



## 1.1.2

### List of Employability/ Entrepreneurship/ Skill Development Courses with Course Contents

Colour Codes		
Employability Contents	Green	
Entrepreneurship Contents	Light Blue	
Skill Development Contents	Pink	
Name of the Subjects/Related to all three Components (Employability/ Entrepreneurship/ Skill Development)	Yellow	

**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
<b>I</b>	Core-01	FOUATT1	Principles and Practice of Silviculture	3	3	100
	Core-01 Practical	FOUALT1		2	3	100
	Core-02	FOUATT2	Fundamentals of Soil Science	3	3	100
	Core-02 Practical	FOUALT2		2	3	100
	Generic Elective (GE)-01	FOUATG1	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/ Swachhata / Plantation Activities)	2		100
	Physical Education	FOUATS2	Non Credit	----	2	100
<b>TOTAL</b>				<b>19</b>	<b>19</b>	<b>1000</b>
<b>II</b>	Core -03	FOUBTT3	Forest Mensuration	3	3	100
	Core -03 Practical	FOUBLT3		2	3	100
	Core -04	FOUBTT4	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/ Swachhta/ 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-03)	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/ Swachhta/ Physical Education/ Plantation Activities)	2	..	100
	<b>Total</b>			<b>22</b>	<b>24</b>	<b>900</b>
<b>IV</b>	Core -08	FOUDTT8	Remote Sensing and GIS Application in Forestry	3	3	100
	Core -08 Practical	FOUDLT8		2	3	100
	Core -09	FOUDTT9	Wood Science and Technology	3	3	100
	Core -09 Practical	FOUDLT9		2	3	100
	Core -10	FOUDTT10	Forest Surveying and Engineering	3	3	100
	Core -10 Practical	FOUDLT10		2	3	100
	Generic Elective- (GE)-04	FOUDTG4	Sericulture	3	3	100
	Generic Elective Practical (GE)-04	FOUDLG4		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>
<b>V</b>	Core -11	FOUETT11	Watershed and its Management	3	3	100
	Core -11 Practical	FOUFLT11		2	3	100
	Core -12	FOUETT12	Forest Biotechnology and Tree Improvement	3	3	100
	Core -12 Practical	FOUFLT12		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	FOUFLD2		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	FOUGTT18	Forest Policy, Legislation and Environmental Act	3	3	100
	Core -18 Practical	FOUGLT18		2	3	100
	Core -19	FOUGTT19	World Forestry Systems and Climate Change Mitigation	3	3	100
	Core -19 Practical	FOUGLT19		2	3	100
	Discipline Specific Elective- (DSE-3)	FOUGTD3	Forestry Extension	3	3	100
	Practical	FOUGLD3		2	3	100
			Entrepreneurship Development			
	Seminar	FOUGSS2	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 specifics 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.

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## 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.

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### **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.

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#### 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.

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#### 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 SPESIFIC 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.

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**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.

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**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 acquaintance 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 SPESIFIC 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 stack holders 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, consultancies projects.

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**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.

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**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 out of nursery bed and soil preparation, types of seed sowing in nursery bed.

#### **Suggested Readings:**

Chapman, 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  $\text{CO}_2$ - 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 m:n 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.

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

## 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 an 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 Acquaah (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,
- Jerram, 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 MPCA/ 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. Juncja (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 sloppy 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 & Isolope 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 Kandy (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 showing, 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 Acquah (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 1. FOREST PATHOLOGY AND ENTOMOLOGY (Core-II) CR:

3 + 2

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 taking 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: Kedarnath, 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. Szaboles (1994). Soil Resilience and Sustainable Land Use. CABI.

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<sup>2</sup>-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 Viniyaman) Adhiniyam 1964, Transit Rules 1961, Forest conservation Act 1980, Fixation of Rates of Timber and Other Produce, Biodiversity Act, Lok Vaniki Adhiniyam, 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 Tommorrow publishers.

L.S. Khanna (2001). Wildlife (Protection) Act 1972 as amended upto date with commentary, Khanna Banda, 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, Caracall, 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.
- Pawar Pankaj (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*, *Rouffiasarperntina*, *Withaniasomnifera*, *DioscoreaBaladona*, *CinconoCitronellgrass*,  
khus grass, *Mentha*, Sweat flag (butch), *Ocimum*, Safedmusti, 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).

### PRACTICAL

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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.

### **PRACTICAL**

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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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