)

- Random variable and mathematical expectation;
- Fitting of distributions, viz., Binomial, Poisson, Normal;
- Correlation and regression;
- Non-linear regression
- Multiple linear regression;
- Testing of hypothesis based on chi square, t and F tests
- . Exercises based on computer software

## VII – Suggested Reading

- Aggarwal BL. 1996. Basic Statistics. Wiley Eastern Limited, New Age International Ltd.
- Bansal ML, Singh S, Singh TP and Kumar R. 2004. Statistical Methods for Research Workers. Kalyani Publishers.
- Chandel SRS. 2014. A Handbook of Agricultural Statistics. AchalPrakashan.
- Goon AM, Gupta MK and Dasgupta B. 1968. Fundamentals of Statistics, vol I, II. The World Press, Calcutta.
- Snedecor GW and Cochran WG. 1980. Statistical Methods. East West Press.

## ABILITY ENHANCEMENT COURSE

### FOR-AEC-901 -INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2- Assess the knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Intellectual Property and its Management in Agriculture	FOR-AEC-901	1+0	60	40	No Practical	100

## IV – Aim of the Course

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

## V-Theory (Total Lecture: 17)

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

## VI- Suggested Readings

- Erbis FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.

- Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
- Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House. The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

## FOR-AEC-902 - BASIC CONCEPTS IN LABORATORY TECHNIQUES

CO1: List & Label different laboratory instruments & chemicals used.

CO2: Classify and explain different safety measures in laboratory.

CO3: Practice, Apply and Experiment with instruments & Chemicals and write the result.

CO4: Calculate data from experiments findings

CO5: Estimate and test the experiment results, evaluate & infer experiments findings.

I - Title	II - Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Basic Concepts in Laboratory Techniques	FOR-AEC-902	0+1	-	40	60	100

### IV – Aim of the Course

To acquaint the students about the basics of commonly used techniques in laboratory.

### V-Practical (Total Lecture: 16)

- Safety measures while in Lab;
- Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets;
- Washing, drying and sterilization of glassware;
- Drying of solvents/ chemicals;
- Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions;
- Preparation of different agro-chemical doses in field and pot applications;
- Preparation of solutions of acids;
- Neutralisation of acid and bases;
- Preparation of buffers of different strengths and pH values;
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, waterbath, oilbath;
- Electric wiring and earthing;
- Preparation of media and methods of sterilization;
- Seed viability testing, testing of pollen viability;
- Tissue culture of crop plants;
- Description of flowering plants in botanical terms in relation to taxonomy.



## VI- Suggested Readings

1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.
2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

## SKILL ENHANCEMENT COURSE

### FOR-SEC-901 – AGRICULTURAL RESEARCH, RESEARCH ETHICS & RURAL DEVELOPMENT PROGRAM.

CO1: Describe and enlist the associated national & international research institutions related to agricultural research, research ethics and rural development program and policies.

CO2: Explain research ethics and classify & describe safety rules in laboratories

CO3: Critical evaluation of rural development policies and programmes.

I - Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Agricultural Research, Research Ethics & Rural Development Program	FOR-SEC-901	1+0	60	40	No Practical	100

## IV – Aim of the Course

To enlighten the students about the organization and functioning of agricultural & Forestry research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

## V- Theory (Total Lecture: 17)

### UNIT I

History of agriculture & Forestry in brief; Global agricultural & Forestry research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural & Forestry research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

### UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

### UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

## VI- Suggested Readings

- Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.

- Punia MS. Manual on International Research and Research Ethics. CCS Haryana Agricultural University, Hisar.
- Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publ.
- Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publ.

## FOR-SEC-902 DISASTER MANAGEMENT

CO1: To understand meaning, nature, types & effect of natural disasters

CO2: To understand meaning, nature, types & effect of man made disasters

CO3: To understand the efforts done nationally & globally for disaster management.

I - Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Disaster management	FOR-SEC-902	1+0	60	40	No Practical	100

### V-Aim of the Course

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

### VI- Theory (Total Lecture: 17)

#### UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

#### UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

#### UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

### VII- Suggested Readings

- Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.
- Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.
- Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India.

## SEMESTER II

### MAJOR COURSES

#### FOR-MC-905– INTERACTIONS IN AGROFORESTRY SYSTEMS

CO1: Explain and classify tree-crop & tree-animal interactions

CO2: Identify trees-crop & tree-animal interphase.

CO3: Explain methods of quantification of interactions and assess the interaction effects.

CO5: Discuss & prioritize management options to reduce negative interactions.

I – Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Interactions in Agroforestry Systems	FOR-MC-905	1+1	60	20	20	100

#### IV – Aim of the Course

To impart knowledge to the students regarding tree-crop interaction, their quantification and techniques to neutralize the negative tree-crop interactions.

#### V – Theory (Total Lecture: 17)

##### Unit I

Tree-crop interphase- biological factors affecting form and function in woody and non-woody plant mixtures. Nature and types of interactions- positive and negative, aboveground and belowground interactions- competition, complementarity in resource sharing.

##### Unit II

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. Allelopathy. Use of radioisotopes in tree-crop interaction studies. Root distribution of trees and crops- competition and/or complementarity. Animal-tree-crop interaction.

##### Unit III

Management options to neutralize negative (competitive) interactions, tree husbandry practices for alleviating competition- tree density manipulation, pruning, mixture of trees and herbaceous crops.

#### VI – Practical (Total Lecture: 16)

- Different methods for quantifying interactions;
- Studies on allelopathy;
- Effect, microclimate modifications, different plant mixtures, tree-soil-crop interactions;
- Estimation of Land Equivalent Ratio, Estimation of competition indices;
- Measurement and interpretation of light interception in agroforestry systems;
- Interpretation of yield responses to shelter, soil water and drainage measurement, transpiration measurement, quantifying root distribution.

#### VII – Suggested Reading

- Avery MA, Cannel MGR and Ong CK. 2005. Biophysical Research for Asian Agroforestry. Oxford and IBH Publishing Co. Pvt. Ltd.
- Mac Dicken, KG and Vergara NT. 1989. Agroforestry- classification and Management.
- Nair PKR. 1993. An Introduction to Agroforestry. Kluwer Academic Pub.
- Ong CK and P Huxley. 2002. Tree-Crop Interactions- A Physiological approach, CAB International.

- Patra AK. 2013. Agroforestry- Principles and Practices. New India Publishing AGENCY, New Delhi (India).

## FOR-MC-906 – MODERN NURSERY & PLANTATION TECHNOLOGY

CO1: Discuss the knowledge of modern nursery techniques.

CO2: Explore the mass plant production in modern nurseries.

CO3: Use of different management practices of nutrient, irrigation and soil fertility.

CO4: Identify different ecological factors for raising forest plantation.

CO5: Identify modern equipment and tools used in nursery.

CO6: Use of different treatment of seed and sowing methods.

CO7: Explore nursery bed preparation and different cultural operations in nursery.

I – Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Modern Nursery & Plantation Technology	FOR-MC-906	2+1	60	20	20	100

### IV – Aim of the Course

To impart knowledge and develop understanding about modern nursery techniques for mass production alongwith various aspects of productivity, integrated nutrient and irrigation management as well as ecological factors in raising forest plantation.

### V – Theory (Total Lecture: 32)

#### Unit I

Introduction and importance of nursery. Types of nurseries-temporary and permanent, bare root, containerized and clonal nursery. Bare root nursery- nursery soil and water management, bed preparation, pre-sowing seed treatments, seed sowing and intermediate operations, viz., pricking, watering, fertilization, weeding and hoeing.

#### Unit II

Root culturing techniques. Containerized nursery- types & size of containers including root trainers. Selection of growing medium. Types of green house and mist chamber for propagation. Vegetative propagation – importance, selection of superior genotypes. Advanced methods of propagation, growing media, fertilizers, sanitation and management in vegetative propagation. Special requirement for clonal propagation. Propagation structure and management.

#### Unit III

Clonal propagation: miniclonal and micro cuttings technology. Vegetative propagation of bamboos and canes. Factors affecting rooting of cuttings. Lifting windows. Important forest nursery pests and diseases and their management. Seedling quality assessment, grading, packaging, storing and transportation.

#### Unit IV

Role of plantation forestry in meeting the wood demand. Purpose of plantation. Factors determining scale and rate of plantation. Land suitability and choice of species.

#### Unit V

Preliminary site preparation for establishing plantation. Plantation planning. Project formulation and appraisal. Planting programme. Time of planting. Spacing, pattern and planting methods.

#### Unit VI

Nutritional dynamics and irrigation of plantation. Mechanization in plantation. Protection and after care of

plantation. Pruning and thinning in plantations. Rotation in plantation. Failures of plantations.

### Unit VII

Sustainable yield from plantations. Case studies in plantations of Eucalyptus. *Poplars, Acacias, Pine, Gmelina, Bamboo*, etc. Production technology of energy plantations. Industrial plantations.

### VI – Practical (Total Lecture: 16)

- Introduction and identification of modern equipments and tools used in nursery;
- Pre-sowing seed treatments;
- Preparation of nursery beds and growing media for containerized nursery;
- Sowing of seed and other intermediate operations;
- Preparation and planting of cuttings;
- Assessment of seedling quality;
- Visit to forest nurseries;
- Nursery practices of commercially important tree species;
- Preparation of plantation calendar;
- Preliminary arrangement for a plantations programme;
- Planting geometry and calculation of planting stock;
- Studies on wood based industries – problems and prospects;
- Management of Eucalyptus, Casuarina, Teak, Sal, Poplar, Acacias and Bamboo plantations;
- Production technology for energy plantations. INM in plantations.

### VII – Suggested Reading

- Bhardwaj RL and Sarolia DK. 2011. Modern Nursery Management. Published by Agrobios Publishing. New Delhi (India).
- Kumar GA and Gopikumar. 2003. Forest Nursery and Tree Husbandry.
- Kumar V. 2012. Nursery and Plantation Practices in Forestry. Scientific Publishers (India).
- Saini RS, Kaushik N, Kaushik RA and Godara NR. 2012. Practical Nursery Production. Agrobios, New Delhi (India).
- Dwivedi AP 1993. Forestry in India. Surya Publ.
- Julius E. 1982. Planation Forestry in the Topics. Clarendon Press Oxford.
- Kumar, V. 1999. Nursery and Plantation Practices in Forestry. Scientific Publ.
- Luna R.K. 1989. Plantation Forestry in India. International Book Distributors.
- Prakash R. Chaudhary DC and Negi SS. 1998. Plantation and Nursery Techniques of Forest Trees. International Book Distributors.

## FOR-MC-910 – TREE AND SHRUBS FOR AGROFORESTRY

CO1: Understand importance of woody perennials in Agroforestry systems

CO2: Explain suitability of tree and shrub according to agro-climatic zones.

CO3: Learn the relevance of fruit trees & their suitable Agroforestry designs.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Tree and Shrubs for Agroforestry	FOR-MC-910	1+1	60	20	20	100

### IV – Aim of the Course

To make students familiar with trees and shrubs (fruit, fodder and small timber) suitable for

agroforestry.

## **V – Theory (Total Lecture: 17)**

### **Unit I**

Introduction, importance of woody elements in agroforestry systems, their role in biomass production. Suitability of species for different purposes. Multipurpose trees in agroforestry systems. Fodder from trees/ shrubs and their nutritive value, propagation techniques.

### **Unit II**

Role of nitrogen fixing trees/ shrubs. Choice of species for various agro-climatic zones for the production of timber, fodder, fuel wood, fibre, fruits, medicinal and aromatic plants. Generic and specific characters of trees and shrubs for agroforestry.

### **Unit III**

Fruit crop and small timber trees and their need and relevance in agroforestry, trees suitable for various assemblage and their planting plan in different agroclimatic zones and agroforestry system. Intercropping in fruit orchards like Apple, Walnut, Jack fruit, Mango, Sapota, Pomegranate, Orange, Citrus, Guava, etc. Modification in tending and pruning operations and canopy management. Fertility management, yield and quality improvement.

## **VI – Practical (Total Lecture: 16)**

- Field survey and acquaintance with specialized features of trees, shrubs and fruit species and varieties for Agroforestry;
- Planting plans including wind breaks;
- Training and pruning of forest trees, shrubs and fruit trees for enhancing production in agroforestry system.

## **VII – Suggested Reading**

- Dwivedi AP. 1992. Agroforestry: Principles and Practices. Oxford & IBH.
- Nair PKR, Rai MR and Buck LE. 2004. New Vistas in Agroforestry. Kluwer.
- Nair PKR. 1993. An Introduction to Agroforestry. Kluwer.
- Ong CK and Huxley PK. 1996. Tree Crop Interactions – A Physiological Approach. ICRAF.
- Srivastava KK. 2007. Canopy Management of Fruit Crops, IBD.
- Thampan PK. 1993. Trees and Tree Farming. Peekay Tree Crops Development Foundation.

## **INTERDISCIPLINARY COURSE**

### **FOR-IDC-902 –APPLIED FOREST TREE IMPROVEMENT**

CO1: Enlist, define & describe relevant terminology and basics of subject.

CO2: Examine the techniques of selecting superior trees in natural stands and plantations, including their floral biology and controlled crossing.

CO3: Plan vegetative propagation techniques.

CO4: Plan to assess pollen viability.

CO5: Investigate Numerical exercises and statistical analysis in quantitative genetics.

CO6: Inspect the seed production areas and seed orchards.

<b>I – Title</b>	<b>II – Code</b>	<b>III - Credit Hours</b>	<b>Theory</b>	<b>Internal</b>	<b>Practical</b>	<b>Total</b>
Applied Forest Tree Improvement	FOR-IDC-902	2+1	60	20	20	100

#### **IV – Aim of the Course**

To acquaint the students about general principles of tree breeding with examples of important trees.

#### **V – Theory (Total Lecture: 32)**

##### **Unit I**

General concept of forest tree breeding, tree improvement and forest genetics.

##### **Unit II**

Reproduction in forest trees, dimorphism, pollination mechanism. Pollen dispersal, pollinators. Attractants for pollinators.

##### **Unit III**

Variation in trees, importance and its causes. Natural variations as a basis for tree improvement. Geographic variations – Ecotypes, clines, races and land races.

##### **Unit IV**

Selective breeding methods- mass, family, within family, family plus within family. Plus tree selection for wood quality, disease resistance and agroforestry objectives. Selection strategies and choice of breeding methods and progress in selective breeding in forest trees.

##### **Unit V**

Seed orchards – type, functions and importance, Genetic testing- mating designs and field designs. Progeny and clone testing estimating genetic parameters and genetic gain, clonal and breeding values. Average performance of half sibs and fullsibs. GxE interaction in trees.

##### **Unit VI**

Heterosis breeding: inbreeding and hybrid vigour. Manifestation and fixation of heterosis. Species and racial hybridization. Indian examples – teak, shisham, eucalypts, acacias, poplar, etc.

##### **Unit VII**

Polyploidy, aneuploidy and haploidy in soft and hard wood species. Induction of polyploidy.

##### **Unit VIII**

Elements of biotechnology in tree improvement.

#### **VI –Practical (Total Lecture: 16)**

- Floral biology, modes of reproduction and modes of pollination in forest trees;
- Estimating pollen viability. Controlled pollination and pollen handling;
- Manipulation of flowering through hormones;
- Identification of ecotypes, races and land-races in natural forest;
- Visit to species, provenance and progeny trials;
- Selection of superior phenotypes;
- Marking of candidate trees, plus trees and elite trees;
- Visit to seed orchards;
- Comparison of parents and their putative hybrids;
- Induction of polyploidy through colchicine treatment;
- In-vitro propagation, study of molecular markers.

#### **VII – Suggested Reading**

- Dutta M and Saini GC. 2009. Advances in Forestry Research in India, Vol. XXX. Forest Tree Improvement and Seed Technology. International Book Distributors.
- Finkeldey R and Hattermer HH. 2006. Tropical Forest Genetics. Springer.
- Mandal AK and Gibson GL. (Eds). 1997. Forest Genetics and Tree Breeding. CBS.

- Sedgley M and Griffin AR. 1989. Sexual Reproduction of Tree Crops. Academic Press.
- Surendran C, Sehgal RN and Paramathma M. 2003. Text Book of Forest Tree Breeding. ICAR.
- White TL, Adams WT and Neale DB. 2007. Forest Genetics. CABI, UK.
- Wright JW. 1976. Introduction to Forest Genetics. Academic Press.
- Zobel BJ and Talbert J. 1984. Applied Forest Tree Improvement. John Wiley and Sons.

## FOR-IDC-903 –AGRO-TECHNIQUES OF MEDICINAL AND AROMATIC CROPS

**CO1:** To understand importance of MAP & organic farming.

**CO2:** To study detailed cultivation practices of economically important medicinal plants

**CO3:** To study detailed cultivation practices of economically important aromatic plants

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Agro-techniques of Medicinal and Aromatic Crops	FOR-IDC-903	2+1	60	20	20	100

### IV – Aim of the Course

To equip the student with the conventional and commercial production techniques of medicinal and aromatic plant species.

### V – Theory (Total Lecture: 32)

#### UNIT I

Importance of medicinal and aromatic plants in human health, national economy and related industries. Need of cultivation of medicinal and aromatic plants as agricultural crops. Concept of organic farming, GACP and GAP in medicinal and aromatic crops production. Quality concern in plant based drugs.

#### UNIT II

Introduction and importance, climate and soil requirements, cultural practices, harvesting and yield, important constituents of medicinal plants – Mulhathi, Senna, *Gloriosa superba*, *Valeriana jatamansi*, *Swertia chirayita*, Isabgol, *Rauwolfia serpentina*, *Withania sominifera*, *Opium Poppy*, *Aloe vera*, Satavar, *Stevia rebaudiana*, Safed Musli, Kalmegh and other important species of the region.

#### UNIT III

Introduction and importance, climate and soil requirements; cultural practices; harvest and yield; important constituents of aromatic plants – Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, *Tagetes minuta*, Lavender, Rosemary, Patchouli, Geranium and other important species of the region.

### VI –Practical (Total Lecture: 16)

- Morphological identification of listed plants and their economic parts, maturity indices;
- Preparation and layout of nursery and field, methods of seed sowing/ transplantation, cultural operations in MAP crops;
- Raising and harvesting of at least one crop grown in the region;
- Visit to government and private Pharmaceutical units/ Institutes in adjoining areas;
- Visit to large scale herb growing and processing units engaged in commercial cultivation and preparation of purified phytochemical/ standardized extracts;
- Visit to nearby marketing/ trade centres.



## VI – Suggested Reading

- Atul CK and Kapur BK. 1982. Cultivation and Utilization Of Medicinal Plants. RRL, CSIR, Jammu-Tawi.
- Chadha KL and Gupta R. 2006. Advances in Horticulture. Vol. XI. Medicinal and aromatic plants. Malhotra Publishing House.
- Chopra AK. 2007. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Books.
- Chopra RN. Nayar SL and Chopra IC. 1956. Glossary of Indian Medicinal Plants. CSIR, New Delhi.
- EIRI Board. 2007. Handbook of Medicinal and Aromatic Plants: Cultivation, Utilization and Extraction Processes. Engineers India Research Institute, New Delhi.
- Gunther E. 1975. The Essential Oils. Robert, K Krieger Pub. Co, New York.
- Khan IA and Khanum A. 2005. Medicinal and Aromatic Plants of India; Herbal Wealth for Human Health. 1 st Ed. Ukaaz Publications.
- Muralia S. 2006. Medicinal and Aromatic Plants 1 st Ed. Neha Publishers and Distributors.

## FOR-IDC-904 – EXPERIMENTAL DESIGNS

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2- Explain the concepts of general statistical methods and statistical inference that would help in understanding the importance of statistical methodology. Illustrate the concepts involved in data presentation, analysis and interpretation of results.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Experimental Designs	FOR-IDC-904	2+1	60	20	20	100

## IV – Aim of the Courses

This course is meant for students who do not have sufficient background of statistical methods. The students would be exposed to concepts of general statistical methods and statistical inference that would help them in understanding the importance of statistical methodology. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation of results.

## V – Theory (Total Lecture: 32)

### Unit I

Design of Experiments: Basic Principles of design of experiments, Completely Randomised Design, Randomised Block Design, Latin Square Design. Elementary idea of factorial experiments. Estimation of genetic parameters from ANOVA table.

### Unit II

Non-parametric tests: Sign test, Wilcoxon test, Mann-Whitney U-test, Wald Wolfowitz run test, Median test, Kruskal- Wallis test.

## VI – Practical (Total Lecture: 16)

- Testing of hypothesis based on chi square, t and F tests.
- Large sample tests. Completely Randomised Design, Randomised Block Design, Latin Square Design and Factorial experiments.
- Non-parametric tests

## VII – Suggested Reading

- Aggarwal BL. 1996. Basic Statistics. Wiley Eastern Limited, New Age International Ltd.
- Bansal ML, Singh S, Singh TP and Kumar R. 2004. Statistical Methods for Research Workers. Kalyani Publishers. Chandel SRS. 2014. A Handbook of Agricultural Statistics. Achal Prakashan.
- Goon AM, Gupta MK and Dasgupta B. 1968. Fundamentals of Statistics, vol I, II. The World Press, Calcutta. Snedecor GW and Cochran WG. 1980. Statistical Methods. East West Press.

## ABILITY ENHANCEMENT COURSE

### FOR-AEC-903 – LIBRARY AND INFORMATION SERVICES

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2: Explain the library users with skills to trace information from libraries efficiently, CO3- Assess information and knowledge resources.

CO3: Carry out literature survey, formulate information search strategies and

CO4: Use modern tools (Internet, OPAC, search engines, etc.) of information search.

I - Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Library and Information Services	FOR-AEC-903	0+1	-	40	60	100

#### IV- Aim of the Course

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines, etc.) of information search.

#### V- Practical (Total Lecture: 17)

- Introduction to library and its services
- Role of libraries in education, research and technology transfer
- Classification systems and organization of library
- Sources of information- Primary Sources, Secondary Sources and Tertiary Sources
- Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.)
- Tracing information from reference sources
- Literature survey; Citation techniques/ Preparation of bibliography
- Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services;
- Use of Internet including search engines and its resources; e-resources access methods.

## SKILL ENHANCEMENT COURSE

### FOR-SEC-903 -TECHNICAL WRITING AND COMMUNICATIONS SKILLS

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2: Write dissertations, research papers, etc.

CO3: Communicate and articulate in English (verbal as well as writing).

<b>I - Title</b>	<b>II – Code</b>	<b>III - Credit Hours</b>	<b>Theory</b>	<b>Internal</b>	<b>Practical/ Term Paper</b>	<b>Total</b>
Technical writing and Communication Skills	FOR-SEC-903	0+1	-	40	60	100

#### **IV- Aim of the Course**

To equip the students/ scholars with skills to write dissertations, research papers, etc. To equip the students/ scholars with skills to communicate and articulate in English (verbal as well as writing).

#### **V- Practical (Technical Writing) (Total Lecture: 17)**

- Various forms of scientific writings- theses, technical papers, reviews, manuals, etc.;
- Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion);
- Writing of abstracts, summaries, précis, citations, etc.;
- Commonly used abbreviations in the theses and research communications;
- Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;
- Writing of numbers and dates in scientific write-ups;
- Editing and proof-reading;
- Writing of a review article;
- Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks);
- Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription;
- Accentual pattern: Weak forms in connected speech;
- Participation in group discussion;
- Facing an interview;
- Presentation of scientific papers.

#### **VI- Suggested Readings**

- Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language
- Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.
- Collins' Cobuild English Dictionary. 1995.
- Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed.
- Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press.
- James HS. 1994. Handbook for Technical Writing. NTC Business Books.
- Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
- Mohan K. 2005. Speaking English Effectively. MacMillan India.
- Richard WS. 1969. Technical Writing.
- Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India.
- Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

## SEMESTER III

### MAJOR COURSE

#### FOR-MC-908 - CLIMATE CHANGE AND CONSERVATION SILVICULTURE

CO1: Understand the basics & terminology of climate change & its mitigation

CO2: Explain the silviculture strategies in change climatic scenario.

CO3: Describe the impacts of anthropogenic & natural disturbance in forests.

CO4: understanding of role of trees to combat climate change.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Climate Change and Conservation Silviculture	FOR-MC-908	2+0	60	40	No Practical	100

#### IV – 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.

#### V – Theory (Total Lecture: 32)

##### Unit I

Global climate change-factors involved, green house 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.

##### Unit II

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.

##### Unit III

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.

##### Unit IV

Impacts of 'No Green Felling' on stand productivity and health. Restoration forestry silvicultural treatments for habitat restoration, catchment area treatments, enrichment planting, Analog forestry for site productivity and carbon value. Expanding forest and tree cover area- TOF sector in India.

##### Unit V

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. Carbon sequestration potential of Trees Outside forests (TOFs), homegardens and urban forests.

#### VII – Suggested Reading

- Anderson P and Palik B. 2011. Silviculture for Climate Change. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center.

## FOR-MC-909 – INDUSTRIAL AGROFORESTRY

CO1: Understand the role of forests & forest based raw material in various industries.

CO2: Explain management of tree plantation for industrial need, certification of production and marketing chain

CO3: Explain the socioeconomic, ecological, biotic, edaphic & climatic impacts of industrial agroforestry

I – Title	II - Code	III - Credit Hours	Theory	Internal	Practical	Total
Industrial Agroforestry	FOR-MC-909	1+1	60	20	20	100

### IV – Aim of the Course

To develop skill and expertise on industrial wood production and processing technology.

### V – Theory (Total Lecture: 16)

#### Unit I

Role of forests in industrial sector, industrial raw material, demand and supply, indigenous and exotic industrial resources, extent of area, policy and legal issues towards industrial wood plantation. Major wood based industries in India; timber, pulp wood, plywood, matches, etc. Raw material requirements and their procurements.

#### Unit II

Industrial wood plantations – status in India and different states, preferred species – current plantation management and establishment, propagation and plantation technique, economics of industrial agroforestry, pest and disease management for major industrial wood species, harvesting, reduced impact logging, mechanization.

#### Unit III

Supply chain; definition, concept, supply chain network, logistic activities, Marketing system; marketing type and channel, price patterns of various industrial wood agroforestry plantations. Contract farming: concept and methods, contract tree farming system in India. Industrial experiences– price support system – constraints. Corporates in industrial agroforestry: International and National corporate, success stories. Corporate social responsibilities. Tree insurance.

#### Unit IV

Impacts of industrial agroforestry – ecological impacts; climatic, edaphic and biotic– carbon sequestration. Carbon storage potential of industrial agroforestry and carbon trading mechanism of industrial agroforestry, socio-economic impacts–clean development mechanism. Certification of industrial plantations.

### VI – Practical (Total Lecture: 16)

- Study of various wood based industries;
- Study on raw material requirement and sourcing of plywood, pulp and paper, matchwood, timber processing;
- Biomass power generation industries;
- Value addition technology of various wood products;
- Industrial wood plantations – economics and impact assessment.

### VII – Suggested Reading

- Cosalter C and C Pye-Smith. 2003. Fast Wood Forestry – Myths and Realities. CIFOR. Bogor, Indonesia. 50p.

- Mehta T. 1981. A Hand Book of Forest Utilization. International Book Distributors, Dehradun.
- Nair PKR. 1993. An Introduction to Agroforestry. Kluwer Academic publishers.
- Parthiban KT, Umarani R, UmeshKanna S, Sekar I, Rajendran P and Durairasu P. 2014. Industrial Agroforestry: Perspectives and Prospectives. Scientific Publishers.
- Tejwani KG. 1994. Agroforestry in India. Oxford and IBH publishing Co., New Delhi.

## FOR-MC-910 – ECONOMICS OF AGROFORESTRY SYSTEMS

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2- Explain the principles of economics and use of economic tools in appraisal of the agroforestry systems.

CO3- Evaluate the ecosystem services from agroforestry- economic and ecological aspects of agroforestry.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Economics of Agroforestry Systems	FOR-MC-910	2+1	60	20	20	100

### IV – Aim of the Course

To acquaint the students with principles of economics and use of economic tools in appraisal of the agroforestry systems. Evaluation of ecosystem services from agroforestry- economic and ecological aspects of agroforestry.

### V – Theory (Total Lecture: 32)

#### Unit I

Basic principles of economics applied to agroforestry. Financial measures. Quantification and valuation of inputs and outputs- direct and indirect methods.

#### Unit II

Optimization techniques-Planning, budgeting and functional analysis. Role of time, risk and uncertainty in decision making. Agroforestry budgeting. Risk analysis, reassessment.

#### Unit III

Financial and socio-economic analysis of agroforestry projects. Principles of financial management and harvesting, post harvest handling, value addition, marketing of agroforestry products including benefit sharing.

#### Unit IV

Valuation of ecosystem services in agroforestry and payment for ecosystem systems. Bankable agroforestry projects, incentives, tree insurance, etc. Certification process in agroforestry based carbon projects, carbon finance, etc.

### VI – Practical (Total Lecture: 16)

- Exercises on agroforestry production relationships;
- Preparation of agroforestry based enterprise, partial and complete budgets;
- Application of various methods in formulation and appraisal of agro-forestry projects;
- Case studies on harvesting, post harvest management and marketing of agroforestry products;
- Valuation of ecosystem services in agroforestry and payment for ecosystem services.

### VII – Suggested Reading

- Alavalapati JRR and Mercer D Evan. 2004 Valuing Agroforestry Systems: Methods and Applications. Kluwer Academic Publishers.

- Kant S and Janaki A. 2014. Handbook of Forest Resource Economics. Publisher: Routledge
- Nair PKR, Rai MR and Buck LE. 2004. New Vistas in Agroforestry. Kluwer Academic Publishers.
- Nair PKR. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers.
- Ong CK and Huxley PK. 1996. Tree Crop Interactions – A Physiological Approach. ICRAF. Sullivan
- Gregory M, Susan Hoke M and Jefferson M. Fox (editors). 1992. Financial and Economic Analyses of Agroforestry Systems.
- Proceedings of a workshop held in Honolulu. Hawaii. USA. July 1991. Paia, Ill: Nitrogen Fixing Tree Association.
- Thampan PK. 1993. Trees and Tree Farming. Peekay Tree Crops Development Foundation.

## INTERDISCIPLINARY COURSE

### FOR-IDC-905 – PULP AND PAPER TECHNOLOGY

CO1: To study the raw materials used & handling of it.

CO2: To understand the various pulping process for paper making.

CO3: To study the paper making process.

CO4: To study the types of papers their properties.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Pulp and Paper Technology	FOR-IDC-905	2+1	60	20	20	100

#### IV – Aim of the Course

To acquaint the students with the resources and processes for making pulp and paper.

#### V – Theory (Total Lecture: 32)

##### UNIT I

Raw material used in pulp and paper industries, characteristics and handling.

##### UNIT II

Pulping process, mechanical, chemical, semi-chemical and biopulping. Pulp bleaching, pulp treatment, defibering, de-knotting, brown stock washing, screening, cleaning, thickening, etc.

##### UNIT III

Recycled fibers, supplementary pulp treatment and additives. Paper making, paper drying, reeling, external sizing, coating, calendaring, etc.

##### UNIT IV

Structure of paper, its characterization and measuring strength method, optional and structural properties of paper, Type of paper: coated paper, corrugated containers, printing quality of paper, ageing of paper. Rayon industry.

#### VI – Practical (Total Lecture: 16)

- Visit to pulp and paper industry;
- Study of raw materials, techniques and pulp yield, making of paper and its quality determination.

## VII – Suggested Reading

- Asuncion J. 2003. The Complete Book of Paper Making. Lark books, New York.
- Bajpai P. 2018. Biermann's Handbook of Pulp and Paper. Vol. 1 st :Raw material and pulp making. Elsevier Science, UK.
- Biermann C. 1996. Handbook of Pulping and Paper Making. 2 nd Ed. Academic Press San Diego, New York, Boston, London, Sydney, Tokyo, Toronto.
- Britt KW. 1970. Handbook of Pulp and Paper Technology. 2 nd Ed. Van Nostrand Reinhold Company, New York.
- Lavigne JR. 1979. Instrumentation Applications for the Pulp and Paper Industry. Miller Freeman Publications.
- Rao KP. 2007. Pulp and Paper Technology: Technology, Testing and Applications. CBS Publishing and Distributors, New Delhi.
- Sjostrom E and Alen R (Eds). 1999. Analytical Methods in Wood Chemistry Pulping and Paper Making. Springer Series in Wood Science.
- Viikari L and Lantto R. 2002. Progress in Biotechnology. Vol. 21 st . Biotechnology in the pulp and paper industry. 1 st Ed. ICBPPI. Elsevier Science.

## SKILL ENHANCEMENT COURSE

### FOR-SEC-904 – MASTER'S SEMINAR

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Master's Seminar	FOR-SEC-904	0+1	--	--	100	100

#### IV – Aim of the Course

To provide training to the students on preparation for seminar, organizing the work, critical analysis of data and presentation skills.

The students will be encouraged to make presentations on the latest developments and literature in the area of various research topic.

### FOR-MC-911A– RESEARCH REVIEW (MASTER THESIS)

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical/ Term Paper	Total
Research Review (Master Thesis)	FOR-SEC-911A	0+8	--	--	100	100

#### IV – Aim of the Course

To provide training to the students on studying the literature related to the research topic and writing of literature review.

The students will be encouraged to access various resources to read research papers and analyze the studies. Make presentations on it.





## SEMESTER IV

### MAJOR COURSE

#### FOR-MC-912– NUTRIENT AND WEED MANAGEMENT IN PRODUCTION FORESTRY

CO1: Enlist, define & describe relevant terminology and basics of subject

CO2: Describe concepts of nutrients and their management, weeds and their management in nurseries and plantations.

I – Title	II – Code	III - Credit Hours	Theory	Internal	Practical	Total
Nutrient and Weed Management in Production Forestry	FOR-MC-912	1+1	60	20	20	100

#### IV – Aim of the Course

To make students to understand the concepts of nutrients and their management, weeds and their management in nurseries and plantations.

#### V – Theory (Total Lecture: 17)

##### Unit I

History of nutrient management in forest nurseries and plantations. Essential nutrient elements and their deficiency. Mechanism of nutrient uptake by plants, functions and translocation/ interactions. Concept of nutrient availability.

**Unit II** Climatic and soil conditions causing micronutrient deficiencies in plants. Occurrence and treatment of micronutrient disorders. Evaluation of soil for the supply of micronutrient. Rare and non-essential elements.

**Unit III** Technology and use of complex liquid and suspension fertilizers. Fertilizer use efficiency. Biological nitrogen fixation and bio-fertilizers. Farm yard manure and other organic fertilizers. Mycorrhizal associations and their significance. Economic implications of nutrient management. Importance of renewable wastes and their recycling.

**Unit IV** Principles of weed control. Methods of weed control-cultural, biological, mechanical and chemical. Herbicide/ weedicide classification, properties and their application.

#### VI – Practical (Total Lecture: 16)

- Methods of soil and plant analysis.
- Preparation of nutrient solutions.
- Practical application of fertilizers;
- Study of fertilizer response and diagnosis of deficiency symptoms.
- Fertilizer testing and pot experiments;
- Nursery inoculation techniques of bio-fertilizers;
- Methods of application of formulated products-seed treatment, root dip, suckers treatment, soil application, foliar application and combination of different methods;
- Important weeds in forest nurseries and plantations. Control of weeds.

#### VII – Suggested Reading

- . Gupta OP. 2011. Modern Weed Management. Agrobios, New Delhi (India).
- . Kumar D, Chowdhary S and Sharma R. 2011. Weed Management: Principles and Practices. Narendra Publishing House.
- . Rajaram C. 2012. Hand book of Plant Nutrition. Neha Publishers and Distributors.

. Rammoorthy and Subbian P. 2012. Weed Management. Agrotech Publishing Academy, Udaipur (India).

### **FOR-MC-911B – MASTER RESEARCH (THESIS)**

CO1: Prepare thesis based on lab/field based study.

CO2: Inspect & assess specific subject and topic and discipline.

<b>I – Title</b>	<b>II – Code</b>	<b>III - Credit Hours</b>	<b>Theory</b>	<b>Internal</b>	<b>Practical</b>	<b>Total</b>
Master Research (Thesis)	FOR-MC- 911B	0+22	--	--	100	100

## **Why should one choose Dolphin Institute?**

Dolphin College is truly regarded as a beacon of first-class competence, absolutely dedicated towards forestry. Along with academic rigor, hands-on training is heightened so that students enter the profession well-prepared to deal with sustainable management of renewable resources as well as environmental conservation. Students will have training from the extremely qualified faculty, well-equipped laboratories, and fieldwork opportunities within a comprehensive learning community. Dolphin College extends its own connection with specific industry players, geared towards competency building and networking to prepare students for their chosen careers. With a clean and green campus all around, the states provides learning about themselves as they and their future in forestry and environmental stewardship unfolds.

## **FAQs for UG and PG Forestry Courses**

1. What is the eligibility criteria for UG course admissions (B.Sc. Forestry)?

The candidate should have passed the 10+2 examination with subjects including biology, chemistry, and physics, as applicable. Passing an entrance examination for admission might be required by the university.

2. What is the eligibility criteria for PG programs?

The candidate must have obtained a bachelor's degree in forestry, agriculture, environmental science, or biology. Entrance exam or merit in the second stage may also be adopted for the selection of candidates.

3. What subjects are taught in the B.Sc. Forestry program?

Key subjects include introductory classes in subjects like forest ecology, silviculture, forest mensuration, wildlife management, forest economics, as well as introductory classes in GIS and remote sensing.

4. What specialization does the MSc Forestry program offer?

Silviculture & Agroforestry with sustainable forest management are among the major domains with specialization, required for intensive sustainable forestry experiments, research, and apprenticeships.

5. What careers are available after completing a forestry degree?

Foresters qualify for management positions, wildlife conservators, environmental consultants, researchers, and academicians, or work with non-governmental organizations, or join the state or central government as forest service personnel. Postgraduates are placed in advanced research and policy-making positions.

6. Is it possible to gain some exposure from practical hands-on work or field-based work in these programs?

Yes, experiential learning takes a prime place in both UG and PG programs, where field trips, internships, research projects, and hands-on training in forest stations and laboratories take priority.

7. What kind of research opportunities are there for M.Sc. Forestry students?

Such contexts might include forest conservation, biodiversity, watershed management, climate change impacts, and remote sensing technology applications.

8. Are there any scholarships or financial aid for the forestry students?

Various scholarships and awards for financial aid are offered in universities based on merit or financial need. Students are requested to ask for special opportunities available at the university.

9. What kind of facilities are provided for forestry students by the department?

The department provides state-of-the-art laboratories, GIS and remote sensing tools, forest stations, herbariums, and well-equipped libraries for learning and research.

10. How does the forestry program equip its students with the knowledge to handle industry and global challenges?

The combination of theoretical background, practical training, internships, and exposure to current industry problems such as climate change and biodiversity conservation is expected to prepare students to meet forestry challenges of tomorrow.