

**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

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

Semester	Course	Course Code	Name of the course	Credit	Hour / week	Marks
I	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/ <i>Swachhta</i> / Plantation Activities)	2		100
	Physical Education	FOUATS2	Non Credit	-	2	100
	TOTAL				19	19
II	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

	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/ Sports)	2	..	100
	Physical Education	FOUBTS4	Non Credit	-	2	100
	TOTAL			19	22	900
Semester	Course Opted	Course Code	Name of the course	Credit	Hour / week	Marks
III	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 Ethnobotany	3	3	100
	Generic Elective (GE-3) Practical	FOUCLG3		2	3	100
	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/ <i>Swachhta</i> / Physical Education/ Plantation Activities)	2	..	100
	Total			22	24	900
IV	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
		TOTAL			22	24
V	Core -11	FOUETT11	Watershed and its Management	3	3	100
	Core -11 Practical	FOUELTT11		2	3	100

	Core -12	FOUETT12	Forest Biotechnology and Tree Improvement	3	3	100
	Core -12 Practical	FOUELT12		2	3	100
	Core -13	FOUETT13	Forest Tree Seed Technology	3	3	100
	Core -13 Practical	FOUELT13		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			
	TOTAL			20	24	800
VI	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
	TOTAL			24	24	900
VII	Core -17	FOUGTT17	Biostatistics	3	3	100

	Core -17 Practical	FOUGLT17		2	3	100
	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
	TOTAL			22	26	900
VIII	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.					
	TOTAL			22 (6 credits for each Training and 4 credits for Dissertation segment)	48 Hours/ week for each Training segment separately	700
GRAND TOTAL						170
						7000

Table 2: Structure of Courses

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

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:

PO1. 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.

PO2. Analytical ability: ability to analyze and address multifaceted scientific issues to forestry, wildlife and environmental sciences; pertain and take independent decision for synchronizing information to formulate innovative and intellectual advances towards focused research over theoretical and different domains of forestry and allied sciences.

PO3. 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.

PO4. 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.

PO5. 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.

PO6. 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.

PO7. 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.

PO8. 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 Specific Outcomes of B.Sc. Forestry

PSO1	To develop undergraduate level student strong competencies in the field of Forestry and its application in a technology-rich, interactive environment.
PSO2	To develop strong student skills in silvicultural activities, forest survey & mapping, forest management planning, forest operation, urban forestry, 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.
PSO3	Apply knowledge and skill in the development of forest and forestry activities to compete for employment in Forestry and its allied disciplines to meet the fulfillment of government and industrial needs.
PSO4	Become trained in the areas of forestry and ready for handling complex issues of forest management for sustainable development in the changing World.

SEMESTER – I

PAPER1. PRINCIPLES AND PRACTICE OF SILVICULTURE (Core-01) CR: 3+2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUATT1 FOUALT1	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide knowledge about forest tree nursery production, site factors, forest types, different tree species planting methods and forest regeneration.
2. The course makes students to identify forest and tree species, their distribution, and vegetation structure, locality factor, etc.
3. To provide information how to conduct regeneration survey and its analysis for vegetation.
4. The subject provide information related to cultural operations like tending operation, pruning, climber cutting etc.

Theory

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 forest seeds, dormancy, natural regeneration, afforestation and reforestation success. Laying out of nursery bed and soil preparation, types of seed sowing in nursery bed.

Suggested Readings:

1. Champman, G.W. and Allan, T.G. (1978). Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome.
2. Dwivedi, A. P. (1992). Principles and Practice of Indian Silviculture, Surya Publication.
3. Dwivedi, A.P. (1993). A Text Book of Silviculture, International Book Distributors, Dehradun.
4. Khanna, L. S. (1984). Principles and Practice of Silviculture, Khanna Bhandu, Dehra Dun.
5. Negi, S.S. (1983), General Silviculture, Bisen Singh Mahendra Pal Singh, 23 A Connaught Place Dehradun.
6. PradiPKrishan (2013). Jungle trees of central India. Penguin Book distributors, India.
7. Ram Prakash and L.S. Khanna. (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.

Course Outcomes:

CO1: Course will enrich the knowledge of students related to forest nursery production and forest types, different tree species and forest survey.

CO2: The course makes students to identify forest and tree species, their distribution, and vegetation structure.

CO3: Students will be able to conduct experiment on seed dormancy, forest regeneration survey and its analysis for vegetation.

CO4: Student will be able to perform cultural operations like tending operation, pruning, climber cutting etc. in a forest stand.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	-	-	2	3	3	3	3	3	2
CO2	3	2	3	-	-	2	3	3	3	3	3	2
CO3	3	2	3	-	-	2	3	3	3	3	3	2
CO4	3	2	3	-	-	2	3	3	3	3	3	2

Weightage: **1-Slightly; 2-Moderately; 3-Strongly**

PAPER II: FUNDAMENTAL OF SOIL SCIENCE (Core-02) CR: 3+2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUATT2 FOUALT2	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide practical knowledge about soil, components and their properties with relation to forest growth and environment.
2. To provide students exposure on soil formation processes and its role in forest nutrient dynamics.
3. It will provide knowledge about soil, fertilizers, biofertilizers and nutrient management in different ecosystem.
4. Course will develop the ability of student in soil testing and site evaluation for establishing forest plantation.

Theory

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, N₂-cycle, P-cycle, S-cycle. Bio-fertilizers –their importance. Nitrogen fixation-Rhizobium-tree legume symbiosis, Frankia- non-legume symbiosis, asymbiotic and associative N₂ 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.

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 CO₂- evolution method, preparation and inoculation technique for mycorrhiza and biofertilizers.

Suggested Readings:

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

Course Outcomes:

CO1: Student's will able to differentiate between different soil types, its components and properties with relation to vegetation growth.

CO2: The students will be enhance the knowledge about soil characteristics, soil –water relationships, soil fertility of different forest and its interaction with each other.

CO3: Graduates will understand the dynamics of soil nutrients and its relation with plants.

CO4: The student will develop skill related to soil testing, nutrient analysis and site evaluation for establishing forest plantation.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	3	3	-	3	3	3	1	2	2
CO2	2	2	3	2	2	-	2	2	3	2	2	2
CO3	3	2	3	3	3	-	3	3	3	1	2	2
CO4	3	3	3	3	3	-	3	3	2	3	3	2

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER 3. BASIC MATHEMATICS(GE-01)**CR: 4**

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUATG1	4	1	-	4 hours	30	70	-	100	5

Objectives

1. To provide knowledge about simple functions of basic mathematics for forest study.
2. 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.
3. Subject provides information related forest problems and solving by using arithmetical, algebraic, geometrical, statistical, or computational methods.
4. Subject support students for calculating forest yield and regulations.

Theory

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

Suggested Books:

1. R. S. Agrawal (2012). Elementary Mathematics. Kalyani Publishers, New Delhi.
2. NCERT, Elementary Mathematics.
3. Hall and Knight: Higher Algebra, Book place, New Delhi.

Tutorial

Teacher- student interaction and interactive lecture for practical based learning.

Course Outcomes:

CO1:The basic mathematical knowledge for forest study will be develop in students.

CO2:The analytical skill will be developed among students to interpretate and visualizeits application in forestry.

CO3:Students will be able to solve various forest related problems using statisticaland computational methods.

CO4:Students will develop the skill for calculating yield and regulations of different forest types.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1	1	2	3	3	3	3	3
CO2	3	3	3	3	1	1	2	3	3	3	3	3
CO3	3	3	3	2	1	1	2	3	3	3	3	3
CO4	3	3	3	3	1	1	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

SEMINAR

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUASS1	-	1	-	1 hours	-	-	100	100	1

Objective

1. Seminar will develop confidence and communication skills in to the students

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.

Course outcomes

CO1: Student will develop their personality and skills in various aspects.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	3	2	3	3	3	3	2	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER IV: ABILITY ENHANCEMENT COURSE (AEC-01)

CR :2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUATA1	2	-	-	2hours	30	70	-	100	2

Objectives:

1. The course will be selected from the University pool by students.

- Such course will enable student and enhance their ability and contribute in understanding on the subject.

Course Outcomes:

CO1:The student will be able to gain the knowledge,value addition and its application in their area of interest.

CO2:The necessary skill will be enhanced related to selected subjects.

CO3:Future career development prospects among students will increase.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER V: SKILL ENHANCEMENT COURSE (SEC- 01) CR : 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUATL1	2	-	-	2 hours	30	70	-	100	2

Objectives:

- The course will be selected from the University pool by students as per their interest.
- This type of course will augment the student's skill on the subject.

Course Outcomes:

CO1:The students will develop skill related to selected subjects.

CO2:The student will be able to gain the theoretical, practical knowledge and its application in their area of interest.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER VI: EXTRACURRICULAR ACTIVITIES (ECA-01)**CR:2**

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUATS1	-	-	2	2 hours	-	-	100	-	2

Objectives:

1. It will be a nature of additional credit course with non-mandatory nature.
2. Students of NSS/NCC/Swachhata/Physical Education/Plantation Activities, etc. may opt such courses for acquiring addition knowledge and practical experience.

Course Outcomes:

CO1:The students will develop practical experience related to different fields.

CO2: The student will be able to gain the theoretical, practical knowledge and its application in their area of interest.

CO3:Future career development prospects among students will increase.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	1	2	3	3	2	3	2	3	2	3	2

Weightage:1-Sightly;2-Moderately;3-Strongly

Physical Education

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUATS2	-	-	2	2 hours	-	-	100	100	-

Objectives

1. To inculcate physical education ability to students towards popularization of various sports, yoga and meditation among students.
2. To make the student physically fit and healthy by conducting physical activities.

Course Outcomes

CO1: Student will be physically and mentally fit and strong during their education and future.

CO2:Course will contribute in holistic development of student's vision, behaviour and decision making.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	1	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

SEMESTER – II

PAPER I: FOREST MENSURATION (Core-03)

CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUBTT3 FOUBLT3	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To develop understanding of students about tree measurements, forest inventory, and yield concepts.
2. To apply biometric measurement of individual trees and forests for forest stock and monetary estimation.
3. To design and implement comprehensive and appropriate forest resource inventories.
4. Students enable skill job opportunities in forestry sectors.

Theory

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, callipers 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, volume, and crown measurements. Measurement of bark thickness, volume, form factor and crown parameters. Calculation of wood volume, sampling of forest and plantation.

Suggested Readings:

1. Agrawal, Praveen, (2008), Forest mensuration- Tree measurement, Bisen Singh Mahendra Pal Singh, 23 A Connaught Place Dehradun.
2. Avery, T.E. (1967). Forest Measurements. Mc Grand Hill Book Company, New York.
3. Chaturvedi, A.N. and L.S. Khanna (1982). A handbook on Forest Mensuration. International Book Distributors
4. Donald Bruce Francis Schumcher, (2015), Forest Mensuration, Agrihorti Press New Delhi.
5. Hamilton, G.L. (1988). Forest Mensuration Handbook. Periodical Expert Book Agency.

Course Outcomes:

CO1:Students will develop knowledge about tree measurements, forest inventory, and yield concepts.

CO2:Student’s ability to observe individual trees and forest crops for future yield and carbon monetization.

CO3:Students will be able to develop and design forest resource inventories.

CO4:Future job prospects to forestry and allied sectors.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1		2	3	3	3	3	3
CO2	3	3	3	3	1		2	3	3	3	3	3
CO3	3	3	3	2	1		2	3	3	3	3	3
CO4	3	3	3	3	1		2	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUBTT4 FOUBLT4	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide basic knowledge on plant cell, genetics and their importance in tree breeding.
2. To understand the plant cell structure and functions.
3. To understand the laws of inheritance, chromosome and basic genetics for their exploitation in plant breeding.
4. To provide information about fertilization pattern of various tree species for tissue culture and genetic breeding programmes.

Theory

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:

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

Course Outcomes:

- CO1:** Students will be enriched with theoretical and practical knowledge about plant cell, genetics and tree breeding programme.
- CO2:** Students will learn the structure and functions of plant cell.
- CO3:** Students will be able to understand the plant breeding programmes which will enhance their skill about future employment related to forestry.
- CO4:** Student will understand fertilization pattern of various tree species.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	1			3	2	3	3	3
CO2	3	1	3	3	1			3	2	3	3	3
CO3	3	2	3	2	1			3	2	3	3	3
CO4	3	1	3	3	1			3	2	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUBTG2 FOUBLG2	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide the basic knowledge of tree taxonomy and morphology of different plants.
2. To know the nomenclature and anatomy of various parts of higher plants.
3. To develop the concept of plant physiology and strategy of plant survival and growth.
4. To make students become expert in plant taxonomy and plant identification.

Theory

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. 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:

1. Strasburger, Schenck, Noll, Fritz, Karsten and W.H. Lang(2010). A textbook of Botany. Academic Press, New York.
2. V. Singh and D.K. Jain (2013) Biology. Nageen Prakashan Pvt Ltd, Meerut, India.
3. L. Taiz, L., Zeiger, E., Ian M. Moller and Angus Murphy-Sixth ed. (2015). Plant Physiology and Development. Published by Sunderland: Sinuaer Associates
4. L. Taiz and E. Zeiger (2010) .Plant Physiology. Sunderland: Sinuaer Associates.
5. V. Verma (2009) Textbook of Plant Physiology. Ane books Pvt. Ltd. New Delhi.
6. S. R. Mishra (2011). Text Book of Dendrology. Discovery Books.

Course Outcomes:

CO1: Students will learn about basic knowledge of plant morphology, physiology of different plant and tree species.

CO2: Students will learn the nomenclature and anatomy of various parts of higher plant.

CO3: Students will have the in-depth knowledge about plant taxonomy and plant identification.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	2	-	2	3	3	3	3	3
CO2	3	1	2	1	2	-	2	3	3	3	3	3
CO3	3	1	2	3	2	-	2	3	3	3	3	3
CO4	3	1	2	3	2	-	2	3	3	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

PAPER IV: ABILITY ENHANCEMENT COURSE (AEC-02) CR: 2

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
FOUBTA2	2	-	-	2 hours	30	70	100	2

Objective:

1. The course will be selected from the University pool by students.

Course Outcome:

CO1:The student will be able to gain the theoretical and practical knowledge and develop future career prospects related to the selected subjects.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	2	2	2	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

PAPER V: SKILL ENHANCEMENT COURSE (SEC- 02) CR: 2

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
FOUBTL2	2	-	-	2 hours	30	70	100	2

Objective:

1. The course will be selected from the University pool by students.

Course Outcomes:

CO1:The student will learn necessary skill related to their subject of interest.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	3	3	2	2	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

PAPER VI: EXTRACURRICULAR ACTIVITIES (ECA-02) CR: 2

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
FOUBTS3	2	-	-	2 hours	-	-	100	2

Objectives:

1. It will be a nature of additional credit course with non-mandatory nature.
2. Students of NSS/NCC/Swachhata/Physical Education/Plantation Activities, etc. may opt such courses for acquiring addition knowledge and practical experience.

Course Outcomes:

CO1: The student will be able to gain the theoretical, practical knowledge and apply it in their social and practical approaches.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

Physical Education

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUBTS4	-	-	2	2 hours	-	-	100	100	-

Objectives:

1. Physical education teaches students different sports, yoga and meditation in the department with their interest.
2. Student will learn how to be physically fit with various kinds of physical activities.

Course Outcomes

CO1: Student will be physically and mentally fit and strong during their education as well as in future also.

CO2: Subject will improve student's vision, behaviour and decision making.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	3	3	3	3	3	3	3	3	3
CO2	3	1	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

SEMESTER – III**PAPER I: FOREST ECOLOGY AND BIODIVERSITY CONSERVATION (Core-05) CR: 3 + 2**

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
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FOUCTT5 FOUCLT5	3	-	2	6 hours	30	70	100	200	5
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Objectives:

1. To develop knowledge about ecological aspects of forest resource and biodiversity conservation.
2. To develop skill on making biodiversity register, biodiversity survey.
3. The student will be able to understand ecological principles and concepts including forest structure and function of ecosystem
4. To develop knowledge about biodiversity conservation (In-situ and ex-situ) approaches for high ecosystem service

Theory

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.

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, biodiversity survey, calculation of Shannon index, etc.

Suggested Readings:

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

Course Outcomes:

CO1: Students will develop in-depth knowledge about forest resource and biological diversity.

CO2: Students will learn the analytical measurement of floral and faunal diversity.

CO3: The student will be able to understand the different methods of biodiversity conservation method (In-situ and ex-situ) and management plan.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	3		3	3	3	3	3	3
CO2	3	1	2	1	3		3	3	3	3	3	3
CO3	3	1	2	3	3		3	3	3	3	3	3
CO4	3	1	2	3	3		3	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

PAPER II: FUNDAMENTAL OF WILDLIFE AND ITS MANAGEMENT (Core-06) CR: 3

+ 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUCTT6 FOUCLT6	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To give the understanding about faunal diversity and strategies of conservation of wildlife.
2. To give the understanding basic knowledge of wildlife classification, identification, wildlife census methods.
3. Management and conservation of wildlife resource of the country as a holistic approach.
4. To give the understanding about man and wildlife conflict

Theory

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 foodchain, 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.

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:

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

Course Outcomes:

CO1: Student will gain knowledge of faunal diversity of different bio-geographical zones.

CO2:Student will able to identify wildlife (mammals, reptiles, amphibian, avian and insects) in their natural habitat.

CO3:Students will learn about management and conservation of protective and natural habitat.

CO4:Students will learn about man and wildlife conflict and also help in solving the related issues.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	2	3	3	3	3	3	3
CO2	3	3	3	1	2	2	3	3	3	3	3	3
CO3	3	2	2	3	2	2	3	3	3	3	3	3
CO4	3	2	2	3	2	2	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER III: FOREST MANAGEMENT (Core-07)**CR: 3 + 2**

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUCTT7 FOUCLT7	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide knowledge about forest management for sustainable growth.
2. To provide knowledge about growth and yield models, silviculture system in different land use patterns.
3. The students will be able to understand community and joint forest management practices.
4. To develop and evaluate management plans in forestry and its allied subject for students.

Theory

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.

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:

1. Champman, G.W. and Allan, T.G. (1978) Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome
2. David M. Smith. (1989) The Practice of silviculture. IBD Educational Pvt. Ltd. Dehradun, India.

3. J B Lal (2007).Forest Management: Classical Approach and Current Imperatives. Natraj publishers, Dehra Dun.
4. Jerram, M. R. K., (2005), A text Book on Forest Management, CBS Publishing.
5. Khanna, L. S.(1984) Principles and Practice of Silviculture, Khanna Bhandu, Dehra Dun. P. 476.
6. Negi, S. S., Forest Management in India.
7. Osmaston, F.C. Management of Forests, (1984) IBD Publication, Dehradun
8. Ram Prakash and L.S. Khanna (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun.
9. Ram Prakash. Forest management, (2006) IBD Publication, Dehradun

Course Outcomes:

CO1:Students will develop knowledge about recent advances in forest management.

CO2:Students will learn about estimation of forest tree volume, gender participation in forest management, community resources and joint forest management.

CO3:Students will develop how to develop and evaluate management plans in forestry.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	1	2	3	3	3	3	3
CO2	3	3	2	1	2	1	2	3	3	3	3	3
CO3	3	3	2	3	2	1	2	3	3	3	3	3
CO4	3	3	2	3	2	1	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER IV: NON- TIMBER FOREST PRODUCTS AND ETHNOFORESTRY (GE-03) CR: 3+2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUCTG3 FOUCLG3	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. Students understanding and knowledge on various non-wood forest products and its value addition
2. To give the knowledge about forest and tribal relationship, indigenous knowledge system.
3. To analyze different forest products, value addition and their impact on tribal economy and livelihood.

4. The course will equip the students employability to wood and forest based industries.

Theory

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 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:

1. Ashok Ranjan Basu & S. Nijhavan (1985) Tribal Development Administration in India. Mittal publications.
2. C.M. Cottan (1996) Ethno botany: Principles & Applications. Jhon Wiley and sons Ltd.
3. Dwivedi, A.P. (1993) Forests - the non-wood resources. International Book Distributor, Dehradun. 352 p.
4. Mehta T (2012) A handbook of forest utilization. Today and Tomorrow publishers.
5. R.K. Sinha (1996) Ethnobotany: the renaissance of Traditional Herbal Medicines. Inashree publishers.
6. Taank P (2010) Forest product and their utilization. Today and Tomorrow publishers.
7. V.P. Agrawal (2002) Forest in India. Oxford and IBH publishers.
8. Vinod M. Mhaiske, Vinayak K Patila and Satish S Narkhede (2016). Forest Tribology and Anthropology. Scientific Publishers, Delhi.

Course Outcomes:

CO1: Students will learn about non-wood forest products and their utilization aspects.

CO2: Students will know that how tribal and local community utilizes the forest resources using indigenous knowledge.

CO3:Students will develop in-depth knowledge about major forest products and tribal economy and livelihood.

CO4:The students will improve the employability to industries.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	1	2	3	3	3	3	3
CO2	3	2	2	1	2	1	2	3	3	3	3	3
CO3	3	2	2	3	2	1	2	3	3	3	3	3
CO4	3	2	2	3	2	1	2	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

PAPER V: ABILITY ENHANCEMENT COURSE (AEC-03) CR: 2

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
FOUCTA3	2	-	-	2 hours	30	70	100	2

Objectives:

1. The course will be selected from the University pool by students.

Course Outcomes:

CO1: The student will learn about the theoretical and practical knowledge and its application in social life.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	2	2	2	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

PAPER VI: EXTRACURRICULAR ACTIVITIES (ECA-03) CR: 2

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
FOUCTS5	2	-	-	2 hours	-	-	100	2

Objectives:

1. 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.

Course Outcomes:

CO1:The student will learn about the extra-curricular activities in different aspects.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

SEMESTER – IV

PAPER I: REMOTE SENSING AND GIS APPLICATION IN FORESTRY(Core-08) CR: 3

+ 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUDTT8 FOUDLT8	3	-	2	6 hours	30	70	100	200	5

Objectives:

- To give exposure on the use of Remote Sensing, GPS and GIS technique in forestry.
- To understand the application of remote sensing and GIS technique for the measurement and mapping of forest areas.
- The assessment of land use land cover changes of forest area using modern tools and technique

Theory

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, 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:

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

Course Outcomes:

CO1:Students will about the application of Remote Sensing and GIS technology inforesstry, change detection studies as well as natural resource mapping.

CO2:Students will have the field exposure and use of GPS technique, and mapping.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	1	2	3	3	3	3	3
CO2	3	3	2	1	2	1	2	3	3	3	3	3
CO3	3	3	2	3	2	1	2	3	3	3	3	3
CO4	3	3	2	3	2	1	2	3	3	3	3	3

Weightage:**1-Sightly;2-Moderately;3-Strongly**

PAPER II: WOOD SCIENCE AND TECHNOLOGY (Core- 09) CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUDDT9 FOUDDLT9	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To acquaint with the physical and characteristics and strength properties of wood.

2. The course enables the students to deal with wood identification, degrading agents and wood moisture.
3. To knowledge about wood preservation techniques and technology for making engineered woods.
4. To knowledge about different seasoning method of wood.

Theory

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 control. Woodworking, 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:

1. Anonymous (1976). Indian forest utilization. Volume I and II ICFRE Publication, Dehradun.
2. T. Mehta(1981). A Handbook of Forest Utilization. Periodical Expert Book Agency, Delhi.
3. K.R. Rao and K.B.S. Juneja (1992). Field identification of 50 important timbers of India. ICFRE Publication, Dehradun.
4. L.C. Sharma (1977). Development of forests and forest based industries, Bishen Singh and Mahendra Pal Singh Publication, New Delhi
5. Terry Porter (2006). Wood Identification and Use. Guide Master Craftman publications.

6. S. Hill Callum (2006). Wood modification: Chemical thermal and other process. Today and Tomorrow publishers.

Course Outcomes:

CO1:Students will learn about detail physical characteristics and strength of wood.

CO2:The students will have practical knowledge about wood identification, wood degradation and protective measures for long term uses.

CO3:Students will learn about wood preservation techniques, seasoning methods and technology for making engineered woods.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	2	1	2	3	3	3	3	3
CO2	3	1	2	1	2	1	2	3	3	3	3	3
CO3	3	1	2	3	2	1	2	3	3	3	3	3
CO4	3	1	2	3	2	1	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUDTT10 FOUDLT10	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To develop understanding about survey and engineering concepts in forest techniques.
2. To enable the students to conduct forest survey using basic survey tools and modern survey equipment's.
3. To empower on judging different types of building materials, bridges and construction of roads.
4. To equip with knowledge for forest and land survey for employment in different sectors.

Theory

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.

Levelling 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, levelling, 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:

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

Course Outcomes:

CO1: Students will have practical knowledge about survey and engineering concepts related to forestry.

CO2: The students will learn the usage of survey tools and perform forest survey.

CO3: Students will develop skill on assessing quality of building materials, roads, and bridge

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	2	2	2	3	3	3	3	3
CO2	3	1	2	1	2	2	2	3	3	3	3	3
CO3	3	1	2	3	2	2	2	3	3	3	3	3
CO4	3	1	2	3	2	2	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER IV: SERICULTURE (GE-04)

CR: 3+2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUDTG4 FOUDLG4	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To inform students regarding host plant for silk production, rearing and reeling technology.
2. The development of students for entrepreneurship and skill on sericulture to cater the need of field personnel's to sericulture industries.
3. To knowledge about silk marketing and trading of silk.

Theory

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 moulting, 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:

1. ByongHo Kim (1989). Filature water engineering, Seoul national university press, Republic of Korea.
2. Huang Guo Rui(1988). Silk reeling, Oxford and IBH publishing co. Pvt. New Delhi.
3. 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.
4. T.N. Sonwalker (2010). Handbook of Silk Technology, New Age International Pvt., Ltd.

5. Yong Woo Lee(1999). Silk Reeling And Testing Manual, FAO Agricultural Services Bulletin No. 136, Rome, Italy.
6. Akira Nakamura (2000). Fiber Science and Technology. Oxford & IBH Publications, New Delhi.

Course Outcomes:

CO1:Students will learn and get practical knowledge about silk, host plants and silk production, rearing and reeling technology.

CO2:The entrepreneurial skill related to sericulture will be developed among students.

CO3: Employment opportunity for students in sericulture department due field based exposure on silk production.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	1	2	1	1	3	3	3	3	3
CO2	3	2	2	1	2	1	1	3	3	3	3	3
CO3	3	2	3	3	3	3	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER V: ABILITY ENHANCEMENT COURSE (AEC-04) CR: 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUDTA4	2	-	-	2 hours	30	70	100	200	5

Objectives:

1. It will be a nature of additional credit course with non-mandatory nature.
2. Students of NSS/NCC/Swachhata/Physical Education/Plantation Activities, etc. may opt such courses for acquiring addition knowledge and practical experience.

Course Outcomes:

CO1: The student will be able to gain the theoretical, practical knowledge and apply it in their social and practical approaches

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

SEMESTER – V

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

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUETT11 FOUELT11	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To give exposure to the students on watersheds and their management for sustainable development.
2. To provide knowledge related to the restoration of riverine ecosystem.
3. To enable students for developing expertise for the implementation of integrated watershed projects.
4. To develop the skill of students by equipping practical exposure on watershed, soil conservation works, dams, etc.

Theory

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:

1. S. K. Datta (1985). Soil Conservation and Land Management. International Book Distributors, Dehradun
2. R. Suresh (2006). Soil and Water Conservation Engineering. R Standard Publishers Distributors, Delhi.
3. Rajvir Singh (2000). Watershed Planning and Management. Yash Publishing House, Bikaner.
4. 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
5. G. Das (2008). Hydrology and Soil Conservation Engineering: Including Watershed Management. Prentice-Hall of India Learning Pvt. Ltd., New Delhi.
6. V.V. Dhruva Narayana, G. Sastry and U.S. Patnaik (1997). Watershed Management. ICAR, New Delhi.
7. Tideman, E.M (1996). Watershed Management: Guidelines for Indian Conditions..., Omega Scientific Publishers, New Delhi.

Course Outcomes:

- CO1:** Students will gain knowledge about regional, national and global watersheds and its management action plan, water and soil conservation efforts.
- CO2:** The technical knowledge related to the restoration of river and its sustainable management of resources.
- CO3:** Students will get expertise knowledge and skill related to the implementation of integrated watershed projects.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	2	3	3	3	3	3	3
CO2	3	3	2	1	2	2	3	3	3	3	3	3
CO3	3	3	2	3	2	2	3	3	3	3	3	3
CO4	3	3	2	3	2	2	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER II. FOREST TREE IMPROVEMENT AND BIOTECHNOLOGY (Core- 12)

CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUETT12 FOUELT12	3	-	2	6 hours	30	70	100	200	5

Objectives:

Objectives:

1. To acquaint the students about tree breeding and genetic resource conservation and importance in forestry.
2. To develop skill related to practical aspects of the role of biotechnological approaches, tissue culture, macro-propagation, transgenic technology in the forestry field.
3. To aware the students about the importance of the subject in the field of ex-situ conservation of biodiversity.

Theory

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 flowchart. 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:

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

Course Outcomes:

- CO1:** Students will be well equipped about the general principles of plant and tree breeding, and plant genetic resources.
- CO2:** Skill related to practical aspects of biotechnology such as tissue culture, macro-propagation and use of transgenic technology will be gained by students.
- CO3:** Students will also have the practical exposure of the field of biodiversity conservation.
- CO4:** Students will enhance about the commercial aspects of biotechnology in forestry and related subjects.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	2	2	3	3	3	3	3
CO2	3	3	2	1	2	2	2	3	3	3	3	3

CO3	3	3	2	3	2	2	2	3	3	3	3	3
CO4	3	3	2	3	2	2	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUETT13 FOUELT13	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To understand and identify the forest tree seeds and viability aspects.
2. To provide knowledge on seed developments, seed types and method of seed testing and seed treatment.
3. To equip learners about seed certification and seed trade for commercialization.
4. To develop seed professionals in forest seed handling and quality testing

Theory

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, levelling 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.

Suggested Readings:

1. Ram Prasad and A K Kandy (1995). Handling of Forestry seeds in India, Natraj Publication, Dehradun
2. P.K. Agrawal and M Dadlani (1987). Techniques in seed science and technology, South Asian Publishers, Delhi

3. R.L. Agrawal (1996). Seed Technology, Oxford and IBM Publishing Co., New Delhi
4. M.P. Nema, M P (1987). Principle of Seed Certification and Technology, Elite Publishers
5. Renuga Devi, J NV Manumani (2011). A handbook of seed testing, Agrivos publication

Course Outcomes:

CO1: Students will get the in-depth knowledge about seeds of forest tree and method to maintain viability.

CO2: Students will get knowledge about seed, seed developments, types of seed, seed viability, seed treatment, dormancy, seed testing etc.

CO3: Students development for seed certification and handling and trading.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	1	2	2	2	3	3	3	3	3
CO2	3	3	2	1	2	2	2	3	3	3	3	3
CO3	3	3	2	3	2	2	2	3	3	3	3	3
CO4	3	3	2	3	2	2	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER IV: (DSE) DISCIPLINE SPESIFIC ELECTIVE (DCE-1):

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

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUETD1 FOUELD1	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To understand the climate, weather and in relation to agricultural crop.
2. To attract students towards commercial crop production by providing skill on production technologies.
3. To encourage students for adopting agriculture production for future food security.

Theory

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:

1. Chhidda Singh (2012) Modern techniques of raising field crops.Oxford and IBH publishing company, New Delhi.
2. Ghadekar S R (2008), Textbook of Agrometeorology. Agromet publishers.
3. Kafi, Mohammad Khan, Muhammad Ajmal (2008) Crop And Forage Production Using Saline Waters Nam S&T Centre. Jain Book Agency.
4. Norman, David Douglas, Malcolm FAO (2007) Farming Systems Development and Soil Conservation FAO. Jain Book Agency.
5. Varsaneya, M.C. and Balakrishna Pillai, P., (2013), Textbook of Agriculture Meteorology, Indian council of agriculture Research, New Delhi.
6. Varshnaya M C and Balakrishna Pillai (2012) A textbook of agriculture metrology. ICAR, New Delhi Publications.

Course Outcomes:

CO1: Students will understand the climate attributes in relation to crop production.

CO2: The students with gain the practical knowledge about the agricultural entrepreneurship.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4

CO1	3	1	2	1	2	2	2	3	3	3	3	3
CO2	3	1	2	1	2	2	2	3	3	3	3	3
CO3	3	1	2	3	2	2	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER IV. BASIC CONCEPTS OF HORTICULTURE AND LANDSCAPING (DSE-1B) CR: 3

+ 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUETD1 FOUELD1	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To impart knowledge on horticultural crops and its production technology.
2. To attract students for selecting career in horticulture and fruit and vegetable production.
3. Aware on nutrient management, disease and pest control methods in different commercial crops and precision farming.

Theory

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:

1. Arora, D., Biotech Dictionary of Horticulture.
2. Christopher, E. P., Introductory of Horticulture.
3. George Acquah (2002) Horticulture - Principles and Practices. Jain book Agency.
4. J.S. Bal (2002) Fruit Growing in India. Kalyani publishers
5. Jitendra Singh (2007) Basic Horticulture. Kalyani publishers.

6. K. L. Chadha (2015) Handbook of Horticulture. Jain book Agency.
7. Wright, W.P., Encyclopedia of Horticulture and Gardening.

Course Outcomes:

- CO1:** Students will learn about the horticultural crops and landscaping and its practical approaches such as nutrient and pest management.
- CO2:** Skill development on fruit and vegetable nursery production and protected cultivation technology.
- CO3:** The students will learn about the marketing, commercial and entrepreneurial aspects of horticulture crops at global level.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	2	2	3	3	3	3	3	3
CO2	3	3	3	1	2	2	3	3	3	3	3	3
CO3	3	3	3	3	2	2	3	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

SEMESTER – VI

PAPER 1. FOREST PATHOLOGY AND ENTOMOLOGY(Core-11)CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUFTT14 FOUFLT14	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide knowledge about forest protection, disease and insect pest of forest nursery, plantation and natural forests.
2. To guide students on integrated approaches of pest control and plant health.
3. To equip students on modern systems of forest protection and constituents of chemicals

Theory

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:

1. Bakshi, B.K. Forest Pathology. (1976) Principles and Practices in Forestry. Controller of Publications, New Delhi.
2. Beeson, C.F.C. (1941) Forest Insects of India, The Ecology and Control of the diseases. International book distributors, Dehra Dun.
3. Brues, T.C., A.L. Melander and E.M. Carpenta, (1954) Classification of Insects, Cambridge Man, USA.
4. Gupta, V.K. and N.K. Sharma. (1988). Tree Protection. Indian Society of Tree Scientists, Solan.
5. Herrick, G.W. (1988). Insect Enemies of Trees. Pioneer Publishers, Jaipur.
6. John Saw Boyce, (2015), Forest pathology, Agrihorti Press.
7. Khanna, L.S. (1984) Forest Protection, Khanna Bandhu, Dehra Dun.
8. Paul D Menan (2003) Tree and disease concept. Prentice hall Inc.
9. Richards, O.N. and R.G. Davies (1977) Imm's General Textbook of Entomology. 10th ED. Chapman and Hall.
10. Satha T V (2009) A textbook of forest entomology. Today and tomorrow publishers.
11. Sathe, T.V., (2016), Forest Entomology, Daya Publishing House, New Delhi.

Course Outcomes:

CO1: Students will learn about forest tree diseases, insect and pest.

CO2: Students will be able to identify pest and disease in nursery, plantation and forest and suggest control measures.

CO3: Students will enable to recommend different chemicals and measures for disease control and forest species growth and development.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	-	2	3	3	3	3	3
CO2	3	3	3	3	2	-	2	3	3	3	3	3
CO3	3	3	3	3	2	-	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER II. AGROFORESTRY AND TREE OUT SIDE FOREST (Core-15) CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUFTT15 FOUFLT15	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide knowledge about status of agroforestry and tree outside forests.
2. To develop student's competencies on tree based farming, and carbon monetization to farmers.
3. To understand the potential areas for outside forest plantations, commercial forestry and tree crop interaction.
4. To develop understanding on carbon sequestration potential of traditional and modern agroforestry systems.

Theory

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:

1. Bane, Lester, (2016), Agroforestry, Syrawood Publishing House, New York.
2. Chundawat D S and Gautam S K (2010) Textbook of agroforestry. Oxford and IBH publishing co pvt. Ltd.
3. Dwivedi, A.P. (2012), Agroforestry, Principle and Practice, Oxford & IBH Publishing Company, New Delhi.
4. Dwivedi, A.P. (1992) Agroforestry principles and practices. Oxford and IBH Publication Co., New Delhi.
5. Huxley, P. (1999) Tropical agroforestry. Blackwell Science, Oxford. 371 p.
6. Khosla, P.K. and Khurana, D.K. (1987) Agroforestry for rural needs. Vol. 1 and II, ISTS, Solan, H.P.
7. Nair, P.K.R. (1993) An introduction to agroforestry. Kluwer Academic Publishers. 499 p.
8. Ong, C.K. and Huxley, P.K. (1996) Tree crop interactions – A physiological approach. ICRAF, Kenya. 386 p.
9. Pathak, P.S and Ram Newaj, (2012), Agroforestry, Potentials and Opportunities, Agrobios (India).
10. Ramakrishnan, P.S. (1992) Shifting agriculture and sustainable development. Man and biosphere series. The Parthenon Publishing Group. 424 p.
11. Sen Sarma, P.K. and Jha, L.K. (1993) Agroforestry. Indian Perspectives. Ashish Publishers, Delhi.

Course Outcomes:

CO1: Students will get information on current scenario of agroforestry and tree outside forests.

CO2: Student's will develop competencies on tree based farming and managements.

CO3: Students will be able to identify the potential areas for plantations and carbon sequestration calculation.

CO4: Students will be able to estimate the demand and requirement related to timber and non wood forests products for its industrial application.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	1	3	2	3	3	3	3	3	3
CO2	3	1	3	1	3	2	3	3	3	3	3	3
CO3	3	1	3	3	3	2	3	3	3	3	3	3
CO4	3	1	3	3	3	2	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER III. FOREST ECONOMICS (Core- 16)

CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUFTT16 FOUFLT16	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To know the basic elements of forest economics for income generation.
2. To the students will be able to gather knowledge on basic economic principles.
3. To develop the concept of production forestry and demand, supply pattern of forest products
4. To provide wider vision related to price and income elasticity in forestry.

Theory

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

Practical

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

Suggested Readings:

1. Edwin S. Mills (1975) Economic Analysis of Environmental Problems. New York: Columbia University Press
2. Fisher, A.C (1979) Resource and Environmental Economics. New York: John Wiley & Sons.
3. Nautiyal, J. C., (2011), Forest Economics, Principle and Applications, Natraj Publishers, Dehradun. New Delhi.
4. Orris C. Herfindahl (1969) Natural Resource Information for Economic Development. Baltimore: The Johns Hopkins University Press
5. Sharma, L.C., Forest economics planning & management.
6. Sharma, S.D (1975) A New Approach to Linear Programming. Meerut: Kedarnath, Ramnath and Co.
7. Subba S Reddy (2012) Agricultural Economics. Oxford and IBH publishers.
8. Tony Prato (1998) Natural Resource and Environmental Economics. Ames: Iowa State University Press

Course Outcomes:

CO1: Students will get knowledge about the implementation of economics in forestry and its allied subjects.

CO2: The students will be able to know about the demand and supply of forest based industries and its diversification.

CO3: The subject knowledge will help the students for further career development.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	1	3	3	3	3	3	3	3	3
CO2	3	3	3	1	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

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

PAPER IV. Urban Forestry (DSE-2A)

CR.3+2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUFTD2 FOUFLD2	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. Planning, establishment, and management of urban forests for wellbeing of urban environment.
2. To identify forest species for suitable place of planting, gardening, avenue plantations for green and smart city concepts.
3. To develop important strategies related urban landscaping and pollution free city.

Theory

Introduction, objective and scope of urban forestry, History of Urban Forestry/Distribution and Ownership of the Urban Forest Functions and Values of the Urban Forest Urban Forest Environment Tree Hazard Assessment and Management 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:

1. Malcom Fisher (1999). Urban forestry: planning and management. Syrawood publication house.
2. V.K. Prabhakar (2000). Forestry and forest resources. Anmol Publication, New Delhi.
3. S S Negi (1989). Urban and recreational forestry. International book distributors, Dehradun.
4. S S Negi (2003). Manual of forestry. Bishensingh, Mahendra Pal Singh, Dehradun.

Course Outcomes:

CO1:Students will learn about the forest/ green belt establishment and management of urban areas.

CO2: Students enable to identify appropriate tree species for urban greening and urban forestry.

CO3: Students will equipped to serve as urban landscaping and urban planner.

CO4:Students will get practical exposure on developing green belt, parks and oxyzones for urban management.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	1	2	2	2	3	3	3	3	3
CO2	3	1	2	1	2	2	2	3	3	3	3	3
CO3	3	1	2	3	2	2	2	3	3	3	3	3
CO4	3	1	2	3	2	2	2	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUFTD2 FOUFLD2	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To address the causes of land and forest degradation and deterioration and restorative technologies.
2. Development of ability to evaluate the site quality of different types of waste and degraded forest
3. To develop competency in students for choosing suitable species and plantation technologies for different types of lands.

Theory

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 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:

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

2. J.W. Doran and A.J. Jones (1996). Methods of Assessing Soil Quality. Soil Science Society of America, Madison.
3. D.J. Greenland and I. Szabolcs (1994). Soil Resilience and Sustainable LandUse. CABI.
4. J. Sehgal J and I.P. Abrol (1994). Soil Degradation in India - Status and Impact.Oxford & IBH.

Course Outcomes:

CO1: Student will enhance knowledge on assessing site quality, causes of forest degradation, and deterioration.

CO2: Develop employability for managing plantation, identifying species for restoration and preparation of project proposals.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	2	3	3	3	3	3	3
CO2	3	3	3	3	2	2	3	3	3	3	3	3

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER V. AEC (ABILITY ENHANCEMENT COURSE) CR: 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
FOUFTA5	2	-		2 hours	30	70	100	200	2

Objectives:

1. The course will be selected from the University pool by students.

Course Outcomes:

CO1: The student will be able to gain the theoretical, practical knowledge and apply it in their social and practical approaches

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER VI. MOOC Course

CR: 2

Sub Code	L	T	P	Duration	IA	ESE	ESE(P)	Total	Credits
MOOCS	-	-	-	-	-	-	-	-	2

Objectives:

1. To utilize and explore online platform courses related to forestry and resource management for updating knowledge on the subject.
2. To promote comprehensive knowledge offered by other institutions for wide adoptability and developing competence.

Course Outcomes:

CO1: The students will be able to explore online learning system for extra skill and knowledge.

CO2: The students will develop competency for national level institutions.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

SEMESTER – VII

PAPER: 1. BIOSTATISTICS (Core-17)

CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE (T)	ESE (P)	Total	Credits
FOUGTT17 FOUGLT17	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. To provide knowledge about fundamentals of biostatistics and its use in forestry.
2. Make students able to understand the data analysis, data representation and tabulation.
3. To develop the concept for testing hypothesis signification in practical's.
4. To understand relationship between two quantitative variables related to the forest.

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), Probability,

Test of signification: basic concepts,(Z- Test, X²-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:

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

CourseOutcomes

CO1:Students enable to exploit biostatistics in forestry and allied subjects.

CO2: Students friendly worksheet using excel sheet for analysis and data interpretation using computer based software.

CO3: Student will be efficient in data handing and graphic, and representation.

CO4: Subject will help in their professional development and career building.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	2	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE (T)	ESE (P)	Total	Credits
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FOUGTT18	3	-	2	6 hours	30	70	100	200	5
FOUGLT18									

Objectives:

1. Develop awareness about forest different policies and environmental Acts.
2. To increase students understanding on offences and penalties for forest and wildlife crimes and authorities for appeal.
3. To provide information related to different acts.

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 centre. Study the effect of mined out area on forest, forest depot to see the rules and regulations.

Suggested Readings:

1. W. Fernandes and Kulkarni (1986). Towards a new Forest Policy. Natral Publishers, Dehra Dun.
2. National Forest Policy (1988). Government of India Publication, Delhi.
3. Indian Forest Acts with short Notes (1975). Allahabad Law Agency, Allahabad.
4. E. Podder and Erai (2011). Forest law and policy in India. Today and Tomorrow publishers.
5. L.S. Khanna (2001). Wildlife (Protection) Act 1972 as amended upto date with commentary, Khanna Bandu, Dehra Dun.
6. S.S. Negi (1985). Forest Law. Natraj Publication, Dehra Dun.

Course Outcome

- CO1:** Student will understand about the forest law and policies.
- CO2:** Student may contribute aware local people on forest rights and forest crimes.
- CO3:** Graduates will help to reduce wildlife crimes and work for the protection of wildlife.
- CO4:** Student enable to join wildlife and forest NGOs for helping wildlife crimes.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	2	3	3	3	3	2	3	3
CO2	3	1	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	2	3	2
CO4	2	3	2	3	2	3	3	2	3	2	3	2

Weightage:1-Sightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE (T)	ESE (P)	Total	Credits
FOUGTT19 FOUGLT19	3	-	2	6 hours	30	70	100	200	5

Objectives:

1. Acquaintance about the world forest and its significance on climate change scenario.
2. To understand the world forest distribution and vegetation structure.
3. To provide information related to forest conservation strategies.
4. To understand the climate change pattern with reference to world forest.

Theory

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:

1. Champion and Seth (1968). Forest Types of India. Natraj publishers.
2. V.P. Agrawal (1985). Forestry in India. Oxford and IBH Publications, New Delhi

3. M.P Shrivastava (1997). Introductory to Forestry. Amazon Publishers.
4. S.S. Negi (1998). World Forest Systems. Natraj Publishers.
5. FAO (2020). Status report on world forestry, FAO, 2020

Course Outcomes

CO1: Student will be able to know about the world wide forest distribution pattern and tree species.

CO2: Graduates will be able to analyze the worth of forest and its contribution in economy.

CO3: Student will be able to identify various forest types and trees distribution pattern in India.

CO4: Student will help to make local strategies to reduce impact on climate change.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	3	1		3	2	3	3	3	3	2	3	3
CO2	3	1		3	3	3	3	3	3	3	3	3
CO3	3	2	3	3	2	3	3	3	3	3	3	3
CO4	3	2	2	2	2	3	3	3	3	3	3	2

Weightage: **1-Slightly; 2-Moderately; 3-Strongly**

PAPER 4. FORESTRY EXTENSION

(DSE-3A)

CR: 3 + 2

Sub Code	L	T	P	Duration	IA	ESE (T)	ESE (P)	Total	Credits
FOUGTD3 FOUGLD3	3	-	2	5 hours	30	70	100	200	5

Objectives:

1. To provide information about basics of extension education in forestry.
2. To aware students on extension methods, interaction with stack holders for popularization of forest activities to the society.
3. Subject provide exposure and make students field worker.
4. Subject build the leadership quality and communication skills in students

Theory

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 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:

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

Course Outcome

- CO1:** Student will able to perform forestry extension and outreach programs.
- CO2:** Improvement in communication skills with stack holders and society.
- CO3:** Student contributes in transfer of technology from lab to land.
- CO4:** Student develop linkages with administration and local people for scheme penetration.

CourseOutcomesandtheirmappingwithProgram Outcomes:

CO	PO	PSO
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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	2	3	3	3	3	2	3	3
CO2	3	1	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	2	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

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

Sub Code	L	T	P	Duration	IA	ESE (T)	ESE (P)	Total	Credits
FOUGTD3 FOUGLD3	3	-	2	6 hours	30	70	100	200	5

Objectives

1. To provide entrepreneurship in forestry sector and improve their communication skill.
2. To encourage students to establish industries and start up related to forest products.

Theory

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:

1. A.S. Sandhu (2004) A Text Book of Agricultural Communication. Kalyani publications.
2. Bilhuti Bhusan Mohanty (1962) A Handbook of Audio Visual Aids. Kitabmehal Pvt. Ltd Allahabad.
3. G.L. Ray (2011) Extension Communication and Management. Kalyani publications.
4. O.P. Dahama & O.P. Bhatnagar (1987) Education & Communication for Development. Oxford University Press, New Delhi.

Course Outcomes

- CO1:** Student exposure to different entrepreneurship related to forestry and allied sectors.
- CO2:** Student promotions towards establishing start-up in forestry field.
- CO3:** Student will be able to analyze marketing pattern with suitable application for forest products.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	2	3	2	3	3	3	3	2	3	3
CO2	3	1	2	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	2	2	3

PAPER 4: SEMINAR

CR: 2

SubCode	L	T	P	Duration	IA	ESE (P)	Total	Credits
FOUGSS2	-	2	-	2 hours	-	100	100	2

Objective

1. Seminar will develop confidence and communication skills in to the students

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.

Course outcomes

CO1: Student will develop their personality and skills in various aspects.

CourseOutcomesandtheirmappingwithProgram Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	3	2	3	3	3	3	2	3	3

Weightage:1-Sightly;2-Moderately;3-Strongly

SEMESTER – VIII

SubCode	L	T	P	Duration	IA	ESE (P)	Total	Credits
FOUHEF1	-	-	6	6 Months	-	200	200	6

PAPER 1. SOCIO-ECONOMIC SURVEY- VILLAGE ATTACHMENT (INTR -1) CR: 06

Objectives:

1. To apprise the students with the field practices which are needed for the sustainable utilization and management of village resources.
2. To enhance understanding of local Forestry and working of other village level institutions.
3. To develop manpower equipped with latest and updated knowledge and awareness for village

resource survey, utilization and management and extension work.

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.

Course Outcomes:

CO1: Students will be able to apply field exposure for the sustainable management of village resources.

CO2: Student will be able apply local Forestry approaches for social welfare.

CO3: Student will spread awareness and knowledge for villagers and help to perform extension work.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	1		3	2	3	3	3	3	2	3	3
CO2	3			3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	3	3	3	3	3

Weightage:1-Slightly;2-Moderately;3-Strongly

PAPER 2. FORESTRY OPERATIONS (WORKING EXPERIENCE) (INTR -2) CR: 06

SubCode	L	T	P	Duration	IA	ESE (P)	Total	Credits
FOUHEF2	-	-	6	6 Months	-	200	200	6

Objectives:

1. To apprise the students with the field practices which are needed for the sustainable utilization and management of forest resources.
2. To develop competence in students to contribute in the sustainable utilization and management of forest.

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.

Course Outcomes:

CO1: Students will able develop own nursery as an income generating source.

CO2: Student will be skilled in developing working plans and preparation of yield tables.

CO3: Subject will develop confidence in students to perform regeneration survey lay out plans and resource analysis.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2		3	2	3	3	3	3	2	3	3
CO2	3	1		3	3	3	3	3	3	3	3	2
CO3	3	2	3	3	2	3	3	3	3	3	3	2

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPARE 3. FOREST INSTITUTES AND INDUSTRIAL VISIT/ TRAINING (INTR-3) CR: 06

SubCode	L	T	P	Duration	IA	ESE(P)	Total	Credits
FOUHEF3	-	-	6	6 Months	-	200	200	6

Objectives:

1. To make the students acquaint with the raw materials, processing techniques, industrial utilization, financial implications and marketing of finished forest based industries.
2. To provide exposure of working of others institution to students.
3. To develop man power equipped with latest techniques and knowledge for the sustainable utilization and management of forest based industries.

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

Course Outcomes

CO1: Students will be able to efficient in raw materials collection and processing of products with its marketing trading methods

CO2: Graduate be able to implement of industrial utilization related to forest resources and financial implications and marketing of finished forest based industries.

CO3: To provide exposure of working of others institution to students.

CO4: To develop man power equipped with latest techniques and knowledge for the sustainable utilization and management of forest based industries.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2		3	2	3	3	3	3	2	3	3
CO2	3	1		3	3	3	3	3	3	3	3	2
CO3	3	2	3	3	2	3	3	3	3	3	3	2

Weightage:1-Sightly;2-Moderately;3-Strongly

PAPER 4. DISSERTATION

CR: 04

SubCode	L	T	P	Duration	IA	ESE (P)	Total	Credits
FOUHDF1	-	-	4	6 Months	-	100	100	4

Objectives

1. To provide the students research based skills on forestry subjects for analysis of the problem, identification of topic and writing skill.
2. 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.

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.

CourseOutcomes

CO1: Student will learn how to perform research work in forestry with proper solving approaches.

CO2: Graduates will be able to analyze problems and its solution with writing skill.

CO3: Skilled students will be performed field/laboratory based research work on different aspects of forestry, wildlife and environmental sciences and to improve their scientific writing skill.

CourseOutcomesandtheirmappingwithProgram Outcomes:

CO	PO								PSO			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3	PSO4
CO1	2	2		3	2	3	3	3	3	2	3	3

CO2	3	1		3	3	3	3	3	3	3	3	2
CO3	3	2	3	3	2	3	3	3	3	3	2	2

Weightage:**1-Sightly;2-Moderately;3-Strongly**