



**List of Courses Focus on Employability/ Entrepreneurship/  
Skill Development**

**Department : Forestry, Wildlife and Environmental Sciences**

**Programme Name : B. Sc. (Forestry)**

**Academic Year : 2021-22**

**List of Courses Focus on Employability/ Entrepreneurship/Skill Development**

Sr. No.	Course Code	Name of the Course
01.	FOUATT1	Principles and Practice of Silviculture
02.	FOUALTT2	Fundamentals of Soil Science
03.	FOUBTT4	Cytogenetics and Plant Breeding
04.	FOUBTG2	Forest Botany and Dendrology
05.	FOUATG1	Basic Mathematics
06.	FOUATS2	Physical Activity
07.	FOUFTT16	Forest Economics
08.	FOUCTT5	Forest Ecology and Biodiversity Conservation
09.	FOUETT11	Watershed and its Management
10.	FOUETT12	Forest Biotechnology and Tree Improvement
11.	FOUBTT3	Forest Mensuration
12.	FOUCTT7	Forest Management
13.	FOUDDT8	Remote Sensing and GIS Application in Forestry
14.	FOUFTT14	Forest Pathology and Entomology
15.	FOUGTT18	Forest Policy, Legislation and Environmental Act
16.	FOUCTG3	Non Timber Forest Products and Ethnoforestry
17.	FOUETD1	Basic Concept of Horticultural and Landscaping
18.	FOUETT13	Forest Tree Seed Technology
19.	FOUCTT6	Fundamentals of Wildlife and its Management



20.	FOUETD1	Meteorology and Crop Production
21.	FOUGTD3	Forestry Extension
22.	FOUFTT15	Agroforestry and Tree Outside Forests
23.	FOUGTT17	Biostatistics
24.	FOUDTT10	Forest Surveying and Engineering
25.	FOUDTT9	Wood Science and Technology
26.	FOUDTG4	Sericulture
27.	FOUGTT19	World Forestry Systems and Climate Change Mitigation
28.	FOUFTD2	Urban Forestry
29.	FOUGTD3	Entrepreneurship Development
30.	FOUHEF3	Forest Institute and Industrial visit (Report Writing, Presentation, Viva-Voce)
31.	FOUHEF2	Forest operation Work Experience (Report Writing, Presentation, Viva-Voce)
32.	FOUHEF1	Socio- economic Survey-Village attachment (Report Writing, Presentation, Viva-Voce)



## Scheme and Syllabus

### LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)

FOR

B.Sc. FORESTRY

(w.e.f. Academic session:2021-22)



“SCHOOL OF NATURAL RESOURCES”

DEPARTMENT OF FORESTRY, WILDLIFE & ENVIRONMENTAL SCIENCES

**GURU GHASIDAS VISHWAVIDYALAYA**

(A Central University established by the Central University Act, 2009 No. 25 of 2009)

BILASPUR-495009, CHHATTISGARH

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**Course Structure and Credit Distribution**

**B.Sc. Forestry (4 -Year / 8- Semester) LOCF based Program**

Semester	Course Opted	Course Code	Name of the course	Credit	Hour / week	Marks
I	Core-01	FOUA/P1	Principles and Practice of Silviculture	3	3	100
	Core-01 Practical	FOUALT1		2	3	100
	Core-02	FOUA/P2	Fundamentals of Soil Science	3	3	100
	Core-02 Practical	FOUALT2		2	3	100
	Generic Elective (GE)-01	FOUA/GE1	Basic Mathematics	4	4	100
	Seminar/Tutorial	FOUASS1		1	1	100
	Ability Enhancement Course (AEC-01)	FOUATA1	Drawn from the University Pool	2	-	100
	Skill Enhancement Course (SEC-01)	FOUATL1	Drawn From the University pool	2	-	100
	Extracurricular Activity (ECA-01) *Additional Credit Course (Non-Mandatory)	FOUATS1	ECA-Extra-curricular activity (Field visit/ NSS/NCC/ <i>Savhita</i> / Plannation Activities)	2		100
	Physical Education	FOUATS2	Non Credit	----	2	100
<b>TOTAL</b>				<b>19</b>	<b>19</b>	<b>1000</b>
II	Core -03	FOUBT3	Forest Mensuration	3	3	100
	Core -03 Practical	FOUBLT3		2	3	100
	Core -04	FOUBT4	Cytogenetics and Plant Breeding	3	3	100

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	Core -04 Practical	FOUBLT4		2	3	100
	Generic Elective (GE)- 02	FOUBTG2	Forest Botany and Dendrology	3	3	100
	Generic Elective (GE)- 02 Practical	FOUBLG2		2	3	100
	Ability Enhancement Compulsory (AEC-02)	FOUBTA2	Drawn from the university pool	2	2	100
	Skill Enhancement Course (SEC- 02)	FOUBTL2	Drawn From the University pool	2	..	100
	Extracurricular Activity- (ECA-02) *Additional Credit Course (Non Mandatory)	FOUBTS3	ECA-Extracurricular activity(Field visit/ NSS/ Swachhna/ vocational Training/ Plantation activities)	2	--	100
	Physical Education	FOUBTS4	Non Credit	---	2	100
	<b>TOTAL</b>			<b>19</b>	<b>22</b>	<b>900</b>
<b>Semester</b>	<b>Course Opted</b>	<b>Course Code</b>	<b>Name of the course</b>	<b>Credit</b>	<b>Hour / week</b>	<b>Marks</b>
<b>III</b>	Core -05	FOUCTT5	Forest Ecology and Biodiversity Conservation	3	3	100
	Core -05 Practical	FOUCLT5		2	3	100
	Core -06	FOUCTT6	Fundamentals of Wildlife and its Management	3	3	100
	Core -06 Practical	FOUCLT6		2	3	100
	Core -07	FOUCTT7	Forest Management	3	3	100
	Core -07 Practical	FOUCLT7		2	3	100
	Generic Elective- (GE)-03	FOUCTG3	Non Timber Forest Products and Ethnoforestry	3	3	100
	Generic Elective (GE- 3) Practical	FOUCLG3		2	3	100

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	Ability Enhancement Course (AEC-05)	FOUCTA3	Drawn From the University Pool	2	...	100
	Extracurricular Activity- (ECA-03) *Additional Credit Course (Non Mandatory)	FOUCTS5	ECA-Extracurricular activity (Field visit/ NSS/NCC/ <i>Swachhata</i> / Physical Education/ Plantation Activities)	2	..	100
	<b>Total</b>			<b>22</b>	<b>24</b>	<b>900</b>
IV	Core -08	FOUDT8	Remote Sensing and GIS Application in Forestry.	3	3	100
	Core -08 Practical	FOIDL8		2	3	100
	Core -09	FOUDT9	Wood Science and Technology	3	3	100
	Core -09 Practical	FOUDL9		2	3	100
	Core -10	FOUDT10	Forest Surveying and Engineering	3	3	100
	Core -10 Practical	FOUDET10		2	3	100
	Generic Elective- (GE)-04	FOUDTG4	Sericulture	3	3	100
	Generic Elective Practical (GE)-04	FOUDEL04		2	3	100
	Ability Enhancement Course (AEC-04)	FOUDTA4	Drawn From the University pool	2	...	100
		<b>TOTAL</b>			<b>22</b>	<b>24</b>
V	Core -11	FOUETT11	Watershed and its Management	3	3	100
	Core -11 Practical	FOUETL11		2	3	100
	Core -12	FOUETT12	Forest Biotechnology and Tree Improvement	3	3	100
	Core -12 Practical	FOUETL12		2	3	100

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	Core -13	FOUETT13	Forest Tree Seed Technology	3	3	100
	Core -13 Practical	FOUFLT13		2	3	100
	Discipline Specific Elective DSE-1	FOUETD1	Meteorology and Crop Production	3	3	100
	Practical	FOUELD1		2	3	100
			Basic Concept of Horticultural and Landscaping			
	<b>TOTAL</b>			<b>20</b>	<b>24</b>	<b>800</b>
<b>VI</b>	Core -14	FOUFTT14	Forest Pathology and Entomology	3	3	100
	Core -14 Practical	FOUFLT14		2	3	100
	Core -15	FOUFTT15	Agroforestry and Tree Outside Forests	3	3	100
	Core -15 Practical	FOUFLT15		2	3	100
	Core -16	FOUFTT16	Forest Economics	3	3	100
	Core -16 Practical	FOUFLT16		2	3	100
	Discipline Specific Elective- (DSE-2)	FOUFTD2	Urban Forestry	3	3	100
	Practical	FOUFLT2		2	3	100
			Land Degradation and Restoration			
	Ability Enhancement Course (AEC- 05)	FOUFTA5	Drawn from the University Pool	2	-	100
	MOOC Course (01)		Online MOOC Course	2	---	---
	<b>TOTAL</b>			<b>24</b>	<b>24</b>	<b>900</b>
<b>VII</b>	Core -17	FOUGTT17	Biostatistics	3	3	100
	Core -17 Practical	FOUGLT17		2	3	100

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	Core -18	FOUGL118	Forest Policy, Legislation and Environmental Act	3	3	100
	Core -18-Practical	FOUGL118		2	3	100
	Core -19	FOUGL119	World Forestry Systems and Climate Change Mitigation	3	3	100
	Core -19-Practical	FOUGL119		2	3	100
	Discipline Specific Elective- (DSE-3)	FOUGL120	Forestry Extension	3	3	100
	Practical	FOUGL120		2	3	100
			Entrepreneurship Development			
	Seminar	FOJCSS2	Seminar	2	2	100
	<b>TOTAL</b>			<b>22</b>	<b>26</b>	<b>900</b>
<b>VIII</b>	INTR-1	FOUHEF1	Socio- economic Survey-Village attachment (Report Writing, Presentation, Viva-Voce)			200
	INTR-2	FOUHEF2	Forest operation Work Experience (Report Writing, Presentation, Viva-Voce)			200
	INTR-3	FOUHEF3	Forest Institute and Industrial visit (Report Writing, Presentation, Viva-Voce)			200
	Dissertation	FOUHDF1	Report Evaluation, Presentation, Viva-Voce			100
	The nature of the course in VIII Semester is field based. Socio- economic survey will be performed by the students in an assigned village. For exposure of forest operational work students will be attached with State Forest Department. Institute/ industrial training will be accomplished by the students through visits of nearby forest based industries /Institutions.					
	<b>TOTAL</b>			<b>22</b> (6 credits for each Training and 4 credits for Dissertation segment)	<b>48 Hours/ week for each Training segment separately</b>	<b>700</b>
<b>GRAND TOTAL</b>				<b>170</b>		<b>7000</b>

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Table 2: Structure of Courses

Semester	Core Courses (19)	GE (4)	DSE (3)	AEC (5)	SEC (2)	Seminar (2)	Dissertation (1)	Internship (3)	Additional Credit Courses (Optional)
I	C1 C2	GE1		AEC1	SEC1	Seminar 1			ECA1 ECA2
II	C3 C4	GE2		AEC2	SEC2				ECA3 ECA4
III	C5 C6 C7	GE3		AEC3					ECA5
IV	C8 C9 C10	GE4		AEC4					
V	C11 C12 C13		DSE1						
VI	C14 C15 C16		DSE2	AEC5					MOOC
VII	C17 C18 C19		DSE3			Seminar 2			
VIII							Dissertation	Internship1 Internship2 Internship3	

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## Program Objectives and Learning Outcomes

### B.Sc. Forestry

(4-Year /8-Semester Programme)

#### Introduction

The educational goal and core objectives of the Bachelor's Degree programme in Forestry have been designed by the course curriculum. The purpose of this course is to educate students with a fundamental understanding of the discipline of forestry, including the concept of the topic, theories and techniques used in forest and forestry operations, and the concept of general principles. This should also assist the ability to pose appropriate questions and acquire answers to these issues through qualitative and quantitative forest and related science investigations. Important student characteristics include an awareness of the physical and natural environment, as well as the discipline of forestry, as well as curiosity, creativity, and a grasp of the connections between forestry and other related areas.

#### Program Objectives:

1. The programme aims to develop the reading, understanding and ability to interpret forestry through qualitative and quantitative methods.
2. Students will also equipped with methodology adopted in forest assessment, planning and correlative assessment of forest with nature.
3. Impart skills required to gather information from resources and use them.
4. To provide high-quality, need-based forestry education.
5. Provide students with a variety of skill-based courses with an interdisciplinary approach.
6. Attract outstanding students from all backgrounds.

#### Graduates Attributes

Graduates Attributes (GAs) are measurable outcomes that signify the capabilities and potentials of the graduate to attain accomplishment and perform in adequate manner at appropriate situations. Following are the Graduate Attributes of B. Sc. Forestry are given as below:

**GA1. Acquaintance with the subject knowledge:** Gain in-depth knowledge and understandings of each discipline or professional area across boundaries of nations with an aptitude to identify, access, analyze and synthesize existing and new knowledge, and integrate them for enrichment of knowledge.

**GA2. Analytical ability:** ability to analyze and address multifaceted scientific issues to forestry, wildlife and environmental sciences; pertain and take independent decision for synchronizing

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information to formulate innovative and intellectual advances towards focused research over theoretical and different domains of forestry and allied sciences.

**GA3. Application of modern tool and techniques:** Select, learn and apply appropriate techniques, resources, sophisticated instruments, RS and GIS all knowledge for explaining different forestry operational activities, wildlife management and environmental ICT tools, consequences and mitigation activities with a thorough understanding.

**GA4. Problem Solving:** Address and solve scientific vis-a-vis environmental problems via rational and original thinking; keep updates of different solution avenues and select appropriate options considering public health, cultural, and societal factors.

**GA5. Multidisciplinary competence:** Develop sound knowledge and perception initiatives and leadership in collaborative-multidisciplinary and trans-disciplinary scientific research, demonstrate a capacity for self-management and teamwork, achieving common goals and objectives; motivate group members to address different issues on forestry, wildlife and environmental stability with scientific temperament.

**GA6. Communication skill:** Ability to communicate scientific/technological knowledge and new learning to the scientific community and the society at large with strong conviction and confidence. This can be achieved through sound technical proficiency of computing skill, training of software's, writing skills, in-depth subject specific knowledge.

**GA7. Ethical values and moral values:** Attain strong academic integrity, professional code of conduct, ethics of experimental research and scientific writings, contemplation of the impact of research findings on conventional issues, and a sense of responsibility towards societal needs for attaining inclusive and sustainable development goals.

**GA 8. Futuristic approach:** Ability to recognize and address current issues of forestry and environment in changing world with a futuristic view and practicing intuitiveness and interest towards scientific prediction via application of basic knowledge of science especially with regard to India's SDGs and national action plan for GHG emission and sustainable development.

**Program Learning Outcomes of B.Sc. Forestry**

PLO1	To develop undergraduate level student strong competencies in the field of Forestry and its application in a technology-rich, interactive environment.
PLO2	To develop strong student skills in silvicultural activities, forest survey & mapping, forest management planning, forest based industries development and value addition, IPR applications, natural resource management, environmental sustainability, socio economic stability, data collection and analysis by using new techniques and tools.

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PLO3	To prepare the students to successfully compete for employment in Forestry and its allied disciplines to meet the fulfillment of government and industrial needs.
PLO4	Apply knowledge and skill in the development of Forest and Forestry activities to cater to the needs of Forestry and its allied disciplines.
PLO5	Become trained in the areas of forestry and ready for handling complex issues of forest management for sustainable development in the changed global world.

### Course-wise Objectives and Learning Outcomes

#### **SEMESTER – I**

##### **PAPER I: PRINCIPLES AND PRACTICE OF SILVICULTURE**

**Objective:** To provide knowledge about forest and forest types, different tree species, vegetation forms and forest regeneration.

**Outcome:** After the end of the course, the students will be able to identify forest and tree species, their distribution, and vegetation structure.

##### **PAPER II: FUNDAMENTAL OF SOIL SCIENCE**

**Objective:** To provide knowledge about soil, components and their properties with relation to vegetation growth and environment. To provide students exposure on soil formation processes, and its role in forest nutrient dynamics.

**Outcome:** The students will be able to understand the soil formation processes, soil characteristics, soil-water relationships, soil fertility in different forest. The student will equipped with ability of soil testing and site evaluation for establishing forest plantation.

##### **PAPER III: BASIC MATHEMATICS**

**Objective:** To provide knowledge about simple functions of basic mathematics for forest study

**Outcome:** The students will be able to understand the interpretation of quantitative information from formulas, graphs, tables, schematics, simulations, and visualizations, and their application in forest related issues. Students will be able to solve forest problems using arithmetical, algebraic, geometrical, statistical, or computational methods.

**PAPER IV: ABILITY ENHANCEMENT COURSE (AEC-01):-** The course will be selected from the University pool by students. Such course will enable student and enhance their ability and understanding on the subject.

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**PAPER V: SKILL ENHANCEMENT COURSE (SEC- 01):-** The course will be selected from the University pool by students. These type of course will augment the students skill on the subject.

**PAPER VI: EXTRACURRICULAR ACTIVITIES (ECA-01):** It will be a nature of additional credit course with non-mandatory nature. Students of NSS/NCC/Swachhata/Physical Education/Plantation Activities, etc. may opt such courses for acquiring addition knowledge and practical experience.

**PAPER VII: PHYSICAL EDUCATION (NON CREDIT):** It will be a nature of non-credit course with mandatory nature for B.Sc. forestry programme.

## SEMESTER – II

### **PAPER I: FOREST MENSURATION**

**Objective:** To develop understanding of students about tree measurements, forest inventory, and yield concepts.

**Outcome:** The students able to determine biometric measurement of individual trees and forest crops. They will also be able to design and implement comprehensive and appropriate forest resource inventories.

### **PAPER II: CYTOGENETICS AND PLANT BREEDING**

**Objective:** To provide basic information about plant cell, genetics and their importance in tree breeding.

**Outcome:** The students will be able to understand the plant cell structure and functions, They will also able to understand the laws of inheritance, chromosome and basic genetics for their exploitation in plant breeding.

### **PAPER III: FOREST BOTANY AND DENDROLOGY**

**Objective:** To provide the basic knowledge of morphology, nomenclature and anatomy of various parts of higher plant and concept of alternation of generation of in lower plant.

**Outcome:** Enabling students to understand the morphological and anatomical features of higher plants and taxonomy.

**PAPER IV: ABILITY ENHANCEMENT COURSE (AEC-02):-** The course will be selected from the University pool by students.

**PAPER V: SKILL ENHANCEMENT COURSE (SEC- 02):-** The course will be selected from the University pool by students.

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**PAPER VI: EXTRACURRICULAR ACTIVITIES (ECA-02):** It will be a nature of additional credit course with non-mandatory nature. Students of NSS /NCC /Swachhata /Physical Education/Plantation Activities, etc. may opt such courses of two credits.

**PAPER VII: PHYSICAL EDUCATION (NON CREDIT):** It will be a nature of non-credit course with mandatory nature for B.Sc. forestry programme.

### SEMESTER – III

**PAPER I: FOREST ECOLOGY AND BIODIVERSITY CONSERVATION**

**Objective:** To develop knowledge about ecological aspects of forest resource and biodiversity conservation.

**Outcome:** After the completion of this course, the learner will be able to understand ecological principles and concepts including forest structure, ecosystems and biodiversity and the method of conservation.

**PAPER II: FUNDAMENTAL OF WILDLIFE AND ITS MANAGEMENT**

**Objective:** To give the understanding about faunal diversity and strategies of conservation of wildlife.

**Outcome:** Its purpose is to provide basic knowledge of wildlife, identification of wildlife, wildlife census, management and conservation of wildlife resource of the country as a holistic approach.

**PAPER III: FOREST MANAGEMENT**

**Objective:** To provide knowledge to students about forest management for sustainable growth.

**Outcome:** The students will be able to understand forest management practices. They will also be able to develop and evaluate management plans in forestry.

**PAPER IV: NON- TIMBER FOREST PRODUCTS AND ETHNOFORESTRY**

**Objective:** To give the understanding and knowledge of various non-wood forest products and their utilization in forest industries. Also to develop ability about forest and tribal relationship.

**Outcome:** Develop competences in the students on analyzing different forest products, value addition and their impact on tribal economy and livelihood. The course will equip the students about non wood forest based industries.

**PAPER V: ABILITY ENHANCEMENT COURSE (AEC-03):-** The course will be selected from the University pool by students.

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**PAPER VI: EXTRACURRICULAR ACTIVITIES (ECA-03):** It will be a nature of additional credit course with non-mandatory nature. Students of NSS /NCC / Swachhata/Physical Education/Plantation Activities, etc. may opt such course of two credits.

#### SEMESTER – IV

**PAPER I: REMOTE SENSING AND GIS APPLICATION IN FORESTRY**

**Objective:** To give the understanding about use of Remote Sensing and GIS technique in Forestry.

**Outcome:** After completing this course, the learner will be able to understand the application of Remote Sensing and GIS technique for the measurement and mapping of forest areas.

**PAPER II: WOOD SCIENCE AND TECHNOLOGY**

**Objective:** To acquaint with the physical characteristics and strength properties of wood.

**Outcome:** The course enables the students to deal with wood identification, properties, wood preservation techniques and technology for making engineered woods.

**PAPER III: FOREST SURVEYING AND ENGINEERING**

**Objective:** To develop understanding about survey and engineering concepts in forest techniques.

**Outcome:** To enable the students to conduct forest survey using basic survey tool and principles. Also to empower them on building materials quality, construction of road and bridge.

**PAPER IV: SERICULTURE**

**Objective:** To impart knowledge on the silk and silk production, rearing and reeling technology.

**Outcome:** The development of students for entrepreneurship and skill on sericulture to cater the need of field personnel's to sericulture industries.

**PAPER V: ABILITY ENHANCEMENT COURSE (AEC-04):-** The course will be selected from the University pool by students.

#### SEMESTER – V

**PAPER I: WATERSHED AND ITS MANAGEMENT**

**Objective:** To give exposure to the students on watershed and its management for sustainable

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development and restoration of river systems.

**Outcome:** Enable students for developing expertise for the implementation of integrated watershed projects and to equip practical exposure on watershed.

**PAPER II: FOREST BIOTECHNOLOGY AND TREE IMPROVEMENT**

**Objective:** To acquaint the students about general principles of tree breeding and the role of biotechnological approaches.

**Outcome:** Students ability enhancement on understanding of plant genetic resources, plant breeding, gene bank, tissue culture, macro-propagation and use of transgenic technology

**PAPER III: FOREST TREE SEED TECHNOLOGY**

**Objective:** To understand the development of forest tree seeds and method to maintain viability.

**Outcome:** After completion of the course, the students will be able to understand how seed develops, types of seed, seed viability, seed treatment, dormancy etc.

**PAPER IV: (DSE) DISCIPLINE SPECIFIC ELECTIVE (DCE-1):**

• **METEOROLOGY AND CROP PRODUCTION**

**Objective:** To understand the relationship of crops, plants and climatic parameters.

**Outcome:** To establish the confidence in students about plant growth and environmental factors.

• **BASIC CONCEPTS OF HORTICULTURE AND LANDSCAPING**

**Objective:** To develop the understanding on horticultural crops and landscaping.

**Outcome:** Students enable to develop understanding on horticultural crops, their nursery management, and modern technology for higher profit.

**SEMESTER - VI**

**PAPER I: FOREST PATHOLOGY AND ENTOMOLOGY**

**Objective:** To provide knowledge about forest pathology and diseases & pest of important tree species.

**Outcome:** Equip students with the information on pests, diseases diagnosis, causing organism and control methods of different forest species and plantation.

**PAPER II: AGROFORESTRY AND TREE OUTSIDE FOREST**

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**Objective:** To provide knowledge about concept of agroforestry and outside forests.

**Outcome:** To develop student's competencies on tree based farming, arrangement and management systems. They will understand the potential areas for outside forest plantations and other tree aspects.

**PAPER III: FOREST ECONOMICS**

**Objective:** To know the basic elements of forest economics for income generation.

**Outcome:** On the completion of this course, the students will be able to gather knowledge on basic economic principles, production forestry, and demand and supply pattern of forest products and case study.

**PAPER IV: (DSE) DISCIPLINE SPESIFIC ELECTIVE (DSE-2)**

• **URBAN FORESTRY**

**Objectives:** Planning, establishment, and management of urban forestry for wellbeing of urban environment.

**Outcomes:** This will enable students to gain knowledge of urban forestry as the foundation for developing and implementing sound urban forest management programs with the use of Geographic Information Systems in urban planning.

• **LAND DEGRADATION AND RESTORATION**

**Objectives:** To address causes of land and forest degradation and deterioration and restorative technologies for combatting desertification.

**Outcome:** Development of ability to evaluate the site quality of different types of waste and degraded forest, suitable species and plantation technologies for different types of lands.

**PAPER V: ABILITY ENHANCEMENT COURSE (AEC-05):** The course will be selected from the University pool by students.

**PAPER VI: MOOC (MOOC-01):** Students will enroll for any MOOC courses offer by different online portals during that academic calendar and complete the course online.

**SEMESTER - VII**

**PAPER I: BIOSTATISTICS**

**Objective:** To provide knowledge about fundamentals of biostatistics and its use in forestry

**Outcome:** At the end of the course the students will be able to comprehend the fundamental concepts of biostatistics. Students also able to understand the data analysis, data representation, tabulation and hypothesis testing.

**PAPER II: FOREST POLICY LEGILATION AND ENVIRONMENTAL ACT**

**Objective:** To develop understanding about forest policy, laws and Environmental Act.

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**Outcome:** Enable students to regarding different forest policies, forest acts, penalty provisions and other legal aspects.

**PAPER III: WORLD FORESTRY SYSTEMS AND CLIMATE CHANGE MITIGATION**

**Objective:** To acquaintances about the world forest and their characteristics and its significance on climate change scenario.

**Outcome:** Students will be able to understand the world forest distribution, vegetation structure, different types of forest, plantations and conservation strategies.

**PAPER IV: DISCIPLINE SPECIFIC ELECTIVE (DSE-3)**

• **FORESTRY EXTENSION**

**Objective:** To provide information about basics of extension education in forestry.

**Output: Develop competence** in students on extension methods, interaction with stakeholders of forests for forest extension and popularization of forest activities to the society.

• **ENTREPRENEURSHIP DEVELOPMENT**

**Objective:** To provide entrepreneurship areas in forestry sector and improve their communication skill.

**Output:** To encourage students for starting entrepreneurship on forest products, consultancy projects.

**SEMESTER - VIII**

**INTERNSHIP 1: SOCIO-ECONOMIC SURVEY- VILLAGE ATTACHMENT (INTR-1):**

**Objective:** To apprise the students with the field practices which are needed for the sustainable utilization and management of village resources. To enhance understanding of local Forestry and working of other village level institutions.

**Outcome:** To develop manpower equipped with latest and updated knowledge and awareness for village resource survey, utilization and management and extension work.

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**INTERNSHIP 2: FORESTRY OPERATIONS (WORKING EXPERIENCE) (INTR-2):**

**Objective:** To apprise the students with the field practices which are needed for the sustainable utilization and management of forest resources.

**Outcome:** To develop competence in students to contribute in the sustainable utilization and management of forest. To develop students to serve manpower to the forest Department.

**INTERNSHIP 3: FOREST INSTITUTES AND INDUSTRIAL VISIT/TRAINING (INTR-3):**

**Objective:** To make the students acquaint with the raw materials, processing techniques, industrial utilization, financial implications and marketing of finished forest based industries. To provide exposure of working of others institution to students.

**Outcome:** To develop man power equipped with latest techniques and knowledge for the sustainable utilization and management of forest based industries.

**DISSERTATION:**

**Objective:** To provide the students research based skills on forestry subjects for analysis of the problem, identification of topic and writing skill.

**Outcome:** This will enable the students for field/laboratory based research work on different aspects of forestry, wildlife and environmental sciences and to improve their scientific writing skill.

**SEMESTER – I**

**PAPER 1. PRINCIPLES AND PRACTICE OF SILVICULTURE (Core-01)**

**CR: 3+2**

Definition, objective and scope of silviculture. Status of forest in India and their role. Forest type and their classification. Trees and their distinguishing features. Site factors and their interactions. Climatic factors and its role. Edaphic factors, Physiographic factors and its influences. Biotic factors- influence of plant insect, wild animals, man and domestic animals. Impact of controlled burning, grazing, influence of forest on vegetation. Microclimate and its effect.

Regeneration: Natural, artificial and factors affecting it. Regeneration Survey. Tending operation: Weeding, cleaning, thinning and improvement felling.

**PRACTICAL**

Acquaintance with various technical terms. Study of forest composition. Recording the observations on phenological characteristics of different tree species. Study of site factors. Study of the natural

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regeneration, afforestation and reforestation success. Lay-outting of nursery bed and soil preparation, types of seed sowing in nursery bed.

**Suggested Readings:**

Champman, G.W. and Allan, T.G. (1978). Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome.

Dwivedi, A. P. (1992). Principles and Practice of Indian Silviculture, Surya Publication.

Dwivedi, A.P. (1993). A Text Book of Silviculture, International Book Distributors, Dehradun.

Khanna, L. S. (1984). Principles and Practice of Silviculture, Khanna Bhandu, Dehra Dun.

Negi, S.S. (1983), General Silviculture, Bisen Singh Mahendra Pal Singh, 23 A Connaught Place Dehradun.

PradipKrishan (2013). Jungle trees of central India. Penguin Book distributors, India.

Ram Prakash and L.S. Khanna. (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.

**PAPER 2. FUNDAMENTALS OF SOIL SCIENCE (Core-02) CR: 3+2**

Composition of earth's crust, soil as natural medium for plant growth, major components of soil, Soil minerals formation, Weathering of rocks and minerals-weathering factor, physical-Chemical-biological weathering and procedure of soil formation. Physical properties-bulk density, soil porosity, soil structure, soil consistency, plasticity. Soil organic matters and litter decomposition, pH, nutrient availability and absorption, soil buffering capacity, Soil water forms-soil moisture, wilting point- field capacity- moisture. water holding capacity, Soil orders- land capability classification. Problem of soils: salted, permeable, flooded and sandy soils.

Forest soils Vs cultivated soils, Soil colloids and exchange phenomenon. 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. Forest soil environment-distribution of various microorganisms, rhizosphere and phyllosphere concept. Mineral Transformation-carbon cycle, N<sub>2</sub>-cycle, P-cycle, S-cycle. Bio-fertilizers -their importance. Nitrogen fixation-Rhizobium-tree: legume symbiosis, Frankia- non-legume symbiosis, asymbiotic and associative N<sub>2</sub> fixation. Mycorrhiza: types, biology and importance with specific relevance to tree seed crops.

**PRACTICAL**

Identification of rocks and minerals; Collection and preparation of soil samples, soil analysis for moisture, color, bulk density, organic matter, pH, EC, Textural analysis.

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Study the forest soil profile. Determination of available N,P& K content of soil, basic sterilization techniques, culturing and maintenance of microorganism occurring in soil, staining methods, study of decomposition of forest litter by CO<sub>2</sub>- evolution method, preparation and inoculation technique for mycorrhiza and biofertilizers.

**Suggested Readings:**

- Armson, K.A. Forest Soils, (1977). IBD Publisher, Dehradun.  
Biswas, T.D. and S.K. Mukherjee (2001). Text book of soil Science. Tata Mc. Grew Hill, Publishing Co., New Delhi.  
Brady, N. and Weil, R.R.(2009). Nature and properties of Soil. Prentice Hall of India.  
Das, D.K (2013) Introductory Soil Science. Kalyani publishers.  
Gaurav, Shalendra Singh (2015), Soil Science, DBS Imprints.  
Halvin J and Pearson (2005). Soil fertility and fertilizers: An introduction to nutrient management. Printice Hall of India.  
Havlin J.L. and Tisdale S.L. (2013). Soil fertility and Fertilizers. Amazon.com  
Kanwar, J.S. (1976). Soil Fertility – Theory and practice ICAR publication, New Delhi.  
Mark Ashman and Geeta Puri (2008). A clear and concise introduction to soil science. Wiley-Blackwell publishers.  
Plaster, Edward J., (2014), Soil Science and Management, Delmar Cengage Learning.

**PAPER 3. BASIC MATHEMATICS (GE-01)**

**CR: 4+1**

Complex numbers, conjugate of complex numbers, properties of Complex numbers, modulus, geometrical representation of Complex numbers, Polar form, square root and cube root of a complex numbers, cube root of unity. Arithmetic progression, geometrical progression, binomial theorem for positive index. Measurement of an angle in radian and degree and its problems, trigonometric ratio and its problems related to them, addition, subtraction and product formula, Height and distance. Coordinate of point, distance between two points, coordinate of a point dividing the line joining two points in mm-ratios, mid-point, centroid, area of a triangle and quadrilateral. Matrices: addition, subtraction, multiplication of matrices, transpose adjoin and inverse of a matrix. Surface Area and Volume: Introduction, Surface area of a Combination of Solids, Volume of a Combination of Solids, Conversion of solid from one shape to another, Frustum of a Cone.

**Suggested Books:**

- R. S. Agrawal (2012). Elementary Mathematics, Kalyani Publishers, New Delhi.  
NCERT, Elementary Mathematics.

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Hall and Knight: Higher Algebra, Book place, New Delhi.

PAPER 4. AEC (ABILITY ENHANCEMENT COURSE)	CR: 2
PAPER 5 SEC (SKILL ENHANCEMENT COURSE)	CR: 2
PAPER 6. ECA ADDITIONAL CREDIT COURSE	CR: 2

#### SEMESTER - II

#### PAPER 1. FOREST MENSURATION (Core-03) CR: 3 + 2

Introduction, definition, objectives and scope of forest mensuration. Units of measurement, standards of accuracy implied in their expression. Accuracy, precision and Bias. Measurement of single tree - objectives, standard rules governing measurement at breast height. Measurement of tree diameter and girth using rulers, calipers and tapes. Height measurements - direct and indirect methods. Height measuring instruments, errors in height measurement. Tree form and method of studying forms. Measurement of cross sectional area, basal area and leaf area. Measurement of volume of trees. Preparation of volume tables, and its classifications. Calculation of log volume and sawn timber. Stand growth site quality, stand structure, yield tables and preparation of yield tables. Biomass measurement. Determination of age of trees. Tree growth measurements, objectives of increment, determination of increment, stump analysis, stem analysis and increment boring. Measurement of volume and yield of plantation area/stand, Forest inventory.

#### PRACTICAL

Units of measurement and their uses. Instruments used in forest mensuration and their working principles, pertaining to tree height, diameter, basal area, bark thickness and crown measurements. Measurement of bark thickness, bark volume, bark area and crown parameters. Calculation of wood volume, sampling of forest and plantation.

#### Suggested Readings:

#### Suggested Readings:

Agrawal, Praveen, (2008). Forest mensuration- Tree measurement, Bisen Singh Mahendra Pal Singh, 23 A Connaught Place Dehradun.

Avery, T.E. (1967). Forest Measurements. Mc Grand Hill Book Company, New York.

Chaturvedi, A.N. and L.S. Khanna (1982). A handbook on Forest Mensuration. International Book Distributors.

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Donald Bruce Francis Schumcher, (2015), Forest Mensuration, Agrihorti Press New Delhi.  
Hamilton, G.L. (1988). Forest Mensuration Handbook. Periodical Expert Book Agency.

**PAPER 2. CYTOGENETICS AND PLANT BREEDING (Core-05) CR: 3 + 2**

Plant cell: its structure and function. Cell reproduction, mitosis, meiosis and its significance. Nucleus chloroplast and mitochondria. Chromosome its structure and function. Chromosomal aberration. Polyploidy. Linkage and crossing over. Mendel's principles of heredity. Deviation from mendelian inheritance, pleiotropy, threshold characters, co-dominance, chromosome theory of inheritance, gene interaction, multiple alleles. Sex determination-theories, sex linked inheritance and characters. Cytoplasmic inheritance and maternal effects. Chemical basis of heredity. Structure of DNA and its replication, RNA: its structure and function. Mutation and its classification, Plant breeding its aim and objectives, modes of reproduction, methods of breeding, selection types and importance.

**PRACTICAL**

Preparation of slide showing various stages of mitosis. Preparation of slides showing various stage of meiosis. Testing the viability and germination of pollen grains. Solving the problems based on Mendelian laws, floral morphology.

**Suggested Readings:**

G. Prasad (1998). Introduction to Cytogenetics. Kalyani publishers New Delhi, India  
P. Singh (2005). Elementary of Genetics. Kalyani publishers Ludhiana, India  
B.J. Zobel and J. Talbert (1984) Applied forest tree improvement. John Wiley & Sons, New York.  
George Acquah (2012). Principles of Plant Genetics and Breeding. 2nd Edition. Wiley-Blackwell  
B.D. Singh (2014). Fundamentals of Genetics. Kalyani Publishers  
P.K. Gupta (2015). Cytology, Genetics and Evolution. Rastogi publications, Meerut, India.

**PAPER 3. FOREST BOTANY AND DENDROLOGY (GE-02) CR: 3 + 2**

Introduction to Botany and Dendrology. Principles and systems of plant classification. Tailed study of Bentham and Hooker natural system, its advantages and disadvantages, plant nomenclature, principles and code of botanical nomenclature. Identification of woody forest flora. Morphology of different parts of typical flowering plant. Structure and types of plant tissues, internal structure of dicot, and monocot stems, root and a typical leaf. Significance of life cycles with special reference to alternation of generation in Nostoc, Rhizopus, Funaria, Adiantum, Pinus and in a flowering plant. Importance of plants in relation to environment.

Water relation in plants. Absorption of water, ascents of sap. Stomata, structure, mechanism of opening and closing of stomata, guttation, transpiration, factors affecting transpiration.

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Photosynthesis, its importance and factors affecting it, Photorespiration, Mechanism of Respiration and factors affecting it, Phyto-hormones and their role in plant growth.

#### PRACTICAL

Morphological description of plant parts and methods of collection of plants techniques of preparing herbarium specimens. General study of herbarium. Morphological studies of root, stem, leaf and flowers. Dissection of flowers- making sketches-construction of floral diagram. Studies of permanent slides of histology and anatomy. General survey of the local vegetation. Forest taxonomy, A field trip during the semester. Osmosis- endo and exo-osmosis demonstration, Plasmolysis- demonstration, Transpiration rate, measuring the rate of photosynthesis in plant species.

#### Suggested Readings:

Strasburger, Schenck, Noll, Fritz, Karsten and W.H. Lang (2010). A textbook of Botany. Academic Press, New York.

V. Singh and D.K. Jain (2013) Biology. Nageen Prakashan Pvt Ltd, Meerut, India.

L. Taiz, L., Zeiger, E., Ian M. Moller and Angus Murphy-Sixth ed. (2015). Plant Physiology and Development. Published by Sunderland: Sinauer Associates

L. Taiz and E. Zeiger (2010). Plant Physiology. Sunderland: Sinauer Associates.

V. Verma (2009) Textbook of Plant Physiology. Ane books Pvt. Ltd. New Delhi.

S. R. Mishra (2011). Text Book of Dendrology. Discovery Books.

**PAPER 4. AEC (ABILITY ENHANCEMENT COURSE) CR: 2**

**PAPER 5 SEC (SKILL ENHANCEMENT COURSE) CR: 2**

**PAPER 6. ECA ADDITIONAL CREDIT COURSE CR:2**

### SEMESTER – III

#### PAPER 1. FOREST ECOLOGY AND BIODIVERSITY CONSERVATION

(Core-05)

CR: 3 + 2

Concept of ecology, levels of biological organization, Ecosystem structure and function. Population ecology and its importance in forest management, plant community structure, Ecological succession, Biodiversity; conservation measurement of diversity and diversity indices. Biodiversity hotspots and biogeographic zones of India. Principles of conservation, Conservation – efforts in India and worldwide. Rangeland ecology, importance of rangeland, Indian rangelands status and management. Rangeland inventory, rangeland improvement.

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#### PRACTICAL

Study of Forest composition; Phyto-sociological study. Measurement of diversity of plants in a nearby forest; Study of succession in field and water bodies; Visit to different ecosystems. Identification of grasses. Rangeland inventory making. Determination of carrying capacity of rangelands. Indicator of heavy grazing.

#### Suggested Readings:

- R. Mishra (1968). Ecology. Work Book Oxford and IBH Publishing Co, Calcutta.  
E.P. Odum (1983). Basic Ecology. Saunders College Publishing. Holt Saunders, Japan.  
Ashok Malik (2008) Dynamics of forest ecosystems. Today and Tomorrow publishers, New Delhi.  
L.D. Vijendra Das (1998). Forage crops. International Book Distributors, Dehradun.  
J.S. Singh, S. P. Singh., S. R. Gupta (2014). Ecology: Environmental Science and Conservation. S. Chand publication.  
Krebs. C.J. (2016), Ecology, Pearson Education Inc.

#### PAPER 2. FUNDAMENTALS OF WILDLIFE AND ITS MANAGEMENT (Core-06) CR: 3 + 2

Definition of wildlife, free living, captive, domesticated and feral animals, uses, values and negative impact of wildlife. Zoogeographic regions and biomes of the world. India's uniqueness in biodiversity, reasons and causes of wildlife depletion. Biogeographic classification of India. Status and distribution of wildlife in India. Scientific and common names of important mammals, birds and reptiles. Rare, endangered and threatened species of mammals, birds and reptiles of India. Agencies involved in wildlife conservation, Govt. and NGO's (BNHS, WWF, Indian Board for Wildlife, CITES). Biological basis of wildlife management. Basic requirements of wildlife – food, water, cover and space, limiting factors. Wildlife ecology: Relevance of basic ecological concepts such as food chain, food-web, ecological pyramids, habitat, ecological niche, carrying capacity, density, prey-predator relations and population dynamics, tourism and multiple use in protected areas. Wildlife damage control: Mitigating human – wildlife conflict: fences, trenches, walls, lure crops, repellents, translocation and compensation. Captive wildlife: Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife census: Purpose, techniques. Wildlife (Protection) Act, 1972. Protected areas –Sanctuary, National Park and Biosphere Reserves. Special projects for wildlife conservation, Project Tiger and Musk Deer Project. Conservation: Meaning, principles and strategies, in-situ and ex-situ conservation, conserving biodiversity.

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### PRACTICAL

Identification and study of wildlife in a nearby zoo. Bird watching. Observe and prepare the list of butterfly in the campus. Preparation of inventory of an area. Study of in-situ and ex-situ wildlife conservation activities. Case study.

#### Suggested Readings:

- Aaron, N.M. (1973). Wildlife ecology. W.H. Freeman Co. San Francisco, U.S.A.  
Anon, (1990). Collection and preservation of animals. Zoological Survey of India.  
Balakrishnan, M., (2016). Wildlife Ecology and Conservation, Scientific Publication.  
Dwivedi A P (2009). Managing wildlife of India. International Book Distributors, Dehradun, India.  
Karanth K. Ullas (2017), Wildlife Population, Nataraj Publications.  
Rajesh Gopal (1992). Fundamentals of wildlife management. Justice Home, Allahabad, India.  
Robert, A.W. (1979). The ecology and evolution of animal behavior. Good Year Pub. Co. California, U.S.A.  
Robert, G.H. (1978). Wildlife management. W.H. Freeman and Co., San Francisco, U.S.A.  
Singh S K (2009). Textbook of wildlife management. Today and Tomorrow publishers.

### PAPER 3. FOREST MANAGEMENT (Core-07)

CR: 3 + 2

Definition and scope of forest management. Peculiarities of forest management. Principles of forest management and their applications. Objects of management, purpose and policy. Forest management and administrative units, felling cycle, cutting section. Definition, Scope and classification of Silviculture System with details. Bamboo Management.

Rotation, kinds of rotations, choice of rotations, length of rotations and conversion period. Increment - definition & types, CAI -MAI relationship. Growing stock: concept and definition determination of growing stock, density, quantity and increment. Normal forest: definition and concept. Even aged and uneven aged models. Normal growing stock in regular, shelter wood system & selection system. Yield: Sustained and progressive yield concept and meaning. Yield regulation - general principles of yield regulation in even aged and uneven aged forest crop. Working Plan: definition, objects and necessity, preparation of working plan. Joint forest management: concept and methodology. Criteria and Indicator for sustainable forest management.

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#### PRACTICAL

Visit to forest department and courts to observe working procedures. Study of working plans of the forests. Learning of preparation of working plan for one of the area. Estimation of MAI and CAI, Fixation of rotation for species. Perform a survey of forest area & chalk out a plan for silviculture management. Study of vegetation features in G.G.V. campus. Drawing of silvicultural treatment map.

#### Suggested Readings:

- Champan, G.W. and Allan, T.G. (1978) Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8, F.A.O Rome
- David M. Smith. (1989) The Practice of silviculture. IBD Educational Pvt. Ltd. Dehradun, India.
- J B Lal (2007). Forest Management: Classical Approach and Current Imperatives. Natraj publishers, Dehra Dun.
- Jerrain, M. R. K., (2005), A text Book on Forest Management, CBS Publishing.
- Khanna, L. S.(1984) Principles and Practice of Silviculture, KhannaBhandu, Dehra Dun. P. 476.
- Negi, S. S., Forest Management in India.
- Osmaston, F.C. Management of Forests, (1984) IBD Publication. Dehradun
- Ram Prakash and L.S. Khanna (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.
- Ram Prakash. Forest management, (2006) IBD Publication, Dehradun

#### PAPER 4. NON WOOD FOREST PRODUCTS AND ETHNOFORESTRY (GE-03) CR: 3+2

Forest and tribes- their relationship, Major tribes in India and Chhattisgarh. Forest ecosystem and cottage industries. Role of tribes in forest protection, development and conservation. Tribal welfare and social forestry, Tribal and co-operative movements. History of tribal welfare and administration, forest & tribes, Seed and biofuels, Herbal medicines in ethno-medical practices, Edible wild fruits, Wild mushrooms, Natural dyes, Economic uses of grasses. Gums and resins, important gum yielding plants. Resins and Oleoresins, their formation in plants and its uses, Sericulture and lac culture Tendu leaves- sources, collection and processing. Dependency of forest dwellers on NTFP in economy Scenario of NTFP obtained from forests of Chhattisgarh (Central India). Ethnoforestry & sustainable management.

#### PRACTICAL

Morphological description and identification of various medicinal plants. Collection of medicinal plants and plants part from natural habitats. Survey and study of nursery techniques of medicinal

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plants... Visit to Herbal Gardens and herbaria to study medicinal plants.. Visit to nearby MPCAs/ nursery/ ayurvedic pharmacies. Study the tribal races of India. Study the important medicinal plant used by traditional healers. Visit to nearby forests to study important NTFP yielding plants. Study of canes and bamboos and their sources. Study of gums and resins and their Visit of sericulture and lac cultivation farms. Tendupatta area and interaction with forest dwellers to study the economy of rural people.

**Suggested Readings:**

Ashok Ranjan Basu & S. Nijhavan (1985) Tribal Development Administration in India. Mittal publications.

C.M. Cottan (1996) Ethno botany: Principles & Applications. Jhon Wiley and sons Ltd.

Dwivedi, A.P. (1993) Forests - the non-wood resources. International Book Distributor, Dehradun. 352 p.

Mehta T (2012) A handbook of forest utilization. Today and Tomorrow publishers.

R.K. Sinha (1996) Ethnobotany: the renaissance of Traditional Herbal Medicines. Inashree publishers.

Taank P (2010) Forest product and their utilization. Today and Tomorrow publishers.

V.P. Agrawal (2002) Forest in India. Oxford and IBH publishers.

Vinod M. Mhaiske, Vinayak K Patila and Satish S Narkhede (2016). Forest Tribology and Anthropology. Scientific Publishers, Delhi.

**PAPER 5. AEC (ABILITY ENHANCEMENT COURSE)**

**CR: 2**

**PAPER 6. ECA ADDITIONAL CREDIT COURSE**

**CR:2**

**SEMESTER – IV**

**PAPER 1. REMOTE SENSING AND GIS APPLICATION IN FOREST**

**(Core-08)**

**CR: 3 + 2**

Introduction of Remote Sensing, World Satellite system, Energy sources and radiation principals. EMR and Spectrum concept, Atmospheric windows. Interaction of EMR with Earth surface features, spectral signatures. SAR Interferometry, Fraction of absorbed photosynthetically active radiation. Basics of GIS, components, application and advantages. GIS software used. Data Image Processing concept, Data analysis, data output in GIS. Global Navigation Satellite System concept, Basic information on vegetation indices (RVI, NDVI, PVI, SAVI and LAI), different vegetation parameters for forested watershed, Plant species specification, DEM creation and Soil mapping methods.

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Topographical character analysis concept in forest. Conceptual knowledge of use of remote sensing in Riparian area, Land cover data, its derivation.

#### PRACTICAL

Acquaintance with GIS software and imageries. map reading of SOI toposheets, Image processing, geo-referencing, digitizing, sub setting, mosaicing and feature identification, GPS survey and point location, unsupervised and supervised classification of images for forest. Forest land use/land cover classification, field visit for ground data collection and truthing.

#### Suggested Readings:

- M. Anji Reddy (1998). Textbook of Remote Sensing and GIS. B S Publications.  
P.J. Curran(1985). Principles of Remote Sensing. Long man Group Ltd., England  
L.F. Janssen (2000). Principles of Remote Sensing. ITC. Edl. Text Book Series II. The Netherlands  
Rolf A.de By. (2000). Principles of Geographical Information Systems. ITC. Edl. Text Book Series. The Netherlands  
M.K. Sharma (1986). Remote Sensing and Forest Surveys. International Book Distributors, Dehra Dun.  
B. Bhatta (2008). Remote Sensing and GIS. Oxford Publications.

#### PAPER 2. FUNDAMENTALS OF WOOD SCIENCE AND TECHNOLOGY

(Core- 09)

CR: 3 + 2

Introduction to Wood. Secondary growth in woody plants. Mechanism of wood formation. Formation of early and late wood, growth rings, transformation of sapwood to heartwood. The macroscopic features of wood. Physical properties of wood; colour, hardness, weight, texture, grain, lusture etc. Mechanical properties of wood i.e. modulus of elasticity, ultimate stress, fiber stress at elastic limit, important factor influencing strength properties. Wood water relationship. Abnormalities in wood; deviation from typical growth form (leaning, bending, crook, fork, and buttress), grain deviation, false and discontinuous growth rings. Wood seasoning and preservation. Wood technology, Plywood, engineered wood, Wood certification, Use of nanotechnology in wood.

#### PRACTICAL

Wood- macroscopic and microscopic feature. Study of anatomical features of different types of wood pores /vessels. Study of wood rays and their types. Study of non-porous woods, their physical and anatomical description. Study of cell inclusions in wood, Estimation of moisture content and density of wood. Physical properties and Mechanical properties of wood.

Preliminary idea regarding conversion and saw milling. Wood seasoning, principles, types, merits and demerits- air seasoning, kiln seasoning and chemicals seasoning. Seasoning defects and their

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control. Wood working, Polishing and finishing of wood. Surface coating applications and wood primers. Wood preservatives. Chemicals used and methods of wood preservation and fire retardant treatments. Manufacture, Properties and Uses of composite wood- plywood, fiber board, particle board and hard board. Improved wood-definition, types -impregnated wood, heat stabilized wood, compressed wood, and chemically modified wood.

**Suggested Readings:**

- Anonymous (1976). Indian forest utilization. Volume I and II ICFRE Publication, Dehradun.  
T. Mehta (1981). A Handbook of Forest Utilization. Periodical Expert Book Agency, Delhi.  
K.R. Rao and K.B.S. Juneja (1992). Field identification of 50 important timbers of India. ICFRE Publication, Dehradun.  
L.C. Sharma (1977). Development of forests and forest based industries, Bishen Singh and Mahendra Pal Singh Publication, New Delhi  
Terry Porter (2006). Wood Identification and Use. Guide Master Craftman publications.  
A. S. Hill Callum (2006). Wood modification: Chemical thermal and other process. Today and Tomorrow publishers.

**PAPER 3. FOREST SURVEYING AND ENGINEERING (Core-10) CR: 3 + 2**

Engineering survey, scope and types of surveying, chain surveying, types and instrumentation 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, compass surveying, chain and compass traversing, magnetic and true bearings, prismatic compass, local attraction, Plane table surveying, plane table and its accessories, methods of plane table surveying, Leveling Instruments, Total station survey, Contour surveying, Map and reading, its method and importance in Forestry.

Building materials- concrete, brick, cement, sand and strength and characteristics, site selection for building construction. Forest roads – alignment, construction and drainage, retaining walls, breast wall, waterways and culverts, Bridges-types, selection of site, simple wooden beam bridges, check dams, spurs, farm ponds, earth dams.

**PRACTICAL**

Chain survey, compass traversing, plane table surveying, Total Station survey, leveling, and calculation of earth work for construction of forest. Earth dams, Alignment of forest roads. Design of simple wooden beam bridge. Design of retaining walls, Design of check dams.

**Suggested Readings:**

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- Ram Prakash (1983). Forest surveying. International Book Distributors, Dehradun.  
B. C. Punmia (2005). Surveying. Firewall Media  
W. Schofield and M. Breach (2007). Engineering Surveying. British Library Book Library  
Cataloguing in Publication Data  
N.J. Masani (2006). Forest Engineering. Natraj publishers.

**PAPER 4: SERICULTURE (GE-04)**

**CR: 3+2**

Introduction, scope and principle of Sericulture. Mulberry and non-mulberry sericulture in India; Silk production in India and other countries and their export and import. Insect and non-insect fauna producing silk; types of silk produced in India; host plants of mulberry and non-mulberry silkworms; mulberry cultivars – tropical and temperate regions, irrigated and rainfed conditions. Characteristic features of the order Lepidoptera; Classification of sericigenous insects. Classification of silkworms based on moultnism, voltinism and geographical distribution; popular silkworm breeds and hybrids of Chhattisgarh, their economic traits; Silkworm morphology, Silkworm rearing methods, Silkworm pest and diseases. Preparation of nursery beds, Selection of materials for cuttings, selection of cutting planting. Selection and grading of sampling. Different propagation methods of silk plant host-grafting and layering. Planting System and Intercultural Operations: - pit and row system, mulching, irrigation. Characteristics of sericulture industry: Land and agro based part of industry. Silk reeling as a cottage industry; Handloom and power loom activities. Textile fibers: Natural and Synthetic fibers: Advantage of silk fiber over other fibers. Sericulture organizations in India and Chhattisgarh; role of State Sericulture department, Central Silk Board. Prospects and problems of Sericulture industry.

**PRACTICAL**

Sericulture World maps and Silk Road, Sericulture map of India and Chhattisgarh, Study of life cycle of silkworm: Morphology of egg, larva, pupa and adult. Cocoon characters of popular uni-, bi- and multivoltine races, Identification of different diseased silkworms based on external symptoms. Identification and uses of two sericulture rearing appliances. Calculate the brushing capacity in accordance to leaf estimation/acre. Morphological study of few important cultivars in Chhattisgarh. Preparation of grafting (bud or shoot grafting) or layering (simple layering) drawing and labelling. Identification of different types of weeds, fertilizers, calculation of dosages. Preparation Compost.

**Suggested Readings:**

Byong Ho Kim (1989). Filature water engineering, Seoul national university press, Republic of Korea.

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Huang Guo Rui (1988). Silk reeling. Oxford and IBH publishing co. Pvt. New Delhi.  
D. Mahadeveppa, V.G. Halliyal, V.G., Shankar, A.G. And Bhandiwad, R. (2000). Mulberry Silk Reeling Technology, Oxford And IBH Publishing Co. Pvt. Ltd. New Delhi.  
T.N. Sonwalker (2010). Handbook of Silk Technology, New Age International Pvt., Ltd.  
Yong Woo Lee (1999). Silk Reeling And Testing Manual, FAO Agricultural Services Bulletin No. 136, Rome, Italy.

Akira Nakamura (2000). Fiber Science and Technology. Oxford & IBH Publications, New Delhi.

**PAPER 5. AEC (ABILITY ENHANCEMENT COURSE)**

**CR: 2**

**SEMESTER – V**

**PAPER 1. WATERSHED AND ITS MANAGEMENT (Core-11) CR: 3+2**

Watershed - introduction and characteristics. Problems and prospects, investigation, topographical survey, soil characteristics, vegetative cover, present land use practices and socio-economic factors. Watershed management - concept, objectives, factors affecting, watershed planning based on land capability classes, hydrologic data for watershed planning, watershed codification, delineation and prioritization of watersheds - sediment yield index. Water budgeting in a watershed. Rainwater conservation technologies: inter-terrace and inter-bund land management. Integrated watershed management - concept, components, arable lands and non-arable lands. Effect of land management on watershed hydrology. Participatory watershed management, Application of Remote Sensing, GIS & Isotope technology in survey and problem identification for planning and management of watershed.

**PRACTICAL**

Exercises on delineation of watersheds using topo-sheets. Surveying and preparation of watershed map. Quantitative analysis of watershed characteristics and parameters. Watershed investigations for planning and development. Analysis of hydrologic data for planning watershed management. Water budgeting of watersheds. Prioritization of watersheds based on sediment yield index. Study of functional requirement of watershed development structures. Study of watershed management technologies. Practice on software for analysis of hydrologic parameters of watershed. Study of role of various functionaries in watershed development programmes. Techno-economic viability analysis of watershed projects. Visit to watershed development project areas.

**Suggested Readings:**

S. K. Datta (1985). Soil Conservation and Land Management. International Book Distributors, Dehradun.

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- R. Suresh (2006). Soil and Water Conservation Engineering. RStandard Publishers Distributors, Delhi.
- Rajvir Singh (2000). Watershed Planning and Management. Yash Publishing House, Bikaner.
- B. Venkateswarlu, Mohammed Osman, M.V. Padmanabhan, K. Kareemulla, P.K. Mishra, G.R. Korwar and K.V. Rao (2013). Field Manual on Watershed Management. CRIDA, Hyderabad
- G. Das (2008). Hydrology and Soil Conservation Engineering: Including Watershed Management. Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
- V.V. Dhruva Narayana, G. Sastry and U.S. Patnaik (1997). Watershed Management. ICAR, New Delhi.
- Tideman, E.M (1996). Watershed Management: Guidelines for Indian Conditions., Omega Scientific Publishers, New Delhi.

## PAPER 2. FOREST TREE IMPROVEMENT AND BIOTECHNOLOGY

(Core- 12)

CR: 3 + 2

Introduction to Forest Tree Improvement. Reproduction in trees. Pollination in trees. Inbreed and outbreed population in forest trees. Genetic variability and its role in tree improvement. Qualitative and quantitative traits in forest trees. Heritability, genetic advance, genetic gain, combining ability and their application. Geographic variation: Provenance, seed source, race, Genetic, environmental and phenotypic expression of trees. Plus tree selection, progeny trials. Forest Genetic Resources and its Conservation. Plant tissue culture - culture media and its formation, cell/tissue culture, haploid culture, basics of Genetic Engineering- Vectors: plasmid, bacteriophage and cosmids. Genetic code. Genetic Engineering. Methods of gene transfer: direct and indirect genetic engineering, gene cloning and polymerase chain reaction. Recombinant DNA Technology. Role of Genetic Engineering in Forest Tree Improvement

### PRACTICAL

Floral biology & phenological observations in some important species. Estimation of pollen viability. Different breeding methods flow chart. Species and provenance selection techniques. Vegetative propagation techniques and tree improvement. Estimation of phenotypic and genotypic coefficient of variation. Exercise in plus tree selection. Protocol and preparation of culture medium, Preparation of stock solutions. Sterilization techniques, preparation of culture medium for establishment of explants of forestry plants, multiplication of shoots, and callus culture.

### Suggested Readings:

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- Agrawal, P.K. and M. Dadlani (1987). Techniques in Seed Science and Technology, South Asian Publishers, Delhi.
- Agrawal, R.L. (1996) Seed Technology. Oxford & IBH, Publishing Co., New Delhi.
- Datta, M., and Saini, G.C. (2009), Forest Tree Improvement & Seed Technology, International Book Distributor, Dehradun.
- FAO. (1985) Forest Tree Improvement, FAO Publication, Rome, Italy.
- Fins, L., Friedman, S.T. and Brotschol, J.V. (1992) Handbook of Quantitative Forest Genetics, Klumer Academy, Dordrach, London.
- Khan I M (2014) Forest Biotechnology. Today and Tommorrow publishers, New Delhi
- Lars Schmidt (2000) Guide to Handling of tropical and sub-tropical forest seeds. Danida Forest Seed Centre, Denmark.
- Mandal, A.K. and Gibson, G.L. (eds) (1997). Forest Genetics and Tree Breeding. CBS Publisher & Distributor, New Delhi
- White, T.M. and G.R. Hodges. (1989) Predicting breeding values with application in forest improvement. Kluwar Publishing, Netherlands.
- Wright, J.W. (1976) Introduction to Forest Genetics. Academic Press, New York.
- Wright, J.W. (1976) Introduction to forest genetics. Academic Press, New York, 463 p.
- Zobel, B.J. and J. Talbert. (1984) Applied forest tree improvement. John Wiley & Sons, New York.
- Zobel, B.J. and Talbert, J. (1984) Applied Forest Tree Improvement. John Wiley & Sons, New York.

### PAPER 3. FOREST TREE SEED TECHNOLOGY (Core- 13) CR: 3 + 2

Seed formation in forest trees. Classification of forest tree seed. Forest Seed structure, chemical composition, germination, seed viability and factors affecting seed viability. Seed dormancy and pre-treatment of break down dormancy, determining optimal harvest maturity indices. Seed collection methods- equipment's and planning, seed processing, seed extraction, drawing, cleaning, grading, treating, bagging, leveling and storage. Storage of Orthodox, recalcitrant seeds and fumigation and seed treatment. Seed cryopreservation, seed quality testing, purity, viability, moisture, vigor and seed certification. Quality seed production technology- seed orchard, selection of seed tree, plus tree and elite tree.

#### PRACTICAL

Identification of seed tree species, seed maturity test, germination test, seed vigor and its measurement, visit to seed production areas and seed orchards.

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**Suggested Readings:**

Ram Prasad and A K Kandya (1995). Handling of Forestry seeds in India, Natraj Publication, Dehradun

P.K. Agrawal and M Dadlani (1987). Techniques in seed science and technology, South Asian Publishers, Delhi

R.L. Agrawal (1996). Seed Technology, Oxford and IBM Publishing Co., New Delhi

M.P. Nema, M P (1987). Principle of Seed Certification and Technology, Elite Publishers

Renuga Devi, J NV Manumani (2011). A handbook of seed testing, Agrivos publication

**PAPER 4. METEOROLOGY AND CROP PRODUCTION (DSE-1A) CR: 3 + 2**

Meaning and scope National and International agriculture research institute in India. Agro-climatic zones of India and Chhattisgarh. Tillage, crops stand establishment, planting geometry and its effect on growth and yield cropping system, harvesting. Crop production of wheat, rice, sugarcane, pulses and oil seeds. Meteorology: weather and climate, micro-climate, weather elements, earth's atmosphere composition and structure, solar radiation, nature, properties, solar constant and energy balance, atmospheric temperature, factors affecting, horizontal and vertical distribution, variations and global warming, air pressure variations, wind factors, cyclones, and anticyclones, atmospheric humidity, vapour pressure and saturation, process of condensation, formation of dew, fog, mist, snow, rain and hail. Formation and classification of clouds, introduction to monsoon, basics of weather forecasting.

**PRACTICAL**

Study of Tillage implements, practice of ploughing, practice of puddling, study of seeding, equipment's. Different methods of sowing, study of manures, fertilizers and green manure crops/seeds.(Including calculation). Study of inter-cultivation implements and practice, practice of methods of fertilizers applications in ongoing field operations. Site selection for agromet observatory, measurement of temperature, measurement of rainfall, measurement of evaporation, measurement of atmospheric pressure, measurement of sunshine duration and solar radiation, measurement of wind direction and speed and relative humidity. Study of weather forecasting and synoptic chart.

**Suggested Readings:**

Chhidda Singh et al (2012) Modern techniques of raising field crops.Oxford and IBH publishing company, New Delhi.

Ghadekar S R (2008). Textbook of Agrometeorology. Agromet publishers.

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Kafi, Mohammad Khan, Muhammad Ajmal (2008) Crop And Forage Production Using Saline Waters Nam S&T Centre, Jain Book Agency.

Norman, David Douglas, Malcolm FAO (2007) Farming Systems Development and Soil Conservation FAO, Jain Book Agency.

Varsaneya, M.C. and Balakrishna Pillai, P., (2013), Textbook of Agriculture Meteorology, Indian council of agriculture Research, New Delhi.

Varshnaya M C and Balakrishna Pillai (2012) A textbook of agriculture metrology. ICAR, New Delhi Publications.

**PAPER 4. BASIC CONCEPTS OF HORTICULTURE AND LANDSCAPING  
(DSE-1B) CR: 3+2**

Horticulture: definition, component and importance, Nursery management practices, vegetable gardens, Nutrition and kitchen gardens landscape garden, establishment of orchard high density and meadow orchard- principles, planning and layout, precision farming of fruit, planting system and planting densities, Vegetative propagation techniques- budding, grafting, cutting, IPM in horticulture. Principles and methods of pruning and training of fruit crops, Use of growth regulators in horticulture, weed management, cropping systems, intercropping, multi-storeyed cropping, Tree based cropping system.

**PRACTICAL**

Feature of orchard, planning and layout of orchard, tools and implements, layout of nutrition garden, preparation of nursery beds for sowing of vegetable seeds, digging of pits for fruit plants, planting system, Training and Pruning of trees, Preparation of fertilizer mixtures and field application, preparation and application of growth regulators, maturity standards, harvesting, grading, packaging and storage.

**Suggested Readings:**

Arora, D., Biotech Dictionary of Horticulture.

Christopher, E. P., Introductory of Horticulture.

George Acquaaah (2002) Horticulture - Principles and Practices, Jain book Agency.

J.S. Bal (2002) Fruit Growing in India, Kalyani publishers

Jitendra Singh (2007) Basic Horticulture, Kalyani publishers.

K.L.Chadha(2015) Handbook of Horticulture, Jain book Agency.

Wright, W.P., Encyclopedia of Horticulture and Gardening.

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SEMESTER - VI

PAPER I. FOREST PATHOLOGY AND ENTOMOLOGY (Core-II) CR:

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Relation of plant pathology with forest pathology and other sciences, classification of tree diseases. General characteristics and reproduction of plant pathogens: fungi, bacteria, viruses. Important characters of ascomycetes and basidiomycetes. Dissemination and survival of plant pathogens. Concept of tree disease and types of wood decay.

Definition, importance and scope of Forest Entomology. Classification of forest pests: types of damages and symptoms; factors for outbreak of pests. Symptoms, etiology and control of diseases/disorders and insect pests of important tree species (Teak, *Dalbergia*, *Eucalyptus*, Sal, and *Acacia*) Fungicides, methods of their application. Principles and techniques of Integrated Pest Management in forests. Symptoms, etiology and management of diseases of important tree species like Teak, *Dalbergia sp.*, *Acacia spp.*, Sal, Pines, Deodar, Eucalyptus. Types of wood decay. Principles of disease management, Fungicides and their use in nurseries and plantation.

**PRACTICAL**

Study of different pathological instruments, collection, observation and preservation of diseased specimen and observation of other pathogenic structure: microscopic characters of pathogen (fungi, Bacteria) preparation of culture media, isolation and sub culturing of pathogens; methods of inoculation and Symptom, sign and diagnosis of tree disease.

Study of different types of insects and their collection. Study of insecticides and their formulations, plant protection appliances; Study of insect pests of forest seeds; Study of insect pests of forest nurseries; Study of insect pests of standing trees, freshly felled trees and finished products. Visit to forest nurseries and plantations.

**Suggested Readings:**

Bakshi, B.K. Forest Pathology. (1976) Principles and Practices in Forestry. Controller of Publications, New Delhi.

Beeson, C.F.C. (1941) Forest Insects of India, The Ecology and Control of the diseases. International book distributors, Dehra Dun.

Brues, T.C., A.L. Melander and E.M. Carpenta, (1954) Classification of Insects, Cambridge Man, USA.

Gupta, V.K. and N.K. Sharma, (1988). Tree Protection. Indian Society of Tree Scientists, Solan.

Herrick, G.W. (1988). Insect Enemies of Trees. Pioneer Publishers, Jaipur.

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- John Saw Boyce, (2015). Forest pathology, Agrihorti Press.
- Khanna, L.S. (1984) Forest Protection, KhannaBandhu, Dehra Dun.
- Paul D Menan (2003) Tree and disease concept. Prentice hall Inc.
- Richards, O.N. and R.G. Davies (1977) Imm's General Textbook of Entomology, 10th ED. Chapman and Hall.
- Satha T V (2009) A textbook of forest entomology. Today and tomorrow publishers.
- Sathe, T.V., (2016), Forest Entomology, Daya Publishing House, New Delhi.

## PAPER 2. AGROFORESTRY AND TREE OUT SIDE FOREST (Core-15)

CR: 3 + 2

Indian agriculture- structure and constraints. Land use definition, classification and planning. Agroforestry- definition, aims objectives and need. Traditional Agroforestry systems: Taungya system, Shifting cultivation, Wind break, Shelterbelts, Homestead gardens. Alley cropping, high density short rotation plantation systems, silvicultural woodlots/energy plantations. Classification of agroforestry system-structural, functional, socio-economic and ecological basis. Multipurpose tree species and their characteristics. Tree architecture, canopy management- lopping, pruning, pollarding and hedging. Diagnosis and design. Agroforestry systems in different agroclimatic zones, components, production and management techniques. Tree-crop interface. Economics of agroforestry systems. People participation, rural entrepreneurship through agroforestry and industrial linkages. Analysis of fodder and fuel characteristics of tree/shrubs. Tree outside forests, social forestry, farm forestry, urban forestry, green belt, oxy-van, industrial plantations.

### PRACTICAL

Study characteristics of trees/shrubs/grasses for agroforestry. Volume and biomass estimation. Crown measurement, light interception and moisture measurement in agroforestry systems. Litter estimation and nutrient analysis, soil analysis, quantification of fertilizer doses, Annual crops/grass growth measurements and yield estimation carbon storage assessment. Tree species for outside forests, impact of tree vandalism on tree outside natural forest, carbon calculation in agroforestry and TOFs.

### Suggested Readings:

- Bane, Lester, (2016), Agroforestry, Syrawood Publishing House, New York.
- Chundawat D S and Gautam S K (2010) Textbook of agroforestry, Oxford and IBH publishing co pvt. Ltd.
- Dwivedi, A.P. (2012). Agroforestry, Principle and Practice, Oxford & IBH Publishing Company, New Delhi.

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- Dwivedi, A.P. (1992) Agroforestry principles and practices. Oxford and IBH Publication Co., New Delhi.
- Huxley, P. (1999) Tropical agroforestry. Blackwell Science, Oxford, 371 p.
- Khosla, P.K. and Khurana, D.K. (1987) Agroforestry for rural needs. Vol. I and II, ISTS, Solan, H.P.
- Nair, P.K.R. (1993) An introduction to agroforestry. Kluwer Academic Publishers, 499 p.
- Ong, C.K. and Huxley, P.K. (1996) Tree crop interactions - A physiological approach. ICRAF, Kenya, 386 p.
- Pathak, P.S and Ram Newaj, (2012), Agroforestry, Potentials and Opportunities, Agrobios (India).
- Ramakrishnan, P.S. (1992) Shifting agriculture and sustainable development. Man and biosphere series, The Parthenon Publishing Group, 424 p.
- SenSarma, P.K. and Jha, L.K. (1993) Agroforestry. Indian Perspectives, Ashish Publishers, Delhi.

**PAPER 3. FOREST ECONOMICS (Core- 16)**

**CR: 3 + 2**

Basic concept of economics, Nature and scope of economics and its relationship with other sciences. Types of goods, Concept and types of demand, law of demand, measures of demand elasticity, Concept and types of supply, law of supply, measures of supply elasticity, Types and theory of utility, Diminishing law of utility, equimarginal utility and Hicks-Allen approach for determining consumer equilibrium, Concept of revenue, Factors of production, their definition and characteristics, Law of diminishing marginal returns, Market - its classification and price determination under different market situations. Theory of consumption, Ricardian theory of Rent, Marginal productivity theory of wages, liquidity preference theory of interest, Marginal productivity theory, risk talking and uncertainty bearing theories of profit, National income and its concepts, Concepts and types of inflation.

**Practical**

Estimation of demand elasticity with respect to price and income. Estimation of Supply elasticity with respect to price and income. Utility measurement- total utility, marginal utility and average utility. Revenue measurement- total revenue, marginal revenue and average revenue. Market classification- visits of different markets. Price determination under different market conditions

**Suggested Readings:**

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Edwin S. Mills (1975) Economic Analysis of Environmental Problems. New York: Columbia University Press

Fisher, A.C (1979) Resource and Environmental Economics. New York: John Wiley & Sons.

Nautiyal, J. C., (2011), Forest Economics, Principle and Applications, Natraj Publishers, Dehradun, New Delhi.

Orris C. Herfindahl (1969) Natural Resource Information for Economic Development. Baltimore: The Johns Hopkins University Press

Sharma, L.C., Forest economics planning & management.

Sharma, S.D (1975) A New Approach to Linear Programming. Meerut: Kedamath, Ramnath and Co.

Subba S Reddy (2012) Agricultural Economics. Oxford and IBH publishers.

Tony Prato (1998) Natural Resource and Environmental Economics. Ames: Iowa State University Press

#### PAPER 4. Urban Forestry (DSE-2A)

CR.3+2

Introduction, objective and scope of urban forestry, History of Urban Forestry/Distribution and Ownership of the Urban Forest Functions and Values of the Urban Forest Urban Forest Environment Tree Hazard Assessment and Management Street, roads and parks tree inventories and Valuation The Urban Wildland Interface, Species selection for Street Tree and Park Management: Planting, Tree Maintenance, Removals Urban Forestry Ordinances, biomass estimation for carbon stock assessment and mitigation of carbon footprint calculation.

#### PRACTICAL

Identification of various types of forest tree species found in urban environment. Tree hazards assessment through different methods. Species selection for plantation and establishment of nursery. Biomass estimation for carbon stock in different species.

#### Suggested Readings:

Malcom Fisher (1999). Urban forestry: planning and management. Syrawood publication house.

V.K. Prabhakar (2000). Forestry and forest resources. Anmol Publication, New Delhi.

S S Negi (1989). Urban and recreational forestry. International book distributors, Dehradun.

S S Negi (2003). Manual of forestry. Bishen singh, Mahendra pal singh, Dehradun.

#### PAPER 4. LAND DEGRADATION AND RESTORATION (DSE- 2B) CR: 3+2

Type, factors and processes of soil/land degradation and its impact on soil productivity, including soil fauna, biodegradation and environment. Land restoration and conservation techniques- erosion

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control reclamation of salt-affected soils; mine land reclamation, afforestation, organic products. Extent, diagnosis and mapping of land degradation by conventional and modern RS-GIS tools; monitoring land degradation by fast assessment, modern tools, land use policy, incentives and participatory approach for reversing land degradation; global issues for twenty first century.

**PRACTICAL**

Assessment land degraded areas, Determination of soil-moisture characteristics curve and computation of pore-size distribution, Determination of hydraulic conductivity under saturated and unsaturated conditions, Soil temperature measurements by different methods, Estimation of water balance components in bare and cropped fields.

**Suggested Readings:**

T.D. Biswas and G. Narayanasamy (1996). Soil Management in Relation to Land Degradation and Environment, Bull. Indian Soc. Soil Sci.17, New Delhi.

J.W. Doran and A.J. Jones (1996). Methods of Assessing Soil Quality. Soil Science Society of America, Madison.

D.J. Greenland and I. Szabolcs (1994). Soil Resilience and Sustainable Land Use. CABL.

J. Sehgal J and I.P. Abrol (1994). Soil Degradation in India - Status and Impact. Oxford & IBH.

**PAPER 5. AEC (ABILITY ENHANCEMENT COURSE)**

**CR: 2**

**PAPER 6. MOOC Course**

**CR: 2-4**

**SEMESTER – VII**

**PAPER: 1. BIostatISTICS (Core-17)**

**CR: 3 + 2**

Definition and application of statistics, types and source of data, classification and tabulation of data, frequency distribution, graphical representation of data, (Bar diagram, pie chart, histogram, frequency polygon) measures of central tendency ( mean, median, mode) measures of Dispersion (range, standard deviation, Mean deviation, Quartile deviation, variance, coefficient of variation),

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Probability, Test of signification: basic concepts,( Z- Test,  $X^2$ -Test, t-Test, F-test), regression, Correlation : (scatter diagram, correlation co-efficient, its properties).

**PRACTICAL**

Histogram, frequency polygon, Bar chart, pie Chart. Measures of central tendency: Mean median and mode for raw and grouped data. Construction of frequency distribution table and its graphical representation. Measures of dispersion: Range, mean deviation, Quartile deviation and standard deviation for raw and grouped data. Paired 't' test, Chi-square test for contingency tables and theoretical ratios Correlation and linear regression.

**Suggested Readings:**

Arora P N (2003) Biostatistics. Himalayan publishers.  
Arora, P.N. and P. K. Malhan (2016). Biostatistics, Himalaya Publishing House.  
K.Balaji, A.V.S. Raghavaiah, K.N. Jayaveera (2012), Biostatistics, I.K. International Publishing House Pvt. Ltd. New Delhi.  
Kenneth N. Berk (1998). Introductory Statistics. www.amazon.com  
Marcello Pagano and Kimberlee Gauvreau (2008) Principles of Biostatistics. Jhon and Wiley Sons Ltd.

**PAPER 2. FOREST POLICY LEGISLATION AND ENVIRONMENTAL ACT  
(Core-18) CR: 3+2**

Origin of Forestry- Historical background and introduction of forest policies of India namely 1894, 1952 and 1988 to protect the Indian Trees. National forest policy 2018, Indian forest Act 1927, Tendupatta (Vyapar Vinnyaman) Adhinyam 1964, Transit Rules 1961, Forest conservation Act 1980, Fixation of Rates of Timber and Other Produce, Biodiversity Act, Lok Vaniki Adhinyam, The scheduled tribes and other traditional forest dwellers act (Forest Rights Act) 2006.

**PRACTICAL**

Visit to different saw mill, Forest department. Case studies of High court, District Court and Lower Court. Tendupatta Collection center. Study the effect of mined out area on forest, forest depot to see the rules and regulations.

**Suggested Readings:**

W. Fernandes and Kulkarni (1986). Towards a new Forest Policy. Natral Publishers, Dehra Dun.  
National Forest Policy (1988). Government of India Publication, Delhi.  
Indian Forest Acts with short Notes (1975). Allahabad Law Agency, Allahabad.

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E. Podder and Erai (2011). Forest law and policy in India, Today and Tomorrow publishers.  
L.S. Khanna (2001). Wildlife (Protection) Act 1972 as amended upto date with commentary, Khanna Bandu, Dehra Dun.  
S.S. Negi (1985). Forest Law. Natraj Publication, Dehra Dun.

**PAPER 3. WORLD FORESTRY SYSTEMS AND CLIMATE CHANGE  
MITIGATION (Core-19) CR: 3+2**

Geographical distribution of world forest and their classification. International and National Forestry Organizations. Critical examination of world forest resources, productivity potential and increment of world forests. Forest resources and Forestry practices in different regions of the world- North and South America, Europe, Africa, China, India, Russia, South East Asia and Australia. Forest development and economy of the world. Recent trends in Forestry development in the world. Climate change adaptation and mitigation. Mechanisms (CDM and REDD+), natural GHG effects, climate change: models, theories, facts and politics, Multilateral Agreements on Climate Change.

**PRACTICAL**

Plot the different biomes of the world map. Study about the different Bio-geographic regions of world & plot them on a map. Study and distribution of forest resources of South America, Africa, India and South East Asia. Plot the different hot spots of India on a map. Study of different hot spots of the world & plot it on a map. Case study on different multi-lateral agreements on climate change.

**Suggested Readings:**

Champion and Seth (1968). Forest Types of India. Natraj publishers.  
V.P. Agrawal (1985). Forestry in India. Oxford and IBH Publications, New Delhi  
M.P Shrivastava (1997). Introductory to Forestry. Amazon Publishers.  
S.S. Negi (1998). World Forest Systems. Natraj Publishers.  
FAO (2020). Status report on world forestry, FAO, 2020

**PAPER 4. FORESTRY EXTENSION (DSE-3A) CR: 3+2**

Extension education: Meaning, definition, nature, scope, objectives, principles, approaches and history. Forestry extension: process, principles and selected programmes of leading national and international forest institutes. People's participation in forestry programmes. Motivation of women community, children, youth and voluntary organizations. for forestry extension work. Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND). 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

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Appraisal (PRA) & Rapid Rural Appraisal (RRA). Management and administration: meaning, definition, principles and functions. Concepts of human resource development (HRD), rural leadership.

#### PRACTICAL

Visit to study the structure, function, linkage and extension programmes of ICFRE institutes/voluntary organization/mahilamandal, village, panchayat, state dept. of forests/All India radio (AIR). Exercises on distortion of message, script writing for farm broadcast and telecasts, planning. Preparation and use of NPVA like poster, charts, flash cards, folder etc. and AVA like OHP and 35mm slide projectors transparencies. Identification of local leaders to study their role in extension work. Evaluation of some selected case studies of forestry extension programmes.

#### Suggested Readings:

- FAO (1986). Forestry Extension Organization, SL.No.68, FAO Publication, Rome, Italy.  
FAO (1986). Planning Forestry Extension Programs, FAO, Bangkok, Thailand.  
Information Kit, International Institute of Rural Reconstruction, Silong, Philippines.  
Research and Extension (2001). Common Wealth Science Council, London, U.K.  
R.C. Desai (1989). Farmers Societies and Agricultural Development. Natraj Publication, Dehra Dun.  
FAO (1987). Forestry Extension Methods, SL No. 80, FAO Publication, Caracali, Rome, Italy.  
S.V. Supe (2009). A textbook on extension education. Agrotech publishing academy, Jodhpur.  
A.K. Jha and P.K. Sharma (2001). Manual of forestry extension education. Today and Tomorrow publishers.

#### PAPER 4. ENTREPRENEURSHIP DEVELOPMENT (DSE-3B) CR: 3 + 2

Entrepreneurship Development, Concept of entrepreneurship entrepreneurial and managerial characteristics: managing an enterprise, motivation and entrepreneurship development. Entrepreneurship development programme, SWOT analysis. Government schemes and incentives for promotion of entrepreneurship. Export and import policies relevant to Forestry sector. Venture capital. Contract farming and joint ventures, public private partnership, Social responsibility of business. Assessing overall business environment in Indian economy. Overview of Indian social, political and economic systems and their implication for decision making by individual entrepreneur. Globalization and emerging business / entrepreneurial environment.

#### Suggested Readings:

- A.S. Sandhu (2004) A Text Book of Agricultural Communication. Kalyani publications.

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Bilhuti Bhusan Mohanty (1962) A Handbook of Audio Visual Aids. Kitabmehal Pvt. Ltd  
Allahabad.

G.L. Ray (2011) Extension Communication and Management. Kalyani publications.

O.P. Dahama & O.P. Bhatnagar (1987) Education & Communication for Development. Oxford  
University Press, New Delhi

**PAPER 4: SEMINAR**

**CR: 2**

Student has to present and participate in class seminar which will be conducted in the department every week. Based on the student performance in the seminar, the score/credit will be evaluated.

**SEMESTER - VIII**

**PAPER 1. SOCIO-ECONOMIC SURVEY- VILLAGE ATTACHMENT**

(INTR -1)

**CR: 06**

Data collection with respect to village profile in respect of socio-economic and cultural status, farm technology used etc. Bench mark survey of plant resources (cropping pattern, yield system etc). Schedule development, tabulation, analysis and preparing plan of work. Understanding local Forestry and other village level institutions (Panchayat, village forest community, corporations, youth/women groups etc.). People's participations in development programmes with special reference to Forestry. Exercise on the use of extension methods and teaching aids for transfer of technology.

**PAPER 2. FORESTRY OPERATIONS (WORKING EXPERIENCE) (INTR -2)**

**CR: 06**

Visit to modern forest nurseries, Herbal garden and watersheds. Study the felling and logging operations, timber lots and important industrial products. Study working plan, Enumeration, volume and yield calculation and component history file. 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, resource mapping, stump analysis, preparation of local volume table.

**PAPER 3. FOREST INSTITUTES AND INDUSTRIAL VISIT/ TRAINING (INTR-3)**

**CR: 06**

Study the nature of forest based industries. Raw material- Collection and processing of raw material. Production and management process. Marketing and financial management. Visits of nearby forestry institutions/ organizations

**PAPER 4. DISSERTATION**

**CR: 04**

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Students select any topic of research, case study, review of literatures, field study, and experiment on forestry, wildlife & Environmental sciences. Supervisor/ Mentors will be allotted to supervise and guide the students for writing and drafting work plan, etc.

**SKILL DEVELOPMENT COURSES (SEC):** For departmental and other departments students).

**SEC 01: NURSERY TECHNOLOGY**

**CR: 2**

Nursery, introduction, objectives and scope, types of nursery, choosing nursery site, design and layout of the nursery, preparation of nursery beds, producing plant from seed, seed handling, dormancy and treatments, methods of sowing, time and season, potting mixtures, transplanting of young seedlings, plant containers, compost and mulches, nutrient and soil management, disease and pest control, sale and marketing.

**PRACTICAL**

Site selection and its assessment, preparation of different types of nursery bed, study of plant containers, seed treatment, seed sowing, preparation of potting mixtures, application of mulches, application of weedicides, Compost preparation, Tools and instruments, nursery record. Assessment of plantation site, visit of nursery and plantations, pruning methods in newly and old plantations, fertilizer and weed management practices. Marketing management of nursery grown seedlings.

**Suggested Readings:**

- Keats C Hall, 2003 Manual on nursery practice. Forest Department, Jamaica. E book
- Kumar, Vinod, (2016), Nursery and Plantation Practices in Forestry, Scientific publishers India.
- Luna RK, (2006), Plantation forestry in India. International book distributor, Dehradun India.
- PawarPankaj (2007), Practical Manual of plantation forestry, Scientific publisher, Jodhpur
- Sharma and Singh NP. (2011), Soil and orchard management. Daya Publishing House, Delhi

**SEC 02: ENVIRONMENTAL IMPACT ASSESSMENT**

**CR:2**

Environment and its components, characteristics, impact, and Projects and stages. Environmental impact assessment (EIA): definitions, introduction and concepts; rationale and historical development of EIA; Components of EIA. The EIA Process, scope and methodology. Role of project proponents, project developers and consultants. Terms of Reference; impact identification and prediction; baseline data collection; Public consultation in EIA. Environmental Impact Statement (EIS), Environmental Management Plan (EMP). EIA regulations in India. Status of EIA in India; current issues in EIA. Case study. Cost-Benefit analysis; environmental appraisal; environmental planning; environmental audit. Risk assessment.

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**PRACTICAL**

Case studies, preparation of environment plan, environmental monitoring plan, environmental auditing plan, review of ETA report, risk assessment.

**Suggested Reading:**

- C.J. Barrow (2000). Social Impact Assessment: An Introduction. Oxford University Press.  
J. Glasson, R. Therivel and A. Chadwick (1994). Introduction to Environmental Impact Assessment. London, Research Press, UK.  
M. Gilbert Masters and P. Wendell (1999). Introduction to Environmental Engineering and Science.  
P. Judith (1999). Handbook of Environmental Impact Assessment. Blackwell Science.  
B. Marriott (1997). Environmental Impact Assessment: A Practical Guide. McGraw- Hill, New York, USA.  
The Environmental Impact Assessment Notification (1994). Government of India Gazette.  
Environmental Impact Assessment Notification (2006). A note

**SEC. 2. MYCORRHIZA AND BIO-FERTILIZER TECHNOLOGY CR:2**

General account about the microbes and biofertilizers, significance for sustainable development and restoration of soil and plant health, Classification of microbial biofertilizers, symbiotic and free living beneficial microbes, Rhizobium, isolation, identification, mass multiplication, carrier based inoculants, *Azospirillum*, *Azotobacter*, blue green algae, *Azolla*, factors affecting the role of microbial biofertilizers. Mycorrhizal fungi, types of mycorrhizal association, occurrence and distribution, role of mycorrhizal fungi, isolation, and inoculum production of Arbuscular Mycorrhizal fungi, Vermicomposting.

**PRACTICAL**

Isolation of mycorrhizal fungi, multiplication, inoculation, rhizobium nodule counting, identification of different products of biofertilizers in the market, visit of biofertilizer labs, KVK, vermin compost production etc.

**Suggested Readings:**

- Anil K. Thakur, Susheel K. Bassi, Kamaljit Singh, Dinesh (2020). Skill Enhancement Course For B.Sc. Classes. Based on New UGC Syllabus Under CBCS.  
Divya Lakshmi Publishers & Distributors (2018). Biofertilizers and Organic Farming.  
N. Ravi Babu and E.M. Sunitha (2011). Pidgin English Edition  
N.S. Subbarao (2017). Bio-fertilizers in Agriculture and Forestry, Medtech publication.

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R.C. Dubey (2005). A Text book of Biotechnology S.Chand & Co, New Delhi.

## AEC 01: ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

### CR:2

Introduction to environmental studies, Scope and importance, Ecosystems: Structure and function  
Natural Resources management, biodiversity and tribal populations. Biodiversity and its  
Conservation. Environmental Pollution: types, causes, effects and controls of air, water, soil and  
noise pollution. Solid waste management, Environmental legislation and Practices. Human and the  
Environment, Sustainable development, Environmental movements. Public awareness, natural  
disasters, climate change, man-made disaster, Disaster Management.

### PRACTICAL

Field work: Visit a local area to document environmental assets river/ forest/ grassland/hill. Visit to  
a local polluted sites- urban/ rural/ industrial/ agricultural. Study and documentation of common  
herbs, shrubs and trees, insects, birds. Study of simple ecosystem- pond, river, hill slopes etc. Nature  
trail. Soil waste analysis.

### Suggested Readings:

P.H.Gleick (1993). Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security.  
Stockholm Environmental Institute, Oxford Univ. Press.

R. Grumbine, Edward, and M.K. Pandit (2013). Threats from India's Himalaya dams. Science  
Journal.

R. Sengupta (2003). Ecology and economics: An approach to sustainable development. OUP.

N.S. Sodhi, L. Gibson and P.H. Raven (2013). Conservation Biology: Voices from the Tropics. John  
Wiley & Sons.

## AEC 2. MEDICINAL PLANT & AROMATIC PLANT

CR:2

Medicinal diversity in India, Indian Traditional knowledge on Medicinal plants: history, scopes,  
opportunities. Merits and demerits of using herbal products. Important medicinal plants viz. *Piper  
cardium*, *Ronfiasarperina*, *Withaniasomnifera*, *DioscoreaBaladona*, *CinconaCitronellgrass*,  
khus grass, *Mentha*, Sweet flag (butch), *Ocimum*, Safedmusli, Giloe. Soil and climate  
requirements, Export and import potential of medicinal plants. Cultivation techniques. Utilization of  
medicinal and aromatic plants. Value addition and processing techniques. Medicinal/herbal garden,  
National Medicinal Plant Development Board, Medicinal plant conservation area (MPCA).

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Identification of different medicinal and aromatic plants. Collection and processing of medicinal and aromatic plants, processing techniques, storage, packaging. Visit of MPCA, forest area. Application of locally available medicinal plants, interaction with Vaidya and local healers.

**Suggested readings:**

Amritpal Singh Saroya (2018). Textbook of Medicinal and Aromatic Plants. Indian Council of Agriculture Research, New Delhi.

Anand Singh Bisht (2019). Hand Book of Medicinal and Aromatic Crops, Brillion Publishing House, New Delhi.

N Deepa Devi (2017). A Text Book of Medicinal and Aromatic Crops. Aavishkar Publishers, Distributors, Jaipur.

**AEC 03: MUSHROOM TECHNOLOGY**

**CR:2**

Mushroom morphology: Different parts of mushroom & variations. Key to differentiate Edible from Poisonous mushrooms. Nutrients of Mushroom: Protein, aminoacids, calorific values, carbohydrates, fats, vitamins & minerals, Health benefits of Mushroom.

Cultivation System & Farm design: Fundamentals of cultivation system- small village unit & larger commercial unit. Principles of mushroom farm layout- location of building plot, design of farm, bulk chamber, composting platform, equipment's & facilities, pasteurization room & growing rooms.

Compost & Composting: Principles of composting, machinery required for compost making, materials for compost preparation. Methods of Composting- Long method of composting (LMC) & Short method of composting (SMC). Spawn & Spawning.

Cultivation of Button, Oyster and Straw Mushrooms: Collection of raw materials, compost & composting, spawn & spawning, casing & case run, cropping & crop management, picking & packing.

**PRACTICAL**

Identification of edible and poisonous mushroom, Mushroom production, visit of mushroom production unit.

**Suggested Reading:**

D. P. Tripathi (2005). Mushroom Cultivation. Oxford & IBH Publishing Co. PVT.LTD, New Delhi.

P. Pathak (2010). Mushroom Production and Processing Technology. Published by Agrobios (India).

S. Kannaiyan and K. Ramasamy (1980). A hand book of edible mushroom, Today & Tomorrows printers & publishers, New Delhi.

Nita Bahl (2000). Handbook on Mushrooms. Oxford & IBH Publishing Co

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**AEC 4. PAPER 4. REMOTE SENSING IN NATURAL RESOURCE MANAGEMENT (AEC- 03) CR :02**

Application of remote sensing techniques in natural resource management; ecosystem inventory and monitoring - forests, wetlands; land use planning; urban planning. snow and glaciers, potential ground water mapping; coastal zone management, protected area management, remote sensing and GIS in international conventions and protocols (Ramsar, CBD, Kyoto etc.).

**PRACTICAL**

Acquaintance with GIS software and imageries. map reading of SOI topo-sheets, Image processing, geo-referencing, digitizing, sub setting, mosaicing and feature identification, GPS survey and point location, unsupervised and supervised classification of images for forest. Forest land use/land cover classification, field visit for ground data collection and truthing.

**Suggested Readings:**

- George Joseph (2005). Fundamentals of Remote Sensing, 2nd Edition. University Press India.  
T. Lillisand, Ralph W. Kiefer and Jonathan Chipman (2007). Remote Sensing and Image Interpretation. Wiley, India.  
Sabins F. Floyd (2007). Remote Sensing: Principle and Interpretation. Waveland Press.  
J. R. Jensen (2009). Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Edition. Dorling Kindersley.  
Jensen, John R. (2004). Introductory Digital Image Processing: A Remote Sensing Perspective. Prentice Hall.  
Joseph L. Awange and Kyalo Kiema (2013). Environmental Geo-informatics –Monitoring, Springer book  
Mario A. Gomarasca (2009). Basics of Geomatics, Springer book

**AEC 05. PLANTATION TECHNOLOGY CR:2**

Plantation: definition and scope; Development of plantation forestry in India, Plantation organization and structure, Land and plantation development, Plantation planning: national and regional planning, Plantation structure: choice of species, plantation, establishment, plantation maintenance, nutrition in plantation, use of fertilizers, major pest and disease in plantation. Sanitation and control measures. Dynamics of stand growth, site quality evaluation, stock assessment, plantation records, plantation journal, energy plantation, avenue plantation, plantation as potential carbon sinks. Marketing.

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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 plantation operations. Study of tending techniques.

**Suggested Readings:**

Keats C Hall (2003). Manual on nursery practice. Forest Department, Jamaica. E book

Pankaj Pawar (2007). Practical Manual of plantation forestry. Scientific publisher, Jodhpur

R.K. Luna (2006). Plantation forestry in India. International book distributor, Dehradun India.

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**List of Courses Focus on Employability/ Entrepreneurship/  
Skill Development**

**Department : Forestry, Wildlife and Environmental Sciences**

**Programme Name : B. Sc. (Organic Farming)**

**Academic Year : 2021-22**

**List of Courses Focus on Employability/ Entrepreneurship/Skill Development**

Sr. No.	Course Code	Name of the Course
1.	OFUATT1	Introductory Organic Farming Principles
2.	OFUATT2	Organic Agronomical Practices
3.	OFUATG1	Nursery Technology
4.	OFUBLT3	Soil and Water Management
5.	OFUBTT4	Plant Protection and Bio-pesticides
6.	OFUBTG2	Farm Machinery
7.	OFUCTT5	Orchard Farming
8.	OFUCTT7	Basics of Plant Genetics and Plant Breeding
9.	OFUCTG3	Organic Farming Startups and Entrepreneurship
10.	OFUDTT8	Biodynamic Farming
11.	OFUDTT9	CARBON NEUTRAL FARMING



12.	OFUDTT10	URBAN FARMING AND TERRACE GARDENING
13.	OFUDTG4	SOIL, WATER AND SEED TESTING
14.	OFUETT11	Fundamentals of Agroforestry
15.	OFUETT12	Floriculture
16.	OFUETT12	Residue Management Practices and Manure Production
17.	OFUETD1	Climatology and Meteorology
18.	OFUELD1	Sericulture Technology
19.	OFUFTT14	Vegetable Farming
20.	OFUFTT15	Medicinal & Aromatic Plants Farming
21.	OFUFTD2	Harvesting Organic Produce, Quality Analysis and Improvement
22.	OFUFTD2	Post-Harvest management and Value Addition
23.	OFUGTT16	Biostatistics
24.	OFUGTT17	Genetic Engineering and Transgenic Plants
25.	OFUGTT18	Organic Certification
26.	OFUGTD3	Mushroom Technology
27.	OFUGTD3	Apiculture Technology
28.	OFUHEF1	Farming operation Work Experience
29.	OFUHEF2	Institute and Industrial visit/training
30.	OFUHDF1	Dissertation

**गुरु घासीदास विश्वविद्यालय**  
(केन्द्रीय विश्वविद्यालय अधिनियम 2009 अ. 25 के अंतर्गत स्थापित केन्द्रीय विश्वविद्यालय)  
**कोनी, बिलासपुर - 495009 (छ.ग.)**



**Guru Ghasidas Vishwavidyalaya**  
(A Central University Established by the Central Universities Act 1999 No. 25 of 1999)  
**Koni, Bilaspur - 495009 (C.G.)**

## **Scheme and Syllabus**

गुरु घासीदास विश्वविद्यालय  
(गुरुदास विश्वविद्यालय अधिनियम 2009 अ. 25 के अंतर्गत चत्तिसगढ़ के गुरुदास विश्वविद्यालय)  
कोनी, बिलासपुर - 495009 (छ.ग.)



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Koni, Bilaspur - 495009 (C.G.)

LEARNING OUTCOME BASED CURRICULUM  
FRAMEWORK  
(LOCF)

FOR

**B.Sc. Organic Farming**  
(A Four Years Degree Program)

(w.e.f. Academic session:2022-23)



“SCHOOL OF NATURAL RESOURCES”

DEPARTMENT OF FORESTRY, WILDLIFE & ENVIRONMENTAL SCIENCES

**GURU GHASIDAS VISHWAVIDYALAYA**

(A Central University established by the Central University Act, 2009 No. 25 of 2009)

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**Course Structure and Credit Distribution**  
**B.Sc. Organic Farming (4 -Year / 8- Semester) LOCF based Program**

Semester	Course Opted	Course Code	Name of the course	Credit	Hour/week	Marks
I	Core-01	OFUATT1	Introductory Organic Farming Principles	3	3	100
	Core-01 Practical	OFUALT1	Introductory Organic Farming Principles	2	3	100
	Core-02	OFUATT2	Organic Agronomical Practices	3	3	100
	Core-02 Practical	OFUALT1	Organic Agronomical Practices	2	3	100
	Generic Elective (GE)-01	OFUATG1	Nursery Technology	3	3	100
	Practical/Seminar	OFUAIG1	Nursery Technology	2	3	100
	Ability Enhancement Course (AEC-01)	OFUATA1	Drawn from the University Pool	2	-	100
	Skill Enhancement Course (SEC-01)	OFUATL1	Drawn From the University pool	2	-	100
	Extra Curricular Activity-(ECA-01) * Additional Credit Course	OFUATS1	ECA-Extra-curricular activity (Field visit/ NSS/NCC/ Swachhata/ Physical Education/ Plantation Activities)	2	-	
<b>TOTAL</b>				<b>21</b>	<b>18</b>	<b>800</b>
II	Core -03	OFUBTT3	Soil and Water Management	3	3	100
	Core -03 Practical	OFUBLT3	Soil and Water Management	2	3	100
	Core -04	OFUBTT4	Plant Protection and Bio-pesticides	3	3	100
	Core -04 Practical	OFUBLT4	Plant Protection and Bio-pesticides	2	3	100
	Generic Elective (GE)-02	OFUBTG2	Farm Machinery	3	3	100
	Generic	OFUBLG2	Farm Machinery	2	3	100

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IV	Core -08	OFUDTT8	Biodynamic Farming	3	3	100	
	Core -08 Practical	OFUDLT8	Biodynamic Farming	2	3	100	
	Core -09	OFUDTT9	Carbon Neutral Farming	3	3	100	
	Core -09 Practical	OFUDLT9	Carbon Neutral Farming	2	3	100	
	Core -10	OFUDTT10	Urban Farming and Terrace Gardening	3	3	100	
	Core -10 Practical	OFUDLT10	Urban Farming and Terrace Gardening	2	3	100	
	Generic Elective-(GE)-04	OFUDTG4	Methods of Soil, Plant, Water & Seed Testing	3	3	100	
	Generic Elective Practical(GE)-04	OFUDLG4	Methods of Soil, Plant, Water & Seed Testing	2	3	100	
	Ability Enhancement Course(AEC-04)	OFUDTA4	Drawn From the University pool	2	-	100	
	<b>TOTAL</b>				<b>22</b>	<b>24</b>	<b>900</b>
V	Core -11	OFUETT11	Fundamentals of Agroforestry	3	3	100	
	Core -11 Practical	OFUFLT11	Fundamentals of Agroforestry	2	3	100	
	Core -12	OFUETT12	Floriculture	3	3	100	
	Core -12 Practical	OFUFLT12	Floriculture	2	3	100	
	Core -13	OFUETT13	Residue Management Practices and Manure Production	3	3	100	
	Core -13 Practical	OFUFLT13	Residue Management Practices and Manure Production	2	3	100	
	Discipline Specific Elective DSE-I	OFUED1	Climatology and Meteorology	3	3	100	
	Practical	OFUFLD1	Climatology and Meteorology	2	3	100	
	OR						
		OFUFLD1	Sericulture Technology	3	3	100	
	Practical	OFUFLD1	Sericulture Technology	2	3	100	
<b>TOTAL</b>				<b>20</b>	<b>24</b>	<b>900</b>	

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VI	Core -14	OFUFTT14	Vegetable Farming	3	3	100
	Core -14 Practical	OFUFLT14	Vegetable Farming	2	3	100
	Core -15	OFUFTT15	Medicinal & Aromatic Plants Farming	3	3	100
	Core -15 Practical	OFUFLT15	Medicinal & Aromatic Plants Farming	2	3	100
	Discipline Specific Elective- (DSE-02)	OFUFTD2	Harvesting Organic Produce, Quality Analysis and Improvement	3	3	100
	Practical	OFUFLD2	Harvesting Organic Produce, Quality Analysis and Improvement	2	3	100
	OR					
	Discipline Specific Elective- (DSE-02)	OFUFTD2	Post-Harvest management and Value Addition	3	3	100
	Practical	OFUFLD2	Post-Harvest management and Value Addition	2	3	100
	Ability Enhancement Course (AEC- 05)	OFUFTA5	Drawn from the University Pool	2	-	100
MOOC Course (01)		Online MOOC Course	2-4	-	-	
<b>TOTAL</b>				<b>17+ 2-4</b>	<b>18</b>	<b>700</b>
VII	Core -16	OFUGTT16	Biostatistics	3	3	100
	Core -16 Practical	OFUGLT16	Biostatistics	2	3	100
	Core -17	OFUGTT17	Genetic Engineering and Transgenic Plants	3	3	100
	Core -17 Practical	OFUGLT17	Genetic Engineering and Transgenic Plants	2	3	100
	Core -18	OFUFTT18	Organic Certification	3	3	100
	Core -18 Practical	OFUFLT18	Organic Certification	2	3	100
	Discipline Specific Elective- (DSE-3)	OFUGTD3	Mushroom Technology	3	3	100

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	Practical	OFUGLD3	Mushroom Technology	2	3	100
OR						
	Discipline Specific Elective-(DSE-3)	OFUGTD3	Apiculture Technology	3	3	100
	Practical	OFUGLD3	Apiculture Technology	2	3	100
	Seminar (S1)	OFUGSS1	Seminar/Experimental learning: NTFP processing, Compost production, Vermi-composting and value addition, Nursery production	2	2	100
<b>TOTAL</b>				<b>22</b>	<b>26</b>	<b>900</b>
<b>VIII</b>	INTR -1	OFUHEF1	Farming operation Work Experience (Report Writing, Presentation, Viva-Voce)	6		200
	INTR -2	OFUHEF2	Institute and Industrial visit/training (Report Writing, Presentation, Viva-Voce)	6		200
	Dissertation	OFUHDF1	Dissertation writing, Presentation, Viva-Voce	6		200
	<b>TOTAL</b>				<b>18</b>	
<p>The nature of the course in VIII Semester will be field based for learning exposure on agricultural operational/organic farming works through attachment with agriculture department/ Farmers-group/ fertilizer industries/ Marketing agencies/NGOs. Institute/ industrial training will be accomplished by the students through visits of nearby farming based Industries / Institutions/ organic certification agencies. Dissertation will be required to inculcate research experience in the students.</p>						
<b>GRAND TOTAL</b>			<b>165 + 2-4 (MOOC)</b>			<b>6500</b>

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**Table 2: Structure of Courses**

Semester	Core Courses (19)	GE (4)	DSE (3)	AEC (5)	SEC (2)	Seminar (1)	Dissertation (1)	Internship (3)	Additional Credit Courses (Optional)
I	C1 C2	GE1		AEC1	SEC1				ECA1
II	C3 C4	GE2		AEC2	SEC2				ECA2
III	C5 C6 C7	GE3		AEC3					ECA3
IV	C8 C9 C10	GE4		AEC4					
V	C11 C12 C13		DSE1						
VI	C14 C15		DSE2	AEC5					MOOC
VII	C16 C17 C18		DSE3			Seminar/ Experimental learning			
VIII							Dissertation	Internship1 Internship2	

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## B. Sc. Degree in Organic Farming

### SEMESTER I

#### PAPER I: INTRODUCTORY ORGANIC FARMING PRINCIPLES (CORE-01)

CR: 3+2

Introduction to organic farming, aim, objective, scope and concept, principles and need of organic farming, agencies and institutions related to organic farming, types of organic farming, benefits of organic farming, conventional farming vs organic farming, scope, potential and present status of organic farming; Chhattisgarh, national and international, essentials for organic farming, farm components for an organic farm.

#### PRACTICAL:

1. Visit of a farm around Bilaspur (CG) to identify their adopted techniques.
2. Field based experiment for organic farming.
3. Organic Farm Industry visit with the vision to know the comparative study of chemical based production and organic based production system.
4. Identification of types of organic farming.
5. Analysis of organic farming pattern at State, national and international levels.

#### Suggested Readings:-

1. Veeresh G. K. (2011). Organic Farming. Publisher: Foundation Books, ISBN: 9788175968813 <https://doi.org/10.1017/UPO9788175968813>
2. Reddy S. R. (2017). Principles of Organic Farming. Publisher: Kalayani, ISBN : 9327274474.
3. Rateaver B. (1993). Organic method primer update: A practical explanation: the how and why for the beginner and the experience (Conservation gardening and farming). Publisher: The Rateavers; Special edition, ISBN: 0915966018.
4. Gershuny G. and Martin D. L. (2018). The Rodale Book of Composting. Newly Revised and Updated: Simple Methods to Improve Your Soil, Recycle Waste, Grow Healthier Plants, and Create an Earth-Friendly Garden (Rodale Classics). Publisher: Rodale Books; Updated edition, ISBN: 1635651026.

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**PAPER-02: ORGANIC AGRONOMICAL PRACTICES (CORE-02) CR:3+2**

Introduction of agriculture, crops, meaning of crop production, classification of crop plants, agronomic classification: cereal, legume, fibre, forage, sugar, oil crops, growing seasons, Crop production methods for rice, wheat, maize, cowpea, Dolichos bean (*Dolichos lablab*), green gram, black gram, pigeon pea, pea.

**PRACTICAL**

1. Paddy field visit and survey of organic cultivation.
2. Practical approaches of agricultural practices preparation of soil, sowing, adding manure and fertilisers, irrigation, protecting from weeds, harvesting, storage of paddy, wheat and maize
3. Analysis of organic cultivation techniques of leguminous vegetables
4. Cost benefit analysis of organic farming.

**Suggested Readings:**

1. Reddy S.R. (2014). Principles of Crop Production. Kalyani Publishers, ISBN-10: 9327218582.
2. An Introduction to Agriculture and Agronomy. 2015. <http://www.newagepublishers.com/samplechapter001757>
3. Onwueme I. C. and Sirha, T. D. (1999). Field Crop Production in Tropical Africa. Netherlands: CTA, Wageningen, Pp. 1-14.
4. Bassey E. (2019). Fundamental Principles of Crop Production. ISBN: 9781706242604, 1706242603. Publisher: Independently Published
5. Jena, J. and Jena, T. (2020). Glimpses of Crop Production, Publisher: Jain Brothers ISBN: 9788194484646

**PAPER-03: NURSERY TECHNOLOGY GE-01 CR: 3+2**

Nursery, introduction, objectives and scope, types of nursery, choosing nursery site, design and layout of the nursery, preparation of nursery beds, producing plant from seed, seed handling, dormancy and treatments, methods of sowing, time and season, potting mixtures, transplanting of young seedlings, plant containers, compost and mulches, nutrient and soil management, disease and pest control, sale and marketing.

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#### PRACTICAL

1. Site selection and its assessment.
2. Preparation of different types of nursery bed
3. Application of seed treatment, seed sowing.
4. Preparation of potting mixtures, application of mulches.
5. Tools and instruments, nursery record
6. Assessment of plantation site, visit of nursery and plantations
7. Marketing management of nursery grown seedlings.

#### Suggested Readings:

1. Hall K. C. (2003). Manual on nursery practice. Forest Department, Jamaica. E book
2. Pawar P. (2007). Practical Manual of plantation forestry. Scientific publisher, Jodhpur
3. Sharma A. and Singh N. P. (2011). Soil and orchard management. Daya Publishing House, Delhi.
4. Luna R. K. (2006). Plantation forestry in India. International book distributor, Dehradun, India.

PAPER 4. ABILITY ENHANCEMENT COURSE (AEC-01)	CR: 2
PAPER 5. SKILL ENHANCEMENT COURSE (SEC-01)	CR: 2
PAPER 6. EXTRA CURRICULAR ACTIVITY (ECA-01)	CR: 2

#### SEMESTER II

##### PAPER- 01. SOIL AND WATER MANAGEMENT (CORE-05) CR: 3+2

Introduction of soil, its formation and properties, plant nutrients, essential nutrients and their role, nutrient uptake phenomenon in plant nutrient cycle, soil tillage, choice of varieties, crop rotation multiple and cropping systems, intercropping in relation to maintenance of soil productivity, sources of nutrients, manures and fertilizers, benefits and drawback of chemical and organic fertilizer, concentrated organic manures, organic preparations, organic amendments and sludges, bio-fertilizers-methods of application, advantages and disadvantages, Standards for organic inputs- fertilizers.

Introduction to traditional and modern methods of water management, water management techniques in agriculture, horticulture and forestry, effects of soil type, soil texture, and inherent limitations, irrigation management, water management benefits of cover crops, irrigation management, watershed management, smart farming.

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**PRACTICAL:**

1. Analysis of adopted farming system adopted for water conservation in Chhattisgarh.
2. Determination of water holding capacity of soil, soil moisture and field capacity.
3. Demonstration of Soil tillage operations.
4. Analysis of cropping systems and intercropping pattern of organic farming
5. Soil analysis to understand the correlation with water management practices
6. Identification of fertilizer.
7. Application methods of biofertilizers

**Suggested Readings:**

1. Singh S. Y. (2021). Soil Fertility and Plant Nutrient Management. Publisher: New India Publishing Agency- Nipa, ISBN: 9789390512270.
2. NPCS Board of Consultants & Engineers (2021). The Complete Book on Organic Farming and Production of Organic Compost. Publisher : Asia Pacific Business Press, ISBN-10 : 8194099528
3. Mishra S. R.(2014). Soil and Nutrient Management. Publisher: Discovery Publishing House Pvt Ltd. ISBN: 9789350564578, 9350564572
4. Fawzy Z. F. (2020). Organic Crop Cultivation. Publisher: Excelic Press, ISBN: 9781642243383.
5. Lalitha B.S., Samagoudar M.S. & Reddy G.(2011). Enhancing Nutrient Use Efficiency: Concepts, Methods and Management Interventions. New India Publishing Agency (NIPA).
6. Cole G.(2017). Water Conservation and Management. Publisher: Larsen and Keller Education, ISBN-10 : 1635492882.
7. Magdoff F. and Van E. H. (2009). Building Soils for Better Crops, 3rd ed. Sustainable Agriculture research and Education (SARE).

**PAPER-02 PLANT PROTECTION AND BIOPESTICIDES (CORE-04)**

**CR: 3+2**

Plant protection- cultural, mechanical methods, botanical pesticides. Plant protection- botanical pesticides, bio-control agents, weed management weedicide, national and international standards for organic inputs- plant protection, disease and pest control by biopesticide of paddy, wheat, maize, pea, market available chemicals, application methods, principles of efficacy, pest and diseases of rice, vegetables and its control methods.

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**PRACTICAL:**

1. Comparative analysis of impact of cultural and mechanical plant protection practices.
2. Preparation of various types of botanical pesticide.
3. Application of pheromone traps and light traps.
4. Weed management practices by bio pesticide and chemical control analysis.
5. Application of herbicides in field and monitoring.

**Suggested Readings:**

1. Vincenzo V. (2017), Handbook of Pest Management in Organic Farming. Mediterranean University, Italy. Serge Kreiser, Montpellier SupAgro, France. Publisher: CABI, ISBN: 9781780644998.
2. Zadoks J. C.(2013). Crop Protection in Medieval Agriculture: Studies in pre-modern organic agriculture. ISBN: 9088901872, Publisher : Sidestone Press.
3. Teulon D.A. Plant Protection in Organic Arable and Vegetable Crops – a grower's resource. Publisher: New Zealand Institute for Crop & Food Research. ISBN 0 478 10843 5.
4. Roger B. Y. Organic plant protection: a comprehensive reference on controlling insects and diseases in the garden, orchard and yard without using chemicals / edited by and the editors of Organic gardening and farming magazine. Publisher: Emmaus, Pa.: Rodale Press. ISBN: 0878571108.

**PAPER-03, FARM MACHINERY (GE-02) CR: 3+2**

Introduction, aim and objectives, tillage, primary tillage equipment's, seedbed refining and leveling equipment, sowing and planting equipment, weeding and intercultural equipment, plant protection equipment, harvesting equipment's for cereals, threshing equipment, forage harvesting and residue handling, rice cultivation machinery, potato planter and harvester, equipments for sugarcane cultivation, estimation of operational cost.

**PRACTICAL**

1. Introduction to various farm machines and equipment used on the farm.
2. To Measure field efficiency of Farm implements.
3. Study of construction details, adjustments and working of plough.
4. Study of construction details, adjustments and working of disc plough.
5. Study of construction details, adjustments and working of cultivator.
6. Study of different type of mechanical paddy transplants.

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7. Study of different weeding equipment and their uses.
8. Study of sprayers and measurement of nozzle discharge

**Suggested readings:**

1. Singh T. P. (2017). Farm Machinery. Publisher, PHI learning private limited.
2. Bell B. M. and Rickatson. (2015). Farm Machinery, 6th Edition. ISBN: 9781910456064, 1910456063
3. Kutz M. Handbook of Farm, Dairy and Food Machinery Engineering. ISBN: 9780128148037, Publisher: Elsevier Academic press.
4. Chen G. (2018). Advances in Agricultural Machinery and Technologies. Publisher: CRC Press, ISBN:9781351132381, 1351132385.

PAPER 4. ABILITY ENHANCEMENT COURSE (AEC-02)	CR: 2
PAPER 5. SKILL ENHANCEMENT COURSE (SEC-02)	CR: 2
PAPER 6. EXTRA CURRICULAR ACTIVITY (ECA-02)	CR: 2

**SEMESTER-III**

**PAPER-01. ORCHARD FARMING (CORE-05) CR: 3+2**

Orchard management, importance, objectives, merits and demerits, clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches, tropical, sub-tropical and temperate horticultural systems; competitive and complementary effect of root and shoot systems, biological efficiency of cropping systems in horticulture, systems of irrigation, soil management, integrated nutrient and pest management, utilization of resources constraints in existing systems, crop model and crop regulation in relation to cropping systems, status of organic horticulture national and international scenario, principles, practices, prospects of organic farming, technological advancements made in organic farming of fruits, Site selection, crop selection, soil preparation, soil solarisation, orchard management and mulching, establishment of orchard, high density and meadow orchard, planting and layout, organic crop production methods of plantation crops, mango, guava, coconut, arecanut, cashew, organic crop production methods- pineapple (*Ananas comosus*), banana, papaya.

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**PRACTICAL:**

1. Site selection criteria with reference to types of crops
2. Land preparation and plantation techniques of plantation crops
3. Cultivation practices of mango and guava
4. Cultivation and management methods of papaya and banana
5. Marketing demand and supply analysis of the horticultural crops.

**Suggested Readings:**

1. Borrell, T. J. Orchard Cultivation. Publisher: Nabu Press, ISBN: 9781289619411
2. Singh H.P., George V. (2010). Thomas Organic Horticulture: Principles, Practices and Technologies Hardcover. Publisher: Westvill Publishing House, ISBN-10 : 8185873615.
2. Rateaver B. (1993). Organic method primer update: A practical explanation : the how and why for the beginner and the experience (Conservation gardening and farming) . Publishers: The Rateavers; ISBN-10 : 0915966018
3. Denckla T. C. (2003). The Gardener's A-Z Guide to Growing Organic Food. Publishers: Storey Publishing, LLC; Revised edition (January 1, 2003). ISBN-10 : 1580173705
4. Pathak R.K. & Ram, R. (2013). Manual on organic farming in Horticultural crops. 10.13140/2.1.1166.9761.  
[https://www.researchgate.net/publication/265846481\\_Manual\\_on\\_organic\\_farming\\_in\\_Horticultural\\_crops](https://www.researchgate.net/publication/265846481_Manual_on_organic_farming_in_Horticultural_crops)
5. Chand G, Akhtar N, Kumar S.(2020). Diseases of Fruits and Vegetable Crops: Recent Management Approaches (Innovations in Horticultural Science). Publishers: Apple Academic Press; 1st edition (1 September 2020) ISBN-10 : 1771888369
6. Reddy P. P. (2012). Organic Farming for Sustainable Horticulture. Scientific Publishers, ASIN : B0783H6YRD

**PAPER-02. ORGANIC FARMING AND BIOFERTILIZERS (CORE-06)**

Concept of organic farming with the production of biofertilizer, biofertilizer's definition, scope, and potential microbes in organic farming, application of biofertilizer's, phosphorus solubilizing bio fertilizers, and microbial activities, biofertilizer formulations, scoping the use of transgenic microorganisms, quality control of biofertilizer, mycorrhizal fungi mass

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production guidelines to establish production unit, biofertilizer's industry and demand, case study on biofertilizer, prospects and challenges for future food utilization in sustainable agricultural, blue green algae, tools and instrument required for microbial production.

#### PRACTICAL

1. Visit to a biofertilizer production centre.
2. Staining- Simple and differential staining of bacteria. Simple staining – *Bacillus subtilis*, differential staining – *Bacillus* and *E.coli*.
3. Culture media preparation- Nutrient broth, nutrient agar slant, potato dextrose agar.
4. Preparation of various biofertilizer.
5. Marketing and survey for biofertilizer availability.

#### Suggested Readings:

1. Inamuddin, M., Inayat A., Boddula R. And Rezakazemi M. (2021). Biofertilizers: Study and Impact Front Cover. Publisher: John Wiley & Sons. ISBN: 1119724678, 9781119724674.
2. Rakshit, A. Singh V. M., Parihar M., Singh, H. B., Singh A. K. (2021). Biofertilizers: Volume I: Advances in Bio-inoculants. Publisher Elsevier Science. ISBN: 0128216670, 9780128216675
3. Parohit S. S. (2006). Microbiology Fundamentals and applications. Agrobios publication. ISBN- 9788177542592
4. Dubey R. C. and Maheshwari D. K. (2010). A text book of microbiology. S. Chand & Company Ltd. ISBN- 978-8121925594

#### PAPER-03: BASICS OF PLANT GENETICS AND PLANT BREEDING (CORE-07)

CR: 3+2

Plant cell: its structure and function. Cell reproduction, mitosis, meiosis and its significance. Nucleus chloroplast and mitochondria. Chromosome its structure and function. Chromosomal aberration. Polyploidy Linkage and crossing over. Mendel's principles of heredity. Deviation from mendelian inheritance, pleiotropy, threshold characters, co-dominance, chromosome theory of inheritance, gene interaction, multiple alleles. Sex determination-theories, sex linked inheritance and characters. Cytoplasmic inheritance and maternal effects. Chemical basis of heredity. Structure of DNA and its replication, RNA: its structure and function. Mutation and its classification. Plant breeding its aim and objectives, modes of reproduction, methods of breeding, selection types and importance.

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1. Preparation of slide showing various stages of mitosis.
2. Preparation of slides showing various stage of meiosis.
3. Testing the viability and germination of pollen grains.
4. Solving the problems based on Mendelian laws, floral morphology.

#### Suggested Readings:

1. Prasad G. (1998). Introduction to Cytogenetics. Kalyani publishers New Delhi, India
2. Singh P. (2005). Elementary of Genetics. Kalyani publishers Ludhiana, India
3. Acquash G. (2012). Principles of Plant Genetics and Breeding, 2nd Edition, Wiley-Blackwell
4. Singh B. D. (2014). Fundamentals of Genetics. Kalyani Publishers
5. Gupta P. K. (2015). Cytology, Genetics and Evolution. Rastogi publications, Meerut, India.

#### PAPER-04. ORGANIC FARMING STARTUPS AND ENTREPRENEURSHIP (GE-03)

CR: 3+2

Organic products start-ups, scope and potential areas for start-ups, funding agencies, food processing and handling, entrepreneurship concept, characteristics, approaches, need for entrepreneurship, traits of an entrepreneur –risk taking, leadership, decision making, planning, organizing, coordinating and marketing, agri-enterprises- stages of establishing enterprise, project identification, step to be considered in setting up an enterprise, feasibility report, product selection, project management and appraisal: market, technical, social, financial analysis. *market management concept planning for marketing target, marketing and competitive strategy, types of entrepreneurs, challenges in organic farming.*

#### PRACTICAL

1. Industrial visits to learn food processing and handling methods
2. Interview of organic farming entrepreneurs to analyse the risk bearing capacity
3. Analysis of problems related to organic farming marketing with its solution
4. Conceptual project development on organic farming by the students
5. Project planning, appraisal and management analysis

#### Suggested Readings:

1. Kumar S. A., Poonima S. C., Abraham M. K. and Jayshree K. (2021). Entrepreneurship Development . Publisher: New Age Publishers, ISBN-10 : 8122414346

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2. Wiswall R. (2009). The Organic Farmer's Business Handbook: A Complete Guide to Managing Finances, Crops, and Staff - and Making a Profit. Publishers: Chelsea Green Publishing; Pap/Cdr edition ASIN : B007EDZ2X6
3. Salatin J. (2013). You Can Farm: The Entrepreneur's Guide to Start & Succeed in a Farming Enterprise. Publishers: Polyface, Incorporated; ISBN-10 : 0963810928
4. Uwajeh A. N. Investments: The Easy Guide to Building Wealth with Agricultural Business for Beginners. Publishers: Kindle Edition, ASIN : B01LG5B0NS.
5. Nuthall P. L. Farm Business Management: The Human Factor. Publishers: Lincoln University, New Zealand 9781789240733.  
(<https://www.cabi.org/bookshop/book/9781789240757/>)

PAPER -05. ABILITY ENHANCEMENT COURSE (AEC-03)

CR: 2

PAPER -6. EXTRA CURRICULAR ACTIVITY (ECA-03) CR: 2

#### SEMESTER IV

PAPER-01. BIODYNAMIC FARMING (CORE-08)

CR: 3+2

Introduction, History, Principle and advantages, biodynamic preparation: crop rotation, Peppering, farm organism, weeds, pests and diseases, Converting a farm to biodynamic, cow horn manure and cow horn silica: preparation, storage and application, preparation, storage and application of jivamrit, bijamrit, plant based preparations, panchgaya preparation and application, dasakavya: preparation, storage and application.

#### PRACTICAL

1. Preparation of cow horn manure and cow horn silica.
2. Compost preparations through plant materials poison preparation, storage and application.
3. Dasagavya: preparation, storage and application.
4. Bijamrit and jivamrit preparation, storage and application methods

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**Suggested Reading:**

1. Selvaraj, N., Anita B., Anusha B. and Saraswathi G. M. (2006). Organic Horticulture creating a more sustainable farming. Horticultural Research Station, Udhagamandalam.
2. Rudolf S. (2004). What is Biodynamics? Publisher SteinerBooks, 2004 ISBN: 0880109890
3. Waldin M. (2015). Biodynamic Gardening. Publisher: Dorling Kindersley Ltd, ISBN: 0241209331, 9780241209332
4. Masson V., Masson P. and Blais M. (2014). A Biodynamic Manual: Practical Instructions for Farmers and Gardeners. Publisher: Floris Books, ISBN-10: 1782500804

**PAPER-02. CARBON NEUTRAL FARMING (CORE-09)**

**CR: 3+2**

Basic concept; meaning, objectives, scope- carbon neutral tools, carbon neutral initiatives, policy frame work related to carbon neutral farming, initiatives for carbon neutral farming, climate neutral agricultural systems practice for increasing carbon in soils, efficient use of farm inputs assessment are identification low carbon emitting farming system, permanent crop farming, mixed farming, agroforestry and organic farming, case studies of carbon stable farming system in India and world, carbon farming business and enterprise.

**PRACTICAL-**

1. Measurement of soil organic matter and soil organic carbon.
2. Measurement of GHG from different farming systems.
3. Measurement of carbon and nitrogen in farm inputs.
4. Determination of carbon stocks in soils of agricultural farms.

**Suggested Readings:**

1. Bansal M. Basics of organic farming.
2. EIP-AGRI workshop processing towards carbon neutral agriculture.
3. USDA report of carbon farming.
4. Global carbon report on carbon reduction and offsets matching activities effectively carbon neutral.
5. Reddy S. R. Farming system and sustainable agriculture.

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6. Piccolo A. Carbon sequestration in agricultural soils.
7. Fraser R. C. A farmers guide to climate disruption.

#### PAPER-03. URBAN FARMING AND TERRACE GARDENING (CORE-10)

CR: 3+2

Introduction: concept, aim and significance, benefits; economic, environmental, organic container gardening, garden design, soil composition and soil texture, seed sowing and transplanting, features of organic fertilizers, principles of making liquid organic fertilizers, in house composting: organic matter, kitchen waste composting guidelines, soil management; general soil care, simple crop rotation plan, water and light management, pest management: organic foliar spray, roof and terrace gardening, ecosystem and working of a sustainable organic garden, soil, garden management and maintain, organic farming: a tool of good food good life, suitable crops for urban farming and terrace gardening yields and crop management practices.

#### PRACTICAL:

1. Garden designing with available space.
2. Demonstration to container selection as per the different types of plants.
3. Soil preparation and preparation of potting mix.
4. Seed sowing methods.
5. Preparation of organic fertilizers with the help of kitchen waste.
6. Application of organic fertilizers as per plant requirement.
7. Management practices; pest, plant, soil and water.
8. Survey of urban kitchen gardening.

#### Suggested Readings:

1. Free e-book 'Organic Urban Farming The Indian Way'  
<https://www.udemy.com/course/organic-container-gardening-the-indian-way/>
2. George R.(2015). Container Gardening for Absolute Beginners  
<https://www.amazon.in/Organic-Container-Gardening-Absolute-Beginners-ebook/dp/B010XWRT1M>
3. Upadhyaya T. (2021). Secrets of Terrace Gardening: A complete guide to setup and maintain your terrace garden in India, ISBN : 9355267274

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4. Latha A.M. (2016). Steps for starting a low budget organic vegetable Terrace garden. Publisher: green house India publisher, www.amazon.in
5. Toth .J (2014). Gardening: Urban Gardening; Growing Vegetables and Fruit in Heavily Populated Areas. www.amazon.in

**PAPER-04. SOIL, WATER AND SEED TESTING (GE-04) CR: 3+2**

Soil formation, physio-chemical properties of the soil and its significance, physical chemical properties of the water, water quality test, importance of water testing in agricultural practices, Seed formation, structure, types of seed, seed viability, dormancy, seedling growth parameters, Economically importance of seed testing, instruments for soil, water and plant testing analysis, nitrogen, phosphorus, potash, organic carbon in soil, hardness, nitrate, pH in water, tetrazolium seed viability test.

**PRACTICAL**

1. Estimation of available soil Potassium by flame photometer method.
2. Estimation of microbial biomass carbon.
3. Estimation of Nitrogen in plant sample.
4. Estimation of pH of Irrigation water.
5. Computation of quality parameters in irrigation water.
6. Description of seed structures composition and economic importance.
7. Seed and soil health test.
8. Normal seedlings and abnormal seedlings.
9. Washing and cleaning of laboratory glass ware.
10. Equivalent weights and Molecular weights of some important chemical.
11. Unit of measurements and conversions.
12. Physical purity test, Determination of Seed Moisture.
13. Colour changes due to pH change in the presence of pH indicators

**Suggested Readings:**

1. Gurumurthy P. Practical Manual for Soil, Plant, Water and Seed Testing. Publisher Education Publishing.
2. Adepetu J. H. and Nalhan H. and Osinubi A. (1996). Simple soil, water and plant testing techniques for soil resource management. FAO.

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3. Singh D. (2015). Manual on Soil Plant and Water Analysis. Publisher: Westville Publishing House, ISBN-10: 8185873267.
4. Patrao B. (2020). Soil Testing and Analysis: Plant, Water And Pesticide Residues. Publisher: New India Publishing Agency- Nipa. ISBN-10 : 939017547X.

PAPER -05. ABILITY ENHANCEMENT COURSE (AEC-04)

CR: 2

#### SEMESTER V

PAPER-01. AGROFORESTRY (CORE-11) CR: 3+2

Indian agriculture- structure and constraints. Land use definition, classification and planning. Agroforestry- definition, aims objectives and need. Traditional Agroforestry systems: Taungya system, Shifting cultivation, Wind break, Shelterbelts, Homestead gardens. Alley cropping, high density short rotation plantation systems, silvicultural woodlots/energy plantations. Classification of agroforestry system-structural, Tree architecture, canopy management, Agroforestry systems in different agroclimatic zones, Tree-crop interface, Economics of agroforestry systems. People participation, rural entrepreneurship through agroforestry and industrial linkages.

#### PRACTICAL

1. Study characteristics of trees/shrubs/grasses for agroforestry.
2. Volume and biomass estimation.
3. Crown measurement, light interception and moisture measurement in agroforestry systems.
4. Litter estimation and nutrient analysis
5. Soil analysis, quantification of fertilizer doses.
6. Annual crops/grass growth measurements and yield

#### Suggested Readings:

1. Dwivedi A. P. (1992). Agroforestry principles and practices. Oxford and IBH Publication Co., New Delhi.
2. Chandrahat D.S. and Gautam S. K. (2010). Textbook of agroforestry. Oxford and IBH publishing co Pvt. Ltd.

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3. Nair P. K. R.(1993). An Introduction to agroforestry. Kluwer Academic Publishers. 499 p.
4. Huxley P. (1999). Tropical agroforestry. Blackwell Science, Oxford. 371 p.
5. Ramakrishnan P. S. (1992). Shifting agriculture and sustainable development. Man and biosphere series. The Parthenon Publishing Group.

**PAPER-02. FLORICULTURE (CORE-12) CR: 3+2**

Floriculture: definition, component and importance, Nursery management practices, Identify Plant morphology, different plant varieties and plant families, poly house, net house, propagation techniques of flower, landscape garden, establishment of farm planning and layout different types of landscapes, mulching, planting system and planting densities. Integrated Organic Pest control management of floriculture. Use of growth regulators in horticulture, weed management, types of indoor gardening, Tree based cropping system, identify commercial flowers rose, gerbera, marigold and marketing, project preparation for commercial flowering plant.

**PRACTICAL**

1. Planning and layout of orchard, tools and implements,
2. Visit of commercial flower production unit.
3. Preparation of nursery beds for sowing of seeds.
4. Land preparation for flowering plants, planting system.
5. Preparation of organic fertilizer mixtures and field application.
6. Preparation and application of growth regulators, maturity standards, harvesting, grading, packaging and storage.

**Suggested Readings:**

1. Merlo G. (2018). Floriculture and Landscaping. Publisher: Scitus Academics LLC, ISBN 9781681179360
2. Kulkarni B. S. (2016). Floriculture and Landscaping. Agro India Publications
3. Singh J. (2007). Basic Horticulture. Kalyani publishers.
4. Singh A. K. (2020). Textbook of Floriculture And Landscaping. Publisher New India Publishing Agency- Nipa, ISBN: 9386546000.
5. Bal J. S. (2002). Fruit Growing in India. Kalyani publishers
6. Chadha K. L. (2015). Handbook of Horticulture. Jain book Agency.
7. Acquah G. (2002). Horticulture - Principles and Practices.

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PAPER-03. RESIDUE MANAGEMENT PRACTICES AND MANURE PRODUCTION (CORE-13) CR: 3+2

Introduction Sources, composition and characterization of the solid waste, Economic consideration, Wastes as a wealth and source of income, Planning system, Valorization of organic solid waste, Recycling of organic wastes; Animal feed, composting, anaerobic digestion, rendering, rapid thermophilic digestion, Immobilized enzyme reaction, process, sanitary land filling, Energy recovery, manure production methods, Nadep compost, vermi-compost, Azola production.

PRACTICAL

1. Evaluation of the source of waste.
2. Categorization of wastes in different categories.
3. Recycling of wastes in organic manure or any other useful materials.
4. Case studies, Field visits, Economic valuation of waste management practices.
5. Vermi compost production.
6. Litter decomposition of different plant species.

Suggested Readings:

1. Pichiel J. (2014). Waste Management Practices. Publisher: CRC press, ISBN: 9781000762648.
2. Sharma C.K.(2022). Solid, Liquid and Hazardous Waste Management. Publisher: Foundation Publishing House, ISBN-1:8195475590.
3. Tabassam B. (2016). Waste Management and Environmental Health. Publisher : Discovery Publishing House Pvt Ltd. ISBN-10 : 9350567776
4. Ramanathan A. L. and Jagbir Singh J. (2019). Solid Waste Management: Present and Future. Publisher: Dreamtech Press, ISBN-10: 9389447925
5. Waldrip, H. M. Pagliari, P. H. and He Z. (2020). Animal Manure: Production, Characteristics, Environmental Concerns, and Management, Volume 67 Print ISBN:9780891183709.

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PAPER-04. CLIMATOLOGY AND METEOROLOGY (DSE-1) CR: 3+2

Introduction the atmosphere: origin, composition and structure, isolation and heat budget temperature of the atmosphere, distribution of temperature, air pressure and winds, general circulation of the atmosphere, monsoon, winds, humidity, fog and clouds, precipitation, atmosphere-equilibrium: stability and instability, air masses, classification of climate, distribution, climate Change, weather forecasting and analysis, applied climatology, global warming, meteorology: weather and climate, micro-climate, weather elements, solar radiation, nature, properties, solar constant and energy balance, introduction to monsoon, basics of weather forecasting.

PRACTICAL

1. Site selection for agromet observatory, measurement of temperature, measurement of rainfall, measurement of evaporation, measurement of atmospheric pressure, measurement of sunshine duration and solar radiation,
2. Measurement of wind direction and speed and relative humidity.
3. Study of weather forecasting and synoptic chart.
4. Field visits to observe changing pattern adopted by farmer for agriculture due to climate change.

Suggested Readings:

1. Lal D.S. (2011). Climatology. Publisher: Sharda Pustak Bhawan, ISBN-10 : 8188204121
2. Ghadekar S.R. (2008). Textbook of Agro-meteorology, Agromet publishers.
3. Norman D. D. and Malcolm (2007). Farming Systems Development and Soil Conservation FAO. Jain Book Agency.
4. Khan M. K. and Ajmal A. (2008). Crop and forage production using saline waters nam S&T Centre. Jain Book Agency.
5. Singh C. (2012). Modern techniques of raising field crops. Oxford and IBH publishing company, New Delhi.
6. Varshuaya M. C. and Pillai B. (2012). A textbook of agriculture metrology. ICAR, New Delhi Publications.

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SERICULTURE TECHNOLOGY (DSE-01)

CR: 3+2

Introduction, scope and principle of Sericulture, Silk production in India and other countries and their export and import, types of silk produced in India; host plants of mulberry and non-mulberry silkworms, classification of sericigenous insects. Classification of silkworms based on moultinism, voltinism and geographical distribution; popular silkworm breeds and hybrids of Chhattisgarh, silkworm morphology, silkworm rearing methods, silkworm pest and diseases. Preparation of nursery beds, Selection of materials for cuttings, selection of cutting planting, Selection and grading of sampling, planting System and intercultural operations; - characteristics of sericulture industry, silk reeling, handlooms and power loom activities; role of state sericulture department, Central Silk Board, prospects and problems of Sericulture industry for livelihood.

PRACTICAL

1. Sericulture World maps and map of India and Chhattisgarh.
2. Study of life cycle of silkworm: Morphology of egg, larva, pupa and adult. Cocoon characters of popular uni-, bi- and multivoltine races.
3. Identification of different diseased silkworms based on external symptoms.
4. Morphological study of few important cultivars in Chhattisgarh.
5. Preparation of grafting (bud or shoot grafting) or layering (simple layering) drawing and labelling.
6. Identification of different types of weeds, fertilizers, calculation of dosages. Preparation Compost.

Suggested Readings:

1. Kim H. B. (1989). Filature water engineering, Seoul national university press, Republic of Korea.
2. Huang G. R. (1988). Silk reeling, Oxford and IBH publishing co. Pvt. New Delhi.
3. Mahadeveppa D. Halliyal, V.G., Shankar, A.G. And Bhandiwad, R. (2000). Mulberry Silk Reeling Technology, Oxford And IBH Publishing Co. Pvt. Ltd. New Delhi.
4. Somwalker T. N. (2010). Handbook of Silk Technology, New Age International Pvt., Ltd.
5. Lee Y. W. (1999). Silk Reeling And Testing Manual, FAO Agrkultural Services Bulletin No. 136, Rome, Italy.

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6. Akira Nakamura (2000). Fiber Science and Technology. Oxford & IBH Publications, New Delhi.

#### SEMESTER-VI

#### PAPER-01, VEGETABLE FARMING (CORE-14) CR 3+2

Introduction to vegetable growing, cultural practices for vegetables, export and import of vegetables, explain general cultural practices used for vegetable production, crop rotation, soils, plant foods, cover crops, cultivation techniques, seed, hybrid seed, storing seed, sowing seed, understanding soils, dealing with soil problems, plant nutrition and feeding, pest, disease & weed control, hydroponic, aeroponic and greenhouse growing, growing selected vegetable varieties, irrigation, harvest & post-harvest, marketing of vegetables, vegetable production methods- okra, amaranthus, cauliflower, cabbage, tomato, solanaceous, cucurbits, spices- pepper, ginger, turmeric, *Azospirillum paspaliiformis*, drumstick (*Moringa oleifera L.*).

#### PRACTICAL

1. Site selection and preparation.
2. Cultural practices of cover crops.
3. Planting Vegetables -seed, hybrid seed, storing seed, sowing seed.
4. Cultivation practices of vegetables as per their requirements and plant nutrition management.
6. Pest and weed management practices.
7. Storage and marketing process of vegetables.

#### Suggested Readings:

1. Jeavons J. and Leler R.(1979). How to Grow More Vegetables. Publisher: Ten Speed Press, ISBN-10 : 0913668990.
2. Coleman E. (2018). The New Organic Grower. Publisher: Chelsea Green Publishing, ISBN-10 : 1603588175.
3. Sowards J. (2021). The First-Time Gardener: Growing Vegetables. Publisher : Cool Springs Press, ISBN-10 : 0760368724.

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4. Matt Rees-Warren M. (2022). Book Review: The Ecological Gardener.  
<https://www.sustainablemarketfarming.com/>

**PAPER-02. MEDICINAL PLANT & AROMATIC PLANT FARMING (CORE-15)**  
CR: 3+2

Medicinal diversity in India, Indian Traditional knowledge on medicinal plants: history, scopes, opportunities, Merits and demerits of using herbal products, important medicinal plants viz. *Pepper*, *Cardamom*, *Rauwolfia serpentina*, *Withania somnifera*, *Dioscorea*, *Baladana*, *Cinchona*, *Citronella*grass, *Khas grass (Vetiver)*, *Mentha*, *Sweet flag (hatch)*, *Cuminum*, *Safedmusli*, *Giloy*, soil and climate requirements, export and import potential of medicinal plants, cultivation techniques, value addition and processing techniques, medicinal/herbal garden, National Medicinal Plant Development Board, Medicinal plant conservation area (MPCA).

**PRACTICAL**

1. Identification of different medicinal and aromatic plants.
2. Collection and processing of medicinal and aromatic plants, processing techniques, storage, packaging.
3. Visit of MPCA, forest area.
4. Application of locally available medicinal plants; Interaction with Vaidya and local healers.

**Suggested readings:**

1. Amritpal Singh Saroya (2018). Textbook of Medicinal and Aromatic Plants, Indian Council of Agriculture Research, New Delhi.
2. Anand Singh Bisht (2019). Hand Book of Medicinal and Aromatic Crops, Brillion Publishing House, New Delhi.
3. N Deepa Devi (2017). A Text Book of Medicinal and Aromatic Crops. Aavishkar Publishers, Distributors, Jaipur

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PAPER-03. HARVESTING ORGANIC PRODUCE, QUALITY ANALYSIS AND IMPROVEMENT (DSE-02) CR: 3+2

Harvesting technology; operations - digging, lifting, winnowing, stocking and threshing, timing of harvest, methods of harvest, special techniques, yield collection and management, planning for postharvest quality, crop-quality indicators, crop rotation, intercropping, designing cropping system, criteria for seed evaluation, characterization and multiplication, importance of traditional varieties, management of crop purity.

PRACTICAL

1. Harvesting operations digging, lifting, winnowing, stocking and threshing
2. Analysis of crop yield and management.
3. Post harvest techniques of quality management of crops.
4. Crop quality indicators to predict the productivity of soil.

Suggested Reading:

1. Thompson and A. K. (2014) Fruit And Vegetables: Harvesting, Handling And Storage, 2 Volume, Publisher: John Wiley, ISBN: 9781118654040.
2. Organic Materials Review Institute, <http://www.omri.org/>
3. Charles D.J.(2004). Handbook of Herbs and Spices, Volume 2
4. Munnaf M.A. and Mouazen A.M.(2020). Advances in Agronomy.
5. [https://www.fao.org/fileadmin/templates/ce/sustainability\\_pathways/docs/Compilation\\_of\\_techniques\\_organic\\_agriculture\\_rev.pdf](https://www.fao.org/fileadmin/templates/ce/sustainability_pathways/docs/Compilation_of_techniques_organic_agriculture_rev.pdf)

OR

POST-HARVEST MANAGEMENT AND VALUE ADDITION (DSE-02) CR: 3+2

Post-harvesting management and its importance, status of food processing in India, concept of safe food and important food regulations in India, harvesting and post-harvest handling of organic crops, fruits and vegetables ripening process, fruits and vegetables, factors affecting the quality of the post-harvest life and deterioration of harvested crops, Principles and methods of food processing and preservation and its benefits. Methods of storage- pre cooling, pre-storage treatments, low-temperature storage, controlled atmosphere storage, hypobaric storage, irradiation, and low-cost storage structures, packaging technology.

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#### PRACTICAL

1. Visit of Mart for identification of different value-added products.
2. Preparation of Pickles, Jam, Jelly, ketchup and Morabba.
3. Drying of fruits, vegetables and flowers.
4. Identification of fresh and aged vegetables and fruits.
5. Visit to cold storage for recording the protocols storage of various fruits and vegetables.
6. Visit to a flower Mandi and record the activities in the Mandi.
7. Visit to a local fruit market and record the activities in the market.

#### Suggested books

1. Geel K. A., Kumar R. and Mann S. S. (2007). Postharvest Management and Value Addition. *Devi Publishing House*. ISBN- 978-8170354543
2. Rathore N. S., Mathur G. K. and Chasta S.S. (2012). Post-Harvest Management and Processing of Fruits and Vegetables. *The Energy and Resources Institute*. ISBN- 978-8171641154
3. Simson S. P. & Straus M.C. (2010). Post-Harvest Technology of Horticultural Crops. *Oxford*. ISBN- 978-01380179254
4. Kumar P. V. S. & Sudha Vani V. (2020). Post-Harvest Handling and Processing of Plantation Crops. *Norion Press*. ISBN- 9781648501289
5. Arya M. A., Kumar T. and Chandra S. (2020). Practical Manual on Post Harvest Management and Value Addition of Fruits and Vegetables. *Join Brothers*. ISBN- 978-8194413743

PAPER -04. ABILITY ENHANCEMENT COURSE (AEC-05)

CR: 2

PAPER-05. MOOC COURSE

CR:2-4

#### SEMESTER VII

PAPER: 1, BIOSTATISTICS (CORE-16)

CR: 3 + 2

Definition and application of statistics, types and source of data, classification and tabulation of data, frequency, distribution, graphical representation of data, (Bar diagram, pie chart, histogram, frequency polygon) measures of central tendency ( mean, median, mode) measures of Dispersion (range, standard deviation, Mean deviation, Quartile deviation,

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variance, coefficient of variation), Probability, Test of signification: basic concepts ( Z- Test,  $\chi^2$ -Test, t-Test, F-test.), regression, correlation : (scatter diagram, correlation co-efficient, its properties).

#### PRACTICAL

1. Histogram, frequency polygon, Bar chart, pie chart.
2. Measures of central tendency: Mean median and mode for raw and grouped data.
3. Construction of frequency distribution table and its graphical representation.
4. Measures of dispersion: Range, mean deviation, quartile deviation and standard deviation for raw and grouped data.
5. Paired 't' test, Chi-square test for contingency tables and theoretical ratios
6. Correlation and linear regression.

#### Suggested Readings:

1. Kenneth N. B. (1998). Introductory Statistics. www.amazon.com
2. Arora P. N. (2003). Biostatistics. Himalayan publishers.
3. Pagano M. and Gauvreau K. (2008). Principles of Biostatistics. John and Wiley Sons Ltd.
4. Chandel S. R. S. (2009). A Hand Book of Agricultural Statistics. Publisher: Anchal Prakashan Mandir.

#### PAPER-02. GENETIC ENGINEERING AND TRANSGENIC PLANTS (CORE-17)

CR: 3+2

Introduction to genetic engineering; scope of genetic engineering; restriction enzymes and DNA Modifying enzymes, Gene Cloning vectors, gene expression; basics of gene expression various recombinant DNA techniques and their applications, genetically modified (GM) crop plants developed by recombinant DNA (rDNA), genetically modified organisms (GMO), new genetic modification techniques (nGMs), transgenic technology principles of transgene technology, scope of transgenic technology, gene tagging (T-DNA) tagging and transposon tagging) in gene analysis (identification and isolation of gene); transgenic and gene knockouts technologies - targeted gene replacement, chromosome engineering, gene therapy, strategies of gene delivery, gene replacement/ augmentation, gene correction, gene editing and silencing, transgenic plants.

#### PRACTICAL

1. Isolation of DNA from plant tissue

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2. Isolation of DNA from animal tissue
3. Agarose gel electrophoresis
4. Effects of antibiotics by gradient method
5. UV induced mutagenesis

**Suggested readings:**

1. Singh G. D. Genetics Engineering of Plants. Publisher: Anmol Publications Pvt Ltd. ISBN: 9788126135998, 9788126135998.
2. Dodds J. H. (2012). Plant Genetic Engineering. Publisher : Cambridge University Press. ISBN-10 : 1107404576, ISBN-13 : 978-1107404571
3. Govil C.M., Aggarwal A. and Sharma J. Plant Biotechnology and Genetic Engineering. Publisher: PHI Learning, ISBN: 9788120353145, 9788120353145.
4. Kumar S., Barone, P. and M. S. (2019). Transgenic Plants. Publisher: Springer Link, ISBN: 978-1-4939-8778-8.
5. T.A. Brown T. A. (2010). Gene Cloning and DNA Analysis, An Introduction. Publisher: Wiley-Blackwell, publication.
6. Primrose, S. B. and Richard M. T. (2009). Principles of Gene Manipulation and Genomics, Publication: Blackwell Scientific.

**PAPER-03. ORGANIC CERTIFICATION (CORE-18) CR: 3+2**

Farm economy: basic concept of economics- demand, supply, economic, viability of a farm. Basic production principles, reducing expenses, ways to increase returns, cost of production system, benefit/ cost ratio, marketing, imports and exports, policies and incentives of organic production, farm inspection and certification: conversion to organic farming, organic earning and national economy, socio economic impacts, procedure of certification of organic products, geo-tagging.

**PRACTICAL**

1. Estimation of the relationship between demand of supply of organic farm produces
2. Estimation of revenue of farm produces
3. Calculate the cost benefit ratio of organic farming
4. Marketing channels of import and export of organic produces
5. Organic certification process with implementation of policies
6. Socio-economic impact assessment with adaptation of organic farming
7. Field visit for Apiculture, Mushroom production, Terrace farming

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**Suggested Reading:**

1. Gehlot D. (2005). Organic Farming: Standard Accreditation Certification and Inspection. Publishers: Agrobios, ISBN-10: 9788177542370.
2. Oganbanwo S A. (2012). Organic Certification for Livelihoods Improvement Paperback - Import. Publishers: LAP Lambert Academic Publishing. ISBN-10 : 9783848416332.
3. Vijayan G. (2014). Organic Food Certification and Marketing Strategies. Publishers: AGRIHORTICO ASIN : B00HZ159ZG
4. Yadav A K. Training Manual Certification and Inspection Systems in Organic Farming in India. Government of India Ministry of Agriculture Department of Agriculture and Cooperation. Publishers: National Centre of Organic Farming CGO-II, Kumbh Nehru Nagar, Ghaziabad, UP - 201 002.

**PAPER-04.MUSHROOM TECHNOLOGY (DSE-03) CR: 3+2**

Introduction to mushroom technology; biology of mushrooms; nutritional value, medicinal value of mushrooms, edible mushrooms and cultivation status in India and world, cultivation technology: infrastructure, equipment and substrates in mushroom cultivation, spawn: types, preparation, mushroom bed preparation and factors affecting, compost technology in mushroom production, casing; raw material used for casing, preparation of casing material; important sanitation cultivation, insect - pests management in cultivated mushroom, disease management in cultivated mushroom, value addition of mushroom.

**PRACTICAL:**

1. Identification of local mushroom Flora and preserved specimens of mushroom.
2. Sterilization of glasswares, equipment, and culture media used in mushroom cultivation.
3. Preparation of culture media: Potato Dextrose medium, Richards medium.
4. Preparation of spawn: Grain spawn, Straw spawn, Sawdust spawn.
5. Preparation of compost and known compost formulations.
6. Identification and management of pests, diseases in Mushroom cultivation.

**Suggested Readings:**

1. Bahl N.(2008). Handbook on Mushrooms. Publisher: Oxford & IBH publishing Company. ISBN: 9788120413993.

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2. Revathy N.(2020). Mushroom Cultivation. Publisher: Shantlax Publications. ISBN: 978939082735
3. Rana R. S.(2020). Mushroom Cultivation and its Diseases. Publisher: Sankalp Publication. ISBN: 9788194717607

OR

**APICULTURE TECHNOLOGY (DSE-03)**

**CR: 3+2**

Introduction to Apiculture - scope, importance; Apiculture development in India - institutions involved; Species of Honey bees - indigenous, exotic - morphology; Honey - its medicinal properties - application in various fields - other valuable products of honey bees; Bee keeping equipment - introduction to types of bee boxes - BIS standard Tools used in apiculture; Bee flora - importance and rearing - congenial conditions for starting up of apiculture; Honey extraction & handling - Quality control standards - Honey testing kit - Processing of honey; Diseases of Honey Bees - Preventive & Control measures.

**PRACTICAL:**

1. To study the morphology of local Honey Bee species and their life cycle.
2. To study the detail of honey extraction procedures and quality assessment of Honey samples obtained from local marketing areas.
3. Identification of Bee Flora, their rearing and other importance.
4. To study various Bee keeping equipment's with well labelled diagrams.

**Suggested Readings:**

1. Mishra R. C. (2013). Prospective in Indian Apiculture. Publisher: Agrobios Publication. ISBN: 9788177541311
2. Nagaraja N. (2014). Honeybees. Publisher: MJP Publishers. ISBN: 9788180940590
3. Mishra R. C. (2013). Honeybees and Their Management in India. Publisher: ICAR, New Delhi. ISBN: 9788171641473

**I. SEMINAR (S1)/ EXPERIMENTAL LEARNING CR: 2**

**SEMESTER - VIII**

**PAPER I. FARMING OPERATIONS WORK EXPERIENCE (INTR -1)**

**CR: 06**

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Visit to Hi-Tech Nursery, green house, Herbal garden and watersheds; Adopted traditional and modern farming pattern by the villages and crop production. Soil type and adopted cropping pattern and yield calculation. Study the CAT (Catchment area treatment) plan. Use of agricultural farming equipment's instruments. Study the marketing and management of important crops. Methods adopted for the organic manure production.

**PAPER 2. INSTITUTES AND INDUSTRIAL VISIT/ TRAINING (INTR-2)**

CR: 06

Study the nature of agricultural/ organic product based industries. Raw material- Collection and processing of raw material. Production and management process. Marketing and financial management. Visits of nearby institutions/ organizations.

**PAPER 3. DISSERTATION**

CR: 06

Students select any topic of research, case study, review of literatures, field study, and experiment on organic farming/ agriculture crop production. Supervisor/ Mentors will be allotted to supervise and guide the students for the dissertation work.

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**List of Courses Focus on Employability/ Entrepreneurship/  
Skill Development**

**Department : *Forestry, Wildlife and Environmental Sciences***

**Programme Name : *M. Sc. (Forestry and Environmental Sciences)***

**Academic Year : *2021-22***

***List of Courses Focus on Employability/ Entrepreneurship/Skill Development***

Sr. No.	Course Code	Name of the Course
01.	FOPATT1	Silviculture
02.	FOPATT2	Forest Biometry, Surveying & Engineering
03.	FOPATT3	Forest Management, Remote Sensing & GIS
04.	FOPATT5	Forest Ecology and Biodiversity Conservation
05.	FOPATT4	Forest Protection
06.	FOPBTM1	Forest Statistics and Research Methodology
07.	FOPATT6	Forest Policy, Law and Environmental Legislation
08.	FOPBTT1	Forest Tree improvement and Biotechnology
09.	FOPBTT3	Wildlife Biology and Conservation
10.	FOPBTT4	Forest Soil and Watershed Management
11.	FOPBTT2	Forest Industries and Wood Technology
12.	FOPBTT5	Global Environment and Climate Change
13.	FOPCTR1	Breeding Methods in Forest Trees
14.	FOPCTR2	Forest Trees Reproductive Biology and Seed Orchards
15.	FOPCTR3	Molecular Genetics of Forest Trees
16.	FOPCTR4	Quantitative Genetics of Forest Trees
17.	FOPCLR5	Forest Genetic Diversity, Conservation and Environmental Impact
18.	FOPDDR1	Field Training ( Attachment with State Forest Department for analysis of FGR & its distribution)





19.	FOPDER1	Forest Based Industrial Training
20.	FOPDPR1	ICT Tools and Techniques Applications in Forestry
21.	FOPCTJ1	Forest Resource Analysis
22.	FOPCTJ2	Production Management in Nursery and Plantation Forestry
23.	FOPCTJ3	Finance and Marketing Management of Forest Resources
24.	FOPCTJ4	Tree Business Management
25.	FOPCLJ5	Sustainable Forest Management in Changing World
26.	FOPCTO1	Urban Forestry
27.	FOPDPR2	Dissertation
28.	FOPDDJ1	Field Training (Attachment with State Forest Department for understanding of Operations and Management / Practices currently used in Forest Management)

गुरु घासीदास विश्वविद्यालय  
(केन्द्रीय विश्वविद्यालय अधिनियम 2009 अ. 25 के अंतर्गत चत्तिसगढ़ केन्द्रीय विश्वविद्यालय)  
कोनी, बिलासपुर - 495009 (छ.ग.)



Guru Ghasidas Vishwavidyalaya  
(A Central University Established by the Central Universities Act 2009 No. 25 of 2009)  
Koni, Bilaspur - 495009 (C.G.)

COURSE SYLLABUS  
FOR

M.Sc. FORESTRY & ENVIRONMENTAL SCIENCES

Choice Based Credit System (CBCS)  
(w.e.f. Academic session:2021-22)



"SCHOOL OF NATURAL RESOURCES"

DEPARTMENT OF FORESTRY, WILDLIFE & ENVIRONMENTAL  
SCIENCES

GURU GHASIDAS VISHWAVIDYALAYA  
BILASPUR-495009, CHHATTISGARH

(A Central University established by the Central University Act, 2009 No. 25 of 2009)

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**Course Structure**  
**M.Sc. Forestry (2 -Year / 4- Semester) CBCS Program**

Semester	Course Opted	Course Code	Name of the Course	Credit	Hour/week	Marks
I <sup>st</sup> SEM	Core-01	FOPATT1	Silviculture	3	3	100
	Core-01 Practical	FOPALT1		1	3	100
	Core-02	FOPATT2	Forest Biometry, Surveying & Engineering	3	3	100
	Core-02 Practical	FOPALT2		1	3	100
	Core-03	FOPATT3	Forest Management, Remote Sensing & GIS	3	3	100
	Core-03 Practical	FOPALT3		1	3	100
	Core-04	FOPATT4	Forest Protection	3	3	100
	Core-04 Practical	FOPALT4		1	3	100
	Core-05	FOPATT5	Forest Ecology and Biodiversity Conservation	3	3	100
	Core-05 Practical	FOPALT5		1	3	100
	Core-06	FOPATT6	Forest Policy, Law and Environmental Legislation	3	3	100
	Core-06 Practical	FOPALT6		1	3	100
	<b>TOTAL</b>				<b>24</b>	<b>36</b>

II <sup>nd</sup> SEM	Core-07	FOPBTT1	Forest Tree Improvement and Biotechnology	3	3	100
	Core-07 Practical	FOPBLT1		1	3	100
	Core-08	FOPBTT2	Forest Industries and Wood Technology	3	3	100
	Core-08 Practical	FOPBLT2		1	3	100
	Core-09	FOPBTT3	Wildlife Biology and Conservation	3	3	100
	Core-09 Practical	FOPBLT3		1	3	100
	Core-10	FOPBTT4	Forest Soil and Watershed Management	3	3	100

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Core -10 Practical	FOPBLT4		1	3	100
Core -11	FOPBTT5	Global Environment and Climate Change	3	3	100
Core -11 Practical	FOPBLT5		1	3	100
RM -01	FOPBTM1	Forest Statistics and Research Methodology	3	3	100
RM-01 Practical	FOPBLM1		1	3	100
<b>TOTAL</b>			<b>24</b>	<b>36</b>	<b>1200</b>

<b>III<sup>rd</sup> SEM Forest Management (FM)</b>	Core -01	FOPCTJ1	Forest Resource Analysis	3	3	100
	Core-01 Practical	FOPCLJ1		1	3	100
	Core -02	FOPCTJ2	Production Management in Nursery and Plantation Forestry	3	3	100
	Core -02 Practical	FOPCLJ2		1	3	100
	Core -03	FOPCTJ3	Finance and Marketing Management of Forest Resources	3	3	100
	Core -03 Practical	FOPCLJ3		1	3	100
	Core -04	FOPCTJ4	Tree Business Management	3	3	100
	Core -04 Practical	FOPCLJ4		1	3	100
	Core -05	FOPCLJ5	Sustainable Forest Management in Changing World	3	3	100
	Core -05 Practical	FOPCLJ5		1	3	100
	OE-01	FOPCTO1	Urban Forestry	2	2	100
	<b>Total</b>			<b>22</b>	<b>32</b>	<b>1100</b>

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IV <sup>th</sup> SEM Forest Management (FM)					
Dissertation/Field work/ Internship/Project/Industry Visit/ Field Visit	FOPDDF1	Field Training (Attachment with State Forest Department for understanding of Operations and Management / Practices currently used in Forest Management.	10	30	150
	FOPDEI1	Forest Based Industrial Training	10	30	150
	FOPDP11	ICT Tools and Techniques Applications in Forestry.	03	09	50
	FOPDP12	Student Project Dissertations.	02	06	50
	<b>Total</b>		<b>25</b>	<b>75</b>	<b>400</b>
<b>GRAND TOTAL</b>			<b>95</b>	<b>179</b>	<b>3900</b>

III <sup>rd</sup> SEM Forest Genetic Resources (FGR)	Core -01	FOPCTR1	Breeding Methods in Forest Trees	3	3	100
	Core -01 Practical	FOPCLR1		1	3	100
	Core-02	FOPCTR2	Forest Tree Reproductive Biology and Seed Orchards	3	3	100
	Core -02 Practical	FOPCLR2		1	3	100
	Core-03	FOPCTR3	Molecular Genetics of Forest Trees	3	3	100
	Core -03 Practical	FOPCLR3		1	3	100
	Core-04	FOPCTR4	Quantitative Genetics of Forest Trees	3	3	100
	Core -04 Practical	FOPCLR4		1	3	100
	Core -05	FOPCLR5	Forest Genetic Diversity, Conservation and Environmental Impact	3	3	100
	Core -05 Practical	FOPCLR5		1	3	100

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OE-01	FOPCTO1	Urban Forestry	2	2	100
<b>Total</b>			<b>22</b>	<b>32</b>	<b>1100</b>

IV <sup>th</sup> SEM Forest Genetic Resources (FGR)					
Dissertation/Field work/Internship/Project/Industry Visit/ Field Visit	FOPDOR1	Field Training (Attachment with State Forest Department for understanding of analysis of FGR, Forest Operations and Management of Forest Genetic Resources)	10	30	150
	FOPDER1	Forest Based Industrial Training	10	30	150
	FOPDPI1	ICT Tools and Techniques Applications in Forestry	03	09	50
	FOPDPR2	Student Projects Dissertations.	02	06	50
	<b>Total</b>		<b>25</b>	<b>75</b>	<b>400</b>
<b>GRAND TOTAL</b>			<b>95</b>	<b>179</b>	<b>3900</b>

**Grand Total of Credits: 95**

- The student project will be allotted in III Semester and will be evaluated at the end of IV Semester. Students will be given a topic for the project related to the curriculum by the supervisor allotted for the project.
- **Visits:** Visits to forest operation sites, forest nursery, wildlife habitats and plantation sites will be conducted as per the requirement of the curriculum.

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### Program Specific Objectives:

- To develop student strong competencies in the field of Forestry and Environmental Sciences and its application in a technology-rich, interactive environment.
- To develop strong student skills in silvicultural activities, Forest genetics and tree breeding, forest survey & mapping, forest management planning, forest based industries development and value addition, IPR applications, natural resource management, environmental sustainability, socio economic stability, data collection and analysis by using new techniques and tools.
- To prepare the students to compete successfully for employment in Forestry and Environmental Sciences and its allied disciplines and to meet the requirements of government and industrial sectors.

### Outcome of the programme:

- The M.Sc. Forestry and Environmental sciences programme will equip the students with knowledge, general competence, and analytical skills on an advanced level, needed in forest and forest based industries as well as in environmental sector consultancy, education, research, and forest administration.
- The hands on field training through one full semester will give special expertise within specializations of Forest Genetic Resources and Forest Management offered by the department.

### Course Objectives

#### SEMESTER-I

##### Paper I. SILVICULTURE

**Objective:** To provide knowledge about Forest ecosystem concept, forest stand dynamics forest succession, forest productivity and regeneration of forest.

**Outcome:** The course will enable the students to know the components and dynamics of forest, its regeneration and production.

##### Paper II. FOREST BIOMETRY, SURVEYING & ENGINEERING

**Objective:** To develop understanding of students about tree measurements, forest inventory, forest survey and yield concepts.

**Outcome:** The students will be able to record the biometric measurements of trees, survey of the forest area and yield assessment of the forest stock.

##### Paper III: FOREST MANAGEMENT, REMOTE SENSING & GIS

**Objective:** To provide knowledge to students about the use of Remote Sensing and GIS technique in the mapping and management of forest resources.

**Outcome:** The course enables the students to be well-versed in forest mapping with latest use of ICT techniques, Remote Sensing & GIS.

##### Paper IV. FOREST PROTECTION

**Objective:** To provide knowledge to students about forest pests and diseases with their control measures through IPM.

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**Outcome:** Enables the students to maintain healthy growth of the trees with protection from pest and pathogens and other damaging agents of forest.

#### Paper V. FOREST ECOLOGY AND BIODIVERSITY CONSERVATION

**Objective:** To develop understanding of students about ecological aspects of forest and its biodiversity conservation strategies.

**Outcome:** The course will enable the students to understand the entire ecosystem of the forest with special emphasis on conservation of its biodiversity.

#### Paper VI. FOREST POLICY, LAWS AND ENVIRONMENTAL LEGISLATION

**Objective:** To develop understanding of students about forest policies, laws and Environmental Legislation for forest and wildlife management.

**Outcome:** Enables the students to manage the forest wealth with legal knowledge and expertise.

### SEMESTER-II

#### Paper I. FOREST TREE IMPROVEMENT AND BIOTECHNOLOGY

**Objective:** To acquaint the students about general principles of tree breeding with examples of important tree species.

**Outcome:** Enables the students to develop improved progeny of the forest trees to undertake tree improvement.

#### Paper II. FOREST INDUSTRIES AND WOOD TECHNOLOGY

**Objective:** To acquaint the students with the physical and mechanical characteristics of wood.

**Outcome:** The course enables the students to identify the wood and its uses for timber and other industries.

#### Paper III. WILDLIFE BIOLOGY AND CONSERVATION

**Objective:** To develop the understanding of conservation strategies of wildlife in forest areas.

**Outcome:** The students will spread the message among society for conservation and protection of wildlife.

#### Paper IV. FOREST SOIL AND WATERSHED MANAGEMENT

**Objective:** The basic objective of the course is to expose the students about the soil properties of world forests, its production function and capability of storing carbon in forest soils and opportunity/challenges in the management of forest soils. Apart from this student will be exposed about the watershed management projects for improving the forest health.

**Outcome:** The student will acquire sound knowledge on world forest soils and its role in carbon storage and CO<sub>2</sub> greenhouse gas mitigation. This will also enable students to have training for implementation of watershed projects.

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#### PAPER V: GLOBAL ENVIRONMENT AND CLIMATIC CHANGE

**Objective:** To develop understanding of students about environment, global climatic changes and their effect on forest ecosystems.

**Outcome:** Enables the student about the regional, global environment and climate changes mitigation measures.

#### PAPER VI: FOREST STATISTICS AND RESEARCH METHODOLOGY

**Objective:** To provide exposure about methods of statistical analysis, design and sampling techniques for data analysis and interpretation.

**Outcome:** Make the students well versed with statistical software, analysis of data and its interpretation.

### SPECIALIZATIONS FOREST MANAGEMENT

#### PAPER I. FOREST RESOURCE ANALYSIS

**Objective:** To develop understanding of students about the nature and importance of forest resources, their availability and management strategies.

**Outcome:** To be well versed in the management of the forest resources and to develop strategies for their improved production with analytical approach.

#### PAPER II. PRODUCTION MANAGEMENT IN NURSERY AND PLANTATION FORESTRY

**Objective:** To develop understanding and management skills of the students in respect of commercial nursery production and plantation forestry.

**Outcome:** Equipped the students with latest skills of forest produce production with commercial nursery production for plantation activities.

#### PAPER III. FINANCE AND MARKETING MANAGEMENT OF FOREST RESOURCES

**Objective:** To develop understanding of students about financial and marketing management tools applied for forest resources business and their marketing.

**Outcome:** Enable the students to make balance sheet and determine sustainability of business of forest based industries.

#### PAPER IV. TREE BUSINESS MANAGEMENT

**Objective:** To develop understanding and management skills of the student with special reference to tree farm business management.

**Outcome:** Enables the students to manage the tree planting business.

#### PAPER V. SUSTAINABLE FOREST MANAGEMENT IN CHANGING WORLD

**Objective:** To develop understanding and management skills of the student with special reference to Environment conservation in the changing world.

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**Outcome:** Enables the students to manage the forest area with the emphasis on environmental conservation and greenhouse gases mitigation and global climatic changes.

#### PAPER V. URBAN FORESTRY

**Objectives:** Planning, establishment, protection, and management of individual trees and forest systems within an urban environment

**Outcomes:** This will enable students to gain knowledge of urban forestry, create urban forests, commercial arborists, city planners and consultants.

### SEMESTER- III

#### FOREST GENETIC RESOURCES

##### Paper I. BREEDING METHODS IN FOREST TREES

**Objective:** To acquaint the students about the concepts of sub- selection, population structure for breeding and production, genetic testing and making designs.

**Outcome:** This will enable students in the selection of superior trees for developing disease resistant and drought resistant quality planting material for future tree improvement programmes.

##### Paper II. FOREST TREES REPRODUCTIVE BIOLOGY AND SEED ORCHARDS

**Objective:** To impart the knowledge of reproduction of forest tree species and to understand the mechanism of breeding, sex expression, and seed orchard development.

**Outcome:** This will enable students to understand the reproductive biology of the tree species and seed orchard which can be helpful for the production of genetically improved seed for large scale afforestation programme.

##### Paper III. MOLECULAR GENETICS OF FOREST TREES

**Objective:** To impart the knowledge of DNA and genomic structure of forest trees for quantification of superior traits for breeding programmes.

**Outcome:** The use of molecular marker will enable students to greatly enhance the understanding of genomic structure of forest trees.

##### PAPER IV: QUANTITATIVE GENETICS OF FOREST TREES

**Objective:** To develop vision of students in the qualitative analysis of genetic & phenotypic characteristics, heritability and fitness of population with inbreeding coefficient.

**Outcome:** This will enable students about the estimation of similarity and dissimilarity in the tree population and give the suitability of individuals in the environment. The students will also be able to understand the fitness of individual, relation with ancestry and genetic variance which can help in tree improvement and tree breeding techniques.

##### PAPER V: FOREST GENETIC DIVERSITY, CONSERVATION AND ENVIRONMENTAL IMPACT

**Objective:** To provide the student knowledge about the genetic diversity of forest tree species, their distribution, assessment and analysis, law and methodology of *in-situ* and *ex-situ*

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conservation.

**Outcome:** Students will be able to know the genetic diversity and evolve conservation strategies of flora and fauna.

#### PAPER V. URBAN FORESTRY

**Objectives:** Planning, establishment, protection, and management of individual trees and forest systems within an urban environment

**Outcomes:** This will enable students to gain knowledge of urban forest, create urban forests, commercial arborist, city planners and consultants.

#### SEMESTER- IV

#### FOREST MANAGEMENT

##### 1. FIELD TRAINING (ATTACHMENT WITH STATE FOREST DEPARTMENT FOR UNDERSTANDING OF FOREST OPERATIONS AND MANAGEMENT PRACTICES CURRENTLY USED IN FOREST MANAGEMENT)

**Objective:** To apprise the students with the field practices which are needed for the sustainable utilization and management of forest resources.

**Outcome:** The student will be equipped with latest techniques of sustainable forest management practices.

##### 2. FOREST BASED INDUSTRIAL TRAINING

**Objective:** To make the students acquainted with the procurement of raw materials, its processing techniques and its best industrial utilization and financial and marketing management of the products needed for the forest based industries.

**Outcome:** The students will be trained with latest techniques for the sustainable utilization and management of forest products in forest based industries.

##### 3. ICT TOOLS AND TECHNIQUES APPLICATION IN FORESTRY.

**Objective:** To develop skill and training of ICT tools and techniques for mapping and measurements of forest.

**Outcome:** this course will enable the students to measure various parameter of forest and its resources through ICT tools and techniques.

##### 4. STUDENT PROJECT DISSERTATION

**Objective:** To provide the students research based skills for the planning, mapping and management of the forest and its resources.

**Outcome:** This will enable the students to carry out independent field/laboratory based research work on different aspects of forestry, wildlife and environmental sciences

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#### SEMESTER-IV

#### SPECIALIZATION: FOREST GENETIC RESOURCES

#### 1. FIELD TRAINING (ATTACHMENT WITH STATE FOREST DEPARTMENT FOR ANALYSIS OF FGR, FOREST OPERATIONS AND MANAGEMENT OF FOREST GENETIC RESOURCES)

**Objective:** To apprise the students with the field practices which are needed for the analysis of genetic resources, forest operations and sustainable utilization of forest genetic resources.

**Outcome:** The student will be equipped with the tools and techniques for analysis of genetic resources of forest, selection of superior trees for the tree improvement programmes.

#### 2. FOREST BASED INDUSTRIAL TRAINING

**Objective:** To make the students acquainted with the procurement of raw materials, its processing techniques and its best industrial utilization and financial and marketing management of the products needed for the forest based industries.

**Outcome:** The students will be trained with latest techniques of the sustainable utilization and management of forest products in forest based industries.

#### 3. ICT TOOLS AND TECHNIQUES APPLICATIONS IN FORESTRY.

**Objective:** To develop understanding and management skills in the students regarding use of ICT tools in mapping and measurement of the forest genetic resources.

**Outcome:** Enables the students to measure and map various forest genetics resources through ICT tools and techniques for forest genetic resources management.

#### 4. STUDENT PROJECT DISSERTATION

**Objective:** To provide the students research based skills for the planning, mapping and management of the forest and its resources.

**Outcome:** Enable the students to carry out independent field/laboratory based research work on different aspects of forestry, wildlife and environmental sciences.

#### SEMESTER-I

#### PAPER I. SILVICULTURE

CR.4 (3+1)

#### Theory

Principles of Silviculture, objective and scope, relationship with the other branch, forest structure and its components, tree and the forest, Ecophysiology of tree growth, factors of the locality, Bioclimatic and microclimate effect, Forest ecosystem concept, stand dynamics-forest succession, classification of world's forest vegetation, forest types and their distribution, Advanced and modern

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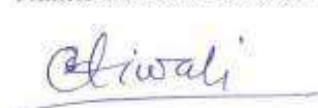
nursery tools & techniques, natural and artificial regeneration, Tending operation. Regeneration of important forest tree species (*Shorea robusta*, *Tectona grandis*, *Gmelina arborea*, *Eucalyptus spp.*, *Dalbergia sissoo*, *Bamboo spp.*, *Cedrus deodara* and *Pinus roxburghii*), regeneration survey and techniques.

### Practical

Acquaintance with various technical terms of silviculture. Study the forest composition. Recording the observations on shoot development, growth rings, crown development, leafing, flowering, and fruiting in (*Shorea robusta*, *Tectona grandis*, *Gmelina arborea*, *Eucalyptus spp.*, *Bamboo*, *Cedrus deodara*, *Dalbergia sissoo*). Study of site factors like climatic, edaphic, physiographic and biotic. Study of natural regeneration, Afforestation and Reforestation success. Layout of nursery bed for sowing Classification of world's forest vegetation.

### Suggested Readings

- Dwivedi AP. 1992. *Agroforestry: Principles and Practices*. Oxford and IBH.
- Dwivedi AP. 1993. *A Text Book of Silviculture*. International Book Distributors, Dehradun.
- Khanna LS. 1996. *Principle and Practice of Silviculture*. International Book Distributors.
- Smith DM, Larson Be, Ketty MJ & Ashton PMS. 1997.
- Jha, L. K. 2014. *Advances in Agroforestry*. Today & Tomorrow's Printers and Publishers New Delhi.
- Lal J.B. 2011. *Forest ecology*. Natraj Publisher Dehradun.
- Mishra, S R. 2010. *Textbook of Dendrology*, Today & Tomorrow's Printers and Publishers New Delhi
- Patra, A K. 2013. *Agroforestry: Principles and Practices*. Today & Tomorrow's Printers and Publishers New Delhi.
- Pradeep Krishan. 2013. *Jungle trees of Central India*. Penguin Books India.
- Smith DM, Larson BC, Ketty MJ, and Ashton PMS. 1997. *The Practices of Silviculture- Applied Forest Ecology*. John Wiley & Sons.
- Raj, Antony Joseph & S B Lal. 2014. *Agroforestry: Theory and Practices*, Today & Tomorrow's Printers and Publishers New Delhi





  
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**PAPER II. FOREST BIOMETRY, SURVEYING & ENGINEERING**

**Cr.4 (3+1)**

**Theory**

Measurement of tree parameters: girth, diameter, height and form factor. Estimation of log volume and volume of standing trees. Estimation of tree age, growth and yield of individual tree and forest stands. Stump analysis and stem analysis for determining past growth. Preparation of volume table, yield table, stand table & its application in forestry. Forest inventory, sampling methods adopted in forestry. Growth and yield prediction models and forecasting of future yield.

Forest surveying: Chain survey, plane table and compass survey. Forest Engineering: Building materials and its quality testing, Design and construction of forest roads and bridges.

**Practical**

Measurement of girth and diameter of plantation and forest, Determination of tree height and form factor, volume calculation of felled and standing trees. Estimation of tree age, Volume table preparation, Application of sampling procedures, Handling of GPS, preparation of yield and stand table.

Survey of forest and plantations using chain, plane table, compass, total station, measurement of road camber and road profile, Identification of building materials and its field testing, visit of different types of bridges.

**Suggested Readings**

Chaturvedi A.N., and Khanna L.S. 1994. Forest Mensuration. International Book Distributor, Dehradun, India

Masani, N.J. 1995. Forest Engineering without tears, Natraj Publisher, Dehradun

Manikandan K and Prabhu S. 2012. Indian Forestry, Jain Brothers, New Delhi

Ram Parkash 1983. Forest Surveying, Khanna Bandhu Book Publisher India.

Sharpe GW, Hendee CW & Sharpe WE. 1986. Introduction to Forestry. McGraw-Hill.

Simmons CE. 1980. A Manual of Forest Mensuration. Bishen Singh, Mahender Pal Singh, Dehradun.

Ram Parkash 1983. Forest Engineering. International Book Distributor, Dehradun, India.

**PAPER III: FOREST MANAGEMENT, REMOTE SENSING & GIS Cr.4 (3+1)**

**Theory**

Principles of forest management and their applications. Development of forest management in India. Concept of Normality. Normal forest, causes of abnormality in forest management Sustainable

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Forest Management, Rotation: Meaning and types. Increment, Types of increment, Yield: Types of yield, Yield regulation in regular forest, Yield regulation in irregular forest Management. Working circles, felling series, cutting section, coupes, periodic blocks and felling cycles. Silviculture system: Definition and types, Bamboo forest management and Working plan prescriptions. Site quality, Stand density, Criteria and Indicators.

Remote Sensing definition, scope, source of energy and interaction with forest, EMR Spectrum concept, Orbit, Platform and Sensor, Multi-band concept. Satellite system and its use for forest mapping and management. GIS definition, Hardware and software used, methods used in forest management, database and modeling concept. Imagery concept its interpretation and map preparation, LiDAR and RADAR concept for forest. Application of RS & GIS for forest management and planning, forest covers type discrimination and change detection analysis.

### Practical

Study of various records and forms maintained in Forest division with regard to management of forests under their control. Study of working plans of the forests. Toposheet reading, determination of scale and height on toposheets, introduction to different GIS software, conversion of file formats, image registration / geocoding, digitization, geo-referencing, Projection, File sub setting, mosaicing, unsupervised and supervised classification of forest, map preparation for forest cover, type, slope, LULC, fire, field visit for ground truthing.

### Suggested Readings

- Burrough PA.1990. *Principles of GIS for Land Resources Assessment*, Oxford & IBH Lilesand T.M. Clarke, Keith. 2011. *Geographical Information System*, Prentice Hall.
- Dwivedi A.P. 1993. *A Text Book of Silviculture*, International Book Distributors, Dehradun.
- J.B. Lal. 2011. *Forest Management: Classical Approach and Current Imperatives*, Natraj Publishers, Dehradun.
- Franklin, Steven. 2014. *Remote Sensing for Sustainable Forest management*, CRC Press.
- John Wiley. Remote Sensing and its application. Universities Press
- Kohl, Michael 2012. *Sampling Methods, Remote Sensing and GIS Multisource Forest Inventory*, Springer publication.
- Lillesand and Kiefer 2009. *Remote Sensing and Image Interpretation*, VI edition of John Wiley & Sons.
- Lecture notes. 2000. *Photogrammetry and Remote Sensing*, module I, IIRS
- Sen, Raj Kumar.2012. *Forest Management and Sustainable Development*, Today & Tomorrow's Printers and Publishers, New Delhi.

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PAPER IV. FOREST PROTECTION

Cr.4 (3+1)

**Theory**

General concept of forest protection. Various abiotic and biotic forest damaging agencies. Forest fire and its impact on forest health. Adverse climatic factors, acid rains and air pollutants in relation to tree health. Tree disease concept and disease cycle. Biodegradation of wood - microscopic and chemical effects of white rot, brown rot, soft rot and wood discoloration. Heart rots - factors affecting heart rots, damage caused, compartmentalization of decay in trees and management of heart rots. Role of mycorrhiza in tree health. Important diseases of forest trees- Teak, Sal, Shisham, *Acacia*, *Dalbergia*, Deodar, Pines and Casuarina. Insect pest of Sal, Teak, Shisham, Babool, *Ailanthus*, Pines, Deodar, Casuarinas and *Albizia*. Biological control of insect pests and diseases of forest trees Nature of disease resistance. Molecular tools for developing disease resistance trees.

**Practical**

Collection, identification and preservation of important insect pests and disease specimens of forest plants. Preparation of culture media and methods of inoculation. Vegetative and reproductive study of pathogens. Detection of insect infestation and seed borne mycoflora. Assessment of losses due to diseases, insect pests etc. Fire control methods and devices, Familiarization with the meteorological and plant protection equipment, Application of pesticides and bio- control agents in the management of insect pests, weeds, diseases in nurseries and plantations, Extraction of spores of Vascular arbuscular mycorrhizal (VAM), fungi from soil and assessment of mycorrhizal root infection,

**Suggested Readings**

- Bakshi BK. 1976. *Forest Pathology*. Controller of Publications, GOI.  
Jha LK & Sen Sarna PK. 1994. *Forest Entomology*. Ashish Publ. House.  
S S Negi, 2006. *Handbook of Forest Protection*. International Book Dist., Reprint  
Schmidt, Olaf. 2006. *Wood and Tree Fungi: Biology Damage Protection and Use*, Today & Tomorrow's Printers and Publishers, New Delhi.  
Paul. D. Mennan. 1991. *Tree Diseases Concept*. Prentice Hall.  
Stebbing EP. 1977. *Indian Forest Insects*. JKJain Bros.

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**Paper V. FOREST ECOLOGY AND BIODIVERSITY CONSERVATION**

Cr.4 (3+1)

**Theory**

Forest ecology, forest community dynamics, forest community structure and function, phytogeography and zoo-geographic regions of India, Basic concept of biodiversity, history of biodiversity conservation, Conservation of natural resources (Hotspot areas, Wildlife Sanctuaries, National parks, Biosphere reserve-terrestrial and aquatic, Botanical Gardens, Zoological Parks), Important Plant and wildlife ecological indicator species, endangered species, Coral reefs, Mangrove forest. Climate change and biodiversity, Global warming and forests, Green House Effect, Ozone depletion and its consequences, Biodiversity Conservation laws and acts. International programmes for biodiversity conservation, convention on biological diversity CBD, CITES UNFCCC Kyoto protocol, TRIPS, Ramsar convention, Intellectual property rights.

**Practical**

Study of forest community structure and its successional status, Estimation of productivity of forest ecosystem, Trip to different regions of the state to study forest vegetation, Collection and preservation of specimen, Identification of ecological indicator species, Methods of vegetation analysis, Measurement of biomass and productivity, Visit to National parks, Wildlife sanctuaries, Botanical gardens and arboreta.

**Suggested Readings**

- Anonymous. 2006. *Report of the National Forest Commission*. Govt. of India.
- Kumar Arvind. 2005. *Biodiversity and Conservation*, Today & Tomorrow's Printers and Publishers New Delhi.
- Dhyani SN. 1994. *Wildlife Management*, Rawat Publ.
- Malik, Ashok. 2008. *Dynamics of Forest Ecosystems*, Today & Tomorrow's Printers and Publishers New Delhi.
- Huxley P, 1999. *Tropical Agroforestry*, Blackwell.
- Khan TI & Al-Azmi DN, 1999. *Global Biodiversity Conservation Measures*, Pointer Publ.
- Kimmins JP. 1976. *Forestry Ecology*, Macmillan.
- Nautiyal S & Koul AK. 1999. *Forest Biodiversity and its Conservation Practices in India*, Oriental Enterprises New Delhi.
- Ramakrishnan PS. 1992. *Shifting Agriculture and Sustainable Development*. Man and

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Biosphere Series, The Parthenon Publ. Group.  
Singh, M P et al. 2013. *Conservation of Biodiversity and Natural Resources*. Today & Tomorrow's  
Printers and Publishers New Delhi.

#### PAPER VI. FOREST POLICY, LAWS AND ENVIRONMENTAL LEGISLATION

Cr.4 (3+1)

##### Theory

Forest policy -Relevance and scope, National Forest Policy-1894, 1952 and 1988, criminal laws, Indian Penal Code, criminal procedure code; Indian Forest Act-1927, Forest Conservation Act 1980, Biodiversity Act 2002, Forest Right Act 2006-Privilege concession and Right of forest dwellers, Environment and their legal issues in India, Legal and policy frameworks related to forest conservation, Environment (protection) act 1986.

##### Practical

Visit to High Court, Lower Court. Visit to forest depot. Visit and study about crime cell of forest department

##### Suggested Readings

- Chaturvedi A. N., 2011. *Forest Policy and law*, Khanna Bandhu.  
*Indian Forest Acts* (with short notes) 1975. Allahabad Law Agency.  
Jha LK. 1994. *Analysis and Appraisal of India's Forest Policy*. Ashish Pub. House.  
Poddar A.K. et al. 2011. *Forest Laws and Policies in India*, Today and Tomorrow Printers and Publishers New Delhi  
Prabhakar V.K., 2001. *Laws on Forests*, Anmol Publication.  
National Forest Policy 1952. Ministry of Food and Agriculture, New Delhi.  
National Forest Policy 1988. Ministry of Environment and Forests, New Delhi.  
Saharia, VB. 1989. *Wildlife Law in India*. Natraj Publ.  
Sairam Bhat 2010. *Natural Resources Conservation Law*, Sage.  
Negi SS. 1985. *Forest Law*. Natraj Publ.

#### SEMESTER-II

#### PAPER I. FOREST TREE IMPROVEMENT AND BIOTECHNOLOGY

CR.4 (3+1)

##### Theory

General concept of forest tree breeding, tree improvement, forest genetics. Reproduction in forest trees, dimorphism Pollination mechanisms. Pollen dispersal, pollinators and their energetics.

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Attractants for pollinators. Variations in tree phenotypes, its importance and causes. Natural variation as a basis for tree improvement. Geographic variations - Ecotypes, clines, races and land races. Seed, seed formation, dispersal, storage, stratification and seed dormancy. Selective breeding methods- mass, family, within family, family plus within family. Plus, tree selection for wood quality. Progeny and clone testing. Seed orchards - type, functions and importance. Estimating genetic parameters and genetic gain. Heterosis breeding: inbreeding and hybrid vigour. Manifestation and fixation of heterosis. Species and racial hybridization. Indian examples - Teak, Shisham, *Eucalypts*, *Acacias*, Pines and Poplars. Polyploidy, aneuploidy and haploidy in soft and hardwood species. Induction of polyploidy. Hardy-weinberg law, null hypothesis, Wohlund's Principle.

Biotechnology in tree improvement Mutation breeding, Micro-propagation, Genetic engineering. Transgenic trees, molecular marker assisted tree improvement, Molecular marker and its application in forestry.

#### Practical

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 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.

#### Suggested Readings

- Khan IM. 2014 Forest Biotechnology, Today and Tomorrow Printers and Publishers New Delhi.  
Mandai A.K., & Gibson GL. (Eds). 1997. *Forest Genetics and Tree Breeding*. CBS.  
Surendran C, Sehgal RN & Paramathma M. 2003. *Text Book of Forest Tree Breeding*. ICAR Publ.  
P. Shanmughavel, 2004. *Tree Improvement and Biotechnology*, Pointer.  
Russel Haines, 1996. *Biotechnology in Forest Tree Improvement with Special Reference to Developing Countries*, Reprint, Dehradun.  
White J.W. 1976. *Introduction to Forest Genetics*. Academic Press.  
Zobel BJ & Talber J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.

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**PAPER II. FOREST INDUSTRIES AND WOOD TECHNOLOGY**

**CR.4 (3+1)**

**Theory**

Wood formation, kinds of wood, wood properties: physical, mechanical, acoustic and electrical properties, Wood strength, Wood moisture, Wood seasoning, defects and wood preservation. Wood machining and wood working. Concept and principle of Smart furniture, application of nano-science in wood industries. Importance of forest based industries in Indian economy, resin, tannin, gums extraction, resources of essential oil, katha and cutch, dyes and pigments.

Wood based industries: paper and pulp, match, sport goods, plywood, matchwood industries, improved wood, engineered wood, composite wood, Wood certification.

**Practical**

Determination of wood density, wood bulking, wood moisture, identification of wood samples, wood defects, determination of wood strength, Effectiveness of wood preservatives, Grading of wood, wood based industries, improved wood and composite wood. Extraction of essential oil, tannin, gums and natural dyes. Grading of plywood, visit of forest based industries, sawmill, timber marts.

**Suggested Reading:**

- Chauhan Laxmi and Vijendra Rao. 2003. Wood anatomy of Legumes of India: their identification, properties and uses. Bisen Singh and Mahendra Pal Singh, Dehradun.
- Eiri Board 2011. Modern Technology of wood, veneer, plywood, particle board, fiberboard, bamboo and forest products. Engineers India Research Institute, India
- Mehta T. 1981. A hand book of forest utilization. Periodical expert book agency Printer and publisher, New Delhi.
- Murthy T.K. 2010. Minor forest products of India. Oxford and IBH Publication, India.
- Negi SS. 1997. Wood Science and Technology. International book distributor, Dehradun.
- Rao KR and Juneja KBS, 1992. Field identification of 50 important timbers of India, ICFRE Publication, Dehradun, India
- Sharma LC. 1977. Development of Forests and forest based industries. Bisen Singh and Mahendra Pal Singh Dehradun, India
- Terry Porter 2006. Wood: Identification and use. Guilds of Master Craftsman Publication.
- Tewari, D.N. 2008. Management of non-timber forest resource of India. International Book Distributor Company, Lucknow, India
- Trotter H. 1992. Manual of Indian Forest Utilization. Forest Research Institute, Dehradun.
- Tsoumis G. 2009. Science and Technology of Wood. Verlag Kessel
- Troup RS. 2007. Manual of Indian forest utilization. Today and Tomorrow Printers and Publishers, New Delhi

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PAPER III. WILDLIFE BIOLOGY AND CONSERVATION

CR.4 (3+1)

**Theory**

Introduction/Conservation ethics- Definitions, Values, Zoological classification, Sign and symptoms. Animals behavior & adaptations, Wild life Ecology, Basic concepts, Wildlife habits and habitat. Wildlife habitat and its component Wildlife conservation: Definition, Concept, significance. Wildlife conservation movement, Wildlife conservation in India, In-situ and Ex-situ wildlife conservation, Role of protected area in wildlife conservation, some rare and threatened wildlife species of world particularly India, special project for endangered species, Project tiger, Gir Lion Project, Crocodile Breeding Project, Wildlife Conservation organization- National and International. Role of zoos parks and sanctuaries for conservation of wildlife, Ramsar wetlands. Wild life management: Wild life management its scope as a natural resource, current status of wildlife management. Tiger, Bear, Elephant, Rhinoceros, deer. Biological basis of management- animal population, shelter, food, WL Policy Legislation and administration policies and programmes. Wild life protection act 1972, Scheduled animals, Age and Sex determination, Tiger census, Preservation of biological material, National Park and Sanctuaries of (C.G). Biotelemetry, Forensic Analysis, Wildlife pathology, wildlife crimes.

**Practical**

Study of mammals birds and animals in university premises, Identification of pugmark, evaluation of Roosting cover in university premises, Plotting of National Park and Sanctuaries on map. Visit and list the wildlife present in nearby zoo, sanctuaries, National Park.

**Suggested Readings**

- Agarwal, K.G., 2000. *Wildlife of India: Conservation and management*, Nidi Publishers India.
- Gopal Rajesh., 1993. *Fundamentals of wildlife management*, Justice Home Publication, Allahabad.
- Hosetti B.B., 1997. *Concept of Wildlife management*, Daya Publishing House, Delhi.
- James, A. 1984 *Principles of wildlife management*, Inc. Bailey, John Wiley & Sons, New York.
- Hunter, M.L. Jr., 1990. *Wildlife forest and forestry principals of managing forest for Biological diversity*, Printice Hall.
- Singh, S K., 2009. *Textbook of Wildlife Management*, Today & Tomorrow's Printers and Publishers New Delhi.
- Stephen H, Berwick and V. B, Sharia, 1995. *Wildlife Research and management*, Oxford University Press, Oxford.

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PAPER IV. FOREST SOIL AND WATERSHED MANAGEMENT

CR.4 (3+1)

**Theory**

Definition and importance of forest soils; Origin, classification and nomenclature of soils; forest soil physical, chemical and microbiological properties, Soils of major forest biomes, Difference between forest soil and other arable soils, understanding of soil dynamics and influence upon forest composition stand regeneration, tree vigor and tree growth, Silviculture practices and forest soils. Soil factors in forest productivity, Forest soil fertility determination, nutrient management in forest soil. nursery soil management. Soil degradation-problems and impact on forest ecosystems; Forest fire and soil resilience; Forest soil pollution, maintenance and improvement of forest soil with special reference to tropical conditions. Watershed basic concept, social aspects of watershed management, watershed management practices, sustainable watershed approach; integrated watershed management, use of modern techniques in watershed management.

**Practical**

Determination of soil moisture, texture, porosity, bulk density, particle density and water holding capacity; Determination of pH, EC, organic C & Study of forest soil profile in field: Studies on fertilizers, biofertilizers and FYM uses in forest nursery, studies on drainage maps, characterization and delineation of watersheds, visits to nearby forest nursery and watershed areas.

**Suggested Readings:**

- A K Mani; R. Santhi and K M Sellamuthu. 2008. *Fundamentals of Forest Soils*, Satish Serial Pub.
- DhuruvaNarayana, V.V., Sastry, G. and Patnaik, V.S. 1990. *Watershed management* ICAR Publication, New Delhi.
- Matt Burshe Christian P. Giardina, Dave and Morris and Debora S. Page Dumroese 2019. Global change ion forest soils, Esiver Science Publisher.
- Murty, J.V.S.1995. *Watershed management in India*. Wiley Eastern, New Delhi.
- Singh, P.K. 2000. *Watershed management: Design and Practices*. E-media publications, Udaipur, India.
- N.C. Brady 1990. *The Nature and Properties of Soils*: Macmillan Publishing Company, New York (10th Edition).
- Negi S.S., 2000. *Forest Soils*, International Book Distributors.
- Osman, Khan Towhid, 2013. *Forest Soils: Properties and Management*, Springer Science publ.
- D. Binkley and R.F. Fischer (2000). *Ecology and Management of Forest Soils* (fifth addition

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Wiley & Blackwell Publisher)

S. A: Wilde 1995. *Forest Soils and Forest Growth*, Periodicals Express-Book Agency, New Delhi, International Book Distributors, Dehradun.

**PAPER V. GLOOBLAL ENVIRONMENT & CLIMATE CHANGE CR.4 (3+1)**

**Objective**

To develop understanding of students about environmental and climatic System. To develop understanding of students about global climatic changes and their effect on forest aquatic ecosystems.

**Theory**

Environment: Definitions and concepts of environment components of atmosphere, hydrosphere, pedosphere, biosphere and their interactions. Biogeochemical cycle of greenhouse gases, source and sinks.

Environment Pollution: Types of pollutions, methods of measurement of pollution, classification of pollutants, national and international Environmental standards of important pollutants.

Air pollution: Major pollutants and their sources. Ionizing radiation, monitoring of gaseous pollutants and particulate matter, Vehicular pollution. Biological abatement of air pollution. Development of green belt.

Water Pollution: Important pollutants-source, impact of heavy metals, halogen and radio nuclides on aquatic flora and fauna. Treatment technologies for industrial effluents/wastewater. Monitoring water pollution and water quality standards.

Soil pollution: Heavy metal toxicity in soil, Impact of pesticides, industrial waste and fertilizers on soil physicochemical properties. Microbiological degradation of xenobiotic in environment.

Climate changes: Earth's climate systems, adaptability and vulnerability. A global perspective of climate change, global warming, greenhouse gases, IPCC initiatives in climate change mitigation, various mitigation mechanism- Kyoto protocol- strategies. Impact of climate changes on Indian forest, adaptation of forest trees to climate change, case studies on the management of certain tree species in India.

Global Environmental Problems: acid rain, Eutrophication, Bio manipulation, Ozone depletion and UV radiation. Bioremediation of contaminated soils and waste lands. Environment Impact Assessment.

**Practical**

Impact of particulate matter on environment, Impact of coal mining on environment Impact of cement pollution in environment. Effect of effluent from several industries on environment. Reclamation of mining wastes with microorganisms. Bio-accumulation studies on metals by

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microorganisms. Assessments of environmental impact on polluted sites, Assessing the awareness of environmental regulation and control methods, Impact of power stations on plant, microorganisms, animals and soils ecosystems, EIA of polluted river ecosystem, Environmental Impact Assessment.

#### Suggested Readings

- Anonymous, 2006. Report of the National Forest Commission. Govt. of India, New Delhi.
- E. Claussen, V. A. Cochran, and D. P. Davis. 2001. *Climate Change: Science, Strategies, & Solutions*, University of Michigan.
- Huxley P. 1999. *Tropical Agroforestry*. Blackwell Science.
- Koskela J, Buck A & Teissier du Cros E. 2007. *Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe*. Biodiversity International; Rome, Italy.
- Streck, C et al, 2006 Climate Change and Forests Emerging Policy and Market Opportunities Today & Tomorrow's Printers and Publishers New Delhi.

#### PAPER VI. FOREST STATISTICS & RESEARCH METHODOLOGY CR.4 (3+1)

##### Theory

Basics of statistics: Scales of measurement, types of data: quantitative and qualitative data of forest tree species frequency arrangement, different series and its arrangement and representation methods, Central tendency: Mean, Median, Mode, Measures of Dispersion: Range, quartile deviation, Mean deviation and Standard deviation- variance, covariance, Basic concept of probability, Correlation: Concept, Karl Pearson's coefficient, Spearman rank correlation coefficient, Regression: Regression equations, linear and nonlinear regressions and regression coefficient. Tests of significance: t- test, paired t-test, Z- test and  $\chi^2$ -test

Analysis of Variance (ANOVA) - one way and two-way analysis of variance, Experiments designs: Basic concept, Principles of experimental designs, Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Split Plot and Strip Plot Designs, Comparisons of all experimental designs

##### Practical

Use of Excel sheet: To arrange forest based statistical data and represent in different diagram and graphical ways, Forest based measurements: arrangements and frequency distribution, Calculation

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of mean, median and mode of measured characteristics of different tree species, Finding out the relationship between the height and DBH of some forest tree species-correlations and regressions. Testing the hypothesis under t- test, z- test and  $\chi^2$ -test. ANOVA under the different types of designs: Completely Randomized Block Design, Randomized Block Design, Latin Square Design.

#### Suggested Readings

- Forestry Statistics India-1996: Indian Council of Forestry Research and Education, 1999  
Mead R & Relay J. 1987. *Statistical Tools for Agro-Forestry Research - Bivariate Analysis for intercropping Experiments*. ICRAF, Nairobi.  
Surendran C, Sehgal RN & Paramathma M. *Statistical Methods for Agricultural Workers*. ICAR. 2003.  
R. Rangaswamy: A Text Book of Agricultural Statistics, New Age International Pvt Ltd Publisher, ISBN-9788122425925, 9788122425925  
Dr. S R S Chandel: A handbook of Agricultural Statistics, IMPECT PUBLISHER ISBN-9780012599754, 0012599751

### SEMESTER- III SPECIALIZATIONS

- A. FOREST MANAGEMENT
- B. FOREST GENETIC RESOURCES

#### A. FOREST MANAGEMNET

##### PAPER I. FOREST RESOURCE ANALYSIS

CR.4 (3+1)

##### Theory

Forest resources: wood produce and non-wood produce. Raw materials of forest origin for industries viz: paper and pulp; plywood and board, saw mills, furniture making, packing case, match splints, toys etc.

Minor forest products: edible products, fodder trees, shrub and grasses, bamboo and cane, medicinal and aromatic plants, oil seeds, gum & resins, fiber and flosses, spices and miscellaneous products e.g. Katha, latex, insecticides, soap nuts, etc. Animal products from forest - lac, honey, silk, fur, skins, tusks etc. Dependency of villagers/ tribal on forest resources for different livelihood options. Nature, scope and importance of forest resources in regional & national economy, nature, role and functions of forest based industries, reasons for resource

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degradation. Causes of low productivity of forest resources, remedial strategies, Trends in the production of important forest resources (wood and non-wood products). Government policies on forest resources. Approaches to achievements under five year plans. Management strategies for improved production and consumption of forest resources.

### Practical

Identification, nature and properties of different wood and non-wood forest resources. Techniques & methods of value addition to forest resources for other upgradation. Exercise for forest resource mapping and analysis.

### Suggested Readings

- Agricultural Production and Resource Use*. Oxford Univ. Press.  
Bamoul W J & Oates WE. 1975. *The Theory of Environmental Policy*.  
FAO 1986. *Guidelines to Project Evaluation*. Natraj Publ.  
FAO. 1981. *Tropical Forest Resources Assessment Project* (In the Framework of Gems). *Forest Resources of Tropical Africa*. Part I & II. *Regional Synthesis*.  
Kerr JM, Marothia DK, Singh K, Ramaswamy C & Bentley WR. 1997. *Natural Resource Economics- Theory and Application in India*. Oxford & IBH.  
Makchau JP & Malcolm LR. 1986. *Economics of Tropical Farm Management*. Cambridge Univ. Press. Nautiyal Jc. 1988. New Delhi 2007  
Prentice Hall. Busby RJN. 1981. *Investment Appraisal in Forestry*. Forestry Commission Research Station, Surveys.  
Rakshit, Swapan Kumar, Forest Resource Management/ Today & Tomorrow's Printers and Publishers  
Sharma LC, 1980. *Forest Economics - Principles and Applications*. Natraj Publ.  
Tewari, D D. 2008 Management of Non Timber Forest Product Resources of India: An Analysis of Forest Development Corporations  
Upton M *Forest Economics - Principles and Applications*. Natraj Publ. 1976.

## PAPER II. PRODUCTION MANAGEMENT IN NURSERY AND PLANTATION FORESTRY CR.4 (3+1)

### Theory

Introduction to production theory, Production basic concepts, Resource-Product Relationship, Types and Kinds of Production Functions, Principles of production analysis, theory of demand

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and supply, theory of production cost analysis, Managing risk and uncertainty in nursery and plantation forestry.

Planning and budgeting techniques applied in nursery production and plantation forestry. Record book keeping system. Income and cash flow analysis. Principles of financial analysis, Investment analysis in plantation forestry, Determination of optimum rotation period. Market structure, Functions, Channels. Marketing efficiency and marketing problems of nursery and plantation forestry.

### Practical

Exercises on production analysis, assessment of efficient production, Exercises on financial analysis of production, studies of marketing channels of different nursery and plantation crops and products, costs, margin and price spread for different nursery and plantation crops.

### Suggested Readings.

Busby RJN. 1981. *Investment Appraisal in Forestry*. Forestry Commission Research Station, Surveys.

FAO 1986. *Guidelines to Project Evaluation*. Natraj Publ.

FAO. 1981. Tropical Forest Resources Assessment Project (The Framework of Gems). *Forest Resources of Tropical Africa*. Part I & II. *Regional Synthesis*.

Makechau JP Makeham and L.R. Malcolm, *Economy of Tropical Farm Management*/ Cambridge University Press.

Nautiyal JC. 1988. *Forest Economics - Principles and Applications*. Natraj Publ.

NPTL E content on managerial economics by Prof. Tripty Mishra IIT Bombay.

Rakshit Swapan Kumar. 2007. *Forest Resource Management*. Today's and Tomorrow's printers and publishers New, Delhi.

Sharma LC. 1980. *Forest Economics - Principles and Applications*. Natraj Publ.

*Natural Resource Economics-Theory and Application in India*. Oxford & IBH.

Makechau JP & Malcolm LR. 1986. *Economics of Tropical Farm Management*. Cambridge Univ. Press.

### PAPER III. FINANCE AND MARKETING MANAGEMENT OF FOREST

#### RESOURCES

CR.4 (3+1)

#### Theory:

Finance and financial management: aims and objective with reference to forest based resources;

Sources of long term finance, Major Sources of funding and financing to the forest sector,

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Organization of finance in forest based industries

Concept of Working capital: Gross and net working capital, sources of working capital, factors influencing working capital of forest based industries.

Financial statements: importance and preparation, Balance sheet preparation of forest based industries with reference to profit and loss accounts,

Budget: Purpose and essentials of budgeting, important components of budget, preparation of budgets.

Challenges in Forest finance, Collaborative Partnership on Forests

Market- Classification, price determination, Demand and supply and factors affecting the market.

Marketing efficiency-measurement methods, Marketing cost, margin and price spread-concepts and applications types of market integration. Marketing and trading of wood and non-wood forest products. IPRs and their implications in forestry.

#### Practical

Working capital analysis of forest based industries. Balance sheet preparation of forest based product industries; field and local area visit and its classification under different types of market, Price determination of any forest products under the different market situation, Demand and supply elasticity measurements of forest produces, Measurement of marketing efficiency, Marketing and trade of national and international timber and non-timber forest products.

#### Suggested Readings

Busby RJN, 1981. Investment Appraisal in Forestry. Forestry Commission Research Station, Surveys.

FAO 1986.Guidelines to Project Evaluation. NatrajPubl.

FAO, 1981.Tropical Forest Resources Assessment Project(In the Framework of Gems). Forest Resources of Tropical Africa.Part 1 & 2RegionalSynthesis.

Grebner D, Betthing P. Siryj.,2013 Introduction to forestry and Natural Resource. Elsevier Publisher.

J.M. Kerr, 1997. Natural Resource Economics-Theory and Application in India, Oxford & IBH.

Joshi.SS. and T.R. Kapoor., 2001.Fundamental of farm business Management. Kalyani Publishers

MakchaulJP&Malcolm LE.1986.Economics of Tropical Farm Management.Cambridge Univ. Press.

Nautiyal JC. 1988. Forest Economics, Principles and Applications; Natraj Publ.



- Panda SC 2011. Farm management and Agricultural Marketing, Kalyani Publishers.  
Shanley Alan R P. 2001 Tapping the green Market: Management and Certification of Non- Timber Forest Products. Amazon.  
Sharma LC. 1980. Forest Economics -Principles and Applications; Natraj Publ.  
W.A. Lauscher, Introduction to forest Resource Economics.  
FAO.2019. Forest finance

#### PAPER IV. TREE BUSINESS MANAGEMENT

CR.4 (3+1)

##### Theory

Tree farm: definition, concept, components and potential in uplifting the farmer's economy. Current farm scenario in India, constraints and the impact of climate change. Farm types and system of tree farming. Tree business management principles, Law of diminishing return, decision making, cost and price principle, Depreciation, Compounding, Planning and budgeting of tree and plantation. Labour efficiency measures, Management of tree based farms: technical and financial components of forest Nursery, plantations, sericulture, agroforestry, lac culture and other commercial plantations.

##### Practical

Visit of tree plantation, agriculture farm, agroforestry fields, Calculation of fertilizer and compost mixture for different plantations, Farm budgeting, Calculation of depreciation of farm machinery, calculation of cost of production, Preparation of farm record and ledger file. Farm tools and working principles, Visit of sericulture plantation and processing center.

##### Suggested reading:

- FAO 1986. Guideline to project evaluation, Natraj Publication, India.  
Joshi SS and Kapoor TR. 2001. Fundamental of Farm Business Management, Kalyani Publication, India.  
Ken JM, Morothia DK, Singh K, Ramashwamy C and Bentley WR. 1997. Natural Resource Economics: theory and application in India. Oxford and IBH publication.  
Makchau JP and Malcolm LE, 1986. Economics of tropical farm management. Cambridge University Press.  
Nautiyal JC, 1988. Forest Economics: Principle and application. Natraj Publisher, India  
Panda SC. 2011. Farm Management and agricultural marketing. Kalyani Publishers.

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**PAPER: VI. Urban Forestry**

**CR.2**

**Theory:**

Introduction, objective and scope of urban forestry, History of Urban Forestry/Distribution and Ownership of the Urban. Forest Functions and Values of the Urban Forest, Urban Forest Environment, Tree Hazard Assessment and Management of Street, roads and parks, tree inventories and Valuation. The Urban Wildland Interface, Species selection for Street Tree and Park Management: Planting, Tree Maintenance, Removals. Urban Forestry Ordinances, biomass estimation for carbon stock assessment and mitigation. Carbon footprint calculation, Report writings on different aspects of urban forestry for the improvement of communication skills.

**Suggested Readings**

1. Urban forestry: planning and management by Malcolm Fisher, Syrawood publication house.
2. Forestry and forest resources edited by V.K. Prabhakar, Anmol Publication, New Delhi.
3. Urban and recreational forestry by S.S. Negi, International book distributors Dehradun.
4. Manual of forestry by S.S. Negi, Bishen singh, Mahendra pal singh, Dehradun.
5. Plantation Forestry by R.K. Luna.

**B. FOREST GENETIC RESOURCES**

**PAPER I. BREEDING METHODS IN FOREST TREES**

**Cr.4 (3+1)**

**Theory**

Introduction to plant breeding, Genetic constitution of tree populations, half-sib, full-sib family in trees. Hardy- Weinberg equilibrium, changes in gene frequency through selection, migration, mutation and population sizes, Long-term and short-term breeding populations. Genetic variation and Heritability, Selective breeding methods- mass, family, within family, family plus within family. Grading system of plus trees in natural stands and plantations regression systems, mother tree selection, Selection for different traits, Clonal selection and hybridization. Genetic testing programs - mating designs, complete designs - nested designs, factorial, single pair mating, full diallel, half diallel and partial diallel, incomplete pedigree designs - open pollinated mating and polycross mating.

Experimental designs in genetic testing. Selection for disease resistance, mutation and polyploidy in plant breeding, Marker assisted selection. Breeding methods for wood quality, agroforestry, diseases and pest resistance, drought and salt resistance. Tree improvement case histories.

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Calculating gene and genotype frequencies. Flow chart for different breeding methods.

#### Practical

Half-sib, full-sib family in trees. Grading system of plus trees in natural stands. Mating designs, complete designs - nested designs, factorial, single pair mating, full diallel, half diallel and partial diallel, incomplete pedigree designs - open pollinated mating and polycross mating. Selection for biotic and abiotic stresses.

#### Suggested Readings

*Breeding*. ICAR.

FAO. 1985. *Forest Tree Improvement*. FAO Publ.

Faulkner R. 1975. *Seed Orchard* Forestry Commission Bull.No.34.

Fins L, Friedman ST & Brotschol JV.1992. *Handbook of Quantitative Forest Genetics*. Kluwer.

Khosla PK. 1981. *Advances in Forest Genetics*. Ambika Publ., New Delhi.

Mandal AK & Gibson GL(Eds.). 1997. *Forest Genetics and Tree Breeding*. CBS.

Namkoong, Gene, Kang, Hyun C., Brouard, Jeans S. *Tree Breeding: Principles and strategies*, Academic Press.

Steve Lee and John Woolliams. 2013. *Novel Tree Breeding*. Publinia@inia.es

Wright JW. 1976. *Introduction to Forest Genetics*, Academic Press.

Yanchuk, A.K. 2009. *Forest and forest plants*- Vol. III, Techniques in forest tree breeding.

Zobel BJ Talbert J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.

Zobel BJ, Wyk GV & Stahl P. 1987. *Growing Exotic Forests*. John Wiley & Sons.

## PAPER II. FOREST TREES REPRODUCTIVE BIOLOGY AND SEED ORCHARDS CR.4 (3+1)

#### Theory

Importance and application of reproductive biology in tree breeding. Modes of reproduction: vegetative, asexual, sexual reproduction their breeding systems and sex expression. Monoecy, dioecy and its evolution. Out-crossing mechanism in forest trees. Environmental effects on sex expression. Floral biology. Initiation and development- Microsporogenesis, Megasporogenesis, modes of pollination; Self and out-crossing. Fertilization in hardwood and softwood species. Embryo development, seed development, Seed dispersal and gene flow. Seed orchard need, establishment of seed orchard, hybrid and research seed orchard, selection and preparation of seed orchard site, isolation, orchard size, orchard design. Seed orchards – production and management.

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different types of seed orchards – SSO and CSO- merits and demerits. Progeny Pests and disease management. Seed production area- its production and management.

### Practical

Sex expression in forest trees. Out crossing mechanisms in forest trees. Measurement of pollen flow in wind-pollinated and insect-pollinated species. Pollen viability and fertility. Seed dispersal mechanism. Visit and study of seed orchard design. Plant growth regulator application for flower induction. Study the Intraclonal variation in floral and seed characters

### Suggested Readings

- FAO.1985. *Forest Tree Improvement*. FAO Publ.
- Faulkner R. 1975. *Seed Orchard* Forestry Commission Bull.No.34.
- Fins L, Friedman ST & BrotschollV. 1992. *Handbook of Quantitative Forest Genetics*.
- Joshi B.N. & P. S. Shrivastava.Reproductive Biology of plants. Springer verlog Berlin & Heidelberg Germany & Co ISBN – 9783642501357.
- Khosla PK. 1981. *Advances in Forest Genetics*. Arnika Publ., New Delhi.
- Khrwer.
- Mandal AK &Gibson GL.1997.*Forest Genetics and Tree Breeding*. CBS.
- Manoj K. Sharma. 2012. Reproductive Biology of Angiosperm, Voyu Education in India. ISBN- 9789382174684.
- Shivana H. 2012. *Handbook of forest Biology*. Today's and Tomorrow printers and publisher, New Delhi.
- Shrivastava K.R. Pollen Biology& Biotechnology. CRP Press. 2019.
- Singh. V. Ponde& P.C. Jain. 2012. Embryology of Angiosperm, Rastogi Publication. ISBN 935078159x
- Surendranan C, Sehgal RN & Parmathama M. 2003.*A Text Book of Forest Tree Breeding*. ICAR.
- Wright JW. 1976. *Introduction toForest Genetics*. Academic Press.
- Zobet BJ &Talbert J. 1984.*Applied Forest Tree Improvement*. John Wiley & Sons.
- Zobel BJ, Wyk GV & Stahl P. 1987. *Growing Exotic Forests*. John Wiley & Sons.

### PAPER III. MOLECULAR GENETICS OF FOREST TREES

CR.4 (3+1)

#### Theory

Genome: Nuclear Genome, Mitochondria Genome, Chloroplast Genome. Evolution of the three Plant Genomes. DNA replication, Transcription and Translation of forest tree Genes. Genetic code.

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Gene expression, Regulation of Gene Expression, DNA damage, repair and recombination.  
Genetic diversity/Genetic variation of forest trees: causes and advantages. Genetic characterization of forest tree species, Morphological, Biochemical and Genetic markers, Molecular markers: Dominant and codominant, Types of molecular markers: advantages and disadvantages, Techniques in molecular genetics of forest trees; DNA isolation, DNA quantification, DNA restriction; Primer, gel electrophoresis; southern, northern and western blotting, polymerase chain reaction, gene sequencing.

Polymorphism and its significance. Calculation of genetic diversity within and between forest tree populations. Molecular markers and genome mapping. Application of molecular markers in forest tree improvement. Genomics of wood formation. Molecular genetics of cellulose biosynthesis. Bioinformatics- its significance in forest tree genetics.

#### Practical

Estimation of genetic diversity between/among forest tree populations through Morphological markers, Preparation of solutions for DNA isolation, Electrophoresis and PCR Standardization of protocols for DNA isolation of different forest tree species. Standardization of working protocol for different markers. Estimation of genetic diversity between/within forest tree population through molecular markers.

#### Suggested Readings

- American Soc. Of Plant Physiologists, Maryland, USA Karp, G. 1999 Cells and Molecular Biology: Concepts and Experiments, John Wiley & Sons, Inc., USA  
Bob B. Baughman Wilhelm Grissem and Russel L. Jones. 2002. Biochemistry & Molecular Biology of plants, Wiley CDA  
Brow T. A2007 Genomes – 3 – Garland Science House, New York,  
Buchanan, BB, W Grissem, RL Jones. 2000. Biochemistry and Molecular Biology of Plants,  
David Freifelder 1996. Essentials of Molecular Biology, Panima Publishing Company, New Delhi.  
Douglas S. Falconer, Trudy F.C. Mackay 2012. *Introduction to Quantitative Genetics*, Darling Kindersley, India Pvt Ltd.  
Jocelyn E. Krebs, Elliott S. Goldstein and Stephen T. Kilpatrick, 2012 GENES XI 11 th Edition, Jones and Bartlett Publisher.



John Wiley & Sons, Somerset NJ Alberts, B. Bray, D Lewis, J., Raff, M., Roberts, K and Walter 1999. *Molecular Biology of the Cell*. Garland Publishing, Inc., New York.

Kole, Chittaranjan 2013. *Forest Trees: Genome Mapping and Molecular Breeding in Plants*, Today & Tomorrow's Printers and Publishers New Delhi

Lewin B. 2000. *Genes VII*. Oxford University Press, New York.

Schnell, R J et al 2012. *Genomics of Tree Crops*, Today & Tomorrow's Printers and Publishers New Delhi.

S.M. Jain and S.C. Minocha. 2002. *Molecular Biology of Woody Plants*. Kulwer Academic Publisher, London.

Sandeep kumar, Mathias Fladung. 2003. *Molecular genetics and Breeding of forest trees*. Food product press. An imprint of Hawarth press. Inc New York. London. Oxford.

#### PAPER IV: QUANTITATIVE GENETICS OF FOREST TREES

CR 4(3+1)

##### Theory

Back ground of quantitative genetics, extension of Mendelian genetics into quantitative genetics. Statistical parameters used in quantitative genetics, polygenic traits, Selection theory for a quantitative character, Fisher's fundamental theorem on natural selection and its implications. Multiple-factor-hypothesis. Mating systems in forest trees, Random mating consequences in small populations

Pedigree population and inbreeding, inbreeding coefficient, rate of inbreeding. Effect of inbreeding on mean and variance, Heterosis and causes for heterosis in F1 and later generations. Models of gene action, estimation of population mean, phenotypic value, breeding value, dominance deviation G x E component of variance, interaction and environment deviation. Estimation of genetic components of variance through resemblance of relative's covariance. Heritability-its estimation and significance. Correlation characters- genetic and environmental correlations. Prediction of selection response: patterns, asymmetry, and causes. Selection criteria and use of information from relatives, response and indirect selection. Combining ability effects, Selection for combining ability. Threshold characters.

##### Practical

Quantitative and qualitative character analysis in forest tree species.

Phenotypic, genotypic correlations and path analysis of forest trees.

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Estimation of variance components from analyses of variance using various mating designs of forest trees.

Estimation of population mean, phenotypic value, and breeding value of a provenance.

#### Suggested Readings

FAO.1985. *Forest Tree Improvement*, FAO Publi.

Faulkner R. 1975. *Seed Orchard*. Forestry Commission Bull.No.34.

Fins L, Friedman ST & Brotschol JY. 1992. *Handbook of Quantitative Forest Genetics*. Kluwer.

Khosla PK. 1981. *Advances in Forest Genetics*. Ambika Publ., New Delhi.

Mandai AK & Gibson GL, (Eds.). 1997. *Forest Genetics and Tree Breeding*. CBS.

Phundan Singh. 2012 Objectives of quantitative genetics. Ludhiana Kalyani Publishers.

R.K singh and B.D. Chaudhary. 2012 Biometrical Methods in Quantitative Genetics Analysis. Kalyani Publishers.

Surendran C, Sehgal RN & Parmathama M. (Eds.). 2003. *A Text Book of Forest Tree Breeding*. ICAR.

Thirugna Kumar. 2012 Objectives Genetics and Crop Breeding. New India Publishing Agency.

White, TL, Adams, WT and D.B. Neal. 2007 Forest Genetics. CABI Publishing, UK.

Wright JW. 1976. *Introduction to Forest Genetics*. Academic Press.

Zobel BJ & Talbert J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.

Zobel BJ, Wyk GY & Stahl P. 1987. *Growing Exotic forests*. John Wiley & Sons.

#### PAPER V: FOREST GENETIC DIVERSITY, CONSERVATION & ENVIRONMENTAL IMPACT CR 4(3+1)

Forest biodiversity: concept, levels Values. Services and threats, Levels of Genetic Variation in Forest Trees. Characteristics of Forest Genetic Diversity, Ecotypes, Subspecies, Population, Metapopulation, Provenance, Land race, Cline. Dynamics of forest genetic diversity: Genetic erosion, Population bottleneck, Genetic drift, Selection, Migration and Mutation and induced genetic diversity in forest tree species. Diversity of biogeographic zones of India. Hotspots of forest genetic diversity. Forest Genetic resource mapping biodiversity indices, methodology of biodiversity conservation, Evolutionary mechanism of FGR due to Environmental Change. Some important threatened/endemic/critically endangered plants of India, Intellectual property rights. The

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Biological Diversity Act, 2002, Quarantine laws and FGR exchange. International initiatives in Biodiversity Conservation

#### Practical

Visits and survey of forests biodiversity within their natural habitat. Measurement of forest biological diversity. FGR analysis of Natural stands in nearby forest area.

#### Suggested Readings

1. FAO. 1985. *Forest Tree Improvement*. FAO Publ.
- Faulkner R. 1975. *Seed Orchard* Forestry Commission Bull.No.34.
- Fins L, Friedman ST & Brotschol JV. 1992. *Handbook of Quantitative Forest Genetics*. Kluwer.
- Fred W. Allendorf, Gordon H. Luikart, Sally N. Aitken. 2012. *Conservation and the Genetics of Population*, 2<sup>nd</sup> Edition ISBN: 978-1-118-40857-5, Wiley E-Book.
- Khosla PK. 1981. *Advances in Forest Genetics*. Ambika Publ., New Delhi.
- Mahmut Caliskan. 2012. *Genetics Diversity in Plants*. In Tech Publishers.
- Mahmut Caliskan. 2012. *The Molecular Basis of Plants Genetics Diversity*. In Tech Publishers
- Mandal AK & Gibson GL. (Eds.). 1997. *Forest Genetics and Tree Breeding*. CBS.
- Padmini Sudarsana, Madhugiri Nageswara-Rao and Jaya R. Soneji. 2012. *Tropical Forest*. A free online edition of this book is available at [www.intechopen.com](http://www.intechopen.com)
- Surendran C, Sehgal RN & Parmathama M. (Eds.). 2003. *A Text Book of Forest Tree Breeding*. ICAR.
- Wright JW. 1976. *Introduction to Forest Genetics*. Academic Press.
- Zobel BJ & Talbert J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.
- Zobel BJ, Wyk GV & Stahl P. 1987. *Growing Exotic forests*. John Wiley & Sons.

#### PAPER: VI. Urban Forestry

CR.2

#### Theory:

Introduction, objective and scope of urban forestry, History of Urban Forestry/Distribution and Ownership of the Urban Forest, Functions and Values of the Urban Forest, Urban Forest Environment, Tree Hazard Assessment and Management of Street, roads and parks, tree inventories and Valuation. The Urban Wildland Interface, Species selection for Street Tree and Park Management: Planting, Tree Maintenance, Removals, Urban Forestry Ordinances, biomass estimation for carbon stock assessment and mitigation. Carbon footprint calculation. Report writing on different aspects for the improvement of communication skills.

*Shivani*

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*28.10.2024*



References:

1. Urban forestry: planning and management by Malcolm Fisher, Syrawood publication house.
2. Forestry and forest resources edited by V.K. Prabhakar, Anmol Publication, New Delhi.
3. Urban and recreational forestry by S.S. Negi, International book distributors Dehradun.
4. Manual of forestry by S.S. Negi, Bishen singh, Mahendra pal singh, Dehradun.
5. Plantation Forestry by R.K. Luna

**SEMESTER- IV**  
**FOREST MANAGEMENT**

**1. FIELD TRAINING (ATTACHMENT WITH STATE FOREST DEPARTMENT FOR UNDERSTANDING OF FOREST OPERATIONS AND MANAGEMENT PRACTICES CURRENTLY USED IN FOREST MANAGEMENT)**

Visit to modern forest nurseries, herbal gardens and watersheds. To study the medicinal and aromatic plants diversity, their conservation and domestication. Study the felling and logging operations, timber lots and industrially important products. Introduction to Working Plan, data generation-enumeration and volume/yield calculation. Writing of compartment history files. Study the catchment area treatment plant and FDA. Study the Regeneration and Management of regionally important forestry tree species. Laying out sample plots, stump analysis, preparation of local volume table and use of forestry field equipment's / instruments. Visit to National Parks, Sanctuaries and Bio-sphere reserves. Visit to ecologically degraded areas around cement plants, mined areas etc. and study rehabilitation measures adopted. Visit to plantation site and data collection for its growth pattern and feasibility.

**2. FOREST BASED INDUSTRIAL TRAINING**

Study the nature structure of Industrial Training and Business Organization: Raw material procurement and processing; Production, Marketing and Economics at Wood workshop and saw mills/wood seasoning and preservation treatment units/Pulp and Paper Industries/ Katha making industry/ Resin, Turpentine, Gums, Tendupatta, Chironji Industry; Herbal Pharmacies and other wood product industries.

**3. ICT TOOLS AND TECHNIQUES APPLICATION IN FORESTRY.**

Introduction to MS Office (Word, Excel, Power Point). Introduction of Statistical, GIS & plagiarism softwares. Application of Remote sensing for forest resource measurements.

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Introduction to Multi-Media and its application. E-content survey consultation of scientific database concept of online learning platform (MOOCS, SWAYAM, NPTEL).

#### 4. STUDENT PROJECT DISSERTATION

Field/laboratory based research work on different aspects of forestry, wildlife and environmental sciences

### SEMESTER- IV

#### FOREST GENETIC RESOURCES

##### 1. FIELD TRAINING (ATTACHMENT WITH STATE FOREST DEPARTMENT FOR ANALYSIS OF FGR FOREST OPERATIONS AND MANAGEMENT OF FOREST GENETIC RESOURCES)

Learn to make FGR Inventory. Analysis of Provenance Variation. Identification of self and cross pollinating forest trees and its genetic diversity pattern analysis. Genetic diversity status on the basis of morphological markers. Population wise conservation priority zones of specific forest tree species. Species wise adaptability in the natural forest stands. Identification of plus tree and elite tree zones in forest. Flowering and seeding pattern of forest. Seed dispersal pattern and its influence on forest genetic resources. Identification of species wise seed production areas. Clone, seed, pollen and specimen collection. Identifying the factors which are threat to forest genetic diversity. Characterization of Genetic Potential against changing climate. Forest regeneration status. Making plans for long-term and short term tree improvement programmes. Development of practical step guide to the in-situ conservation of FGR. Forest genetic resource management by forest department.

##### 2. FOREST BASED INDUSTRIAL TRAINING

Study the nature structure of Industrial Training and Business Organization: Raw material procurement and processing; Production, Marketing and Economics at Wood workshop and saw mills/wood seasoning and preservation treatment units/Pulp and Paper Industries/ Katha making industry/ Resin, Turpentine, Gums, Tendupatta, Chironji Industry; Herbal Pharmacies and other wood product industries.

##### 3. ICT TOOLS AND TECHNIQUES APPLICATION IN FORESTRY.

Introduction to MS Office (Word, Excel, Power Point). Introduction of Statistical, GIS & plagiarisms softwares. Application of Remote sensing for forest resource measurements.

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Introduction to Multi-Media and its application. E-content survey consultation of scientific database concept of online learning platform (MOOCS, SWAYAM, NPTEL).

#### 4. STUDENT REPORT DISSERTATION

Field / laboratory based mini research work on different aspects of forestry, wildlife and environmental sciences.

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28/10/2021

*JJ Singh*  
28.10.2021