

**SYLLABUS AND COURSE BREAKUP
FOR
BACHELOR OF SCIENCE (Hons.)
FORESTRY**

**Approved by the Academic Council
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**COLLEGE OF FORESTRY
ODISHA UNIVERSITY OF AGRICULTURE
& TECHNOLOGY
Bhubaneswar – 751 003**

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3.	SAF 421	Agroforestry Systems and Management	
4.	WLS 421	Wildlife Management	
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6.	FOR 421	Project Work & Dissertation	

COLLEGE OF FORESTRY SYLLABUS AND COURSE BREAKUP

Semester I (12+9=21 Credit Hours including 2 Non-Credit)

Sl. No.	Course No.	Title of the Course	Credit
1.	SAF 111	Introduction to Forestry	2+0
2.	SAF 112	Dendrology	2+1
3.	NRM 111	Introduction to Agronomy and Horticulture	2+1
4.	NRM 112	Geology & Soils	2+1
5.	BAS 111	Information and Communication Technology	1+1
6.	BAS 112	Communication Skills and Personality Development	1+1
7.	BAS 113	Plant Biochemistry	1+1
8.	BASM 114/ BASB 114	Forest Botany/Basic Mathematics	1+1
9.	FPE 111	Physical Education-I	0+1*
10.	FNCC111/ FNSS111	NCC-I/NSS-1	0+1*
TOTAL			12+9

Semester II (13+9=22 Credit Hours including 2 Non-Credit)

Sl. No.	Course No.	Title of the Course	Credit
1.	FBT 121	Plant Physiology	2+1
2.	FBT 122	Plant Cytology and Genetics	1+1
3.	SAF 121	Theory and Practice of Silviculture	2+1
4.	FPU 121	Wood Anatomy	2+1
5.	WLS 121	Wildlife Biology	2+1
6.	NRM 121	Forest Protection	2+1
7.	BAS 121	Statistical Methods & Experimental Designs	2+1
8.	FPE121	Physical Education-II	0+1*
9.	FNCC121/ FNSS121	NCC-II/NSS-II	0+1*
TOTAL			13+9

Semester III (14+9=23 Credit Hours including 2 Non-Credit)

Sl. No.	Course No.	Title of the Course	Credit
1.	NRM 211	Environmental Studies and Disaster Management	2+1
2.	NRM 212	Forest Survey & Engineering	2+1
3.	NRM 213	Soil Biology & Fertility	2+1
4.	NRM 214	Forest Ecology & Biodiversity	2+1
5.	FBT 211	Tree Improvement	2+1
6.	SAF 211	Principles of Agroforestry	2+1
7.	SAF 212	Forest Mensuration	2+1
8.	FPE 211	Physical Education-III	0+1*

9.	FNCC211/ FNSS211	NCC-III/NSS-III	0+1*
TOTAL			14+9

Semester IV (15+8=23 Credit Hours including 1 Non-Credit)

Sl. No.	Course No.	Title of the Course	Credit
1.	SAF 221	Forest Management	2+1
2.	SAF 222	Silviculture of Indian Trees	2+1
3.	FPU 221	Wood Products & Utilization	2+1
4.	FPU 222	Ethnobotany, Medicinal and Aromatic plants	2+1
5.	WLS 221	Ornithology & Herpetology	2+1
6.	FBT 221	Seed Technology & Nursery Management	2+1
7.	NRM 221	Rangeland and Livestock Management	1+1
8.	BAS 221	Forest Tribology & Anthropology	2+0
9.	FOR-221	Study Tour of State Forest	0+1*
TOTAL			15+8

Semester V (12+12 = 24 Credit Hours)

Sl. No.	Course No.	Title of the Course	Credit
1.	SAF 311	Forest Hydrology and Watershed Management	2+1
2.	NRM 311	Climate Science	2+1
3.	FPU 311	Wood Science and Technology	2+1
4.	FPU 312	Logging and Ergonomics	1+1
5.	BAS 311	Forest Extension & Community Forestry	2+1
6.	BAS 312	Entrepreneurship Development & Business Management	1+1
7.	BAS 313	Forest Economics and Marketing	2+1
8.	FOR-311	Experiential Learning-I	0+5
TOTAL			12+12

Semester VI (11+11=22 Credit Hours)

Sl. No.	Course No.	Title of the Course	Credit
1.	SAF 321	Plantation Forestry	2+1
2.	NRM 321	Forest Laws- Legislation and Policies	2+0
3.	NRM 322	Geomatics	1+2
4.	NRM 323	Recreation & Urban Forestry	1+1
5.	NRM 324	Restoration Ecology	1+1
6.	FPU 321	Non-Timber Forest Products	2+1
7.	FPU 322	Certification of Forest Products	2+0
8.	FOR 321	Experiential Learning-II	0+5
TOTAL			11+11

Semester VII (0+23=23 Credit Hours including 3 Non-Credits)

Sl. No.	Course No.	Title of the Course	Credit
1.	FOR 411	Forestry Work Experience	0+20
2.	FOR 412	All India Study Tour	0+3*
TOTAL			0+23

Semester VIII (8+15=23 Credit Hours)

Sl. No.	Course No.	Title of the Course	Credit
1.	NRM 421	Forest Inventory and Yield Prediction	1+1
2.	FBT 421	Forest Biotechnology	2+1
3.	SAF 421	Agroforestry Systems and Management	2+1
4.	WLS 421	Wildlife Management	1+1
5.	BAS 421	Agricultural Informatics	2+1
6.	FOR 421	Project Work & Dissertation	0+10
TOTAL			8+15
Grand Total			85+96=181

Note : *Non credit courses

1. SAF 111**Introduction to Forestry****2 (2+0)****Theory**

Forests: definitions, role, benefits, direct and indirect. History of Forestry- definitions, divisions and interrelationships. Classification of forests - High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests, even and uneven aged stands. Forest types of India- classification. Agroforestry - farm forestry, social forestry, joint forest management, concepts, programmes and objectives. Important acts and policies related to Indian forests. Global warming - forestry options for mitigation and adaptation, carbon sequestration. Important events/dates related to forests and environment, themes and philosophy.

Introduction to world forests- geographical distribution and their classification, factors influencing global forests distribution, productivity and increment of world forests. Forest resources and forestry practices in different regions of the world, Western Europe, North America, Central Africa, Australia, Central America, Russia, Japan and China. General problems of forest development and economy. Forest based industries in the developed and developing countries. Trade patterns of forest based raw materials. Recent trends in forestry development in the world. National and international organizations in forestry.

Lecture outline

Lecture schedule	Topic
1	Forests: definitions, role, benefits, direct and indirect.
2	History of Forestry- definitions, divisions and interrelationships.
3	Classification of forests - High forests, coppice forests, virgin forest and second growth forests.
4	Classification of forests - Pure and mixed forests, even and uneven aged stands
5 -9	Forest types of India- classification: Details classification
10-11	Agroforestry - farm forestry, social forestry, joint forest management, concepts, programmes and objectives.
12	Important acts and policies related to Indian forests.
13-14	Global warming - forestry options for mitigation and adaptation, carbon sequestration.
15	Important events/dates related to forests and environment, themes and philosophy.
16	Doubt clearing class before midterm examination.
17-18	Introduction to world forests- geographical distribution and their classification, factors influencing global forests distribution, productivity and increment of world forests
19	Forest resources and forestry practices in different regions of the world: Western Europe, North America.
20	Forest resources and forestry practices in different regions of the world: Central Africa, Australia.
21	Forest resources and forestry practices in different regions of the world: Central America, Russia.
22	Forest resources and forestry practices in different regions of the world: Japan and China.
23	General problems of forest development and economy of different countries.
24	General problems of forest development and economy of India.
25-26	Forest based industries in the developed and developing countries.
27-28	Trade patterns of forest based raw materials
29	Recent trends in forestry development in the world.
30	Recent trends in forestry development in India.
31	National and international organizations in forestry
32	Doubt clearing class before final examination.

Reference Book:

1. Principles and Practice of Silviculture. by L. S. Khanna, Khanna Bandhu- New Delhi
2. Text book of Silviculture by A. P. Dwivedi
3. World Forestry by S. S. Negi, IBD publication
4. Forestry for people by S. A. Shah; ICAR Publication.
5. Forest policy and Law by S. S. Negi, IBD publication
6. World forest resources, by R. Persson, Periodical experts- New Delhi.
7. Introduction to World Forestry, by J. Westoby

2. SAF 112**Dendrology****3(2+1)****Theory**

Introduction – importance and scope of dendrology. Principles and systems of plant classification systems. Detailed study of Bentham and Hooker natural system, its advantages and disadvantages. Plant Nomenclature – objectives, principles and International Code of Botanical Nomenclature. Role of vegetative morphology in identification of woody forest flora. Peculiarities of bole- general form of woody trunk and deviations like buttresses, flutes etc. Morphology and description of barks of common trees. Characteristics of blaze, bark colour, exudations etc. Morphology of leaf- different types of leaves, colour of young and old leaves in some species as (regular) features of identification. Reproductive morphology of plants with reference to description and identification of reproductive parts. Detailed study of the families- diagnose the features, floral variations, distribution and economic importance, systematic position as per Bentham & Hooker System of classification- Magnoliaceae, Annonaceae, Guttiferae, Dipterocarpaceae, Malvaceae, Sterculiaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardiaceae, Leguminosae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae, Bignoniaceae, Lamiaceae, Lauraceae, Euphorbiaceae, Orchidaceae, Palmae and Graminae. Brief description of the families- Bombacaceae, Santalaceae, Casuarinaceae.

Practical

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

Theory Lecture Outline

Lecture	Chapter	Details
1	Introduction	Introduction – importance and scope of dendrology
2	Plant classification	Principles and systems of plant classification systems.
3-4	Bentham and Hooker system	Detailed study of Bentham and Hooker natural system
5	Plant Nomenclature	Plant Nomenclature – objectives, principles
6	ICBN	International Code of Botanical Nomenclature
7-8	Plant morphological characters	Role of vegetative morphology in identification of woody forest flora
9-10	Morphology of	Peculiarities of bole- general form of woody trunk and deviations

	Stems	like buttresses, flutes etc.
11-12	Morphology of barks and exudates	Morphology and description of barks of common trees. Characteristics of blaze, bark colour, exudations etc.
13-14	Morphology of leaf	Morphology of leaf- different types of leaves colour of young and old leaves in some species as (regular) features of identification
15	Doubt clearance	Doubt clearance
16-17	Reproductive morphology	Reproductive morphology of plants with reference to description and identification of reproductive parts.
18	Magnoliaceae, Annonaceae	Detailed study of the Magnoliaceae and Annonaceae families- diagnose the features, floral variations, distribution and economic importance, systematic position as per Bentham & Hooker System of classification
19	Guttiferae, Dipterocarpaceae	Detailed study of the Guttiferae and Dipterocarpaceae families- diagnose the features, floral variations, distribution and economic importance, systematic position as per Bentham & Hooker System of classification
20	Malvaceae, Sterculiaceae	Detailed study of Malvaceae and Sterculiaceae families- diagnose the features, floral variations, distribution and economic importance, systematic position as per Bentham & Hooker System of classification
21	Tiliaceae, Rutaceae	Detailed study of the Tiliaceae & Rutaceae families- diagnose the features, floral variations, distribution and economic importance, systematic position
22	Meliaceae, Sapindaceae	Detailed study of the Meliaceae & Sapindaceae families- diagnose the features, floral variations, distribution and economic importance, systematic position
23	Anacardiaceae, Leguminosae	Detailed study of the families- diagnose the features, floral variations, distribution and economic importance, systematic position
24	Rhizophoraceae, Combretaceae	Detailed study of the families- diagnose the features, floral variations, distribution and economic importance, systematic position
25	Myrtaceae, Rubiaceae	Detailed study of the families- diagnose the features, floral variations, distribution and economic importance, systematic position
26	Sapotaceae, Apocyanaceae	Detailed study of the families- diagnose the features, floral variations, distribution and economic importance, systematic position
27	Bignoniaceae, Lamiaceae	Detailed study of the Bignoniaceae and Lamiaceae families- diagnose the features, floral variations, distribution and economic importance, systematic position
28	Lauraceae, Euphorbiaceae	Detailed study of the Lauraceae and Euphorbiaceae families- diagnose the features, floral variations, distribution and economic importance, systematic position
29	Orchidaceae, Palmae, Graminae	Detailed study of the families Orchidaceae, Palmae, and Graminae diagnose the features, floral variations, distribution and economic importance, systematic position
30	Bombacaceae, Santalaceae	Brief description of the Bombacaceae and Santalaceae families
31	Casuarinaceae	Brief description of the Casuarinaceae and doubt clearance
32	Doubt clearance	

Practical Class Outline

Class	Practical
1.	Morphological description of plant parts
2.	Method of collection of plants
3.	Techniques of preparing herbarium specimens
4.	General study of herbarium
5.	Dissection of flowers-making sketches, construction of floral diagrams of Annonaceae and Guttiferae
6.	Dissection of flowers-making sketches, construction of floral diagrams of Dipterocarpaceae and Malvaceae
7.	Dissection of flowers-making sketches, construction of floral diagrams of Sterculiaceae and Tiliaceae
8.	Dissection of flowers-making sketches, construction of floral diagrams of Rutaceae and Meliaceae
9.	Dissection of flowers-making sketches, construction of floral diagrams of Sapindaceae and Anacardiaceae
10.	Dissection of flowers-making sketches, construction of floral diagrams of Leguminosae and Papilionaceae
11.	Dissection of flowers-making sketches, construction of floral diagrams of Mimosae and Caesalpiniaceae
12.	Dissection of flowers-making sketches, construction of floral diagrams of Rhizophoraceae and Combretaceae
13.	Dissection of flowers-making sketches, construction of floral diagrams of Myrtaceae, Rubiaceae and Sapotaceae
14.	Dissection of flowers-making sketches, construction of floral diagrams of Apocyanaceae, Bignoniaceae and Lamiaceae
15.	Dissection of flowers-making sketches, construction of floral diagrams of Euphorbiaceae, Santalaceae and Casuarinaceae
16.	Dissection of flowers-making sketches, construction of floral diagrams of Orchidaceae, Graminae and Pinaceae

Suggested Readings:

1. Taxonomy of Vascular Plants. Lawrence, G.H.M.(1967). Oxford&IBH- New Delhi.
2. Text book of Botany, by A. C Dutta,
3. *Manual of Indian Forest Botany*, by N. L. Bor
4. Taxonomy of Angiosperms. By Pandey S. N. and S. P. Mishra.

3. NRM 111 Introduction to Agronomy and Horticulture 3(2+1)**Theory**

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

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

Practical

Identification of field crop and tillage implements. Preparation of seed beds, identification of fertilizers and manures – mixing chemical fertilizers – calculating fertilizer requirements. Identification of green manure plants. Identification of important weeds of the region with particular reference to forest plantations. Preparation of weed herbarium. Calculations of spray volume and herbicide concentrations. Methods of application of herbicides. Identification of horticultural crops, garden tools and implements. planning and layout of orchard and plantations. Digging and filling of pits for fruit and plantation crops, planting systems, training and pruning of orchard trees, preparation and application of regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits, bearing habits and maturity standards, harvesting, grading, packaging and storage.

Theory Lecture Outline

Lecture	Topic to be Covered
Agronomy	
1	Origin, meaning and definition of Agriculture and Agronomy. scope of Agronomy. Agronomy as an art, science and business, Role of Agronomy in crop production
2	Major field crops of India, Classification of crops(Economic, Botanical, Leaf morphology, Commercial, Ontogeny, Origin, Seasonal, Agronomic, Based on special purpose) Area, distribution and productivity of major field crops
3	Cropping system, Mono, sole, relay, sequential and intercropping and multiple cropping Crop rotation- definition, principle, advantages, characteristics of crop rotation and examples. Farming system, Definition, principles , Components of farming system, Integrated Farming Ssystem models ,
4	Tillage- definition , objectives, advantages, tilth, characteristics of good tilth, Effect of tillage on soil properties,
5	Types of tillage ,tillage implements, harvesting implements
6	Soil fertility vs Soil productivity, Factors affecting soil fertility, Essential elements, forms of essential elements absorbed by plants, criteria of essentiality
7	Classification of elements (amount of nutrient, mobility of nutrients, chemical nature of nutrients, functions in plant), sources of nutrients, losses of nutrients
8	Function, source, deficiency and toxicity symptoms of essential elements
9	Organic manures, importance of organic manure, FYM and compost, green manures, bio fertilizers and types
10	Classification of fertilizers depending upon number of nutrients, conc. of nutrients, physical form of nutrients, acidity and basicity of fertilizer, equivalent acidity, equivalent basicity, fertilizer grade, fillers, fertilizer ratio. Integrated Nutrient Management concepts
11	Importance of water in plant growth; Water absorption by plants: Water in soil-plant-atmosphere system and it's path way; Water absorption process, Water and plant process. Soil moisture extraction pattern
12	Soil-Water relationship: Soil as a system. Basic soil properties influencing soil-moisture availability. Texture, structure and organic matter status
13	Methods of irrigation: surface irrigation methods: Wild flooding; Check flooding, Basin flooding, Ring irrigation, Contour ditch irrigation, Border flooding ; Furrow flooding . subsurface irrigation. Micro irrigation- sprinkler and drip irrigation ; Components of drip and sprinkler system; Types of sprinklers and drips

14	Causes and Effects of water logging, Benefits of drainage. Classification of drainage, Drainage characterization , Methods of drainage: Surface drainage, Subsurface drains, Installation of Tile drains, Other types of drainage devises , Bio-drainage.
15	Definition, characteristics of weeds, Damage due to weeds, benefits of weed, Classification based on ontogeny, photosynthesis(C ₃ & C ₄), habitat, crop association, crop bound (parasite weeds)
16	Methods of weed control: control vs prevention of weeds, Methods of weed control, Preventive, physical, cultural, chemical weed management
17	Biological methods, merits and demerits, classical & bio-herbicide approach, quarantine method .
18	Herbicides: advantages and limitation of herbicide usage in India. Herbicide classification. Integrated weed management in forestry
19	Soil and its management :Types of soil in India and Odisha and their management, Management of problem soils, physical constraints viz. soil crusting, swelling and shrinkage, eroded soils and waterlogged soils, chemical constraints viz. acidity, iron toxicity, alkalinity, salinity. Management in acid, saline , alkaline and water logged soils
20	Revision, discussion, model questions
Horticulture	
21	Definitions and importance of horticulture, Economic importance and classification of horticultural crops and their culture and nutritive value
22	Classification – economic importance – area, production, productivity and export and import horticultural crops with special reference to fruit crops.
23	Classification – economic importance – area, production, productivity and export and import horticultural crops with special reference to vegetables.
24	Classification – economic importance – area, production, productivity and export and import horticultural crops with special reference to plantation crops
25	Classification – economic importance – area, production, productivity and export and import horticultural crops with special reference to spices
26	Soil requirement of Horticultural crops
28	Climate requirement of Horticultural crops
29	Principles-planning and layout- management of orchards-Planting systems and planting densities
30	Principles and methods of pruning and training of fruit, plantation crops
31	Use of growth regulators in horticulture crops
32	Horticultural zones of state and country

Practical Class Outline

Class	Practical
1	Identification of Kharif crops and seeds,
2	Identification of horticultural crops-
3	Identification of tillage implements like reversible plough, one way plough, harrow, leveller, seed drill Preparation of seed bed
4	Calculation of fertilizer requirement and identification of fertilizers
5	Identification of green manure crops, various manure and concentrated manure
6	Identification of important weeds of the region with particular reference to forest plantations, Preparation of weed herbarium
7	Calculation of spray Volume & herbicide concentration
8	Method of application of herbicides
9	Identification of rabi crops
10	Identification of horticultural crops, garden tools and implements.
11	Planning and layout of orchard and plantations.

12	Digging and filling of pits for fruit and plantation crops-planting systems
13	Training and pruning of orchard trees-preparation and application of regulators
14	Layout of different irrigation systems,
15	Identification and management of nutritional disorder in fruits-bearing habits and maturity standards,
16	Harvesting, grading, packaging and storage.
17	Revision, discussion, model questions

Suggested Readings:

1. Principles and Practices of Agronomy, Balasu bramaniyan, P and Palaniapan, S.P.; Agro Bios (India)Ltd., Jodhpur.
2. Principles of Agronomy, Reddy, S.R., Kalyani Publishers, Ludhiana.
3. introduction to Horticulture by N. Kumar, Oxford and IBH
4. Basic Horticulture, By J. singh by Kalyani Publisher

4. NRM 112

Geology and Soils

3(2+1)

Theory

Introduction to geology , its significance, composition of earth's crust, soil as a natural body , major components by volume. Pedology ,rocks, types – igneous, sedimentary and metamorphic, classification , soil forming minerals , definition, classification, silicates, oxides, carbonates, sulphides, phosphates, occurrence. Weathering of rocks and minerals ,weathering factors, physical, chemical, biological agents involved, weathering indices. Factors of soil formation parent material, climate, organism, relief, time. Soil forming processes, eluviations and illuviation, formation of various soils. Physical parameters, texture, definition, methods of textural analysis, Stokes law, textural classes, use of textural triangle, absolute specific gravity, definition apparent specific gravity/bulk density, factors influencing, field bulk density, relation between bulk density particle density. Pore space, definition, factors affecting capillary and non capillary porosity, soil colour,definition-its significance - colour variable-hue- value- chroma- Munsell colour chart factors influencing-parent material-soil moisture-organic matter. Soil structure-definition classification-clay- prism like structure-factors influencing genesis of soil structure- soil consistency- plasticity- Atterberg's constants. Soil air-composition- factors influencing-amount of air space. Soil temperature-sources and distribution of heat-factors influencing, measurement. Chemical properties ,soil colloids organic, humus, inorganic, secondary silicate, clay, hydrous oxides. Soil organic matter decomposition , concept of pH , soil acidity ,nutrient availability soil buffering capacity – a brief overview of saline, sodic and calcareous soils. Soil water forms, hygroscopic, capillary and gravitational, soil moisture constants, hygroscopic coefficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity, energy concepts pF scale measurement, gravimetric, electric and tensiometer methods, pressure plate and pressure membrane apparatus, Neutron probe, soil water movement, saturated and unsaturated infiltration and percolation. Elementary knowledge of soil classification – soil orders. Forest soils characteristics, distinguishing features, changes in physical and chemical properties compared to agricultural soils.

Practical

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

Theory Lecture outline

Lect.	Details of topic to be covered
1	Introduction to geology- its significance, Composition earth's crust, soil on a nature body, major components by volume.
2	Pedology –Rock-types. Igneous, Sedimentary, Metamorphic.
3	Classification- soil forming minerals- definition, classification-silicates, oxides, carbonates, sulphides, phosphates-occurrence.
4	Weathering of rocks and minerals- weathering factors- Physical weathering –agents of Physical weathering and their role.
5	Chemical weathering- Solution, hydration, hydrolysis, carbonation, oxidation and reduction , biological agents involved, weathering indices.
6	Factors of Soil Formation- Parent material, Climate, Organisms, Relief and Time.
7	Soil Forming Processes-Evaluation, Illuviation, and formation of various soils.
8	Physical Parameters-Texture-definition & methods of textural analysis
9	Stock's law, assumption, limitations , textural classes, use of textural triangle.
10	Absolute specific gravity-definition, apparent specific gravity/bulk density, factors influencing field bulk density, Relation between BD , PD and practical problems.
11	Por space- definition factors affecting capillary and non- capillary porosity.
12	Soil Colour- definition, its significance, Colour variable-Hue, Value, Chroma & Munsells soil colour chart.
13	Factors influencing soil colour- parent materials, soil moisture, and soil organic matter.
14	Soil Structure- definition, classification – clay-prism , block, granular& crumby.
15	Factors influencing genesis of soil structure.
16	Revision class before midterm examination
17	Soil Consistency, plasticity, Atterbergs constants.
18	Soil air-composition, factors influencing amount of soil air.
19	Soil temperature-sources and distribution of heat- factors influencing measurement.
20	Chemical properties - Soil colloids, organic, Human, inorganic, secondary silicate clay, Hydrous oxides.
21	Silicate clay minerals
22	Soil Organic Matter-decomposition.
23	Concept of pH –soil acidity-nutrient availability, soil buffering capacity .
24	A brief overview of saline, sodic and calcareous soils
25	Soil Water-forms –hygroscopic, capillary and gravitational-soil moisture constants- hygroscopic co-efficient, wilting point, field capacity, moisture equivalent, maximum water holding capacity.
26	Energy concepts- pF scale measurement-gravimetric-electric etc
27	Tensiometer, pressure plate and pressure membrane apparatus-neutron probe
28	Soil water movement-saturated and unsaturated, infiltration and percolation.
29	Elementary knowledge of soil classification-soil orders.
30	Forest soils-characteristics
31	Distinguishing features –changes in physical and chemical properties compared to agricultural soils.
32	Revision class before final theory examination

Practical class outline

Class	Practical
1	Identification of important soil farming rocks.
2	Identification of important soil farming minerals.
3	Collection and preparation of soil samples.
4	Study of soil moisture by gravimetric method.
5	Study of soil colour by Munsell soil colour chart.
6	Determination of bulk density of soil
7	Determination of particle density and porosity of soil.
8	Determination of soil texture by Bouyoucos hydrometer method.
9	Determination of organic carbon in soil by walkley and black's rapid titration method.
10	Determination of pH of soil.
11	Determination of electrical conductivity of soil.
12	Study of soil profile.
13	Study tour for identification of rocks and minerals and profile studies
14	Determination of water holding capacity of soil.
15	Practicals on introduction to tensiometer, pressure plate and neutron probe etc.
16	Revision class for practicals

Reference

1. The nature and properties of soils. 10th ed. Macmillan publishing Co.Inc., New York :N.C. Brady (1990)
2. Text book of Soil Science. Tata McGraw Hill publishing Co., New Delhi : Biswas, T.D and Mukherjee, S.K (1987)
3. Fundamental of Soil Science. 5th edn. Wiley Eastern Pvt. Ltd., New Delhi : Foth, H.D. and Turk, L.M. 1972
4. Fundamental of Soil Science. Published by Indian society of soil science, IARI, New Delhi : Indian society of soil science (ISSS).2002
5. Soil, plant , water and fertilizer analysis. Published by AGROBIOS (India), Jodhpur : Gupta, P.K. 2007
6. Soil, plant and water analysis. 2nd Edn. Kalyani Publishers, Ludhiyana : Jaiswal, P.C. 2006
7. Proprties and management of forest soils. John Wiley, New York : Pritchett and Fisher R.F. 1987

5. BAS 111 Information and Communication Technology 2(1+1)**Theory**

Introduction to computers, hard ware and soft ware, basic works of computer, operating systems. DOS, WINDOWS commands for managing files. Windows component like icons, desktop, My Computer, recycle bin, My Documents, task bar, start menu options. Familiarizing with MS OFFICE (MS Excel, MS Word, MS PowerPoint). Introductions to FOSS for OS and for work related to word processing, spreadsheet and presentation. Introduction to intra and internet and its application. Introduction to statistical packages and image processing software. Audio visual aids , definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing. Communication process, Berlo' s model, feedback and barriers to communication.

Practical

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of fisheries data using MS Excel. Handling of audio visual equipments. Planning,

preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.

Theory Lecture outline

Lecture	Topic to be Covered
1	IT and its importance in ICT
2	IT Tools, IT enabled services and their impact on society
3	Computer fundamentals: hardware and software
4	Input and output devices, word and character representation
5	Features of computer language like Machine language, Assembly Language & High level language with their merits and demerits
6	Principles of programming i.e. algorithms and flowcharts
7	Operating systems – Definition, basic concepts, introduction to Windows
8	Operating system – introduction to Linux
9	Local Area Network (LAN), Wide Area Network (WAN)
10	Internet and World wide Web (WWW), HTML, IP
11	Introduction to MS-Office (MS-Word and its details)
12	MS-Excel and its details
13	MS-Powerpoint and its details
14	Audio Vvsual aids- definition, advantages, classification
15	Evaluation of AV aids, Video conferencing
16	Doubt clearance

Practical class outline

Class	Practical
1	Exercise to binary number system
2	Algorithms and flowcharts
3	MS-Word (Part-1)
4	MS-Word (Part-2)
5	MS-Excel (Part-1)
6	MS-Excel (Part-2)
7	MS-Powerpoint (Part-1)
8	MS-Powerpoint (Part-2)
9	Internet applications: Web Browsing, Creating E-Mail and its operations
10	Analysis of data using MS Excel
11	Handling audio visual equipments
12	Planning, preparation and presentation of posters
13	Making of charts, overhead presentation i.e. slides
14	Organizing of an audio visual programme

References:

1. Communication Skill and Personality Development by Sagar Mandal, Kalyani Publishar
2. Communication Skill and Personality Development by Bodh raj
3. English for college, by Carroll, B.J. 1986. Macmillan India Ltd. New Delhi

6. BAS 112 Communication Skills and Personality Development 2(1+1)

Theory

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

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Theory Lecture outline

Lect.	Topic to be Covered
1	Communication Skills and Personality development-meaning and orientation-1 Class
2	Structural and functional grammar-1 Class
3-4	Meaning and process of communication-Definition of communication, process and elements-2 Classes
5	Verbal and non verbal communication – meaning, types, process-1 class
6	Listening and note taking – Meaning types and process-1 class
7	Writing skills-meaning, tips for effective writing – 1 class
8	Oral presentation skills, public speaking-Meaning, process, Key points of public speech – class
9	Field diary and lab records ; indexing, footnote and bibliographic procedures- 1 class
10	Reading and comprehension of general and technical articles, precise writing – 1 class
11	Summarizing, abstracting; individual and group presentations-1 class
12	Impromptu presentation-meaning, steps, important points-1 class
13	Group discussion-Meaning, steps, important points-1 class
14-15	Seminars and conferences-meaning, process, important points to conduct seminar and conference – 1 class
16	Doubt clearance

Practical class outline

Class	Practical
1	Listening and note taking skill practice – 1 class
2	Writing skills-writing for farmer, folder -2 classes
3	Oral presentation skills, practice of public speaking – 2 classes
4	Skill of maintaining field diary and lab record – 1 class
5	Indexing-writing subject and author index – 1 class
6	Footnote and bibliographic procedures – 1 class
7	Assignment and Revision – 1 class
8	Reading and comprehension of general and technical articles – comprehension skill – 1 class
9	Précis writing skill practice- 1 class
10	Writing summary and abstract – 1 class
11	Individual and group presentations – Group discussion practice -2 classes

References:

1. Carroll, B.J. 1986. English for college, Macmillan India Ltd. New Delhi
2. Hahn, "The Internet complete reference", TMH
3. Hornby, A.S. 1975. Guide to patterns and usage in English. Oxford University, New Delhi.
4. Quirk, R and Greenbaum, S 2002. A University grammar

7. BAS 113**Plant Biochemistry****2(1+1)****Theory**

Chemistry of carbohydrates—classification, mono, diandpoly saccharides, anomerism, epimerism, mutarotation, configuration of sugars and inversion. Chemistry of lipids—classification, simple lipids and phospho lipids. Fatty acids and fat constants, lipids of chloroplast, membrane lipids. Chemistry amino acids, peptides and proteins, classification, levels of protein structure. Chemistry of nucleic acids—bases, sugars, Nucleic acids—classification, enzyme kinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes. Metabolism of carbohydrates—glycolysis, TCA cycle, HMP shunt, glyoxylic acid cycle, electron transport chain. Lipids metabolism—beta oxidation and fatty acid biosynthesis. Photosynthesis—light reaction, dark reaction, Hill's reaction, photorespiration, C₄ pathway, C₃ and C₄ plants, CO₂ fixation, regulation of photosynthesis. Plant hormones and their mode of action.

Practical

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

Theory Lecture Outline

Lect.	Topic to be covered
1	Chemistry of carbohydrates—classification
2	Mono, diandpoly saccharides, anomerism, epimerism, mutarotation,
3	Configuration of sugars and inversion.
4	Chemistry of lipids—classification
5	Simple lipids and phospho lipids
6	Fatty acids and fat constants
7	Lipids of chloroplast, membrane lipids.
8	Chemistry amino acids
9	Peptides and proteins, classification, levels of protein structure
10	Enzymes—classification, enzyme inhibition, allosteric enzyme
11	Enzyme kinetics enzymes, lysozymes, coenzymes
12	Metabolism of carbohydrates—glycolysis
13	TCA cycle, hmpshunt, glyoxylic acid cycle, electron transport chain.
14	Lipids metabolism—beta oxidation and fatty acid biosynthesis.
15	Hill's reaction, photorespiration, C ₄ pathway, C ₃ and C ₄ plants, CO ₂ fixation
16	Regulation of photosynthesis. Plant hormones and their mode of action.

Practical Class Outline

Class	Practical
1	Qualitative tests for carbohydrates

2	Qualitative tests for carbohydrates
3	Qualitative tests for carbohydrates
4	Quantitative estimation of reducing sugars by DNS method
5	Quantitative estimation of reducing sugars by DNS method
6	Quantitative estimation of non-reducing sugars
7	Quantitative test for total carbohydrates by Anthrone reagent
8	Qualitative tests for lipids,
9	Determination of Saponification number of oils/fats
10	Determination of Iodine number of fatty acids
11	Qualitative tests for proteins/amino acids
12	Estimation of protein by Lowry's method
13	Determination of Michaelis constant of enzymes
14	Estimation of RNA.

References:

1. Lehninger : Principles of biochemistry; published by Freeman and company
2. Plant Biochemistry by V. Arun Kumar, Senthil Kumar and Siba Kumar
3. Plant Physiology by S. N. Pandey, B. K.Sinha, Vikash Publishers

8. BASB 114**Forest Botany****2(1+1)****Theory**

Introduction to Allied and Applied Branches of Botany; General classification of plants – Phanerogams, Cryptogams, Angiosperms and Gymnosperms, Dicotyledons and Monocotyledons; General body organization and characters of Algae (e.g. *Chlamydomonas*), Fungi (*Mucor*), Bryophytes (*Moss*) and Pteridophytes (*Nephrolepis*); Parts of flowering plants, Root system and Shoot system, typical structure of root, stem and leaf; Functions of root, stem and leaves; Basic Structure of Flower, Essential and Non essential parts of flower; Morphology of root, stem and leaves; Morphology of Flower with emphasis on Inflorescence; Types of Phyllotaxy and Venation in leaves, types of placentation and aestivation in flower; Basic types of tissues (Structure and Function) , Dermal, Vascular and Ground tissues; Parenchyma, Sclerenchyma, Collenchyma, Chlorenchyma, Aerenchyma, Cambium, Xylem and Phloem; Types of vascular bundles in flowering plants.

Practical

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

Theory Lecture outline

Lect.	Chapter	Topic to be Covered
1	Difference between living and Non living	Characteristic of living and non living
2	Diversity and importance of plant life	Cryptogams and Structure and function of phanerogams.
3		Different plant groups

4	Classification of plant kingdom	Two kingdom classification, Five kingdom classification Merit and demerit
5	Branches of botany	Different branches of botany
6	Morphology of angiosperms	Root and its modifications, Stem and its modifications, Leaf and its modifications
7		Flower, Inflorescences and Reproductive parts
8	Structure and function of cell organelles	Structure of cell, Structure and function of cell wall, cell membrane, mitochondrion, chloroplast
9		Structure and function of nucleus, Other cell organelles
10	Cell division	Cell division, cell cycle, Mitosis
11		Meiosis – 1, Meiosis – 2
12	Genetics	Mendelism (Elementary idea)
13		Monohybrid and dihybrid cross
14	Physiology	Water relation, Water absorption
15		Elementary idea of photosynthesis,
16		Physiology of seed and flower
17	Economic botany	Economics importance of selected cereals, pulses, jute & selected medicinal plants

Practical class outline

Class	Practical
1	Study of an angiospermic plant
2	Study of modifications of root
3	Study of modifications of stem
4	Study of inflorescence
5	Study of floral parts
6	Study of plasmolysis and calculation of op.
7	Different stages of cell division
8	Different stages of cell division
9	Study of photosynthesis in different wavelengths of light
10	Study of leaching in beet root
11	Economic importance of different plant parts
12	Economic importance of different plant parts

References:

1. Text book of Botany, by A.K.Nanda
2. Text book of practical botany vol-1
3. Text book of Practical Botany, by Bendre

8. BASM 114

Basic Mathematics

2(2+0)

Elementary idea of complex number. Arithmetic and Geometric progressions. Elementary idea of permutation and combinations. Matrix of a system of linear equations. Binomial theorem for positive integral index, any index and their applications, addition and subtraction formulae. A, B and C, D formulae. Sine and Cosine formulae. Inverse Trigonometric functions, ratios and their interrelationships. Limit of functions, differentiations and integrations simple applications maxima

and minima least square techniques, Introduction to matrices and determinants, special type of matrices, addition, subtraction and multiplication of matrices.

Theory Lecture outline

Lect.	Topic to be Covered
1	Elementary idea of Complex numbers
2	Arithmetic Progression
3	Geometric Progression
4	Counting Principle
5	Problems on Counting principle
6	Permutation
7	Problems on Permutation
8	Basic Criteria of Binomial theorem
9	Binomial theorem of Integral index
10	Sum and difference of Binomial coefficient
11	Binomial theorem of any index
12	Application of binomial theorem
13	Problems on Binomial theorem
14	A,B,C,D formula
15	Sine and Cosine Formula
16	Inverse trigonometric formula
17	Introduction to matrices
18	Introduction to determinants
19	Special types of matrices
20	Addition of matrices
21	Subtraction of matrices
22	Multiplication of matrices
23	Inverse of a matrix
24	Cramer's Rule for solving system of linear equations
25	Matric method for solving system of linear equations
26	Measures of central tendency
27	Measures of dispersion
28	Correlation
29	Regression
30	Introduction to probability
31	Axioms of probability
32	Problems on probability

Suggested Readings

1. Topics in Mathematics, Vol-1 and Vol-2 by Rath R.S., Acharya B.P., Padhy S. Das G.; Kalyani publishers
2. Elements of Mathematics, Vol-1 & Vol-2, CHSE Publication

9. FPE 111

Physical Education-I

1(0+1)

Practical

Concept of Physical Education, Meaning, need & importance, aim & objectives. Conditioning exercises, warming up, warming down (general & specific), and flexibility exercise. Physical Fitness exercises for speed, strength, agility, endurance and coordination. Posture &

Concept, Definition, values of good posture, causes & draw backs of bad posture, Common postural deviation, their causes and correct exercises, Kyphosis, Scoliosis, Lordosis Knock knee & Bowlegs, Flatfoot. Running ABC'S, walking ABC'S, Major games, Rules and regulations of important games, Skill development in any one of the games, Football, Basketball & Ball badminton. Indoor games , Participation in one of the indoor games , Shuttle badminton & table tennis. Athletic events, Rules & regulations of athletic events, Participation in any of the athletic events–Broad jump, high jump and short put. Conduct of Health Related Physical Fitness Test (TPFP): One mile run/Beep test, Sit,Up60 sec, Sitandr each, Modified pull ups. NOTE: (one to be selected major games, in door games and Athletic events).

10. FNCC 111

NCC-I

1(0+1)

Practical

Introduction to NCC, defence services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, armsdrill, shoulderarm, orderarm, presentarm, guard of honour, ceremonial drill.

10. FNSS 111

NSS-I

1(0+1)

Aims and objectives of NSS. NSS logo- mottoetc. Orientation of students in national problems- study of philosophy of NSS- fundamentals rights- directive principles of state policy- Village adoption.

1. FBT 121**Plant Physiology****3(2+1)****Theory**

Introduction to tree physiology. Photosynthesis, C₃, C₄ and CAM plants, Photorespiration, Factors affecting photosynthesis. Respiration: energetic of dark respiration. Plant-water relations. Concept of water potential- ascent of sap and water balance. Stomatal physiology, Stomatal conductance, resistance. Mineral nutrition, macro micronutrients. Arnon's criteria of essentiality – deficiency. Plant growth regulators – classification. Tree structure. Growth and development growth kinetics. Growth regulation and co-ordination. Plant growth analysis Canopy architecture. Forest Biomes. Light interactions models of forest canopies - Sun plants and shade plants shade tolerance. Temperature -temperature influence on forest development, energy budgets, low and high temperature - Physiological adaptations for high temperature, chilling injury. Water stress - Mechanism of drought tolerance and drought resistances . Physiological basis of drought avoidance and tolerance. Water relations of forest trees – Transpiration from forest canopies, evapotranspiration models of forest stands. Water use efficiency of forest stands. Salinity stress- its effects on tree growth. Resistance to salinity. Forest and microclimate . Carbon balance and dry matter production in forest trees. Dry matter production and partitioning – source/ sink - . GPP and NPP of forest stands . Carbon cycling .Nutrient dynamics and plant growth. Nutrient cycling of C,N,P,S.

Practical

Preparation of solutions. C₃ and C₄ leaf anatomy. Estimation of transpiration using porometer. Estimation of photosynthesis using IRGA. Extraction and estimation of chlorophyll in plants. Estimation of stomatal index. Demonstration of plasmolysis. Estimation of water potential in plants using Plant water status console. Estimation of leaf area of plants. Plant growth analysis – RGR, NAR and LAR, specific leaf area and leaf weight ratio LAI CGR, LAD etc. Measurement of moisture stress tolerance parameters in trees, membrane stability, chlorophyll stability, proline content- wax and cuticle thickness. Measurement of relative water content, leaf water potential, osmotic potential. Measurements of stomatal resistance/stomatal conductance under varying stress condition. Observation on tree architecture of important species.

Theory Lecture Outline

Lecture	Topic
1	Introduction to tree physiology.
2	Photosynthesis, C ₃ , C ₄ and CAM plants, Mineral nutrition, macro micronutrients.
3	Photorespiration,
4	Factors affecting photosynthesis.
5	Respiration: energetic of dark respiration.
6	Plant-water relations..
7	Concept of water potential- ascent of sap and water balance.
8	Stomatal physiology,
9	Stomatal conductance
10	Stomatal resistance
11	Arnon's criteria of essentiality – deficiency.
12	Plant growth regulators – classification. Tree structure.
13	Growth and development growth kinetics. Growth regulation and co-ordination. Plant growth analysis Canopy architecture. Forest Biomes.
14	Light interactions models of forest canopies -
15	Sun plants and shade plants shade tolerance.
16	Temperature -temperature influence on forest development, energy budgets, low and high temperature -
17	Physiological adaptations for high temperature,
18	chilling injury. Water stress - Mechanism of drought tolerance

19	drought resistances .
20	Physiological basis of drought avoidance and tolerance. Water relations of forest trees –
21	Transpiration from forest canopies,
22	evapotranspiration models of forest stands.
23	Water use efficiency of forest stands.
24	Salinity stress- its effects on tree growth.
25	Resistance to salinity. Forest and microclimate
26	. Carbon balance and dry matter production in forest trees.
27	Dry matter production and partitioning – source/ sink - .
28	GPP and NPP of forest stands .
29	Carbon cycling .
30	Nutrient dynamics and plant growth.
31	Nutrient cycling of C,N
32	Nutrient cycling of P,S.

Practical Class Outline

Class	Practical
Practical 1	Preparation of solutions. C3 and C4 leaf anatomy.
Practical 2	Measurement of moisture stress tolerance parameters in trees, membrane stability
Practical 3	Estimation of transpiration using porometer.
Practical 4	Estimation of photosynthesis using IRGA.
Practical 5	Extraction and estimation of chlorophyll in plants.
Practical 6	Estimation of stomatal index.
Practical 7	Demonstration of plasmolysis.,
Practical 8	Estimation of water potential in plants using Plant water status console.
Practical 9	Estimation of leaf area of plants.
Practical 10	Plant growth analysis – RGR, NAR and LAR,
Practical 11	specific leaf area and leaf weight ratio LAI CGR, LAD etc.
Practical 12	leaf water potential, osmotic potential.
Practical 13	Measurements of stomatal resistance/.
Practical 14	stomatal conductance under varying stress condition.
Practical 15	Observation on tree architecture of important species
Practical 16	chlorophyll stability, proline content- wax and cuticle thickness. Measurement of relative water content

References:

1. Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.
2. Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons. New York
3. Larcher, W. (2003). Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups. Springer Science & Business Media
4. Lambert, Chapin, F.S. and Pons, T.L. (1998). Plant Physiological Ecology. Springer Scientific Business Media inc. Newyork.
5. Landsberg, J.J (1986). Physiological Ecology of Forest Production. Academic Press Inc. London
6. Landsberg, J.J and Gower, S.T (1997). Applications of Physiological Ecology to Forest Management. Academic Press Inc. London.
7. Nobel P. S. (2005). Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, Amsterdam

8. Salisbury, F. B. and Ross, C. W. (2004) Plant Physiology. Thomson Asia Ptd- Ltd. Singapore.
9. Taiz, L. and Zeiger, E. (2010) 5th edition Plant Physiology. Sinauer Associates Inc. Massachusetts

2. FBT 122 Plant Cytology and Genetics 2(1+1)

Theory

History of genetics. Mendel's principles of inheritance, segregation, independent assortment. Cell structure and functions. Cell organelles. Cell reproduction, mitosis, meiosis and its significance. Chromosome theory of inheritance. Modification to Mendelian inheritance, multiple alleles, codominance, gene interaction, epistasis, pleiotropy, polygenic inheritance, penetrance and expressivity, cytoplasmic inheritance. Linkage and crossing over, cytological consequence of crossing over. Detection of linkage and linkage maps. Chromosomal aberrations numerical and structural. Structure of DNA and types and its replication. Chromosomes – its structure and function. Fine structure of gene; Gene expression and their functions. RNA its structure function and types. Gene action, protein synthesis. Mutation- its classification and uses.

Practical

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

Theory Lecture Outline

Lect.	Details of Topic
1	History of genetics
2	Mendel's principles of inheritance- Segregation, independent assortment
3	Chromosomal theory of inheritance
4	Modification to Mendelian inheritance- codominance, gene interactions, epistasis, pleiotropy, penetrance and expressivity
5	Multiple alleles, Polygenic inheritance
6	Cytoplasmic inheritance
7	Linkage and crossing over- Cytological consequence of crossing over, Detection of linkage and linkage maps
8	Chromosomal aberrations- numerical and structural
9	Cell structure and functions
10	Cell organelles
11	Cell reproduction- Mitosis, meiosis and its significance
12	DNA- Structure, types, replication
13	Chromosome- Structure and function
14	Fine structure of gene, Gene expression and their functions
15	RNA Structure, types, function
16	Gene action- protein synthesis
17	Mutation- classification and uses

Practical Class Outline

Class	Experiment
1	Study of fixatives and stains.
2	Working out problems related to monohybrid cross

3	Working out problems related to dihybrid cross
4	Working out problems related to independent assortment
5	Working out problems related to probability and chi-square
6	Working out problems related to multiple alleles
7	Working out problems related to linkage
8	Working out problems related to gene mapping
9-10	Preparation of slides showing various stages of mitosis.
10-12	Preparation of slides showing various stages of meiosis.
13	Doubt clearance

References:

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

3. SAF 121 Theory and Practice of Silviculture 3(2+1)

Theory

Definitions: Forests and Forestry. Silviculture objectives and scope of silviculture, relation with other branches of Forestry & Silvics. Site factors- climatic, edaphic, physiographic, biotic and their interactions. Trees and their distinguishing features- growth and development. Root growth fine root/functional root production- direct and indirect benefits, biophysical interactions, trees and buffering functions, C sequestration potential of forests. Silvicultural systems-definition, scope and classification. Systems of concentrated regeneration, systems of diffused regeneration, accessory systems. Clear felling systems, Shelterwood system, Selection system and its modifications. Coppice systems, Culm selection system in Bamboo. Canopy lifting system in Andaman. Silvicultural systems followed in other countries.

Regeneration of forests – objectives, ecology of regeneration, natural and artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment. Requirement for natural regeneration- advance growth, coppice, root sucker, regeneration. Natural regeneration supplemented by artificial regeneration. Artificial regeneration - object of artificial regeneration, advantages. Factors governing the choice of regeneration techniques. Tree planting- Sowing v/s planting different kinds of pits, tending and cultural operations. Weeding- kinds of weeding. Release operations- singling, cleaning, liberation cutting.

Practical

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

Theory Lecture Outline

Lect.	Topics to be covered
1	Introduction. Definitions: Forests and Forestry
2	Silviculture: Objective and scope
3	Relation of silviculture with other branches of Forestry. Silvics

4	Site factors - climatic, edaphic, physiographic and biotic factors.
5	Influence of climatic factors on forest vegetation
6	Influence of edaphic and physiographic factors on forest vegetation
7	Influence of biotic factors on forest vegetation
8	Trees and their distinguishing features
9	Growth and development of trees
10	Root growth-fine root/functional root production
11	Direct and indirect benefits of trees and buffering functions - C sequestration potential of forests
12	Silvicultural systems - definition and scope. Classification: Systems of concentrated regeneration, systems of diffused regeneration and accessory systems
13	Clear felling systems
14	Shelterwood systems
15	Shelterwood systems will continue
16	Pre-Midterm examination revision and doubt clearance
17	Selection system and its modifications
18	Accessory systems
19	Coppice systems
20	Culm selection system in Bamboo. Canopy lifting system in Andaman
21	Silvicultural systems followed in other countries
22	Regeneration of forests – objectives
23	Natural regeneration- seed production, seed dispersal, germination and establishment
24	Advance growth, coppice, root sucker, regeneration survey, natural regeneration supplemented by artificial regeneration
25	Artificial regeneration - object of artificial regeneration. Factors governing the choice of regeneration methods
26	Different aspects of artificial regeneration- choice of species, site, method, spacing and arrangement of manpower.
27	Factors influencing choice of species
28	Selection of site and choice of method of artificial regeneration
29	Spacing and arrangement of manpower for artificial regeneration
30	Tending and cultural operations
31	Weeding, cleaning, thinning, pruning, climber cutting, girdling, improvement felling
32	Pre-Final examination revision and doubt clearance

Practical Class Outline

Class	Practical
1	Acquaintance with modern silvicultural tools
2	Identification of important tree species (Part-I)
3	Identification of important tree species (Part-II)
4	Identification of important tree species (Part-III)
5	Visit to Godibari forests, Chandaka and study of forest composition
6	Visit to Jhalara forests, Chandaka and study of forest composition
7	Visit to forest plantations

8	Practice of seed collection
9	Preparation of soil mixture for nursery raising
10	Pre-sowing treatment of forest seeds
11	Sowing of seeds in nursery
12	Study of site preparation, pit making and planting in main field
13	Practice of various tending operations- weeding, cleaning
14	Practice of singling, thinning
15	Practice of pruning
16	Practice of fertilization in forest crop

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1. Principles and Practices of Silviculture - L. S. Khanna.
2. A Text Book of Silviculture – A.P. Dwivedi.
3. Theory and Practice of Silvicultural Systems – Ram Prakash and L. . Khanna
4. Text Book of Introduction to Forestry – N. Bhol, V.K. Mishra and S.K. Chauhan
5. Silviculture in the Tropics – S. Gunter, M. Weber, B. Stimm and R. Mosandl.

4. FPU 121

Wood Anatomy

3(2+1)

Theory

Introduction to wood anatomy. Classification of plant kingdom. Gymnosperms versus angiosperms. Kinds of woody plants. The plant body; a tree and its various parts. Meristems; promeristem, primary meristem, secondary meristem. Simple tissues; parenchyma, collenchyma, sclerenchyma and the vascular tissues. Parts of the primary body; typical stems and roots of dicots and monocots. Secondary growth in woody plants. Mechanism of wood formation in general, and with special reference to typical dicot stem. Ray initials and fusiform initials; anticlinal and periclinal division. Physiological significance of wood formation. The macroscopic features of wood, sapwood, heartwood, pith, early wood, late wood, growth rings, wood rays, etc. Sapwood versus heart wood, anatomical differences. Transformation of sapwood to heartwood; factors affecting transformation. Microscopic features of wood. Prosenchymatous elements, tracheids, vessels, fibers. Parenchymatous elements, parenchyma and rays, resin canals, gum canals, latex canals, infiltrants in wood. Three dimensional features of wood; transverse, tangential and radial surfaces. Elements of wood cell walls. The structure and arrangement of simple pit, bordered pits. Extractives in wood. Comparative anatomy of gymnosperms and angiosperms. Anatomical features of common Indian timbers; classification into porous and nonporous woods, ring porous and diffuse porous woods. Effect of growth rate on wood properties. Juvenile wood and mature wood.

Practical

Study of primary growth in stems of typical dicots and monocots. Study of wood formation in typical dicot stem. Study of vascular bundles in monocots. Parts of the logs (woody trunks), and the three distinctive surfaces of wood (i.e. cross, radial and tangential planes). Timber identification and its importance. Procedures for field identification of timbers. Study of physical features of wood. Study of gross features of wood. Study of anatomical features of wood, pores or vessels, different types. Study of soft tissue in timbers and their different types distributions. Study of wood rays, and their different types. Study of the non-porous woods, their physical and anatomical description. Study of infiltration and inclusions in wood. Anatomical keys and methods to use them. Dichotomous keys, punched card keys and computer aided identification. Field identification of important timbers of Kerala.

Theory Lecture Outline

Lect.	Lesson	Subject Matter
1-2	Introduction	Introduction to Wood Anatomy, Importance of wood anatomy
3-4	Classification of plant	Gymnosperms versus angiosperms. Kinds of woody plants.

5	Plant Body	Tree and its various parts.
6-7	Meristems	meristems, promeristem, primary meristem, secondary meristem, apical and intercalary meristems
8-9	Simple tissues	parenchyma, collenchyma, sclerenchyma.
10-12	Complex and vascular tissues	Xylem , phloem: The structure and arrangement of simple pit, bordered pits.
13	Anatomy dicot stem	Anatomy of stems of dicots.
14	Anatomy dicot root	Anatomy of roots of dicots.
15	Anatomy monocot stem	Anatomy of stems of monocots
16	Anatomy monocot root	Anatomy of roots of monocots
17-18	Secondary growth and wood formation	The secondary growth in woody plants. Mechanism of wood formation. Formation of early and late wood, growth rings, transformation of sapwood to heartwood.
19	Macroscopic features of wood	Bark, sapwood, heartwood, pith, growth rings
20-21	Microscopic features of wood	Prosenchymatous elements, tracheids, vessels, fibers. Parenchymatous elements, parenchyma and rays, resin canals, gum canals, latex canals, infiltrants in wood.
22-23	Three dimensional features of wood;	Transverse, tangential and radial surfaces.
24-26	Extractives in wood.	Resins, gums, sugars, cellulose, lignin, hemicellulose other biochemicals
27	Comparative anatomy	gymnosperms and angiosperms.
28-31	Anatomical features of common Indian timbers	classification into porous and nonporous woods, ring porous and diffuse porous woods. Anatomy of sal. Teak. Bijasal, pines , kendu, etc
32	Effect of growth	Growth rate affecting wood properties. Juvenile wood and mature wood

Practical Class Outline

Class	Title of experiment
1	Study of primary growth in typical dicot stem
2	Study of primary growth in typical monocot stem
3	Study of vascular bundles in monocots
4	Study of three dimensional features (cross, radial and tangential planes) of logs (woody trunks)
5	Study of physical features of wood
6-7	Anatomical features of softwoods
8-11	Anatomical features of hardwoods
12	Study of anatomical features of different types of wood pores /vessels
13	Study of soft tissues in timbers and their distribution
14	Study of wood rays and their types
15	Study of cell inclusions in wood
16	Anatomical keys and methods to use them. Dichotomous keys, punched card keys

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5. WLS 121**Wildlife Biology****3(2+1)****Theory**

History of Wildlife studies in India; Classification of Indian Mammals, Basic requirements of wildlife – food, water, shelter, space, limiting factors; Food chain, Food web, Ecological pyramids; Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity; Effect of light and temperature on animals; Wildlife Habitat: Niche, Territory, Home Range, Territoriality, Edge, Cruising Radius, Carrying Capacity; Animal behavior and adaptation; Habitat Improvement: Food-Water- Shelter improvement.

Practical

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

Theory Lecture Outline

Lect.	Chapter	Details
1	General introduction	Definition of wildlife, branches of wildlife science
2	History	History of Wildlife studies in India
3	Taxonomy (Classification of Indian Mammals)	Order- Primate
4		Order: Carnivora- Feliformes
5		Order: Carnivora- Caniformes
6		Order: Artiodactyla-I
7		Order: Artiodactyla-II
8		Order: Perissodactyla
9		Aquatic and Marine mammals
10		Minor orders-I
11		Minor orders-II
12		Basic requirements of wildlife
13		Food chain, Food web, Ecological pyramids
14	Wildlife Ecology	Biotic factors, Biological basis of wildlife, Productivity
15	Effect of light and temperature on animals	Thermoregulation
16		Concept of adaptation, hibernation, torpor, aestivation
17		Adaptation strategies against heat and cold
18		Photoperiodism
19		Effect of light and concept of light pollution
20	Wildlife Habitat	Niche, Territory, Home Range,
21		Territoriality
22		Advertisement and demarcation of territory

23		Edge, Cruising Radius, Juxtaposition and Interspersion
24		Carrying Capacity
25	Animal behavior and adaptation	Concept and origin of behaviour
26		Basics of behaviour patterns
27		Learning/Conditioning in wild animals
28		Predation
29		Anti-predation strategies-I
30		Anti-predation strategies-II
31	Habitat Improvement	Food, Water,
32		Shelter improvement

Practical Class Outline

Class	Practical
1.	Visit to various protected areas
2.	Observations on the morphological activities of different species of wild animals in India-I
3.	Observations on the morphological activities of different species of wild animals in India-II
4.	Observations on the behavioral activities of different species of wild animals in India
5.	Observations on the behavioral activities of different species of wild animals in India
6.	Observations on the feeding activities of carnivorous wild animals in India-I
7.	Observations on the feeding activities of herbivorous wild animals in India-II
8.	Observations on the reproductive activities of different species of wild animals in India-I
9.	Observations on the reproductive activities of different species of wild animals in India-II
10.	Various study methods on the wild animals, such as focal animal sampling, Sherman trapping, mist netting, camera trapping, for identification-I
11.	Various study methods on the wild animals, such as focal animal sampling, Sherman trapping, mist netting, camera trapping, for identification-II
12.	Various study methods on the wild animals, such as focal animal sampling, Sherman trapping, mist netting, camera trapping, for identification-III
13.	Determination of age and sexing of animals including the small mammals-I
14.	Determination of age and sexing of animals including the small mammals-II
15.	Determination of age and sexing of animals including the small mammals-III
16.	Faecal analysis of wild animals-I
17.	Faecal analysis of wild animals-II
18.	Summing up the course

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6. NRM 121

Forest Protection

3(2+1)

Theory

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

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

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

Practical

Visit to forest areas with fire damages, Studying fire registers as records, studying encroachments and problems caused due to disturbance, visit to illegally felled areas, Visit to fire station, Study and acquaint with machinery used for fire control, identification of weeds, parasites and epiphytes. Observation of symptoms in laboratory and in forests, examination of scrapings, host, parasite relationships, causal organisms of above forest diseases. Examination of cultures of important pathogens. Visit to nurseries and plantations. Insect pests of forest seeds; forest nurseries; standing trees; freshly felled trees and finished products. Survey and identification of invertebrate fauna from forest areas. Methods of isolating soil invertebrate macro and micro fauna. Insecticides and their formulations- plant protection appliances.

Theory Lecture Outline

Lect.	Details of topic to be covered
1	Forest Entomology in India. Methods and principles of pest control, concept of IPM
2	Requisites and tools of IPM, autocidal and botanicals
3	Mechanical and physical methods of pest control
4	Silvicultural and legal methods of pest control along with suitable examples
5	Biological control methods, history, use of predators and parasites, introduction
6	Augmentation and conservation of natural enemies
7	Microbial control, use of viruses, bacteria and fungi
8	Chemical control methods, history
9	Classification of chemical pesticides in different ways
10	Biorational pest management tactics
11	Principles and techniques of Integrated Pest Management in forests.
12	Classification of forest pests, sap feeders, defoliators and other types

13	factors for outbreak of pests in forests, types of outbreaks and managements
14	Insect pests and diseases of forest seeds Nature of damage and management
15	Nature of damage and management of Insect pests of forest
16	Nature of damage and management of Insect pests of natural and plantation forests
17	Pest of teak acacia ,sal and their management
18	Insect pests of freshly felled trees, finished timbers and their management
19	Importance of Forest Pathology, tree disease classification
20	Principles of tree disease management ,
21	Causes and symptoms, losses due to forest tree diseases
22	root diseases (wilt, root and butt rot),and their management
23	stem diseases (heart rots, stem blisters, rusts, stem wilt
24	cankers, pink diseases, gummosis, water blister)
25	foliar diseases viz. rust, powdery mildew, leaf spot, leaf
26	Etiology, symptoms, mode of spread, epidemiology and management of important diseases like canker
27	Nursery diseases and their management
28	Chemical methods of disease management
29	Silvicultural, Biological methods of disease management
30	Disease due to physiological causes. Abiotic diseases.
31	Forest fire types and management
32	Injury to forest due to man, lopping, cutting for fuel wood, Encroachment different types, control of encroachment illegal felling of trees, method of control legislation. Forest weeds and weed management, management of woody climbers, parasites and epiphytes.

Practical Class Outline

Class	Practical
1	Visit to forest areas with fire damages, Studying fire registers as records
2	Survey and identification of invertebrate fauna from forest areas
3	Methods of isolating soil invertebrate macro and micro fauna.
4	Insecticides and their formulations
5	Plant protection appliances.
6	Visit to fire station, Study and acquaint with machinery used for fire control,
7	identification of weeds,parasites and epiphytes.
8	Examination of cultures of important pathogens
9	Observation of symptoms in laboratory and in forests , examination
10	visit to nurseries and plantations. Insect
11	visit to forest nurseries for observing pests and diseases
12	Visit to standing trees for observing pests and diseases
13	Visit to freshly felled trees and finished products for observing pests and diseases
14	Visit to forests for observing pests and diseases
15	Revision class

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7. BAS 121 Statistical Methods & Experimental Designs 3(2+1)

Theory

Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution, tables –graphic presentation of data, simple, multiple component and percentage, bar diagram, pie chart, histogram, frequency polygon and frequency curve and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quartiles for raw and grouped data. Dispersion: Range standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoretical distributions, binomial, poisson and normal distributions, sampling, basic concepts, sampling vs. Complete enumeration parameter and static, sampling methods, simple random sampling and stratified and omnibus sampling. Tests of significance: Basic concepts, tests for quality mean, unpaired and paired, t-tests, chi-square tests for application of attribute and test for goodness of fit for multinomial ratios. Correlation: Scatter diagram, correlation coefficient and its properties, regression, fitting of simple linear regression, tests of significance of correlation and regression coefficient. Introduction to design of experiment, Basic principles of experimental design, replication, randomization and local control. Analysis of variance, assumptions, construction of ANOVA table –conclusions based on ANOVA. Comparisons based on means, critical difference, DMRT. Transformations of data square root, logarithmic and angular transformations. Completely randomized design, Layout, analysis, advantages and limitations. Randomized block design layout, analysis, choice of no. of blocks, advantages and limitations. Latin square designs, layout, analysis, applications, advantages and limitations.

Practical

Formation of frequency distribution. Diagrammatic and graphic representation. Calculation of different measures of central tendency. Computation of various measures of dispersion. Calculation of coefficient of variation, coefficients of skewness and kurtosis. Computation of product moment correlation coefficient, rank correlation, coefficient, and coefficient of concordance. Fitting of linear regression models for prediction. Simple problems on probability fitting of binomial

distribution. Fitting of poisson distribution, problems on normal distribution. Selection of simple random sample – estimation of parameters – sample size determination. Selection of stratified and om sample–equal, proportional and Ney man’s allocation in stratified sampling. Large sample tests. Small sample tests, t and F tests, Chi –square test, test of goodness of fit – test of independence of attributes in a contingency table , computation of mean – square contingency. Analysis of variance,construction of ANOVA table of one,way classified data. Analysis of variance,construction of ANOVA table of two,way classified data. Layout and analysis of CRD, Layout and anal ysis of RBD. Analysis of data from 2n factorial experiments in RBD. Formation of Yate's table,calculation of main effects and interaction effects. Layout and analysis of split-plot design.

Theory Lecture Outline

Lect.	Details of topic to be covered
1	Basic concepts: Variable statistics
2	Types and sources of data, classification and tabulation of data
3	Construction of frequency distribution, tables –graphic representation of data,
4	simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve ave rage
5	measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles for raw and grouped data.
6	measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles for raw and grouped data.
7	Dispersion: Range standard deviation, variance, coefficient of variation for raw and grouped data.
8	Dispersion: Range standard deviation, variance, coefficient of variation for raw and grouped data
9	Probability: Basic concept, additive and multiplicative laws
10	Probability: Basic concept, additive and multiplicative laws
11	Theoretical distributions, binominal, poisson and normal distributions
12	Theoretical distributions, binominal, poisson and normal distributions
13	sampling, basic concepts, sampling vs. Complete enumeration parameter and static
14	sampling methods, simple random sampling and stratified and om sampling
15	Tests of significance: Basic concepts, tests for equality mean, an independet and paired t tests
16	Chi square tests for application of attribute sand test for good ness to fit of mendalian ratios
17	Correlation: Scatter diagram, correlation co,efficient and its properties
18	
19	regression, fitting of sample linear regression
20	tests of significance of correlation and regression coefficient
21	Introduction to design of experiment, Basic principles of experimental design
22	replication, randomization and local control
23	Analysis of variance, assumptions
24	construction of ANOVA table–conclusions based on ANOVA
25	Comparisons based on means, critical difference
26	DMRT
27	Transformations of data square root, logarithmic and angular trans formations
28	Completely randomized design, Layout, analysis, advantages and limitations
29	Randomised block design, layout, analysis, choice of no. of blocks, advantages and limitations
30	Latin square designs, layout, analysis, applications, advantages and limitations.
31	Doubt clearance class

Practical Class Outline

Class	Practical
1.	Formation of frequency distribution. Diagrammatic and graphic representation
2.	Calculation of different measures of central tendency
3.	Computation of various measures of dispersion.
4.	Calculation of coefficient of variation, coefficients of skewness and kurtosis
5.	Computation of product moment correlate on coefficient, rank correlation, coefficient, and coefficient of concordance
6.	Fitting of linear regression models for prediction
7.	Simple problems on probability fitting of binomial distribution
8.	Fitting of poisson distribution, problems on normal distribution
9.	Selection of simple random sample – estimation of parameters – sample size determination, Selection of stratified and om sample–equal, proportional and Ney man’s allocation in stratified sampling
10.	. Large sample tests. Small sample tests, t and F tests, Chi –square test, test of goodness of fit – test of independence of attributes in a contingency table
11.	computation of mean – square contingency
12.	Analysis of variance, construction of ANOVA table of one, way classified data
13.	Analysis of variance, construction of ANOVA table of two, way classified data.
14.	Layout and analysis of CRD, Layout and anal ysis of RBD. Analysis of data from 2n factorial experiments in RBD
15.	Analysis of data from 2n factorial experiments in RBD. Formation of Yate's table, calculation of main effects and interaction effects
16.	Layout and analysis of split-plot design.

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8. FPE 121 Physical Education–II 1(0+1)

Practical

Concept of Health -Physical health- mental health- social health- spiritual health- spectrum of health. Fitness & wellness-Motor components. Regular exercises. Amount of training- Scientific way of training- Rest and relaxation- conditioning- Good posture- Heredity- Environment- Standard of living- Balance Diet- Stress & tension- Drugs- Intoxication. Means of Fitness Development- Aerobic activities- anaerobic activities- Sports & Games- Yoga- Recreational Activity. Safety Education–Swimming. Yoga, Meaning & importance of Yoga. Role of Yoga in life, Teaching of Yoga. Physical Fitness test, TPFPT Fitness test: One mile run/ Beep test, Sit-Up 60 sec, Sit and reach, Modified pull-ups. Major games, Rules and regulations of important game, Skill development in any one of the game, Hockey, Volley ball, Hand ball and Kho-Kho. Indoor games, Participation in one of the indoor games–(Table Tennis & Badminton). Athletic events, Rules & regulations of athletic events participation in any one of the athletic events, Triple jump, Discus throw and Javelin throw. NOTE: (one to be selected, major games, indoor games and Athletic events)

9. FNCC 121 NCC-II 1(0+1)

Weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush.

9. FNSS 121 NSS-II 1(0+1)

Socio-economic structure of Indian society- population problems- brief of Five Year Plan. Functional literacy- non-formal education of rural youth- eradication of social evils- village adoption continued.

1. NRM 211 Environmental Studies and Disaster Management 3(2+1)

Theory

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

Practical

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

Theory Lecture Outline

Lect.	Topic to be Covered
1	Environmental conservation and management – introduction-scope, objectives.
2	Natural Resources: Renewable and non-renewable resources; Natural resources and associated problems. Forest resources.
3	Water resources: Use and over-utilization of surface and ground water; Floods; Drought; Conflicts over water; Dams-benefits and problems.
4	Mineral resources: Use and exploitation; Environmental effects of extracting and using mineral resources; Case studies.
5	Food resources: World food problems; Changes caused by agriculture and overgrazing; Effects of modern agriculture; Fertilizer-pesticide problems; Water logging; Salinity; Case studies.
6	Energy resources: Growing energy needs; Renewable and non-renewable energy sources; Use of alternate energy sources; Case studies.
7	Land resources: Land as a resource; Land degradation; Man induced landslides; Soil erosion and desertification.
8	Role of an individual in conservation of natural resources; equitable use of resources for sustainable lifestyles.
9	Ecosystem components – structure and composition. Major ecosystems in general. Major terrestrial ecosystems-types and components. Aquatic ecosystems- types and components.
10	Ecological succession: Primary, Secondary succession, theories of succession
11	Biodiversity Introduction, definition, genetic, species and ecosystem diversity and biogeographical classification of India; Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values; Biodiversity at global, national and local levels; India as a mega-diversity nation; Hot-spots of biodiversity;
12	Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; Endangered and endemic species of India; Conservation of biodiversity: <i>In-situ</i> and <i>Ex-situ</i> conservation of biodiversity
13	Pollution-introduction-Air pollution-classification -primary and secondary-causes and

	effects. Control mechanism.
14	Acid rains, ozone layer depletion- global warming-prevention and control.
15	Noise pollution – classification of noise- causes and effects--prevention and control
16	Water pollution: classification-Point source and diffused source- –causes and effects- Pollution of rivers, ocean and other water sources-prevention and control
17	Soil pollution- classification--causes and effects- prevention and control
18	Solid waste management: causes, effects and control measures of urban and industrial wastes;
19	Social issues and the environment; From unsustainable to sustainable development; Urban problems related to energy; Role of an individual in prevention of pollution; Pollution case studies.
20	Water conservation, rain water harvesting, watershed management.
21	Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation; Consumerism and waste products
22	Environmental policies and Laws: Environment Protection Act; Air (Prevention and Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act;
23	Environmental policies and Laws: Issues involved in enforcement of environmental legislation; Public awareness.
24	Human population and environment: population growth, variation among nations, population explosion, Family Welfare Programme; Environment and human health: human rights, value education, HIV/AIDS; Women and child welfare; Role of information technology in environment and human health; Case studies.
25	Natural disasters - Meaning and nature of natural disasters; their types and effects.
26	Natural disasters: Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves; Climatic change: global warming, sea level rise, ozone depletion
27	Man-made disasters - Nuclear disasters, chemical disasters, biological disasters,
28	Man-made disasters -Building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation,
29	Man-made disasters: Industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.
30	Disaster management - Efferts to migrate natural disaster at national and global levels; International strategy for disaster reduction;
31	Concept of disaster management; National disaster management framework; Financial arrangements
32	Role of NGOs, community-based organizations and media; Role of central, state, district and local administration; Armed forces, police and other organizations in disaster response.

Practical Class Outline

Class	Practical
1	Visit to a local area to study and identify common Tree species
2	Visit to a local area to study and identify common Medicinal Plants and weeds
3	Visit to a local area to study and identify common Insects
4	Visit to a local area to study and identify common Birds
5	Visit to Agro-ecosystem/forest and enlist different components
6	Visit to a Grass land ecosystem and enlist different components
7	Visit to a water pollution site and enlist different components
8	Estimation of total suspended solids in effluent sample
9	Estimation of total dissolved solids in effluent sample and calculation of total solids in effluent sample
10	Estimation of pH and Electrical conductivity of effluent sample
11	Estimation of dissolved oxygen (DO)/ BOD in effluent sample
12	Estimation of Ascorbic acid content of leaves of different tree species
13	Estimation of relative water content of leaves of different tree species
14	Estimation of pH of aqueous leaf extract of different tree species
15	Estimation of total chlorophyll content of leaves of different tree species
16	Estimation of Air Pollution Tolerance Index of different tree species
17	Estimation of Dust accumulation on leaf surfaces of different trees species

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3. Kaushik A and Kaushik C. P. Prospectives in environmental studies. New Age International Publisher.
4. Gupta h. K. Disaster management, Orient Black swan Pvt. LtdGupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.
5. Hodgkinson PE & Stewart M. 1991. Coping with catastrophe. Handbook of Disaster Management. Routledge.
6. Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.

2. NRM 212

Forest Survey & Engineering

3(2+1)

Theory

Forest survey, scope and types of surveying, chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check and tie lines; ranging of survey lines; offsets and their types; chain of sloppy grounds, chaining across obstacles; cross staff surveying, Areas of irregularly bounded fields, different methods; Simpson's, trapezoidal rule; compass surveying, chain and compass traversing, magnetic and true bearing, prismatic compass, local attraction. Computation of interior angles and balancing of closed traverse. Plane table surveying; plane table and its accessories, methods of plane table surveying. Leveling: terms used types of level. Theodolite and its uses. Contour surveying

buildings materials, types, strength and characteristics, site selection for building construction, forest roads, alignment, construction and drainage; retaining walls, breast wall, water ways and culverts; bridges, types, selection of site, simple wooden beam bridge, check dams, spurs, farm ponds, earth dams.

Practical

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

Theory Lecture Outline

Lect.	Chapter
1.	Forest survey, scope and types of surveying
2.	Chain surveying, types
3.	Chain surveying- instruments used
4.	Traversing
5.	Traversing
6.	Ranging of survey lines
7.	Offsets and their types
8.	Chain survey of slopy grounds
9.	Chaining across obstacles
10.	Cross staff surveying
11.	Areas of irregularly bounded fields, different methods
12.	Simpson's, trapezoidal rule
13.	Compass surveying
14.	Chain and compass traversing
15.	Magnetic and true bearing
16.	Prismatic compass, local attraction
17.	Computation of interior angles and balancing of closed traverse
18.	Plane table surveying; plane table and its accessories
19.	Methods of plane table surveying
20.	Leveling: terms used types of level
21.	Theodolite and its uses
22.	Contour surveying
23.	Buildings materials- types
24.	strength and characteristics
25.	Site selection for building construction
26.	Forest roads, alignment
27.	Forest roads construction
28.	Drainage
29.	Retaining walls, breast wall
30.	Water ways and culverts
31.	Bridges , types, selection of site, simple wooden beam bridge
32.	Check dams, spurs, farm ponds, earth dams.

Practical Class Outline

Class	Practical
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1.	Chain surveying
2.	Compass traversing
3.	Plane table surveying
4.	Leveling
5.	Calculations of earth work for construction of forest roads
6.	Calculations of earth work for construction of forest earth dams
7.	Alignment of forest roads
8.	Allignment of forest roads
9.	Preparation building plans
10.	Preparation building plans
11.	Design of water ways
12.	Design of water ways
13.	Design of simple wooden beam bridge
14.	Design of retaining walls
15.	Design of check dams
16.	Design of check dams

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

3. NRM 213

Soil Biology & Fertility

3(2+1)

Theory

Introduction , forest soils vs. cultivated soils, special features of forest soils, forest soil formation and vegetation development. Pedogenic processes. Podzolization and Laterization. Properties of soils under different forest ecosystems. Forest floor, stratification, types of humus. Essential nutrient elements, occurrence, availability and their functions. Diagnosis of nutrient deficiencies, visual symptoms, soil fertility evaluation methods. Site productivity and nutrient cycling in forest soils. N, P and K, macro and micronutrient fertilizers and their uses. Forest soil , biology, distribution of various microorganisms in soil ecosystem and their interaction effects. Role of microorganisms in soil fertility. Mineral transformations, carbon cycle with reference to organic matter decomposition and humus formation, Microbial degradation of cellulose & lignin. Bio,fertilizers, their importance. Nitrogen fixation, Rhizobium,tree legume symbiosis, Frankia X non-legume symbiosis, asymbiotic and associative N₂ fixation. Nitrification and denitrification in forest ecosystems. Microbial transformation of phosphorous, sulphur, and micronutrients. Mycorrhizae: types, biology and importance with specific relevance to tree crops and mobilization of phosphorus and micro-nutrients. Rhizosphere and phyllosphere concept. Fertility management of forest soils. Integrated nutrient management in plantation forestry.

Practical

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

litter by CO₂ – evolution method; Estimation of nitrification rate in soil; Isolation of legume bacteria and Azotobacter; Preparation and inoculation techniques for mycorrhizae and biofertilizers.

Theory Lecture Outline

Lect.	Course Break-up
1	Introduction, Forest soil and biology
2	Distribution of various micro-organisms in soil
3	Role of micro-organisms in soil fertility
4	Role of micro-organisms in soil fertility
5	Mineral transformation
6	Introduction, forest soils vs. cultivated soils, special features of forest soils
7	Forest soil formation and vegetation development, podzolization and laterization
8	Properties of soils under different forest ecosystems, forest floor-stratification- types of humus
9	Essential elements, occurrence, availability and their functions
10	Nitrogen
11	Phosphorus
12	Carbon cycle and Organic matter decomposition
13	Humus formation
14	Potassium
15	Sulphur
16	Revision for midterm examination
17	N fertilizers and their uses
18	Biofertilizers and their importance
19	Microbial degradation of cellulose and lignin
20	P fertilizers and their uses
21	Nitrogen fixation, Rhizobium tree legume symbiosis, frankia, non legume symbiosis, asymbiotic and associative N fixation
22	K fertilizers and their uses
23	Micronutrient fertilizers and their uses
24	Nitrification and Denitrification in forest ecosystems
25	Microbial transformation of phosphorus and Sulphur
26	Diagnosis of nutrient deficiencies, visual symptoms and soil fertility evaluation method
27	Site productivity and nutrient cycling in forest soils
28	Mycorrhizae : types, biology, rhizosphere and phyllosphere concept
29	Importance with specific relevance to tree crops and mobilization of phosphorus and micronutrients
30	Fertility management of forest soils
31	Integrated nutrient management in plantation forestry
32	Revision for Final examination

Practical Class Outline

Practical	Course Break-up
1	Study of forest soil profile
2	Determination of soil pH
3	Determination of electrical conductivity in soil
4	Determination of organic carbon
5	Determination of available nitrogen in soil
6	Determination of available potassium in soil

7	Basic sterilization techniques, culturing and maintenance of micro-organisms occurring
8	Study the staining methods
9	Determination of available phosphorus in soil
10	Study the decomposition of forest litter by CO ₂ evolution method
11	Estimation of nitrification rate in soil
12	Determination of available sulphur in soil
13	Determination of calcium and magnesium in soil
14	Isolation of legume bacteria and azotobacter
15	Preparation and inoculation techniques for mycorrhizae and biofertilizers
16	Revision class for Practical examination

Suggested book reading:

1. Brady, N.C. The Nature and Properties of Soils. Mac Millan Pub. Comp. New York
2. Burges, A. and Raw, F. 1967. Soil biology. Acad. Press, New York
3. Mengel, K. and Kirkby, A. 1978. Principles of Plant Nutrition. International Potash Institute, Switzerland
4. Prichett and Fisher RF 1987. Properties and management of forest soils. John Wiley, New York
5. Tisdale, L.S. Nelson, L.W and Beaton, J.D. 1985. Soil fertility and Fertilizers. Macmillan Publishing company, New York
6. Young, A. 1989. Agroforestry for soil conservation. CAB International, U.K

4. NRM 214**Forest Ecology and Biodiversity****3(2+1)****Theory**

Historical development of ecology as a science. Levels of biological organization. Major forest Ecosystem. Forest environment, major abiotic and biotic components and their interaction, Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow. Population ecology, definition, population dynamics and carrying capacity, preparation of life table and its importance in forest management. Community ecology, species interactions, ecological succession, terminology, basic concepts, theories of succession, climax vegetation types- forest management and succession. Island Biogeography. Autecology of important tree species. Perturbation ecology- Biodiversity and conservation – definition- levels of study- distribution of diversity in life forms- hotspots of biodiversity- measurement of diversity and diversity indices. Principles of conservation biology- Ex-situ and In-situ methods of conservation, Genetic and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide.

Practical

Study of ecological modifications in plants; Effects of fire on forest ecosystem; Study of population dynamics; Preparation of Species diversity tables; Study of spatial dispersion among plants; Study of Forest composition; Computation of diversity indices; Measurement of diversity of plants and insects in a nearby forest; Study of succession in field and water bodies; Visit to different ecosystems.

Theory Lecture Outline

Class	Course covered
1.	Introduction, historical development of ecology as a science.
2.	Levels of biological organization.
3.	Major Forest Ecosystem.
4.	Forest environment, major abiotic and biotic components and their interaction
5.	Nutrient cycling, trophic levels, food webs
6.	Ecological pyramids and energy flow

7.	Population ecology , definition, population dynamics and carrying capacity
8.	Population ecology , definition, population dynamics and carrying capacity
9.	Preparation of life table and its importance in forest management
10.	Community ecology, species interactions,
11.	Community ecology, species interactions,
12. -13	Ecological succession: terminology, basic concepts, theories of succession, climax & vegetation types
13.	Forest management and succession
14.	Island Biogeography.
15.	Auto-ecology of important tree species.
16.	Perturbation ecology
17.	Biodiversity and conservation – definition, levels of study- distribution of diversity in life forms
18.	Status of biodiversity in World and India
19.	Importance of biodiversity
20.	Valuation of biodiversity
21.	Measurement of diversity and diversity indices.
22.	Hotspots of biodiversity principles, status in India and world
23.	Threats of biodiversity
24.	Principles of conservation biology
25.	Application ecological principles in biodiversity conservation
26.	Ex-situ and In-situ methods of conservation,
27.	Genetic and evolutionary principles in conservation
28.	Genetic and evolutionary principles in conservation
29.	Genetic and evolutionary principles in conservation
30.	Biosphere concept. Conservation – efforts in India Protected area network, conservation projects
31.	Biosphere concept. Conservation – efforts in India and worldwide.

Practical Class Outline

Class	Experiment
1	Quantitative parameters for plant community,
2	Physiognomic method of studying vegetation
3	Quadrat method of studying vegetation
4	Transact method of studying vegetation
5	Loop method of studying vegetation
6	Point method of studying vegetation
7	Study of Raunkaier;s Life form in a habitat
8	Preparation of Species diversity tables IVI, A/F, Cd etc. in a forest
9	Preparation of Species diversity tables IVI, A/F, Cd etc. in a pasture
10	Plant diversity study in an aquatic ecosystem
11	Regeneration study of dominant tree species in a forest
12	Preparation of life table of dominant tree species in a forest
13	Calculation of primary production in an ecosystem
14	Visit to forest ecosystems and quantitative study of community structure.
15	Study of succession in field/ water bodies
16	Visit to different forest/mangrove ecosystem.
17	Visit to different forest/mangrove ecosystem.

References::

1. Odum EP 1983. Basic Ecology. Saunders College Publishing, Philadelphia etc. 613p
2. Misra KC 1974. Manual of Plant Ecology. Oxford & IBH Pub Co. New Delhi etc. 491p
3. Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw, Hill Pub. Co. New Delhi, 404p
4. Montagnini, F and Jordan, C.F. 2005. Tropical Forest Ecology: The Basis for Conservation and Management. Springer. 295p.
5. Frankel, O.H., Brown, A.H.D., Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p
6. Sagwal, S.S. 1995. Forest Ecology of India. Pioneer Publishers, India. 368p
7. Sahoo, A.K. 2011 The Text book of Forest Ecology, Biodiversity and Conservation. IBD, Dehradun.

5. FBT 211**Tree Improvement****3(2+1)****Theory**

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

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

Practical

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

Theory Lecture Outline

Lecture	Chapter	Details
1.	Introduction – history and development of tree improvement	Introduction – history and development of tree improvement
2.	its relation to other disciplines of forestry	its relation to other disciplines of forestry
3.	Reproduction in forest trees.	Reproduction in forest trees. Anthesis and pollination – their importance in tree breeding
4.		Reproduction in forest trees. Anthesis and pollination – their importance in tree breeding
5.	Incompatibility and sterility	Incompatibility and sterility

6.	Quantitative inheritance.	Quantitative inheritance. Relevance in forestry
7.	Variation	Interaction components of variation - heritability and genetic advance
8.	Genetic basis of tree breeding	Genetic basis of tree breeding
9.	Natural variability in trees	Natural variability in trees – types and importance., forces that change variability
10.	Exotic forestry	Exotic forestry
11.	Provenance testing, Selection	Provenance testing, Selection
12.	seed production areas	seed production areas
13.	seed orchards	seed orchards
14.	Progeny trial and improvement of seed orchards.	Progeny trial and improvement of seed orchards. Combining ability and genetic gain
15.	Hybridization in trees	Hybridization in trees – back cross breeding
16.	Doubt clearance class	Doubt clearance class
17.	Heterosis breeding	heterosis breeding
18.	Breeding for resistance to insect pest's diseases	Breeding for resistance to insect pest's diseases
19.	Breeding for resistance	Breeding for resistance to insect pest's diseases, air pollution
20.	Breeding for wood properties	Breeding for wood properties
21.	Vegetative propagation and clonal forestry	Vegetative propagation and clonal forestry
22.	Conservation of forest tree germplasm	Conservation of forest tree germplasm
23.	Recent techniques in tree improvement.	Recent techniques in tree improvement.
24.	Mutation breeding	Mutation breeding
25.	Ploidy breeding	Ploidy breeding
26.	Breeding of self pollinated crops	Breeding objectives and concepts of breeding in self pollinated crops
27.	Breeding of cross pollinated crops	Breeding objectives and concepts of breeding in cross pollinated crops
28.	Breeding of vegetatively propagated crops	Breeding objectives and concepts of breeding in vegetatively propagated crops
29.	Breeding of important tree species.	Breeding of important tree species. Breeding procedures for development of hybrids- / varieties of various crops
30.	DUS testing.	DUS testing. Concepts of Geographical indications
31.	Artificial hybrids in trees	Artificial hybrids in trees-crossing in trees, problems and perspectives-crossing hybrids and hybrid breakdown
32.	Hybrid nomenclature in trees.	Hybrid nomenclature in trees. Future of hybrid in applied tree improvement

Practical Class Outline

Class	Practical
1.	Floral biology in some important species
2.	Phonological observations in some important species
3.	Pollen morphology. Estimation of pollen sterility and viability
4.	Pollen morphology. Estimation of pollen sterility and viability
5.	Emasculation and hybridization in forest tree species
6.	Emasculation and hybridization in forest tree species
7.	Different breeding methods, flow chart

8.	Different breeding methods, flow chart
9.	Different breeding methods, flow chart
10.	Recording observations in provenance trial
11.	Estimation of phenotypic and genotypic coefficient of variation
12.	Estimation of genetic advance, heritability
13.	Estimation of GCA.
14.	Exercise in plus tree selection
15.	Exercise in plus tree selection, recording data, design and observation in teak, eucalyptus seed orchard
16.	Exercise in plus tree selection, recording data, design and observation in teak, eucalyptus seed orchard

References::

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2. Surendran, C., Sehgal, R.N. and Parmathma, M. (Eds.) (2003). A text book of Forest Tree Breeding. ICAR, New Delhi.
3. Wright- J. (2012). Introduction to Forest Genetics. Elsevier.
4. Zobel, B. and Talbert, J. (2003). Applied Forest Tree Improvement. Blackburn Press.

6. SAF 211 Principles of Agroforestry**3(2+1)****Theory**

Overview of the Agriculture scenario – its structure and constraints. Concept of sustainable agriculture and land use management. Paradigm shift in Agriculture development, impacts of green revolution. Agro-biodiversity – significance, threats and conservation strategies. Agroforestry – definition and scope, rising demands of fuel wood, fodder and timber. Social- ecological- and economic reasons for agroforestry. History of agroforestry. Components of Agroforestry. Provisioning and regulator services of agroforestry. Nutrient cycling. Soil improvement- Increased production and productivity. Microclimate amelioration and carbon sequestration. Tree-crop interaction in agroforestry– Definition, kind of interaction, Positive interactions, complimentary, compatibility, mutualism, commensalism. Negative interactions – allelopathy and competition. Interaction management - Aboveground and belowground interactions. Manipulation of density, space, crown and roots. Tree Management – structure and growth of trees, crown and root architecture, agroforestry practices to minimize negative interaction, coppicing, thinning, pollarding and pruning. Crop planning and management –selection of suitable crops, management of nutrients, water and weeds. Classification of agroforestry systems – National Agroforestry Policy 2014, National and International organizations in Agroforestry.

Practical

Visit to social / Urban / Community forestry plantations and study their impact on socioeconomic status of rural people- Traditional agroforestry systems in the country and visits to some of the local agroforestry systems. Agroforestry systems in different agroecological zones their structural and functional features. Visit to on farm agroforestry models. Studies on fodder banks and live fences. Studies on light and below ground interactions in agroforestry systems- MPTs and Nitrogen fixing trees in agroforestry- Studies on allelopathy- Design & Diagnostics exercise in agroforestry- Land capability classification of various topographic regions- Visit to industrial plantations.

Theory Lecture Outline

Lecture	Topic
1	Overview of the Agriculture scenario.... -
2	Overview of the Agriculture scenario
3	its structure and constraints

4	Concept of sustainable agriculture
5	Concept of sustainable agriculture and land use management.
6	Paradigm shift in Agriculture
7	impacts of green revolution
8	impacts of green revolution
9	Agro-biodiversity –
10	Agro-biodiversity – significance, threats and conservation strategies
11	Agroforestry – definition and scope
12	rising demands of fuel wood, fodder and timber
13	Social- ecological- and economic reasons for agroforestry
14	History of agroforestry.
15	Components of Agroforestry.
16	Provisioning and regulator services of agroforestry
17	Nutrient cycling. Soil improvement-
18	Increased production and productivity.
19	Microclimate amelioration and carbon sequestration
20	Tree-crop interaction in agroforestry–
21	Definition, kind of interaction, Positive interactions, complimentary, compatibility, mutualism, commensalism
22	Negative interactions – allelopathy and competition.
23	Interaction management
24	Aboveground and belowground interactions.
25	Manipulation of density, space, crown and roots.
26	Tree Management – structure and growth of trees, crown and root architecture,
27	agroforestry practices to minimize negative interaction, coppicing, thinning, pollarding and pruning.
28	Crop planning and management
29	selection of suitable crops, management of nutrients, water and weeds
30	Classification of agroforestry systems
31	National Agroforestry Policy 2014,
32	National and International organizations in Agroforestry.

Practical Class Outline

Practical	Practical
Practical 1	Visit to social / Urban / Community forestry plantations and study their impact on socioeconomic status of rural people-
Practical 2	Visit to social / Urban / Community forestry plantations and study their impact on socioeconomic status of rural people
Practical 3	Visit to social / Urban / Community forestry plantations and study their impact on socioeconomic status of rural people
Practical 4	Traditional agroforestry systems in the country and visits to some of the local agroforestry systems.
Practical 5	Traditional agroforestry systems in the country and visits to some of the local agroforestry systems.
Practical 6	Traditional agroforestry systems in the country and visits to some of the local agroforestry systems.
Practical 7	Agroforestry systems in different agroecological zones their structural and functional features.

Practical 8	Visit to on farm agroforestry models.
Practical 9	Studies on fodder banks and live fences..
Practical 10	Studies on light and below ground interactions in agroforestry systems-
Practical 11	MPTs and Nitrogen fixing trees in agroforestry- Studies on allelopathy-
Practical 12	Design & Diagnostics exercise in agroforestry-
Practical 13	Land capability classification of various topographic regions-
Practical 14	Visit to industrial plantations

References::

1. Huxley, P.A. 1983 (ed). Plant Research and Agroforestry- ICRAF- Nairobi- Kenya. Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.
2. Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science. The Netherlands: 307p
3. Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw- Hill Pub. Co. New Delhi.
4. Nair- P.K.R., Rao MR. and Buck, L.E (eds). 2004. New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry. Kluwer, Dordrecht, The Netherlands.
5. Nair- P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers- Dordrecht- The Netherlands.
6. Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
7. Nair, P.K.R., Kumar- B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. J. Plant Nutr. Soil Sci. 172: 10–23.
8. Nanda, S.S. 2016.(ed.) Integrated Farming System Practices: Challenges and Opportunities, NIPA, New Delhi
9. Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.
10. Patra, A.K. 2013. Agroforestry : Principles and Practices. NIPA. New Delhi.

7. SAF 212

Forest Mensuration

3(2+1)

Theory

Forest Mensuration - Definition and objectives. Scales of measurement, Units of measurements. Precision- bias and accuracy. Diameter and girth measurements, Breast height measurements, instruments used. Measurement of height-Definitions, Methods of measurement of height . in occular- non instrumental and instrumental methods. Sources of error in height measurements of leaning trees. Tree stem form, Metzgr's theory, form factor, types of form factor, form height for quotient, form class. Volume measurements of standing trees, logs, branch wood-formulae involved. Volume tables preparation -graphical method, regression method. Determination of growth of trees- Increment, CAI & MAI, increment percent-increment borer, Stump analysis, Stem analysis. Measurement of tree crops- objects, crop diameter, crop height, crop age, crop volume.

Practical

Determination of pace length, Measurements of diameter, girth and basal area of trees using Callipers, Tape, Ruler, Penta Prism Tree Calliper etc. Measurement of height using non instrumental method. Preparation and use of simple height measuring instruments- Christens Hypsometer, Smithies Hypsometer, Modified Smithies Hypsometer, Measurement of tree height using instrumental methods, Abneys level, Haga altimeter, Relaskop, Clinometer, Blumeleiss

Hypsometer, Laser Hypsometer, Volume determination of standing and felled trees. Exercise on Stump analysis. Exercise on stem analysis. Annual ring counting using ring borer. Preparation of volume tables - local volume table.

Objective: To develop understanding of students about tree measurements, tree crop measurements and yield concepts.

Theory Lecture Outline

Lect.	Topics to be covered
1	Introduction. Definition and objectives of forest mensuration
2	Scales/Units of measurement- Precision, bias and accuracy
3	Measurement of single tree: Diameter and girth measurements- Breast height measurements
4	Instruments used in measuring diameter and girth. Comparison between tape and calliper measurements
5	Measurement of upper stem diameter and use of instruments such as Ruler, Finish Parabolic Calliper, Relaskop, Pentaprism
6	Measurement of bark thickness. Measurement of under bark diameter and girth. Measurement of crown width
7	Measurement of tree height- Definitions, Methods of measurement of height: ocular, non-instrumental and instrumental methods
8	Height measurement employing geometric and trigonometric principles
9	Height measurement by different instruments
10	Height measurement of leaning trees. Sources of error in height measurement
11	Measurement of cross sectional area, basal area and bole surface area
12	Tree stem form - Metzger's theory and methods of studying form
13	Form factor- types of form factor, form height; form quotient and form class
14	Volume measurement of trees: volume estimation of felled trees-logs and formulae involved
15	Volume measurement of branch wood, pulp wood, charcoal, bark and root
16	Pre-Midterm examination revision and doubt clearance
17	Volume estimation of standing trees - methods
18	Volume tables- definition and their classification (general, regional and local volume tables)
19	Preparation of volume tables: methods - graphical method-regression method
20	Preparation of local volume table
21	Preparation of general volume table
22	Biomass measurement.
23	Determination of age of trees: age of standing trees and age of felled trees.
24	Determination of growth of trees- Increment
25	CAI & MAI
26	Increment percent
27	Increment boring
28	Stump analysis
29	Stem analysis
30	Measurement of tree crops-objects, crop diameter and crop height
31	Measurement of crop age and crop volume
32	Pre-Final examination revision and doubt clearance

Practical Class Outline

Class	Topics to be covered
1	Measurement of DBH and GBH over bark
2	Measurement of bark thickness and crown width
3	Measurement of DUB and GUB and basal area
4	Measurement of upper stem diameter
5	Measurement of tree height by non-instrumental methods
6	Preparation and use of height measuring instruments - Christen's hypsometer and Smithy's hypsometer
7	Measurement of tree height by Abney's level and Ravi altimeter
8	Measurement of tree height by Haga altimeter, Relaskop and other instruments
9	Measurement of height of leaning trees
10	Volume determination of felled trees
11	Volume estimation of standing trees
12-13	Preparation of local volume table
14	Exercise on Stump analysis
15	Exercise on Stem analysis
16	Increment boring and age determination

References:

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

8. FPE 211 Physical Education-III 1(0+1)1

Practical

Lifestyle diseases & dietary and lifestyle changes that reduce the incidence of chronic diseases. Obesity, Coronary heart diseases (CAD), ischemic stroke Diabetes Mellitus, Blood pressure, Osteoporosis. Injuries–Injuries in sports. Prevention of sports injuries. First aid training in sports, Sprain, Fractures, Burns, Snakebite, Drowning, Unconscious victim, First aid ABC, First aid CPR, Sling and Splint and carrying techniques. Yoga continuation. Major games, Rules & regulation of important games, Skill development in any one of the game, Cricket, Football, Basket ball, Volley Ball and Net ball. Athletic events, Rules & regulations of athletic events–participation in any one of the athletic events, short & long distance running. Any one to be selected major games and Athletics events. Adventure training, On Land– Trekking, High Altitude Trekking, Rock Climbing, Mountaineering. In water, River Crossing.

9. FNCC 211 NCC-III 1(0+1)

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

9. FNSS 211 NSS-III 1(0+1)

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

1. SAF 221**Forest Management****3(2+1)****Theory**

Definition- scope, objective and principles of forest management, organization of state forests. Sustained yield-definition, principles and limitations. Sustainable forest management-criteria and indicators. Increasing and progressive yields. Rotation –definitions, various types of rotations, length of rotations, choice of type and kind of rotation. Normal forest-definitions, basic factors of normality. Factors governing the yield and growth of forest stands. Working plan-preparations objectives and uses forest maps and their uses. Joint forest management-concept and principles. Modern tools in forest management. Introduction to the concept of forestry as a common property resource. Definition, Scope and necessity of community forestry. Forests and man- Forestry in support to agriculture, animal husbandry and horticulture, development of cottage industry in rural environment, NFP 1988 and the importance of people in forest conservation. Community forest management- Community forest development, social economical and environmental aspects. Community forest development through NGOs, civil societies, citizen groups. Gender dimensions in Community forest management. Social Forestry- definition, NCA report of 1976, need and purpose. Social Forestry for fodder production – fuel wood, leaf manure, timber production. Integrated rural development approach – with proper marketing facility, employment generation in raising, tending and harvesting of tree crops. Place of social forestry in the national forest policy of India, role of forest department.

Practical

Visit to different forest divisions to study the various stand management aspects including thinning- felling and sale of timber. Study forest organizational set up and forest range administration including booking of offences. Visit to forest plantation. Field Exercise for the estimation of actual growing stock volume. Field visit to JFM operational areas. Study the different field exercises for data collection for working plan.

Theory Lecture Outline

Lect.	TOPICS (THEORY)
1	Introduction - definition scope and object.
2	Forest Organization in state
3	Sustained yield-definition, principles and limitations.
4	Sustainable forest management-criteria and indicators.
5	Increasing and progressive yields.
6 -7	Rotation –definitions, various types of rotations, length of rotations, choice of type and kind of rotation
8	Normal forest-definitions, basic factors of normality.
9	Factors governing the yield and growth of forest stands.
10 - 11	Working plan: Its preparation, objectives and uses forest maps and their uses.
12	Joint forest management-concept and principles.
13	Modern tools in forest management.
14	Introduction to the concept of forestry as a common property resource.
15	Definition, Scope and necessity of community forestry.

16	Doubt clearing class before midterm examination.
17 -18	Forests and man- Forestry in support to agriculture, animal husbandry and horticulture, development of cottage industry in rural environment.
19 -20	NFP 1988 and the importance of people in forest conservation.
21 -22	Community forest management- Community forest development, social economical and environmental aspects.
23 - 24	Community forest development through NGOs, civil societies, citizen groups.
25	Gender dimensions in Community forest management.
26	Social Forestry- definition, NCA report of 1976, need and purpose.
27	Social Forestry for fodder production – fuel wood, leaf manure, timber production.
28 - 29	Integrated rural development approach – with proper marketing facility, employment generation in raising, tending and harvesting of tree crops.
30	Place of social forestry in the national forest policy of India.
31	Social forestry and role of forest department.
32	Doubt clearing class before final examination.

Practical Class Outline

Class	PRACTICAL
1 - 3	Visit to different Forest division to study the various stand management aspects including thinning, felling and sale of timber.
4	Visit to Chandaka WL division to study the various stand management aspects.
5	Study forest organizational set up and its structure.
6	Study forest organizational set up and forest range administration including booking of offences.
7 - 9	Visit to nearby forest plantation.
10 - 12	Field Exercise for the estimation of actual growing stock volume in nearby forest area.
13 - 14	Field visit to JFM operational areas in Khurdha forest division.
15 -16	Study the different field exercises for data collection for working plan of nearby forest divisions.

Suggested Readings:

1. Balakathiresan, S (1986).Essentials of Forest Management. Nataraj Publishers, Dehradun.
2. Bhattacharya P., Kandya A.K. and Krishna Kumar (2008).Joint Forest Management in India. Aavishkar Publisher. Jaipur.
3. Desai, V.(1991). Forest Management in India–Issues and Problems. Himalaya Pub. House.
4. Bombay. Edmunds, Dand Wollenberg, E (2003). Essentials of Forest Management, Natraj Publishers, Dehradun.
5. Jerome L Cutteretal. (1983). Timber Management: A Quantitative Approach. John Wiley and Sons
6. National Working Plan Code (2014). Mo EF- New Delhi. Ramprakash (1986).Forest Management, IBD, Dehradun.
7. Recknagel, A and Bentley.J. (1988). Forest Management. IBD, Dehradun.
8. Trivedi, P,R and Sudarshan,K,N. (1996). Forest Management. Discovery publications, New Delhi.

2. SAF 222**Silviculture of Indian Trees****3(2+1)****Theory**

Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems stand management practices pest and diseases and economic importance of the following tree species of India. Broadleaved species: *Tectona grandis*, *Shorea robusta*, *Dalbergia latifolia*, *Dalbergia sissoo*, *Anogeissus spp*, *Terminalia spp.*, *Santalum album*, *Swietenia macrophylla*, *Albizia spp*, *Pterocarpus marsupium*, *Gmelina arborea*, *Pterocarpus santalinus*, *Azadirachta indica*, *Hopea parviflora*, *Lagerstroemia microcarpa*, Bamboos, reeds and rattan, *Quercus spp*. Conifers: *Abies pindrow*, *Picea smithiana*, *Cedrus deodara*, *Pinus roxburghii*, *Pinus wallichiana*. Fast growing MPTs: Tropical pines, *Eucalyptus spp.*, *Casuarina equisetifolia*, *Leucaena leucocephala*, *Ailanthus triphysa*, *Grevillea robusta*, *Pongamia pinnata*, *Melia dubia*, *Acacia spp*, *Populus spp*.

Practical

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

Theory Lecture Outline

Class	Topics to be covered
1	Introduction. Silviculture of important Indian tree species including origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices, pest and diseases- <i>Tectona grandis</i> .
2-3	Silviculture of <i>Tectona grandis</i>
4	Silviculture of <i>Acacia auriculiformis</i>
5	Silviculture of <i>Casuarina equisetifolia</i>
6	Silviculture of <i>Acacia nilotica</i>
7	Silviculture of <i>Santalum album</i>
8	Silviculture of <i>Dalbergia sissoo</i>
9	Silviculture of <i>Dalbergia latifolia</i>
10-11	Silviculture of <i>Shorea robusta</i>
12	Silviculture of <i>Dendrocalamus strictus</i>
13	Silviculture of <i>Bambusa bambos</i>
14	Silviculture of <i>Bambusa vulgaris</i>
15	Silviculture of <i>Eucalyptus tereticornis</i>
16	Silviculture of <i>Eucalyptus globulus</i>
17	Silviculture of <i>Hopea parviflora</i>
18	Silviculture of <i>Anogeissus latifolia</i>
19	Silviculture of <i>Terminalia arjuna</i>
20	Silviculture of <i>Terminalia tomentosa</i>
21	Silviculture of <i>Albizia lebbek</i>

22	Silviculture of <i>Leucaena leucocephala</i>
23	Silviculture of <i>Pterocarpus marsupium</i>
24	Silviculture of <i>Pterocarpus santalinus</i>
25	Silviculture of <i>Azadirachta indica</i>
26	Silviculture of <i>Gmelina arborea</i>
27	Silviculture of <i>Melia dubia</i>
28	Silviculture of <i>Swietenia macrophylla</i>
29	Silviculture of <i>Populus deltoides</i>
30	Silviculture of <i>Pinus roxburghii</i>
31	Silviculture of <i>Cedrus deodara</i>
32	Silviculture of <i>Abies pindrow</i>
33	Silviculture of <i>Pinus wallichiana</i>
34	Silviculture of <i>Picea smithiana</i>
35	Silviculture of <i>Quercus spp</i>
36	Silviculture of <i>Pinus kesiya</i>

Practical Class Outline

Class	Topics to be covered
1	Study of morphological description and field identification characters of important forest seeds (Part-I)
2	Study of morphological description and field identification characters of important forest seeds (Part-II)
3	Study of morphological description and field identification characters of important tree species (Part-I)
4	Study of morphological description and field identification characters of important tree species (Part-II)
5	Study of phenology of important tree species
6	Study of seed collection and extraction methods of important tree species
7	Study of silvicultural characters of important tree species
8	Study of natural regeneration of important tree species
9	Study of planting technique of important tree species
10	Study of growth and development of <i>Tectona grandis</i> stand
11	Study of growth and development of <i>Acacia auriculiformis</i> stand
12	Study of growth and development of <i>Bambusa vulgaris</i> stand
13	Study of growth and development of <i>Dendrocalamus strictus</i> stand
14	Study of growth and development of <i>Eucalyptus hybrid</i> stand
15	Visit of forest plantations and other woodlots to study the planting density and stand management regimes for various end uses
16	Visit of various problem areas and study on species suitability

Suggested reading:

1. Plantation Trees – R. K. Luna
2. Silviculture of Indian trees - R.S.Troup. Vol. I, II & III.
3. Monograph on Bamboo by D.N.Tewari.
4. Manual of Coniferae - J. Veltch.

3. FPU 221**Wood Products and Utilization****3(2+1)****Theory**

Uses of wood. Growth of wood based industry in India, effect of globalization. Importance of forest based industries in relation to Indian economy. Wood as a source of energy and chemicals, wood as raw material for industries like pulp, paper, rayon, composite woods and improved woods. Description of different forest based industries, paper and pulp, furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes. Structural uses of Timber – bridges and other super structures. Decorative uses of wood. Introduction to wood modification, its need and scope, chemical modification of wood (acetylation, reaction with isocyanates, acetates, ethers, epoxides etc.). Primary conversion; sawing and veneering. Composite wood; plywood, laminated wood, core board, sandwich board, fibre board, particle board; manufacturing process, uses and properties. Adhesives used in manufacture of composite wood. Improved wood; compressed wood, impregnated wood etc.; manufacturing process, uses and properties. Nano technology in wood. Manufacture of rayon and match. Wood carving and handicrafts. Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast. Biochar, technology, bioenergy concepts – short rotation crops as raw materials.

Practical

Estimation of specific gravity and calorific value of wood specimens. Maceration techniques and determination of sizes of fibres, vessels etc. Visits to various wood based industries like, plywood, packing case, match, tannins, furniture, saw mills etc. to study the manufacturing process. Visit to saw mill to study veneering and different kinds of sawing. Handicraft manufacturing unit. Visit to wood distillation unit. Visit to nearby industrial plantations.

Suggested Readings:

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

Theory Lecture Outline

Lect.	LESSON	SUBJECT MATTER
1	Uses of wood.	Various utility of wood in different cottage, small scale and large scale industries
2	Growth of wood based industry in	Importance of forest based industries in relation to Indian economy, effect of globalization.
3-4	Wood as a source of raw material	Wood as a source of energy and chemicals, wood as raw material for industries like pulp, paper, rayon, composite woods
5-6	Paper and pulp Industry	Mechanical methods of pulp production,
7-10		Soda, sulphate and sulphite method of pulp production, is properties and uses
11-12	Paper and pulp Industry	Treatment of pulps and paper making
13		Types of papers

14-15	Rayon	Viscose rayon and cellulose acetate methods
16-17	Other wood based industries	Furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes. Decorative uses of wood. Wood carving and handicrafts . bioenergy concepts - short rotation crops as raw materials.
18-19	Structural uses of Timber	Bridges and other super structures
20-21	Wood modification	Introduction to wood modification, its need and scope, chemical modification of wood (acetylation, reaction with isocyanates, acetates, ethers, epoxides etc.).
22-23	Primary conversion	sawing and veneering. Saw mill: Types of sawing , saws .
24-26	Composite wood	Plywood, laminated wood, core board, sandwich board, fibre board, particle board; manufacturing process, uses and properties. Adhesives used in manufacture of composite wood.
27-29	Improved wood	Improved wood; compressed wood, impregnated wood etc.; manufacturing process, uses and properties. Nano technology in wood.
30-31	Destructive distillation of wood.	Destructive distillation of hard wood and soft wood and their byproducts.
32	Saccharification of wood	Production of wood molasses, alcohol and yeast.

Practical Class Outline

Class.	Experiment
1-6	Estimation of specific gravity of various wood specimens.
7-8	Maceration techniques and determination of sizes of fibres, vessels
9-12	Visits to various wood based industries like, plywood, packing case, furniture etc. to study the manufacturing process.
13	Visit to saw mill to study veneering and different kinds of sawing.
14	Visit to Handicraft manufacturing unit.
15-16	Visit to nearby industrial plantation

4. FPU 222 Ethnobotany, Medicinal and Aromatic Plants 3(2+1)

Theory

Definition and scope of ethnobotany. Terms employed in relation to ethnobotany and its relationship with man and domestic animals. Ethnic – people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects. Important plants and their folk uses for medicines, food, dyes, tans, etc Methods and tools in Ethnobotanical studies. Ethnobotany of tribal in Southern India. Traditional Botanical Knowledge, concepts. Major tribes of Northern, Central, North East and Andaman and Nicobar Islands. Ethnobotany of the plants from the following families. Guttiferae (Clusiaceae), Malvaceae, Fabaceae, Mimosaceae,

Caesalpinaceae, Combretaceae, Umbelliferae (Apiaceae), Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae, Thymeliaceae.

Definition, role of medicinal and aromatic plants in Indian economy, Important essential oil yielding plants in India, Detailed study of lemon grass, citronella, palmarosa, vetiver, Japanese mint, eucalyptus, jasmine, patchouli and geranium, botany, climate and soil requirements, planting cultural and manorial practices, harvesting, curing and extraction of essential oils. Medicinal plants in India and Kerala, history, origin, area and distribution, production, botany and varieties, cultivation, extraction of active principles and their uses, uses of different medicinal plants like *Atropa*, *Cinchona*, *Rauwolfia*, *Opium*, *Sandal*, *Acorus*, *Cannabis*, *Digitalis*, *Strychnos nuxvomica*, *Aconitum*, *Neem*, *Dioscorea*, *Costus*, *Solanum* etc. Cultivation practices of medicinal plants like *Adhathoda zylanica*, *Sida cordifolia*, *Sterospermum colais*, *Plumbago zylanica*, *Tinosporacordifolia*, *Kaemferia glanga*, *Indigofera tinctoria*. Conservation packages for the medicinal plants collected in wild.

Practical

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

Theory Lecture Outline

Lect.	TOPICS (THEORY)
1.	Definition and scope of ethnobotany. Terms employed in relation to ethnobotany and its relationship with man and domestic animals.
2.	Ethnic – people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects
3.	. Important plants and their folk uses for medicines, food, dyes, tans, etc
4.	Methods and tools in Ethnobotanical studies.
5.	Ethnobotany of tribal in Southern India.
6.	Traditional Botanical Knowledge, concepts.
7.	Major tribes of Northern, Central,
8.	Major tribes of North East and Andaman and Nicobar Islands
9.	Ethnobotany of the plants from Guttiferae (Clusiaceae), Malvaceae, families.
10.	Ethnobotany of the plants from Fabaceae,
11.	Ethnobotany of the plants from Mimosaceae, Caesalpinaceae, families.
12.	Ethnobotany of the plants from Combretaceae, Umbelliferae (Apiaceae), Rubiaceae,
13.	Ethnobotany of the plants from Ebenaceae, Apocynaceae, Asclepiadaceae,
14.	Ethnobotany of the plants from Lauraceae, Palmaceae, Poaceae,
15.	Ethnobotany of the plants from Liliaceae, Coniferae, Santalaceae, Thymeliaceae
16.	Doubt clearance
17.	Definition, role of medicinal and aromatic plants in Indian economy
18.	Important essential oil yielding plants in India
19.	Detailed study of botany, variety, cultivation of lemon grass,
20.	Detailed study of botany, variety, cultivation of citronella, palmarosa

21.	Detailed study of botany, variety, cultivation of , vetiver,
22.	Detailed study of botany, variety, cultivation of Japanese mint,
23.	Detailed study of botany, variety, cultivation of eucalyptus,
24.	Detailed study of botany, variety, cultivation of jasmine,
25.	Detailed study of botany, variety, cultivation of patchouli and geranium
26.	Medicinal plants in India and Odisha , history, origin, area and distribution, production, botany and varieties , cultivation, extraction of active principles and their uses , uses of different medicinal plants like <i>Atropa</i> , <i>Cinchona</i> , <i>Rauwolfia</i> , <i>Opium</i> , <i>Sandal</i> , <i>Acorus</i> , <i>Cannabis</i> , <i>Digitalis</i> , <i>Strychnos nuxvomica</i> , <i>Aconitum</i> , <i>Neem</i> , <i>Dioscorea</i> , <i>Costus</i> , <i>Solanum</i> etc.
27.	Detailed study of botany, variety, cultivation of <i>Adhathoda zylanica</i> ,
28.	Detailed study of botany, variety, cultivation of , <i>Sterospermum colais</i> , <i>Plumbago zylanica</i> ,
29.	Detailed study of botany, variety, cultivation of <i>Tinosporacordifolia</i> ,
30.	Detailed study of botany, variety, cultivation of <i>Kaemferia glanga</i>
31.	Detailed study of botany, variety, cultivation of, <i>Indigofera tinctoria</i> .
32.	Cultivation Practices of <i>Sida cordifolia</i> . Conservation packages for the medicinal plants collected in wild.

Practical Class Outline

Class.	PRACTICAL
1.	Identification of Medicinal and aromatic plants in the college of Forestry campus.
2.	Visit to AICRP on Medicinal and aromatic plants and beetle vine for cultivation
3.	Visit to medicinal Knowledge centre for studying conservation of valuable edicinal plants of state
4.	Visit to state Medicinal garden at bindusagar
5.	Visit to RPRC to study protected cultivation of Medicinal and aromatic plants
6.	Collection and preparation of herbarium specimens
7.	Identification of medicinal and aromatic plants –
8.	propagation techniques of commercially important medicinal plants
9.	propagation techniques of commercially important Aromatic plants
10.	Study of post harvest management of medicinal plants
11.	Study of post harvest management of Aromatic plants
12.	Field visit to a tribal regions to gain ethnobotanical knowledge and the inter-relation between plant and people,
13.	Survey and identification of plants used by the tribal for medicine, food and
14.	Harvesting and oil extraction of aromatic plants
15.	Field visit, collection and preparation of herbarium
16.	Visiting commercial units of medicinal plants.

Suggested Readings:

1. Atul, C.K. and Kapur, B.K. (1982). Cultivation and utilization of medicinal plants. RRL., CSIR, Jammu, Tawi.

2. Chopra, R.N., Nayar, S.L. and Chopra, I.C. (1956). Glossary of Indian medicinal plants. CSIR, New Delhi.
3. Cunningham, A. 2014. Applied Ethnobotany: "People, Wild Plant Use and Conservation". Taylor & Francis,
4. EIRI Board. (2007). Handbook of Medicinal and Aromatic Plants: Cultivation, Utilisation and Extraction
5. Ethnobotany. Principles and applications. (1997). C. M. Cotton. John Wiley and Sons Ltd. 424p.
6. Gunther, E. (1975). The essential oils. Robert, K Krieger Pub. Co., New York.
7. Jain, S.K. 2010. Manual of Ethnobotany (2nd Ed). Scientific Publishers, India, 242p.
8. Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers, Jodhpur, India, 672p.
9. Sahu, R.K., Sahoo, A.K., Sadangi, Nalini; Singh, Kalyani and Nahak, Gayatri 2011. Ethenomedicinal Plant Resources of Orissa. NIPA, New Delhi.

5. WLS 221

Ornithology & Herpetology

3(2+1)

Theory

Introduction. History of ornithology in India. Origin and ancestry of birds. A brief knowledge of bird anatomy, morphology and physiology, digestive, skeletal, respiratory, excretory systems of birds. Skeleton, feathers, skin, beak and taxidermy. Thermoregulation in birds. Bird ecology and behaviour; migration and territorial behaviour, feeding, song and nests. Eggs and egg laying. Water birds, scavenger birds, frugivorous birds, pest birds, pet birds and pollinator birds. Importance of birds to different ecosystems. Birds and man. Bird watching, Bird conservation and management in India. Important Bird areas of India, Red Data Book birds of India. Wetland conservation, Ramsar sites of India. Classification of Indian birds, birds belonging to the Orders Podicipediformes, Procellariiformes, Pelicaniformes, Ciconiiformes, Phoenicopteriformes, Anseriformes, Falconiformes, Galliformes, Gruiformes, Caradriiformes, Columbiformes, Psittaciformes, Cuculiformes, Strigiformes- Caprimulgiformes- Apodiformes- Trogoniformes- Coraciiformes- Upupiformes- Piciformes and Passeriformes.

Practical

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

Theory Lecture Outline

Lecture	Chapter	Details
1	General introduction	Definition of wildlife, branches of ornithology and herpetology
2	History	History of ornithology and herpetology in India, famous personalities
3	Origin and ancestry of birds	Evolution of birds and reptiles
4		Different evolutionary changes
5	A brief knowledge of bird anatomy, morphology and physiology	Digestive systems of birds
6		Skeletal systems of birds
7		Respiratory systems of birds
8		Excretory systems of birds
9		Skeleton, feathers, skin, beak and taxidermy
10	Thermoregulation	Thermoregulation
11		Concept of adaptation, hibernation, torpor, aestivation

12		Adaptation strategies against heat and cold
13	Bird ecology	Importance of birds to different ecosystems
14		Different ecology w.r.t. birds
15		Roles of different categories of birds in various ecosystems
16		Water birds, scavenger birds, frugivorous birds, pest birds, pet birds and pollinator birds
17	Bird behaviour	Migration and territorial behaviour
18		Behaviour: Feeding, song and nests
19		Eggs and egg laying
20	Birds and man	Bird watching
21		Bird conservation and management in India
22		Wetland conservation, Ramsar sites of India
23		Red Data Book birds of India
24		Important Bird areas of India
25	Classification of Indian birds	Podicipediformes, Procellariiformes, Pelicaniformes, Ciconiiformes, Phoenicopteriformes,
26		Anseriformes, Falconiformes, Galliformes, Gruiformes, Caradriformes, Columbiformes
27		Psittaciformes, Cuculiformes, Strigiformes, Caprimulgiformes
28		Apodiformes, Trogoniformes, Coraciiformes, Upupiformes, Piciformes and Passeriformes
29	Basic herpetology	Physiology of snakes
30		Taxonomy of snakes
31		Taxonomy of crocodiles
32		Taxonomy of tortoise, turtle

Practical Class Outline

Class	Practical
1	Field identification of major birds of India
2	Bird watching and drawings-I
3	Bird watching and drawings-II
4	Bird watching and drawings-III
5	Bird watching and drawings-IV
6	Bird watching and drawings-V
7	Bird watching and drawings-VI
8	Study of feathers of different groups of birds
9	Study of beak leg types of different groups of birds
10	Study of leg types of different groups of birds
11	Study of the nest and eggs of birds-I
12	Study of the nest and eggs of birds-II
13	Study of the nest and eggs of birds-III
14	Mist netting and tagging/marketing of birds for the bird migration studies-I
15	Mist netting and tagging/marketing of birds for the bird migration studies-II
16	Bird census techniques-I
17	Bird census techniques-II
18	Visit to different bird habitats

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6. FBT 221 Seed Technology & Nursery Management 3(2+1)

Theory

Importance of seed in present day forestry, seed and fruit development, seed dispersal. Planning seed collection. Collection of immature fruits. Methods of seed collection. Fruit and seed handling, maintaining viability and identity, special precautions for recalcitrant seeds. Seed processing- operations prior to extraction-pre-cleaning, methods of extraction, operations after extraction, cleaning, grading and control of moisture level, factors affecting drying of orthodox seeds. Seed storage- definition, purpose, recalcitrant seeds. Harrington's rule of thumb, seed maturity, parental and annual effects. Storage condition and ageing of seeds. Storage methods - Storage containers. Seed dormancy- types of dormancy, treatments for breaking exogenous and endogenous dormancy. Seed dressing and pelleting. Seed testing – definition, ISTA rules. Sampling- seed weight, moisture, authenticity, seed health. Germination testing- germination equipment- conditions for selected species. Germination evaluation- germination testing in nursery. Indirect tests of viability. Seed Act and Seed Certification. Introduction and scope of Forest nursery. Nursery establishment - site selection – planning- and layout of nursery area. Types of forest nursery- types of nursery beds- preparation of beds- fumigation. Methods of seed sowing and mulching- seedling growth and development- pricking- weeding- hoeing- rotation- organic matter supplements and cover crops- mycorrhizae- fertilization- shading- pruning- root culturing techniques- lifting windows- grading- packaging. Storing and transportation. Containerised nursery technique - advantages- disadvantages - root deformations - container designs and types/root trainers and rooting media. Conditions/practices affecting survival and early growth- acclimating containerised stock- field handling of containerised stock- planting techniques for containerized stock. Planting bare-root

seedlings: advantages- disadvantages. Methods for field handling and planting bare-root stock. Containerised nursery technique- Type and size of containers. Merits and demerits of containerized nursery. Root trainer techniques- Preparation of ingredient mixture. Study of important nursery pests and diseases and their control measures. Nursery practices for some important tree species. Target seedling concept.

Practical

Identification of seeds of tree species; Seed maturity tests; Physical purity analysis; Determination of seed moisture; Seed germination test; Hydrogen peroxide test; Tetrazolium test for viability; Seed vigour and its measurements; Methods of breaking dormancy in tree seeds; Testing membrane permeability; Study of seed collection and equipments; Planning of seed collection; Seed collection; Seed extraction; Visit to seed production area and seed orchard; Visit to seed processing unit/testing laboratory; Study of seed sampling equipments. Preparation of production and planning schedule for bare root and containerized nurseries. Nursery site and bed preparation. Pre-sowing treatments. Sowing methods of small- medium- and large sized seeds. Mother beds and transplant bed preparation- Pricking and transplanting of in transplant beds. Intermediate nursery management operations. Preparation of ingredient mixture. Filling of containers. Visit to tree nurseries.

Theory Lecture Outline

Lecture	Chapter	Details
1.	Importance of seed in present day forestry	Importance of seed in present day forestry
2.	Seed development	Seed development
3.	Fruit development	Fruit development
4.	seed dispersal	seed dispersal
5.	Planning seed collection	Planning seed collection
6.	Methods of seed collection	Collection of immature fruits. Methods of seed collection
7.	Fruit and seed handling	Fruit and seed handling
8.	Recalcitrant seeds	maintaining viability and identity, special precautions for recalcitrant seeds
9.	Seed processing	Seed processing- operations prior to extraction-pre-cleaning, methods of extraction, operations after extraction, cleaning, grading and control of moisture level
10.		Seed processing- operations prior to extraction-pre-cleaning, methods of extraction, operations after extraction, cleaning, grading and control of moisture level
11.	Orthodox seeds	factors affecting drying of orthodox seeds
12.	Seed storage-	Seed storage- definition, purpose, recalcitrant seeds. Harrington's rule of thumb
13.	Seed maturity, parental and annual effects	seed maturity, parental and annual effects
14.	Storage methods	Storage condition and ageing of seeds. Storage methods - Storage containers
15.	Seed dormancy-	Seed dormancy- types of dormancy, treatments for breaking exogenous and endogenous dormancy
16.		Seed dormancy- types of dormancy, treatments for breaking exogenous and endogenous dormancy
17.	Doubt clearance	

18.	Seed dressing and pelleting	Seed dressing and pelleting
19.	Seed testing	Seed testing – definition, ISTA rules
20.	Seed Sampling	.Sampling- seed weight, moisture, authenticity, seed health. Germination testing
21.	Germination testing	Sampling- seed weight, moisture, authenticity, seed health. Germination testing
22.	Germination equipment-	Germination equipment- conditions for selected species
23.	Indirect tests of viability	Indirect tests of viability
24.	Seed Act and Seed Certification	Seed Act and Seed Certification
25.	Forest nursery.	Introduction and scope of Forest nursery. Nursery establishment - site selection – planning- and layout of nursery area. Types of forest nursery- types of nursery beds
26.	Forest nursery.	Preparation of beds- fumigation. Methods of seed sowing and mulching- seedling growth and development- pricking- weeding- hoeing- rotation- organic matter supplements and cover crops- mycorrhizae- fertilization- shading- pruning- root culturing techniques- lifting windows- grading- packaging. Storing and transportation. Storing and transportation
27.		Containerised nursery technique - advantages- disadvantages - root deformations - container designs and types/root trainers
28.		Rooting media, Conditions/practices affecting survival and early growth- acclimating containerised stock- field handling of containerised stock- planting techniques for containerized stock. Planting bare-root seedlings: advantages- disadvantages. Methods for field handling and planting bare-root stock.
29.		Containerised nursery technique- Type and size of containers. Merits and demerits of containerized nursery. Root trainer techniques- Preparation of ingredient mixture
30.	Study of important nursery pests and diseases and their control measures	Study of important nursery pests and diseases and their control measures
31.	Nursery practices for some important tree species	Nursery practices for some important tree species
32.	Target seedling concept doubt clearance	Target seedling concept doubt clearance

Practical Class

Class	Practical
1.	Identification of seeds of tree species
2.	Seed maturity tests
3.	Physical purity analysis
4.	Determination of seed moisture
5.	Seed germination test; Hydrogen peroxide test; Tetrazolium test for viability
6.	Seed vigour and its measurements
7.	Methods of breaking dormancy in tree seeds, Testing membrane permeability

8.	Study of seed collection and equipments
9.	Planning of seed collection; Seed collection; Seed extraction
10.	Visit to seed production area and seed orchard
11.	Visit to seed processing unit/testing laboratory
12.	Study of seed sampling equipments
13.	Preparation of production and planning schedule for bare root and containerized nurseries
14.	Nursery site and bed preparation
15.	Pre-sowing treatments. Sowing methods of small- medium- and large sized seeds. Mother beds and transplant bed preparation- Pricking and transplanting of in transplant beds. Intermediate nursery management operations
16.	Visit to tree nurseries

Suggested Readings:

1. Agrawal, R.L. 1986. Seed Technology. Oxford , IBH Publishing Co. New Delhi
2. Ahuja, P.S. et al. 1989. Towards developing "Artificial Seeds" by shoot and root encapsulation. In: Tissue Culture and Biotechnology of Medicinal and Aromatic Plants. CIMAP, Lucknow- India- P. 22-28.
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4. Bose, T.K; Mitra- S.K. and Sadhu- M.K. 1986 Propagation of tropical and sub tropical Horticultural crops. Naya Prakash- Calcutta
5. Chin, H.F. and Roberts, E.H. 1980. Recalcitrant Crop Seeds. Tropical Press Sdn. Bhd. Kuala Lumpur - 22-03- Malaysia
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16. Prakash, R. 1990. Propagation Practices of Important Indian Trees. International Book Distributors, Dehra Dun.
17. Schmidt, L. 2000. Guide to Handling Tropical and Subtropical Forest Seed. Danida

7. NRM 221 Rangeland and Livestock Management 2(1+1)

Theory

Definition, scope and importance ,cattle and fodder resources of India, grassland types of India and their distribution ,ecological status of Indian grasslands ,principles of grassland management for maximizing forage yield and quality. Feeding habit and grazing behavior of range animals. Carrying capacity ,definition, method of calculation. Establishment and management of grasslands ,selection of species, planting, cultural practices ,liming, fertilizer application, burning, weed control, grazing and cutting intensity. Storage of fodder ,silage and hay ,methods of preparation ,hay banks, Fodder trees and shrubs, Forest grazing. Definition and importance of Livestock management. Important breeds of important livestock eg. Cattle, buffalo, sheep and goat. Breeding and reproductive management for higher productivity. Feeding management ,types of feedstuffs available for feeding livestock, methods of feeding. Assessing nutritive value of feed and fodder, estimation of digestible nutrients and energy in feedstuffs. Principles of rationing. Prevention and control of diseases.

Practical

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

Theory Lecture Outline

Lecture	Details
1	Definition, scope and importance – cattle and fodder resources of India
2 -3	grassland types,of India and their distribution – ecological status of Indian grasslands – principles of grassland management for maximizing forage yield and quality.
4	Feeding habit and grazing behavior of range animals. Carrying capacity – definition, method of calculation
5 -6	Establishment and management of grasslands – selection of species, planting, cultural practices – liming, fertilizer application, burning, weed control, grazing and cutting intensity.
7	Storage of fodder – silage and hay – methods of preparation – hay banks
8	Fodder trees and shrubs, Forest grazing
9	Definition and importance of Livestock management.
10	Important breeds of livestock eg. Cattle, buffalo,
11	Important breeds of livestock eg. sheep and goat
12 -13	Breeding and reproductive management for higher productivity
14	Feeding management – types of feedstuffs available for feeding livestock, methods of feeding.
15	Assessing nutritive value of feed and fodder, estimation of digestible nutrients and energy in feedstuffs.
16	Principles of rationing. Prevention and control of diseases.

Practical Class Outline

Class	Experiments
1.	Identification of common fodder grasses in the locality
2.	Identification of common fodder grasses in the locality
3.	Identification of common fodder trees in the locality

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

Suggested Readings:

1. Banerjee, G.C. 2010. A text book on Animal Husbandry, 8th Edition, Oxford and IBH New Delhi.
2. Holechek J.L. et al. 1989. Range Management. Prentice Hall- New Jersey
3. Sastry- N.S.R. and C.K. Thomas. 2005. Livestock Production Management- Kalyani Publishers- New Delhi.
4. Singh R.V. 1982. Fodder trees of India. Oxford and IBH New Delhi.
5. Ward H.M. 1980. Grasses. A handbook for use in the field and laboratory- Scientific Pub.- Jodhpur

8. BAS 221**Forest Tribology & Anthropology****2(2+0)****Theory**

Meaning, scope and development of Anthropology. Relationships with other disciplines. Main branches of Anthropology, their scope and relevance. Human Evolution and emergence of Man. Phylogenetic status, characteristics and geographical distribution. Principles of Prehistoric Archaeology. Chronology: Relative and Absolute Dating methods. Culture, Society, Marriage, Family, Kinship, Economic and Political Organization, Social Control, Religion, Anthropological theories, Language and Communication, Research Methods in Anthropology. Race and Racism. Applications of Anthropology. Ethno,archaeology in India. Demographic profile of India. The structure and nature of traditional Indian social system. Caste system in India Definition and characteristics of a tribe. Tribes and aborigines, an anthropological perspective. Racial classification and distribution of tribes. Tribes in India and Kerala. Tribal economy. Tribals and Constitution of India Administration of tribal areas in independent India, appraisal of tribal development , problems of tribal identity and integration in the mainstream. Relation between tribes and forests, forest as their immediate environment. Forests as the means of livelihood. Girijan habitat , changes consequent to government control of forests. Forest management and tribal welfare, management conflicts and way forward. Role of forest department in tribal welfare. Role of Non wood Forest products in the economy of tribal's and Tribal cooperative societies. Social forestry and tribal welfare.

Theory Lecture Outline

Lecture	Topic
1	Meaning, scope and development of Anthropology.
2	Relationships with other disciplines.
3	Main branches of Anthropology, their scope and relevance.
4	Human Evolution and emergence of Man. Phylogenetic status, characteristics and geographical distribution.
5	Principles of Prehistoric Archaeology.
6	Chronology: Relative and Absolute Dating methods.

7	Culture, Society, Marriage, Family, Kinship, Economic and Political Organization,
8	Social Control, Religion, Anthropological theories, Language and
9	Communication, Research Methods in Anthropology. Race and Racism.
10	Applications of Anthropology.
11	Ethno,archaeology in India.
12	Demographic profile of India..
13	The structure and nature of traditional Indian social system.
14	Caste system in India Definition and characteristics of a tribe.
15	Racial classification and distribution of tribes
16	Tribes in India and Kerala.
17	Tribal economy.
18	appraisal of tribal development
19	problems of tribal identity and.
20	integration in the mainstream
21	Tribes and aborigines, an anthropological perspective.
22	Social forestry and tribal welfare
23	Relation between tribes and forests
24	forest as their immediate environment.
25	Forests as the means of livelihood.
26	Girijan habitat ,
27	changes consequent to government control of forests.
28	Forest management and tribal welfare,
29	management conflicts and way forward.
30	Role of forest department in tribal welfare.
31	Role of Non wood Forest products in the economy of tribal's
32	Tribal cooperative societies.

Suggested Readings:

1. Furer,Haimendorf, C.V. 1985. Tribes of India , the struggle for survival. OUP. New Delhi
2. Hasnain, N. 2007. Tribal India. New Royal Book Company
3. Hasnain, N. 2011. Indian Anthropology. Palaka Prakashan
4. Sharma, R.N. and Bakshi, S. 1984. Tribes and tribal development. Uppal Publ. House, New Delhi
5. Sharma, R. N., Sharma, R.K. 1997. Anthropology. Atlantic Publishers & Distributors.
6. Thakur, D. 1986. Socio,economic development of tribes in India. Deep and Deep Publications, New Delhi

9. FOR 221**Study Tour (State)****1(0+1*)****Practical**

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

1. SAF 311 Forest Hydrology and Watershed Management 3(2+1)

Theory

Importance and scope of Hydrology. Definitions. Hydrological cycle. Energy and water balance equations precipitation, rain and snow hydrology. Interception, infiltration, evaporation and transpiration, paired water sheds, surface water, run off processes and hydrograph. Soil water energy concept, movement, availability and measurement. Watershed management, an approach for sustainable productivity, principles and practices, Methods for water conservation, water harvesting techniques. Role of trees in water conservation, natural terracing, species suitability. Recharging of water springs. Forest treatment and water yield. Application of GIS in watershed delineation.

Practical

Study of hydrological equipment; Measurement and analysis of rainfall data; Estimation of runoff using rational formula; Preparation, use and analysis of hydrograph; Measurement of evaporation by different methods; Visit to forest watersheds to study the effect of forest treatment on hydrological properties. Assessment of the impact of watershed treatments such as afforestation / restocking, assisted regeneration etc. on the watershed functioning, field layout regeneration assessment, interpretation of results.

Theory Lecture Outline

Lecture	Chapter
1	Importance and scope of Hydrology. Definitions
2	Hydrological cycle
3	Energy and water balance equations
4	Precipitation rain snow hydrology
5	Runoff
6	Interception infiltration
7	Evaporation
8	Transpiration
9	Watershed, Characteristics, types
10	Geomorphology of watersheds
11	paired water sheds
12	paired water sheds
13	surface water, run off processes
14	Hydrograph
1.	Soil water energy concept, movement, availability and measurement
2.	Doubt clearance
3.	Soil water energy concept, movement, availability and measurement
4.	Watershed management
5.	Watershed management
6.	Approach for sustainable productivity, principles and practices
7.	Approach for sustainable productivity, principles and practices
8.	Methods for water conservation
9.	Methods for water conservation
10.	water harvesting techniques
11.	Role of trees in water conservation
12.	natural terracing, species suitability
13.	Recharging of water springs
14.	Forest treatment and water yield

15.	Forest treatment and water yield
16.	Application of GIS in watershed delineation
17.	Application of GIS in watershed delineation
18.	Doubt clearance

Practical Class Outline

Class	Practical
1.	Study of hydrological equipment
2.	Study of hydrological equipment
3.	Measurement and analysis of rainfall data
4.	Estimation of runoff using rational formula
5.	Preparation, use and analysis of hydrograph
6.	Preparation, use and analysis of hydrograph
7.	Measurement of evaporation by different methods
8.	Measurement of evaporation by different methods
9.	Visit to forest watersheds to study the effect of forest treatment on hydrological properties
10.	Visit to forest watersheds to study the effect of forest treatment on hydrological properties
11.	Assessment of the impact of watershed treatments such as afforestation / restocking, assisted regeneration etc. on the watershed functioning
12.	Assessment of the impact of watershed treatments such as afforestation / restocking, assisted regeneration etc. on the watershed functioning
13.	Assessment of the impact of watershed treatments such as afforestation / restocking, assisted regeneration etc. on the watershed functioning
14.	field layout regeneration assessment
15.	field layout regeneration assessment
16.	interpretation of results

Suggested Readings:

1. Bennet, H. H. 1965. Elements of Soil conservation. Mc Graw Hill Book Co. Inc. New York
2. Dhruva Narayana V. V. 1993. Soil and Water Conservation Research in India, ICAR, New Delhi
3. Dhruva Narayana V. V., G. Sastry and U. S. Patnaik. 1997. Watershed Management. Indian Council of Agricultural Research, New Delhi- 176 p
4. Gurmial Singh et al, 1988. Manual of Soil and Water Conservation. Oxford IBH Publishing Co. New Delhi
5. Hamilton L. S. 1983. Tropical Forested Watersheds: hydrologic and soils response to major uses or conversions. International Book Distributors- Dehra Dun
6. Hamilton, L.S. (ed.). 1983. Forest and Watershed Development and Conservation in Asia and the Pacific. International Book Distributors, Dehra Dun
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8. Hudson- N. 1981. Soil Conservation. BT Batsford Limited, London 324 p.
- Lal R. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press- London.
10. Michael, A.M. 2008. Irrigation theory and practice- Vikas Publishing House Pvt Ltd. 768p
11. Morgan, R.P.C. 1988. Soil Erosion and Conservation. English Language Book Society, Longman, London
12. Murthy- V.N.N. 1983. Land and Water Management Engineering, Kalyani Publishers- New Delhi.
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14. Riedl, O. and Zachar, D. 1984. Forest Amelioration. Elsevier- Amsterdam
15. Satterlund, DR. 1972. Wildland Watershed Management. The Ronald Press Company, New York
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17. USDA 1961. A Manual on Conservation of Soil and Water. Oxford and IBH Publishing Company

2. NRM 311

Climate Science

3(2+1)

Theory

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

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

Practical

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

Theory Lecture Outline

Class	Course covered
1.	Introduction- Agro meteorology– definition, aim and scope
2.	Agro meteorology– definition, aim and scope
3.	Factors and elements of weather and climate.
4.	Composition and structure of atmosphere.
5.	Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost
6.	Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost
7.	Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost
8.	Cyclones, anticyclones and thunder storms.
9.	Cyclones, anticyclones and thunder storms.
10.	Solar radiations components and effect on plant growth.
11.	Solar radiations components and effect on plant growth.
12.	Effect of weather and climate on the growth and development of crops.

13.	Community ecology, species interactions,
14.	Climatic normal for crops and trees.
15.	Agro climatic zones of India.
16.	Evaporation and transpiration.
17.	Climate change: Understanding climate change and its Consequences.
18.	Global warming and its effects on Forest.
19.	Forest and climate change: Vulnerability and adaptability
20.	Forest and climate change: Vulnerability and adaptability
21.	Evidence of forest disturbance due to climate change –Climate change influence on agroforestry
22.	Evidence of forest disturbance due to climate change –Climate change influence on agroforestry
23.	Evidence of forest disturbance due to climate change –Climate change influence on agroforestry
24.	Climate resilient forestry
25.	Economic worth of carbon storage in forest
26.	Forest and UN convention on climate change
27.	NATCOM initiatives – Decision making in emission of Green House Gases (GHG).
28.	Kyoto protocol, awareness about climate change.
29.	National Action Plan for Climate change – Green India Mission
30.	National Action Plan for Climate change – Green India Mission
31.	Indian Network for Climate Change Assessment (INCCA)
32.	State Action Plans on Climate Change

Practical Class Outline

Class	Practical
1	Study of temperature instruments
2	Study of pressure instruments
3	Study of, humidity instruments
4	Study of wind instruments
5	Study of rain instrument
6	Study of wind rose.
7	Study of solar radiation instruments with pyranometer
8	Layout of an agromet observatory and types
9	Measurement of wind and evaporation
10	Measurement of sunshine hours
11	Measurement of soil temperature and dew.
12	Estimation of green house gases into atmosphere.
13	Doubt Clearance

Suggested Readings:

1. Ghadekar, S.R. (2003) Meteorology . Agromet Publishers, Nagpur
2. Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi
3. Mavi, H.S. (1994) Agrometeorology . Oxford &IBH, New Delhi
4. Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,
5. Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg
6. Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi.
7. Sahoo, A.K.2012. Climate Mitigation and Carbon Finance: Global Initiatives and Challenges, NIPA, New Delhi

3. FPU 311**Wood Science and Technology****3(2+1)****Theory**

Kinds of woods; hardwood, softwood, bamboos and palms, merits and demerits of wood as a raw material, the physical features of wood. Electrical, thermal and acoustic properties of wood. Mechanical properties of wood like tension, compression, bending, shearing, cleavage, hardness, impact resistance, nail and screw holding capacities. Suitability of wood for various uses based on mechanical and physical properties. Wood water relationship; shrinkage, swelling, movement, fibre saturation, equilibrium moisture content. Wood seasoning; merits, principles and types; air seasoning, kiln seasoning and chemical seasoning. Refractory classes of timbers, kiln schedules. Seasoning defects and their control. Classification of timbers based on durability. Wood preservation; principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.). General idea about fire retardants and their usage. Non-pressure methods; steeping, dipping, soaking open tank process, Boucherie process. Pressure methods; full cell process, empty cell process (Lowry and Rueping). Wood machining. Sawing; techniques, kinds of saws; cross cut, edging, cudless, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Various stages in wood working. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

Practical

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

Theory Lecture Outline

Lect.	LESSON	SUBJECT MATTER
1-2	Introduction	Wood as raw material, kinds of wood – hardwood , softwood , bamboos and canes. Merits and demerits of wood as raw material.
3-4	Physical properties of wood	Weight , density , specific gravity , odour, texture , figure, reaction of light on wood - colour , lusture , Phosphorescence , fluorescence , residual luminescence.
5-6	Mechanical properties of wood	Tension , compression , bending , shearing cleavage , hardness, impact resistance , nail and screw holding capacities.
7-8	Uses of wood	Suitability of wood for various uses based on mechanical and physical properties.
9-10	Electrical properties of wood	DC properties of wood , AC properties of wood
11-12	Acoustic properties of wood	Reaction of sound on wood - velocity of sound on wood , absorption and reflection of sound , resonance in wood.
13-16	Wood water relationship	Forms of water held in wood , moisture content of wood , fibre saturation point , shrinkage of wood , movement of moisture in wood- diffusion of bound water and vapour in wood below FSP , movement of free water above the FSP , equilibrium moisture content, permeability of wood.
17-20	Wood seasoning	Merits , principles and types – air seasoning , kiln seasoning and chemical seasoning . Refractory classes of timbers , kiln schedules. Seasoning defects and their control.

21-26	Wood preservation	Principles , processes , types of wood preservatives – oil type , water soluble leachable type , water soluble fixed type ,organic solvent type. Classification of timber based on durability. Fire retardants and its uses . wood preservation techniques - Non pressure methods and pressure methods.
27-30	Wood machining	Sawing technique , kinds of saws – cross cut , edging , hand , circular and bow saws. Wood working tools used in wood working (parting , slicing, shaping , measuring and marking tools)
31-32	Dimensional stabilization of wood	Surface coating method , bulking method , impregnation of resins.

Practical Class Outline

Class	Title of experiment
1-3	Study of mechanical testings of wood : Static bending, impact bending, compression parallel and perpendicular to the grain, hardness, shear, torsion, nail and screw pulling test, brittleness test and calculation of properties.
4-5	Estimation of directional shrinkage and swelling of wood.
6	Non-destructive wood testing instruments.
7	Visit to wood testing laboratories.
8	Identification of types of wood as raw material
9	Estimation of moisture content of timber species by ODM
10	Estimation of moisture content of fuel wood species by ODM
11-12	Estimation of density of some timber and fuel wood species
13-14	Estimation of Oven dry specific gravity of timber and fuel wood species
15	Estimation of specific gravity of timber in green condition
16	Estimation of standard specific gravity of timber species

Suggested Readings:

1. Bowyer J. L., Shmulsky, R. and Haygreen, J. G. 2007. Forest products and wood science: An introduction. 5th Ed. Blackwell publishing, Ames, IA. 496p.
2. Brown, H. P. 1985. Manual of Indian wood technology. International books and periodicals supply service, New Delhi. 121 p.
3. FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.
4. Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw,Hill. New York, USA: 722p.
5. USDA [U.S. Department of Agriculture]. Wood handbook , Wood as an engineered material. 1999. U.S. Department of Agriculture, Forest Service. Forest Products Laboratory, Madison, WI. 508p.

4. FPU 312 Logging and Ergonomics 2(1+1)

Theory

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

description of converted material. Means of transport of timber; carts, dragging, skidding, overhead transport, ropeways, skylines. Transport by road and railways. Transport by water; floating, rafting and concept of booms. Non-destructive sampling methods of wood. Grading and storage of timber in the depots for display and disposal, temporary and final storage. Timber Depots; types, lay out and management. Systems of disposal of timber. Ergonomics: definition, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition. Personal protective equipments, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids.

Practical

Equipments and tools used in logging operations and their uses. Instructions regarding maintenance of various records and registers in logging operations; Conversion of felled trees into logs, poles, firewood, pulpwood. Visit to local saw mills to study the equipments used and process of conversion. Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers. Visit to local dumping yard (timber depot) to trace the logs delivered from different forest sites. Sorting of logs, poles and firewood in the depots according to species, quality, length and girth classes. Stacking and stock checking of different logs, poles and firewood in the depots so as to confirm that all the converted materials in the forests have reached their destination. Stacking of the lots for display and final disposal; recording of the lots for auction sale. Final disposal of the material. Visit during the auction sale in the government timber depots; Preparation of ergonomic check lists. Familiarize the e-auctioning procedure of State Forest Department. Safety rules and first aids in forestry operations

Theory Lecture Outline

Lect.	TOPICS
1.	Definition and scope of logging, logging plan and execution.
2.	Location and demarcation of the area for logging and estimation of produce available for extraction.
3.	Implements used in logging operation- traditional and improved tools.
4.	Felling rules and methods.
5.	Conversion, measurement and description of converted material
6.	Means of transport of timber- carts, dragging, skidding.
7.	Means of transport of timber-, overhead transport, ropeways, and skylines.
8.	Transport by road and railways
9.	Transport by water- floating, rafting and concept of booms.
10.	Non-destructive sampling methods of wood.
11.	Grading and Storage of timber in the depots for display and disposal, temporary and final storage.
12.	Timber Depots- types, layout and management. Systems of disposal of timber. Size of material in logging operation.
13.	Ergonomics: definition, components and provision of energy. Ergonomics: definition, components and provision of energy.
14.	Effect of heavy work, posture, weather and nutrition. Personal protective equipments, safety helmets, ear and eye protections
15.	Personal protective equipments, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids.
16.	Plants, animals and insect infestations; diseases and their prevention.

Practical Class Outline

Class	PRACTICAL
1	To study about different Equipments and tools used in logging operations and their uses

2	Study about Instructions regarding maintenance of various records and registers in logging operations
3	Study about Conversion of felled trees into logs, poles, firewood, pulpwood.
4	Visit to Khapuri, OFDC saw mills to study the equipments used and process of conversion.
5 -6	Visit to local saw mills to study the equipments used and process of conversion.
7	Study about Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers
8	Visit to local dumping yard (timber depot) to trace the logs delivered from different forest sites.
9	Study about Sorting of logs, poles and firewood in the depots according to species, quality, length and girth classes.
10	Study about Stacking and stock checking of different logs, poles and firewood in the depots so as to confirm that all the converted materials in the forests have reached their destination.
11	Study about Stacking of the lots for display and final disposal; recording of the lots for auction sale.
12	Study about sale of timber and its Final disposal of the material.
13	Visit during the auction sale in the government timber depots.
14	Study about Preparation of ergonomic check lists.
15	Study about the e-auctioning procedure of State Forest Department.
16	Know about different Safety rules and first aids in forestry operations

Suggested Readings

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

5. BAS 311 Forest Extension & Community Forestry 3(2+1)

Theory

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

Audio-visual aids: importance, classification and selection. Programm planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA). Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group, classification of group.

Community Forestry: Introduction to the concept of forestry as a common property resource– Definition, Scope and necessity of community forestry. Forests and man: Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment, NFP 1988 and the importance of people in forest conservation. Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups. Gender dimensions in Community forest management. Social Forestry, definition, need and purpose, historic development. Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS. Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation, problems and prospects, Microplan Preparation. JFMs, FDCs, VFCs, CBOs, NGOs and co-operative societies.

Practical

Visits to study structure, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/Mahila Mandal/Village Panchayat/Van Panchayat/ State Forest Department (Social forestry wing). Group discussion at farm homesteads. Preparing individual and village level production plans. Preparation of charts, posters and flash cards. Participation in conducting exhibitions and method demonstrations/campaigns at the village level. Familiarization of the use of audio,visual aids. PRA exercises. Visit to village to study the community forestry components, Community reserve, organizational set up and administrative procedures in a social forestry (SF) Range, Microplan preparation, Field visit to a JFM operational area and conduct PRA surveys. Afforestation techniques and social forestry.

Theory Lecture Outline

Lecture	TOPICS (THEORY)
1-2	Introduction- human behaviour and psychology. Concept- scope- principles- philosophy and objectives of extension education and forestry extension education
3	Extension education: meaning- definition- nature- scope- objectives- principles- approaches and history.
4 -5	Forestry extension: process, principles and types of education, Formal, informal non formal education.
6	People's participation in Forestry programmes.
7	Elements of extension education. Rural Development: meaning, definition, objectives and genesis.
8 -9	Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Van Vigyan Kendras, Technology Assessment and Refinement Programme (TARP) of ICAR/ ICFRE
10	Introduction to the concept of forestry as a common property resource– Definition, Scope and necessity of community forestry.
11 -12	Forests and man: Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment.
13 -14	NFP 1988 and the importance of people in forest conservation.
15- 16	Community forest management, Community forest development, social economical

	and environmental aspects.
17	Community forest development through NGOs, civil societies, citizen groups.
18	Communication: meaning, definition, elements and selected models.
19	Programme planning process – meaning, scope, principles and steps.
20- 21	Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA).
22-23	Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group, classification of group.
24	Gender dimensions in Community forest management.
25 -26	Social Forestry, definition, need and purpose, historic development. Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS.
27 -28	Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops.
29 - 30	Joint Forest management: concept, legislation, rules, importance.
31	FDCs, VFCs, CBOs, NGOs and co-operative societies.
32	Doubt clearing class

Practical Class Outline

Class	PRACTICALS
1-5	Visits to study structure, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/MahilaMandal/Village Panchayat/Van Panchayat/ State Forest Department (Social forestry wing).
6	Group discussion at farm homesteads.
7	Preparing individual and village level production plans.
8	Preparation of charts, posters and flash cards.
9	Participation in conducting exhibitions and method demonstrations/campaigns at the village level.
10	Visit to village to study the community forestry components.
11	Visit to village to study the community reserve.
12	Visit to village to study the organizational set up and administrative procedures in a social forestry (SF) Range.
13	Visit to village for the Micro plan preparation.
14 -15	Field visit to a JFM operational area and conduct PRA surveys.
16	Study about Afforestation techniques and social forestry.

Suggested Readings

1. FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasylva , No. 143, Published by FAO.
2. L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.
3. D. Sim, H. A. Hilmi (1987), Forestry Extension Methods, FAO Forestry Paper,80, P. 153.
4. Jalihal- K.A. Veerabhadraiah- V. (2007)- Fundamentals of Extension Education and
5. Management in Extension- Concept Publishing Company.
6. Balakathiresan- S. (1986). Essentials of forest management- Nataraj Publishers- Dehradun.
7. Bullock- R. C. L. and Hanna- K.S. (2012). Community Forestry Local Values- Conflict and Forest Governance. Cambridge University Press.

8. Gunter- J. (Ed.). (1973). The Community Forestry Guidebook (http://www.forrex.org/sites/default/files/forrex_series/FS15.pdf).
9. Ojha- H.R.- Timsina- N.P.- Kumar- C.- Banjade- M.R and Belcher- B. (2007). Communities- Forests and Governance: Policy and Institutional Innovations from Nepal. Adroit Publishers- New Delhi, India.
10. Roy, S.B. and Chatterjee, M.(1994). Joint Forest Management. Inter India Publications
11. Tiwari, K.M. (1983). Social forestry for rural development. International Book Distributors.
12. Vyas, G. P.D. (2006). Community Forestry. Agrobios, India.

6. BAS 312 Entrepreneurship Development & Business Management 2(1+1)

Theory

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to forestry sector. Venture capital. Contract farming and joint ventures, public,private partnerships. Overview of forestry inputs industry. Characteristics of Indian forestry processing and export industry. Social Responsibility of Business.

Practical

SWOT analysis, developing leadership skills, developing managerial skills, problem solving skill, supply chain management and total quality management, project planning formulation and report preparation.

Theory Lecture Outline

Lecture	TOPICS
01	Concept of Entrepreneurship, characteristics of entrepreneurs & managers, difference between entrepreneur & manager – entrepreneur & intrapreneur.
02	Assessing overall business environment in the Indian economy, Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs.
03	Globalisation and the emerging business / entrepreneurial environment.
04	Managing an enterprise. Motivation and entrepreneurship development.
05	Importance of planning, monitoring, evaluation and follow up. Managing competitions.
06	Entrepreneurship development programmes, SWOT analysis of Business.
07	Generation, incubation and commercialization of ideas and innovations.
08	Revision for Mid-term examination
09	Government schemes and incentives for promotion of entrepreneurship.
10	Government policy on Small and Medium Enterprises (SMEs) / SSIs.
11	Export and Import policies relevant to agriculture sector.
12	Venture capital.
13	Contact farming and joint ventures, public-private partnership.

14	Overview of Forestry-inputs industry. Characteristics of Indian Forestry processing and export industry.
15	Social Responsibility of Business
16	Revision for Final Semester Exam.

Practical Class Outline

Practical	LESSONS
1.	Study of SWOT Analysis.
2.	Study of SWOT Analysis.
3.	Developing Leadership skills.
4.	Developing Leadership skills.
5.	Developing Managerial skills.
6.	Developing Managerial skills.
7.	Study of Problem solving skills.
8.	Study of Problem solving skills.
9.	Supply chain management skill.
10.	Total Quality Management skills.
11.	Total Quality Management skills.
12.	Project Planning Formulation
13.	Project Planning Formulation
14.	Report Preparation.
15.	Report Preparation
16.	Revision for Final Exam.

List of Reference Books –

- 1 Fundamentals of Entrepreneurship-S.K.Mohanty
- 2 Participatory Planning and Project Management in Extension Sciences, M.M. Adhikary
- 3 The Entrepreneurs Hand Book- J. Mancuso
- 4 Agricultural Communication- A reference Manual (FAO) - B.E. Swanson *et al*
- 5 Development Communication for Agriculture- R.K. Samanta
- 6 Market Led Extension – Dimensions & Tools- F.M. H.Kaleet *al*
- 7 A handbook of extension education-Dipak De & B. Jirli
- 8 Textbook on rural development, Entrepreneurship and Communication Skill - SagarMondal&G.L.Ray
- 9 Motivation and personality– A.H.Maslow, Harper and Raw Publishers, New York. 1970
- 10 Human Behaviour – Perelson,B and Steiner, G, Harcourt Brace Jovanovich, New York. 1964

7. BAS 313 Forest Economics and Marketing 3(2+1)

Theory

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

non-timber products-Economics of timber and non-timber forest products. Forest planning–forest policy and development. Production-Meaning- factors of production-land- labour- capital-organization- entrepreneurship-Distribution-rent- wages- interest- profit-National Income-definition and concepts-.Public finance- meaning- Public resource-Meaning- sources- Taxation-types-Public expenditure-meaning, principles, Money, meaning, evolution, Inflation: definition, types of inflation, Welfare economics, Meaning and basic concepts. Marketing, definition. Marketing Process, Need for marketing, Role of marketing,– Marketing functions. Classification of markets. Marketing of various channels. Price spread , Marketing Efficiency. Integration, Constraints in marketing of agricultural produce. Market intelligence. Basic guidelines for preparation of project reports, Bank norms. Insurance, SWOT analysis, Crisis management.

Practical

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

Theory Lecture Outline

Lecture	Topic
1	Computer Programming, General Concepts,
2	Documentation and Program Maintenance,
3	Debugging programs,
4	Errors. Introduction to Visual Basic, ,
5	Java, Fortran, C/ C++, etc,
6	concepts and standard input/output operations,
7	Variables and Constants,
8	Operators and Expressions, Flow of control,
9	Inbuilt and User defined functions
10	programming techniques for agriculture/forestry.
11	e-Agriculture, concepts, design and development.
12	Application of innovative ways to use information and
13	communication technologies (IT) in agriculture/forestry.
14	ICT for Data Collection, formation of development programmes,
15	monitoring and evaluation of Programmes.
16	Computer Models in agriculture/forestry: statistical, weather analysis and crop
17	concepts, structure, inputs, outputs files, limitation,
18	advantages and application of models for understanding plant processes,
19	sensitivity, verification, calibration and validation.
20	IT application for computation of water and nutrient requirement of crops,
21	Computer, controlled devices (automated systems) for Agri-input management,
22	Smartphone mobile apps in Agriculture for farm advises,
23	For market price,
24	Postharvest management etc;
25	Geospatial technology, concepts, techniques,
26	components and uses for generating valuable agri-information.
27	Decision support systems,
28	taxonomy, components, framework,
29	classification and applications in agriculture/forestry,
30	DSS, Agriculture Information/ Expert System,
31	Soil Information Systems etc for supporting Farm decisions.
32	Preparation of contingent crop, planning and crop calendars using IT tools.

Practical Class Outline

Class	Practical
1.	Study of Computer Components, accessories, practice of important
2.	DOS Commands. Introduction of different operating systems such as
3.	Unix, Linux, Creating, Files & Folders, File Management.
4.	Use of MS,WORD and
5.	MS Power point for creating, editing and presenting a scientific Document
6.	Handling of Tabular data, animation, video tools, art tool, graphics, template & designs
7.	. MS,EXCEL , Creating a spreadsheet, use of statistical tools, writing expressions,
8.	creating graphs, analysis of scientific data, handling macros. MS,ACCESS:
9.	Creating Database, preparing queries and reports, demonstration of Agri,information system. Introduction to
10.	World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web.
11.	Visual Basic, Java, Fortran, C, C++, and their components Hands on practice on writing small programmes. Hands on practice on Crop Simulation
12.	Models (CSM), DSSAT/Crop,Info/CropSyst/ Wofost. Preparation of Inputs file for CSM and study of model outputs, computation of water and nutrient
13.	Use of smart phones and other devices in agro,advisory and dissemination of market information.
14.	Introduction of Geospatial Technology,
15.	demonstration of generating information important for Agriculture.
16.	Hands on practice on preparation of Decision Support System

Suggested Readings

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

8. FOR 311**Experiential Learning-I****5(0+5)**

1. Production and Marketing of high value forest produce (0+5) (FPU)/
2. Raising Quality Planting Materials for forest regeneration (0+5) (SAF/FBT)/
3. Apiculture/Sericulture (0+5) (FBT/NRM/WLS)/
4. Ecotourism (0+5) (BAS/WLS)/
5. Wild Animal Health Management (0+5)(WLS)

Details:**1. Production and Marketing of high value forest produce****5(0 + 5)**

Project formulation, Market survey and prioritization of species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to timber markets, saw mills, forest depots etc. Lesser known, but highly utilizable indigenous species of timbers will be given priority. Fast rotation timber species raised under various trials of the University will also be included to the extent possible.

Potential of different species for various end uses will be determined. Timber samples have to be converted into sticks / smaller sizes / macerated through appropriate procedures such as sawing and sizing in a saw mill or maceration in a laboratory. Mechanical tests: Static bending, compressive tests, across and along the grain. Finding out safe working stresses of lesser known or exotic/new species. Wood database currently available in the department will be updated based on the test results. Project report preparation and presentation, final examination. Wood conversion in an integrated saw mill, turnery for handicrafts, joineries and furniture making. Data analysis, project report writing, presentation and final examination.

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

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

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

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

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

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

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

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

1. SAF 321 Plantation Forestry**3(2+1)****Theory**

Plantations, definition and scope. History of plantations, Development of plantation forestry. Plantation organization and structure. Land and plantation development. Plantation planning, National and regional planning, project appraisal and project implementation, feasibility studies. Plantation silviculture: Choice of species, Plantation establishment, Plantation maintenance. Nutrition in plantations: use of fertilizers. Major pest and disease in plantations, sanitation and control measures. Dynamics of stand growth, CCF, MCA, stand density management in plantation. Thinning regimes, improvement felling, Site quality evaluation, stand basal area, site index concept in plantation forestry, plantation productivity assessment, growing stock assessment, MAI, sustainability of plantations. Plantation records plantation journal. Industrial plantations, paper and pulp wood, match wood, plywood plantations, Plantations yielding NTFPs, Energy plantation: high density short rotation plantations, petro crops. Avenue plantations. Plantations as potential carbon sinks. Economic factors in plantation development: social and cultural considerations.

Practical

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

Objective: To acquaint students about different types of plantation forestry activities, their planning, raising, management, assessment and economics for enhancing productivity.

Theory Lecture Outline

Lect.	Topic
1	Introduction. Plantations-definition and scope
2	History of plantations, Development of plantation forestry
3	Plantation organization and structure
4	Land and plantation development
5	Plantation planning-national and regional planning
6	Project appraisal and project implementation- feasibility studies
7	Plantation silviculture - Choice of species
8	Plantation establishment- Plantation maintenance
9	Nutrition in plantations- use of fertilizers
10	Major pests in plantations
11	Major disease in plantations
12	Sanitation and control measures
13	Dynamics of stand growth- CCF (Continuous Cover Forestry) –MCA (Multi Criteria Analysis)
14	Stand density management in plantations- thinning regimes
15	Improvement fellings
16	Pre-Midterm examination revision and doubt clearance
17	Site quality evaluation
18	Stand basal area- site index concept in plantation forestry
19	Plantation productivity assessment- growing stock assessment- MAI
20	Sustainability of plantations
21	Plantation records- plantation journal
22	Industrial plantations- paper and pulp wood plantations
23	Match wood & plywood plantations

24	Plantations yielding NTFPs
25	Energy plantations
26	High density short rotation plantations
27	Petro crop plantations
28	Avenue plantations
29	Plantations as potential carbon sinks
30	Economic factors in plantation development
31	Social and cultural considerations in plantation development
32	Pre Final examination revision and doubt clearance

Practical Class Outline

Class	Topic
1	Study of tools and materials for plantation establishment
2	Preparation of a commercial plantation layout
3	Study of general land preparation for plantation
4	Study of general planting operations
5	Visit to small and large plantations to study their management and functioning
6	Study of plantation project preparation - economic evaluation and feasibility studies of plantation projects
7	Study of tending techniques
8	Study of planting methods and techniques for energy plantations
9	Study of planting methods and techniques for canal bank plantations
10	Study of planting methods and techniques for pulp wood plantations
11	Study of Forest Development Corporation plantations
12	Study of road side plantations
13	Study about plantation planning and plantation journal
14	Study of choice of species for plantations
15	Study of economic considerations in plantation
16	Study of government vs private plantations

Suggested Reading

1. Bowen, G.D., E. K. S. Nambiar, E.K.S 1984. Nutrition on Plantation Forests. Academic Press, 1984 ,Nature , 516 pages
2. Evans, J. 1992. Plantation Forestry in the Tropics, 2nd edition. Oxford, UK, Clarendon Press.
3. Evans, J. and Turnbull, J.W. 2004. Plantation Forestry in the Tropics: The Role, Silviculture and Use of Planted Forests for Industrial, Social, Environmental and Agroforestry Purposes. OUP Oxford, 467p.
4. Krishnapillay.B. 2000. Silviculture and Management of teak plantations. Unasylva. 201. Vol 51. 14,21p
5. Nambiar, E.K.S. and Brown, A.G. 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for Internat. Agricultural Research. 571p.
6. Nambiar, E.K.S., Cossalter, C and Tiarks.A. 1998. Site Management and Productivity in Tropical Plantation Forests. Workshop Proceedings, South Africa.
7. Suzuki, K., Ishii, K., Sakurai, S. and Sasaki, S. 2006. Plantation Forestry in the Tropics. Springer Tokyo.

2. NRM 321 Forest Laws, Legislation and Policies 2(2+0)

Theory

National forest policies, scope and importance, comparative analysis of all forest policies ,Indian judicial system, Legal definitions, application of penal code to forests, general principles of criminal law, legal principles of punishment, criminal procedure code, the law of evidence and the

Indian Evidence Act, 1872 as applied to forestry matters. Indian Forest Act, 1927 general provisions, Code of Civil procedure, 1908. Forest (Conservation) Act, 1980. Brief description about other major forest laws of regional, national and international significance. Detailed study of OFA1972. Biological Diversity bill 2002, discussion of court verdicts on issues of utmost importance to conservation.

Theory Lecture Outline

Lect.	TOPICS (THEORY)
1.	Introduction: Laws, legislation and policy and differentiation.
2.	Forest policy, 1894: Its scope, salient features and importance.
3.	National forest policy, 1952: Its scope, salient features and importance.
4.	National forest policy, 1988: Its scope, salient features and importance.
5.	NFP 1988 and the importance of people in forest conservation.
6.	Comparative analysis of all forest policies.
7.	Indian judicial system, Legal definitions.
8.	Indian penal code: Application of penal code to forests.
9.	Criminal law and its general principles.
10 - 11	Legal principles of punishment
12	Criminal procedure code, principles and applications.
13	The law of evidence act: Definition and basic principles and the Indian Evidence Act, 1872 as applied to forestry matters.
14 - 15	The Indian Evidence Act, 1872 and its application to forestry matters.
16	Doubt clearing class before midterm examination.
17 -19	Indian Forest Act, 1927 general provisions: in details
20	Code of Civil procedure, 1908: Applications.
21 -22	Forest (Conservation) Act, 1980.
23 - 25	Brief description about other major forest laws of regional, national and international significance.
26 - 27	Detail study of Orissa Forest Act (OFA), 1972
28 -29	Biological Diversity bill 2002: In details
30 -31	Discussion of court verdicts on issues of utmost importance to conservation.
32	Doubt clearing class before final examination.

Suggested Reading

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

3. NRM 322

Geomatics

3(1+2)

Theory

Remote sensing , classification based on source: Active and passive remote sensing; Aerial and space remote sensing; Interaction of electromagnetic radiation with atmosphere and earth surface; Aerial photographs – types; Photo interpretation , Satellite remote sensing – platforms and

sensors; Satellite systems. Indian Remote Sensing Programme; Visual and digital image processing; Application of satellite based remote sensing techniques in forestry – vegetation mapping using satellite imagery, NDVI; Forest cover monitoring and damage assessment; Microwave remote sensing. Introduction to GIS. Differences between GIS and conventional cartography. Spatial and non,spatial data, Integration of attribute data with spatial data. Spatial data , Raster and Vector data, Thematic over lays in GIS, topology building and calculation of area and length etc. Application of GIS in forestry – using imageries and integration with GIS data. Maps, its projection, Toposheet and Map reading. Global Positioning System (GPS) applications in resource inventory, Global Navigation Satellite System, Galileo, GLONASS, QZSS, Compass, IRNSS etc., GAGAN

Practical

Preparation maps; Visual interpretation of satellite imagery; Forest cover mapping and land use mapping. Digital image processing. Introduction to various GIS software – Q, GIS, ERDAS, Arc GIS etc. Exercises in viewing, editing, overlay. Visit to the GIS labs at State level.

Theory Lecture Outline

Lecture	Topic
1.	Remote sensing , classification based on source: Active and passive remote sensing; Aerial and space remote sensing;
2.	Interaction of electromagnetic radiation with atmosphere and earth surface;
3.	Aerial photographs – types; Photo interpretation
4.	Satellite remote sensing platforms and sensors;
5.	Satellite systems. Indian Remote Sensing Programme;
6.	Visual and digital image processing;
7.	Application of satellite based remote sensing techniques in forestry vegetation mapping using satellite imagery
8.	NDVI; Forest cover monitoring and damage assessment;
9.	Microwave remote sensing.
10.	Introduction to GIS. Differences between GIS and conventional cartography. Spatial and non, spatial data, Integration of attribute data with spatial data. Spatial data , Raster and Vector data,
11.	Thematic over lays in GIS,
12.	Topology building and calculation of area and length etc
13.	Application of GIS in forestry Maps, its projection, Toposheet and Map reading.
14.	Global Positioning System (GPS) applications in resource inventory,
15.	Global Navigation Satellite System,
16.	Galileo, GLONASS, QZSS, Compass IRNSS etc., GAGAN

Practical Class Outline

Class	Practical
1-3	Preparation maps;
4-7	Visual interpretation of satellite imagery;
8-10	Forest cover mapping
11-12	land use mapping.
13-15	Digital image processing.
16-20	Introduction to Q, GIS

21-25	Introduction to Arc GIS etc
26-27	Introduction to ERDAS
28	Exercises in viewing
29	Editing and overlay.
30	Visit to the GIS labs at State level.
32	Visit to the GIS labs at State level.

Suggested Reading

1. Campbell, J.B. (2002). Introduction to Remote Sensing, Third edition. Taylor and Francis, London
2. Environment System Research Institute, (1999). GIS for Everyone. Redlands, CA:ESRI
3. Jackson, M.J. (1992). Integrated Geographical Information Systems. International Journal of Remote Sensing, 13(6,7): 1343,1351
4. Joseph, G. (2005). Fundamentals of Remote Sensing, Second edition. Universities Press
5. Lillesand, T.M. and Kiefer, W.R. (1994). Remote sensing and Image Interpretation, Fourth edition. John Wiley & Sons, Inc., USA
6. Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS & LUP, Nagpur.

4. NRM 323 Recreation & Urban Forestry 2(1+1)

Theory

Forest recreation – Definition and scope, social and environmental aspects of recreation components new approaches in forest recreation. Principles and elements of landscaping –types of landscape designs formal, Persian and Mughal designs, and informal, British and Japanese. Landscape components, plant and other components, lawn, pergolas, hedges, edges, topiary, baloon, arbours, carpet beds, trees, flower beds, annuals, and climbers. Practices of landscaping, Tools and implements for landscaping. Specialised gardens, butterfly, water, bog or marsh, terrace, roof, Sunken, Indoor and rock. Planning and planting programmes in institutional and industrial complexes, roads, bridges, parking area and other structures. Urban forestry – definition and scope – uses of urban forests, Management of urban forest, Arboriculture and its importance in urban forestry.

Practical

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

Theory Lecture Outline

Lect.	Lessons
1	Forest recreation – Definition and scope, social and environmental aspects of recreation components new approaches in forest recreation
2	Principles and elements of landscaping –types of landscape designs
3	Urban forestry – definition and scope – uses of urban forests, History of urban forestry
4	Planning and Management of urban forests ,land and policy considerations
5	Biodiversity and water shed management in upf, role of collaborative institutes
6	Arboriculture and its importance in urban forestry
7	Risk management in UF, disease and pest management in UF
8	Planning and planting programmes in institutional and industrial complexes,

9	Planning and planting programmes in roads, bridges, parking area and other
10	Types of landscape designs formal, Persian and Mughal designs
11	Types of landscape designs informal, British and Japanese.
12	Landscape components, plants
13	Landscape components others, lawn, pergolas, hedges, edges, topiary, balloon, arbours,
14	Practices of landscaping, Tools and implements required for landscaping
15	Specialized gardens, butterfly, water, bog or marsh
16	Specialized gardens, terrace, roof, Sunken, Indoor and rock

Practical Class Outline

Sl no	Lessons
1	Study on different garden components
2	Preparation, planning and designing the planting pattern for parks
3	Preparation, planning and designing the planting pattern of sanctuaries and industrial complexes
4	Studies on the features of plants suitable for avenue planting
5	Studies on the features of foliage trees suitable for avenue planting
6	Studies on the features of flowering shrubs suitable for avenue planting
7	Studies on the features of climbers used in lawns
8	Visit to landscaped areas
9	Visit to parks
10	Visit to tourist spots and centres,
11	visit to national parks and sanctuaries
12	practice planting methods
13	Preparation of Triennium
14	Visit to ecotourism spots and centres
15	Visit to important avenue plantations
16	Revision class

Suggested Reading

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

5. NRM 324

Restoration Ecology

2(1+1)

Theory

Degraded lands: Concept, classification, status, extent and causes of degraded lands/wastelands, different types of degraded lands – physical, chemical and biological land degradation. Soil erosion, types, causes and mechanism, measures to control erosion, ravine and sand dune formation and their control measures. Salt affected soils, classes of salt affected soils, causes, extent and their effects on plant growth and afforestation / reclamation practices. Acid soils, definition,

characteristics, causes and afforestation. Water logged areas, explanation, impact on plant growth and Bio-drainage techniques. Afforestation and reclamation of denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas. Desertification definition, impact and causes, prevention and counter measures (shelter belts and wind breaks). Soil pollution, types, effects and control measures through forestry techniques. National and state level programmes on degraded lands/wasteland development. Role of Government agencies and NGO's in degraded lands/wasteland development programme.

Practical

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

Theory Lecture Outline

Lecture	Chapter	Details
1	Introduction	Degraded lands: Concept, physical, chemical and biological land degradation classification,
2	Land utilization	Land utilization pattern in India and Odisha, Wastelands Classification & status,
3	Soil erosion	Soil erosion: concept, types, causes and mechanism,
4		Water erosion: cause, studying rate of siltation, measures to control ravine erosion,
5		Wind erosion, cause, impact and sand dune formation and their control measures.
6	Salt affected soils	Salt affected soils, classes of salt affected soils, causes, extent and their effects on plant growth and afforestation / reclamation practices.
7	Acid soils	Acid soils, definition, characteristics, causes and afforestation & their management
8	Water logged areas & their management	Water logged areas, explanation, impact on plant growth and Bio-drainage techniques.
9	Afforestation and reclamation of difficult sites	Afforestation and reclamation of denuded hill slopes, land slips and landslides
10		Afforestation and reclamation of cold desert
11		Afforestation and reclamation of mined out area: Mining, types, mine overburden soils, stabilization through afforestation,
12		Afforestation and reclamation of lateritic & murramy soils, dry, rocky areas.
13	Desertification	Desertification definition, impact and causes, prevention and counter measures (shelter belts and wind breaks).
14	Soil pollution	Soil pollution, types, effects and control measures through forestry techniques.
15	National and state level programme	National and state level programmes on degraded lands/wasteland development.
16	Government agencies and NGO's in wasteland management	Role of Government agencies and NGO's in degraded lands/wasteland development programme.

Practical Class Outline

Class	Experiment
1	Study of different types of pits and trenches
2	Determination of pH of problematic soils
3	Determination of Ec of problematic soils
4	Determination of organic carbon content of soil
5	Analysis of soil for Gypsum requirement.
6	Analysis of soil for lime requirement.
7	Selection of species for afforestation programme
8	Identification and study of various degraded lands.
9	Tree species suitable for different degraded lands.
10	Study of tree species suitable for mined over burden soil
11	Study of tree species suitable for bald hill plantation
12	Study of tree species suitable for land slips and landslides
13	Study of techniques for Mangrove plantation
14	Study of techniques for plantation of waterlogged area
15	Visit to nearby degraded lands water eroded site, ravine
16	Visit to nearby, coastal plantation sites

Suggested Reading

1. Anilkumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi
2. Buol, S.W., Kole, F.D. and McGracken, R.J. 1975. Soil Genesis and Classification. Oxford and IBH Publ. New Delhi.
3. Butler, B.E. 1980. Soil Classification for Soil Survey. Clerneder Press, Oxford Publ. Co., London.
4. Gregersen, H. Draper, S. and Elz. D.(eds.) 1989. People and Trees, The Role of Social Forestry in Sustainable Development EDI Seminar Series, The World Bank, Washington, D. C. 273p
5. Hegde NG 1987. Handbook of Wasteland Development. BAIF, Pune 102p.
6. Hegde NG and Abhyankar 1986 (eds). The Greening of Wastelands. BAIF, Pune 204p
7. IARI 1960. Soil Survey Manuel, IARI. New Delhi.
8. ICAR 1977. Desertification and its Control. ICAR, New Delhi 358p.
9. National Commission on Agriculture 1976. Report of the National Commission on Agriculture, Part ix,
10. Prasad, V. N. 1985. Principles and Practices of Social, Cum, Community Forestry. International Book Distributors, Dehradun, 108p
11. Shah, S. A. 1988. Forestry for People. ICAR, New Delhi, 147p
12. Sharma, S. C., Chaturvedi R. B and Mishra O. P 1990. Utilization of Wastelands for Sustainable Development In India. Concept Publishing Co. New Delhi, 59, 488p

6. FPU 321 Non-Timber Forest Products 3(2 +1)**Theory**

Types of markets for timber and non-timber forest produce, market locations of timber and non-timber forest produce and their features. Demand forecasts. Price determination in timber and non-timber forest produce. Economic features of specialized timber markets in terms of degree and type of competition in buying and selling, price spread, costs of marketing functions involved like pre-commercial thinning, commercial thinning, harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in teakwood, rosewood, matchwood, pulpwood, sandalwood, veneers; type and degree of competition in market for services of saw mill

and other intermediate wood processing industries, price spreads across different channels of marketing. Economic features of specialized markets in terms of degree and type of competition for bamboo, canes, lac, gums, resins, hides and skins. Economics of gathering medicinal plants from forests, economics of processing medicinal plants. Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce. Market inefficiencies in timber, non-timber forest produce and measures to check in efficiencies, role of cooperative societies in marketing of timber and non-timber forest produce. Economic policy and regulations of international timber trade. Essentials of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and timber certification.

Practical

Library review of studies on marketing and trade of; timber forest produce (teak, rosewood, *Terminalia* spp. *Pterocarpus* and other important timber of national importance etc.); Non, Timber Forest Produce (NTFP such as bamboo, canes, eucalypts etc.); forest based medicinal plants. Visits to timber produce and NTFP markets to collect price data and quantity sold and to observe auctions and competitions. Analysis of price and quantitative data of timber forest produce, NTFP for examining trend; seasonal, cyclical variations. Visit to markets of forest based medicinal plants. Study of buy back arrangements in forest based medicinal plants trade. Valuation of timber and NTFP (existence value, use and option values, intrinsic value etc). Development of hypotheses to study the marketing of forest produce. Presentation of results on analysis of price and quantity. Economics of processing pulp to paper/poly fiber; wood to plywood/veneers.

Theory Lecture Outline

Lect.	LESSON	SUBJECT MATTER
1	Introduction to NTFPs	Methods of collection, management and importance of Non-Timber Forest Products (NTFP)
2-4	Bamboo , canes, essential oils and fatty oil	General description, propagation methods , uses , Important bamboo species found in Odisha and India . Introduction, distribution , harvesting and processing of canes , important cane species of India and their uses. General concept , methods of extraction, classification of essential oils with brief note on different species. General concept , methods of extraction , Classification of fatty oils and uses , Important tree borne oil seeds of India , important biodiesel yielding species.
5-7	Gums, resins, tans , dyes , cutch and katha	Introduction, classification, methods of extraction, uses, factors affecting gum formation, important gum yielding plants. Introduction, classification , factors affecting resin yield , classification of resin. Introduction, nature of tannin, classification , Introduction, classification of plant dyes. Source of katha and cutch , methods of extraction , uses,
8-10	Fibre flosses , Bidi leaf processing and medicinal plants	Introduction , classification on basis of origin, on basis of texture , on basis of morphology, on basis of uses. Sources, kendu leaf, quality of kendu leaf , bush cutting, harvesting, processing and bidi making. Important medicinal plants from forest , its uses and its active principles
11-12	Types of markets	Types of markets for timber and non-timber forest produce, market locations of timber and non-timber forest produce and

		their features.
13-14	Demand and price determination	Demand forecasts. Price determination in timber and non-timber forest produce.
15-20	Economic features of timber market	Economic features of specialized timber markets in terms of degree and type of competition in buying and selling, price spread, costs of marketing functions involved like pre-commercial thinning, commercial thinning, harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in teakwood, rosewood, matchwood, pulpwood, sandalwood, veneers; type and degree of competition in market for services of saw mill and other intermediate wood processing industries, price spreads across different channels of marketing.
21-24	Economic features of NTFPs market	Economic features of specialized markets in terms of degree and type of competition for bamboo, canes, lac, gums, resins, hides and skins. Economics of gathering medicinal plants from forests, economics of processing medicinal plants.
25-26	Domestic and international trade of forest produces	Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce.
27-28	Marketing constraints of timber, non-timber forest produce	Market inefficiencies in timber, non-timber forest produce and measures to check in efficiencies, role of cooperative societies in marketing of timber and nontimber forest produce.
29-32	Economic policy and regulations of international timber trade	Essentials of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and timber certification.

Practical Class Outline

Class.	Title of experiment
1.	Identification of important NTFPs of Odisha
2.	Library review of studies on marketing and trade of; timber forest produce (teak, rosewood, Terminalia spp. Pterocarpus and other important timber of national importance etc.)
3.	NonTimber Forest Produce (NTFP such as bamboo, canes, medicinal plants etc.)
4.	Visits to timber produce and NTFP markets to collect price data and quantity sold and to observe auctions and competitions.
5.	Analysis of price and quantitative data of timber forest produce, NTFP for examining trend; seasonal, cyclical variations.
6.	Visit to markets of forest based medicinal plants.
7.	Study of buy back arrangements in forest based medicinal plants trade.
8.	Valuation of timber and NTFP (existence value, use and option values, intrinsic value etc).
9.	Development of hypotheses to study the marketing of forest produce.
10.	Presentation of results on analysis of price and quantity.

11.	Economics of processing pulp to paper/poly fiber; wood to plywood/veneers.
12.	Extraction of essential oil
13.	Extraction of fixed fatty oils
14.	Extraction of dyes
15.	Extraction of gums
16.	Procedures of lac cultivation

Suggested Reading

1. Gray, J. W. 1993. Forest resource systems in developing countries. Food and agricultural organization. Rome. 259p.
2. ITTO. [International Tropical Timber Organisation]. 1993. The economic linkages between international trade in tropical timber and sustainable management of tropical forests. London environmental economic centre, International Institute for Environment and Development, London, UK. 330p.
3. ITTO. [International Tropical Timber Organisation]. 2012. Annual review and assessment of the world timber situation, Yogyakarta, Indonesia. 182p.
4. Kula, E. 1996. The economics of forestry: Modern theory and practice. Timber press, Portland, Oregon. 182p.
5. Muraleedharan, P. K. Subramanian, K. K., and Pillai, P. P. 1998. Basic readings in forest economics. Kerala Forest Research Institute and Ford Foundation, Thrissur, Kerala. 177p
6. Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers & Publishers), Dehradun, India. 140p.

7. FPU 322 Certification of Forest Products 2(2 +0)

Theory

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

Theory Lecture Outline

Lect.	LESSON	SUBJECT MATTER
1-2	Forest certification	Definition of forest certification. Need of forest certification. Responsible sourcing of wood.
3-5	Principal stages in the process of certification.	Stages and processes of forest certifications. 1. certification of forest management 2. certification of the chain of custody
6-10	Principles of sustainable forest management and forest certification.	Principle 1: Compliance with laws Principle 2: Workers' rights and employment conditions Principle 3: Indigenous peoples' rights Principle 4: Community relations

		Principle 5: Benefits from the forest Principle 6: Environmental values and impacts Principle 7: Management planning Principle 8: Monitoring and assessment Principle 9: High conservation values Principle 10: Implementation of management Activities
11-13	Origin of certification.	Organizations responsible. Legislations and policies of importance.
14-18	Certification schemes in operation	Forest Stewardship Council (FSC), Programme for Endorsement of Forest Certification Schemes (PEFC) etc. CIFOR certification tool kit. Indian scenario in certification.
19-22	International trade in tropical logs and sawn wood.	Certification of logs and sawn wood for international trade , quality assessment and higher trade value .
23	Pros and cons of certification.	Benefits and constraints in forest certification
24-27	Potential for certifying forests and forest products of India.	Forest certification of different temperate and tropical forests of India, certification of rain forest, mangroves. Certification of eucalyptus for paper industry, bamboos and canes of northeast , other NTFPs
28-32	Tracing illegal logging	Identification of species and Timber tracing : a) FSC: Forest Stewardship Council and b) PEFC: Programme for as a traceability application. Identification of species and region of origin. Timber tracing through genetic methods and (analysis of stable isotope ratios).

Suggested Reading

1. Bass, S. Introducing forest certification. 1996. A report prepared by the Forest Certification Advisory Group (FCAG) for DG VII of the European Commission. European Forest Institute, Discussion Paper 1. 30p. Details available at: http://www.giz.de/Themen/de/dokumente/end28_inenpenent,certification,verification,forest,manage.pdf
2. Bass, S., Thornber, K., Markopoulos, M., Roberts, S. and Grieg, gran, M. 2001. Certification's Impact on forests, stakeholders and supply changes. International Institute for Environment and Development. London. 153p.
3. Conroy, M. E. 2007. Branded! How the "certification revolution" is transforming global corporations. New Society publishers, Gabriola Island, BC. 354p.
4. Gupta, H. S., Yadav, M., Sharma, D. K. and Singh, A. M. 2013. Ensuring sustainability in forestry: certification of forests. TERI, New Delhi. 284p.

8. FOR 321

Experiential Learning-II

5(0+5)

1. Production and Marketing of high value forest produce (0+5) (FPU)/
2. Raising Quality Planting Materials for forest regeneration (0+5) (SAF/FBT)/
3. Apiculture/Sericulture (0+5) (FBT/NRM/WLS)/
4. Ecotourism (0+5) (BAS/WLS)/
5. Wild Animal Health Management (0+5)(WLS)

Details:

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

Project formulation, Market survey and prioritization of species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to timber markets, saw mills, forest depots etc. Lesser known, but highly utilizable indigenous species of timbers will be given priority. Fast rotation timber species raised under various trials of the University will also be included to the extent possible.

Potential of different species for various end uses will be determined. Timber samples have to be converted into sticks / smaller sizes / macerated through appropriate procedures such as sawing and sizing in a saw mill or maceration in a laboratory. Mechanical tests: Static bending, compressive tests, across and along the grain. Finding out safe working stresses of lesser known or exotic/new species. Wood database currently available in the department will be updated based on the test results. Project report preparation and presentation, final examination. Wood conversion in an integrated saw mill, turnery for handicrafts, joineries and furniture making. Data analysis, project report writing, presentation and final examination.

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

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

3. Apiculture 5(0+5)

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

4. Ecotourism 5(0+5)

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

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

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

1. FOR 411 Student READY, Forestry Work Experience (FOWE) 20(0+20)

The Forestry Work Experience (FOWE) course would have the following modules.

Orientation (10 days)	0+1
Forest Range Training Programme (50 days)	0+12
Industrial placement (20 days)	0+3
Weapon Training and First-Aid Training (5+3=8 days)	0+1
Socio-economic Surveys and Village Attachment (20 days)	0+2
Report writing and presentations (12 days)	0+1

Orientation

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

Forest Range Training Programme

Visit to modern forest nurseries, herbal gardens and watersheds, study the felling and logging operations, timber lots and important industrial products, study working plan, enumeration, volume and yield calculation & compartment history files, study the 'CAT' (Catchment Area Treatment Plan) and FDA (Forest Development Agencies). Use of forestry equipments/ instruments, Study the regeneration and management of important forestry tree species, Sample plots, layout studies, stump analysis, preparation of local volume Tables. Study the working of other Forestry related organizations/industries. At the Wild life Sanctuaries/National Parks/Tiger Reserves, the students are expected to learn about the aspects related with the preparation of the Management Plans/Conservation Plans, to undertake and familiarize the various wildlife population enumeration techniques and the biodiversity assessment techniques. To undertake pilot studies on the man, animal conflict and other issues in the forest areas etc.

Industrial Placement

Attachment with Forest Based Industries like Wood Workshop, Saw Mills, Wood Seasoning and Preservation Treatment Plants, Pulp and Paper Industries, Aromatic and Medicinal Plant Units including AMPRS, Odakkali, Oushadhi, Kottakkal, KAPL, Aluwa, Ayurdhara, etc. Carpentry, bamboo and reed crafts, other Wood Products Industries, rubber, NWFP etc. Works to be undertaken includes study the nature of industrial and business organization–structure, raw material– collection and processing of raw, material, hands on practical, production and management process, marketing and financial management.

Weapon Training and First-Aid Training:

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

Socio Economic Surveys and Village Attachment:

Data collection, use of PRA techniques with respect to village profile including socioeconomic and cultural status, farm technology used, homesteads, agro forestry, biodiversity etc., Bench Mark survey of plantre sources (cropping pattern, homesteads, agro forestry, biodiversity, yield system etc.), Schedule development, tabulation, analysis and preparing plan of work. Understanding local for estry and other village level institutions (Panchayat, Village Forest Committees, corporations, youth/women groups etc.), People's participation in developmental

programmes with special reference to forestry. Exercises on the use of extension methods and teaching aids for Transfer of Technology.

Report Writing and Presentation

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

2. FOR 412

All India Study Tour 3(0+3*)

Three weeks' duration: To familiarize the students with the flora , fauna and other research activities of SAUs, research institutes, forest industries, govt. and private organization of different parts of India. To expose the students to various national / heritage monuments as part of national integration activity.

NRM 421**Forest Inventory and Yield Prediction****2(1+1)****Theory**

Yield: In regular forests. In Irregular forests. Estimation of growth and Yield of stands – Forest Inventory, Point sampling Forest Inventory , Definition, objectives, Kinds of enumeration, Tree assessment techniques, Measurement of wood volume, tree volume & tree volume tables – Kinds of sampling ,Sampling design , Kinds of sampling units, Fixed area and point sampling units , Plots, strips, topographical units , sampling intensity, Inventory designs used in India – Sampling errors and non sampling errors. Organisation of field work and conduct of enumeration – Point sampling, Concept of horizontal point sampling . Estimation of growth and yield prediction in forest stands, Stand structure , Growth of stand , Methods of predicting future growth of stands , Stand density , Canopy density ,Crown competition factor, Yield tables, definition, Preparation of yield table , Application and use of yield tables , Stand table, definition and use.

Practical

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

Theory Lecture Outline

Lect.	Lessons
1	Yield: In regular forests.
2	In Irregular forests, factors affecting yield in both types of forests
3	Types of rotation ,site quality ,stand density ,genetic and biotic including disease and pest attack
4	Silvicultural systems giving rise to even aged and uneven aged forest
5	Annual increments ,CAI, MAI, relation between the two
6	Growth of stands, normal age class in regular forest
7	Objectives of forest enumeration, types advantages of different types
8	Types of sampling, Kinds of sampling ,Sampling design , Kinds of sampling units, fixed area sampling units
9	Plots, strips, topographical units , sampling intensity
10	Inventory designs used in India – Sampling errors and non sampling errors
11	Organisation of field work and conduct of enumeration
12	Point sampling, Concept of horizontal point sampling
13	Methods of predicting future growth of stands , Stand density , Canopy density ,Crown competition factor,
14	Yield tables, definition, Preparation of yield table, Application and use of yield tables, Stand table, definition and use.
15	Tree assessment techniques, age, and height of standing and felled trees,.
16	Measurement of wood volume, tree volume & tree volume tables
17	Stand table

Practical Class

Class.	Experiment
1	Determination of height of stand
2	Determination of diameter of stands
3	Determination of growth of stands
4	Study the demarcation and alignment of plots,

5	Study the demarcation and alignment of strips etc
6	Field exercise on Horizontal point sampling
7	Field demonstration of various sampling techniques, Simple, stratified, sampling techniques
8	Field demonstration of various sampling techniques, , multi stage, multiphase, sampling techniques
9	Field demonstration of various sampling techniques, non-random sampling techniques
10	Use of wedge prism
11	Use of Relaskop in sampling
12	Site quality determination
13	Field exercise on the determination of site quality , Visit to local forest divisions
14	Preparation of yield table and its use
15	Preparation of stand table and its use
16	Study the methods of preparation of yield table and use of yield
17	Use of aerial photographs in forest inventory

Suggested Reading

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

2. FBT 421

Forest Biotechnology

3(2+1)

Theory

Concepts and history of Plant Biotechnology; Scope and importance in tree Improvement: Totipotency and Morphogenesis, Nutritional requirements of in vitro cultures; Techniques of in vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in vitro culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in tree improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer, Gene cloning, Direct and indirect method of gene transfer. Transgenic plants. their applications , achievements and bio-safety regulations, Blotting techniques, DNA finger printing and bar coding, DNA based markers, RFLP, AFLP, RAPD, SSR , VNTRS, CAPS, SNPs, ESTs and DNA Probes, Mapping QTL, Future prospects. MAS, and its application in tree improvement.

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants;

Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel electrophoresis technique.

Theory Lecture Outline

Lecture	Chapter
1.	Concepts of Plant Biotechnology
2.	History of Plant Tissue Culture
3.	Scope and importance in crop importance
4.	Totipotency and morphogenesis
5.	Nutritional requirements
6.	Techniques of in vitro culture
7.	Micro-propagation
8.	Anther and pollen culture
9.	Ovule and embryo culture
10.	Test tube fertilization
11.	Endosperm culture
12.	Factors affecting callus induction and morphogenesis
13.	Somaclonal variation: Types and its origin
14.	Somatic embryogenesis, Synthetic seeds-Techniques and application
15.	Protoplast isolation and Culture
16.	Protoplast fusion: Production of somatic hybrids and cybrids, manipulation,
17.	Doubt clearing
18.	Genetic engineering-concept, history of plant genetic engineering
19.	Restriction enzymes
20.	Vectors: Types, structure, application in molecular biology
21.	Vectors for gene transfer
22.	Gene cloning –Technique
23.	Direct gene transfer techniques
24.	Agrobacterium -mediated gene transfer in plants
25.	Transgenic plants and their applications
26.	Blotting techniques-Southern, Northern and western blotting
27.	Molecular markers -concept, properties; DNA fingerprinting
28.	Molecular marker systems-DNA probes, RFLP
29.	PCR technique-primers
30.	PCR based DNA marker systems-RAPD, SSR, AFLP
31.	Mapping populations
32.	Identification and mapping of QTL – Future prospects
33.	Marker Assisted Selection and its application in crop improvement.
34.	Special class: <i>Doubt clearing</i> of whole course.

Practical Class

Class	Practical
1.	Orientation of Plant tissue culture laboratory and genetic engineering laboratory
2.	Requirements for Plant Tissue Culture Laboratory.

3.	Sterilization techniques
4.	Techniques in plant tissue culture
5.	Components of different types of media used in tissue culture
6.	Preparation of MS medium
7.	Inoculation of various types of explants
8.	Aseptic manipulation of various explants for callus induction and plant regeneration
9.	Micro propagation of important crop plants
10.	Anther culture
11.	Embryo and Endosperm culture
12.	Hardening/acclimatization of regenerated plants
13.	Induction of somatic embryogenic cultures
14.	Synthetic/artificial seed production
15.	Demonstration of protoplast culture and fusion of protoplasts
16.	Demonstration of Isolation of DNA

Suggested Reading

1. J.H. Hammond, P. Mcgarvey, and V. Yusibov (eds), Plant Biotechnology, Springer Verlag, Heidelberg.
2. Bhojwani and Razdan, Plant Tissue Culture: Theory and Practice, Elsevier.
3. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press.
4. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
5. Brown TA, Genomes, 3rd ed. Garland Science 2006
6. R.H.Smith, Plant Tissue Culture: Techniques and Experiments, Academic Press, San Diego. 1992.

3. SAF 421 Agroforestry Systems and Management 3(2+1)

Theory

Land use and land capability classification; overview of agroforestry around the world; agroforestry systems in India. Classification of agroforestry systems; structural, functional, agroecological, socio,economic and physiognomic basis. Agrisilvicultural systems; Improved fallows in shifting cultivation; soil dynamics in shifting cultivation, Taungya systems. Alley cropping, structural and functional attributes. Multipurpose trees and shrubs on farmlands, agricultural fields, Plantation crop combinations, commercial crops under shade of planted trees and natural forests, Windbreaks & Shelterbelts. Silvopastoral systems, protein banks, Live fence of fodder trees and hedges, trees and shrubs in pastures. Pastoral silviculture systems: grassland and tree management in the humid, arid and semi, arid regions. Agri,silvipastoral systems, tropical home gardens, structural and functional attributes. Other systems: apiculture, sericulture and mixed woodlots. Major Agroforestry practices in different agroecological zones of India, arid and semi arid regions, agroforestry practices for wasteland reclamation. Agroforestry practices for salt affected soils. Agroforestry practices for wetlands and waterlogged areas. Non,wood forest products based agroforestry – Soil fertility improvement and water conservation through agroforestry. Socio,economic analysis of various agroforestry systems.

Practical

Study the desirable characteristics of trees/shrubs/grasses for various agroforestry programmes. Assessment of standing stock of tree species in various agroforestry systems such as home gardens. Survey of agroforestry practices in local/adjoining areas. Field observations to

characterize the structural, functional and economic attributes of the following agroforestry systems and practices: agrosilviculture systems, silvopastoral systems, pastoral silviculture systems, agrosilvopastoral systems, shelterbelts and windbreaks, live fences; fodder trees and protein banks. Exercise on Diagnosis and Design of agroforestry systems and practices. Assessment of productivity of tree crop combinations. Studying resource partitioning in agroforestry systems, water, light and nutrients. Analysis of soil and plant samples for organic carbon N, P and K.

Theory Lecture Outline

Lect.	Topic
1	Introduction and scope of the subject
2	Land use and land capability classification
3	Overview of agroforestry around the world
4	Agroforestry systems in India
6	functional and agroecological classification
7	Socio-economic and physiognomic basis
8	Agrosilvicultural systems
9	Improved fallows in shifting cultivation
10	Soil dynamics in shifting cultivation
11	Taungya systems
12	Alley cropping – structural and functional attributes
13	Multipurpose trees and shrubs on farmlands, agricultural fields
14	Plantation crop combinations
15	Commercial crops under shade of planted trees and natural forests
16	Pre-Midterm examination revision and doubt clearance
17	Windbreaks & Shelterbelts
18	Silvopastoral systems – protein banks, live fence of fodder trees and hedges, trees and shrubs in pastures.
19	Pastoral silviculture systems- grasslands
20	Tree management in the humid, arid and semi- arid regions
21	Agrosilvopastoral systems – tropical homegardens – structural and functional attributes
22	Other systems – apiculture, sericulture and mixed woodlots
23	Major Agroforestry practices in different agroecological zones of India – Humid areas
24	Agroforestry in arid and semi arid regions
25	Agroforestry in high lands
26	Agroforestry practices for wasteland reclamation
27	Agroforestry practices for salt affected soils
28	Agroforestry practices for wetlands and waterlogged areas
29	Non-wood forest products based agroforestry
30	Soil fertility improvement and water conservation through agroforestry.
31	Socio-economic analysis of various agroforestry systems
32	Pre-Final examination revision and doubt clearance

Practical Class Outline

Class	Topic
1	Preparation of layout of a remunerative agroforestry model for the locality
2	Development of the remunerative agroforestry model in field
3	Study of different management aspects of the agroforestry model developed

4	Study the desirable characteristics of trees/shrubs/grasses for various agroforestry programmes
5	Assessment of standing stock of tree species in various agroforestry systems such as homegardens
6	Survey of agroforestry practices in local/adjoining areas
7-10	Field observations to characterize the structural, functional and economic attributes of the following agroforestry systems and practices agrosilviculture systems, silvopastoral systems, pastoral silviculture systems, agrosilvopastoral systems, shelterbelts and windbreaks, live fences; fodder trees and protein banks.
11	Exercise on Diagnosis and Design of agroforestry systems and practices
12	Assessment of productivity of tree crop combinations
13-14	Studying resource partitioning in agroforestry systems - water, light and nutrients.
15-16	Analysis of soil and plant samples for organic carbon N, P and K.

Suggested Reading

1. Huxley, PA 1983 (ed). *Plant Research and Agroforestry*, ICRAF, Nairobi, Kenya.
2. Huxley, P. 1999. *Tropical Agroforestry*. Wiley: 384p.
3. Kumar, B. and Nair, P.K.R. (eds). 2006. *Tropical Homegardens: A Time Tested Example of Sustainable Agroforestry*. Volume 3 in the Book Series “Advances in Agroforestry”. Springer Science, the Netherlands
4. Kumar, B.M. 2011. Species richness and aboveground carbon stocks in the homegardens of central Kerala, India. *Agriculture, Ecosystems and Environment*. 140: 430–440
5. Kumar, B.M. and Nair, P.K.R. 2004. The enigma of tropical homegardens. 2004. *Agroforestry Systems*. 61: 135–152.
6. Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. *Advances in Agroforestry* 8. Springer Science, The Netherlands: 307p
7. Michael P. 1984. *Ecological Methods for Field and Laboratory Investigations*. Tata McGraw,Hill Pub. Co. New Delhi.
8. Mohan, S., Nair, P.K.R., Long, A.J. 2007. An Assessment of Ecological Diversity in Homegardens: A Case Study from Kerala State, India. *Journal of Sustainable Agriculture*. Volume 29, Issue 4: 135,153.
9. Nair, P.K.R, Rao MR, and Buck LE (eds), 2004. *New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry*, Kluwer, Dordrecht, The Netherlands.
10. Nair, PKR 1993. *An Introduction to Agroforestry*. Kluwer Academic Publishers, Dordrecht, The Netherlands.
11. Nair, P.K.R. *Agroforestry Systems in the Tropics*. Springer. 680p.
12. Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. *J. Plant Nutr. Soil Sci*. 172: 10–23.
13. Pathak P.S. and Ram Newaj (eds.) 2003. *Agroforestry: Potentials and Opportunities*. Agrobios, Jodhpur.

4. WLS 421

Wildlife Management

2(1+1)

Theory

Definition, History of wildlife management and conservation in India; values of wildlife , aesthetic, recreational, scientific, educational, commercial, farming, technological and ecological values. Zoogeographic regions of the world – Palearctic region, Nearctic region, Oriental region, Ethiopian region, Neotropical region, Australasian region. Major biomes of the world – polar region, coniferous forests, temperate forests, tropical forests, grasslands, deserts, mountains, inland waters,

oceans and oceanic islands. Biogeographic zones of India , trans-Himalayan, Himalayan, Indian desert, semi-arid, Western Ghats, Deccan peninsula, Gangetic plain, North East India, islands, coasts. Habitat requirements of animals. Red Data Book and red listing, IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned. Wildlife census: Purpose, techniques. Direct and indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities, block counts, road side counts, dung counts, pug mark census, water hole census, line transect, statistical analysis. Telemetry, transmitters, receivers, analysis of data, visual tagging and marking. Captive wildlife: Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife (Protection) Act, 1972. Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Introduction and reintroduction of species. Wildlife corridors. MAB, CITES. Wildlife Damage , Appraisal, Control and Management. Healthcare, Disease Management and Nutrition in Wild Animals Protected areas concept, wildlife sanctuaries and national parks, biosphere reserves, major protected areas of India.

Practical

Exercise on the census methods , direct method , total count, block count, water hole count, capture , recapture method, point transect, and line transect method – use of soft ware for analysis. Exercise on the census methods , indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for other ungulates. Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife. Direct and indirect methods of studying food habits of different wildlife. Studying habitat management and manipulation techniques. Wildlife damage and control: Questionnaire survey. Wildlife photography.

Theory Lecture Outline

Lect.	Chapter	Details
1.	Definition	Definition of wildlife, branches of wildlife science
2.	History of wildlife management	History of wildlife management and conservation in India, renowned personalities and their contribution in the field of wildlife
3.	Values of wildlife	Aesthetic, recreational, scientific, educational, commercial, farming, technological and ecological values
4.	Zoogeographic regions of the world	Pale-arctic region, Ne-arctic region, Oriental region, Ethiopian region, Neo-tropical region, Australasian region,
5.	Major biomes of the world	Polar region, coniferous forests, temperate forests, tropical forests, grasslands, deserts, mountains, inland waters, oceans and oceanic islands,
6.	Bio-geographic zones of India	Trans-Himalayan, Himalayan, Indian desert, semi-arid, Western Ghats, Deccan peninsula, Gangetic plain, North East India, islands, coasts,
7.	Habitat requirements of animals	Food, shelter, cover and their improvement Concept of Niche, Territory, Home Range, Territoriality, Carrying Capacity, Edge, Cruising Radius, Juxtaposition and Interspersion
8.	Red Data Book and red listing	IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned
9.	Wildlife census	Block counts, roadside counts, dung counts, pug mark census, water hole census, line transect- statistical analysis
10.	Telemetry	Transmitters, receivers, analysis of data, visual tagging and marking
11.	Captive wildlife	Zoos and safari parks, Central Zoo Authority of India
12.	Captive breeding	Purpose, principles, Guidelines
13.	Wildlife (Protection) Act, 1972	Wildlife (Protection) Act, 1972- Schedules and legal provisions

14.	Special projects for wildlife conservation	Project Tiger and Musk Deer Project, Introduction and reintroduction of species, Wildlife corridors, MAB, CITES
15.	Wildlife Damage	Appraisal, Control and Management
16.	Healthcare	Disease Management and Nutrition in Wild Animals
17.	Protected areas concept	wildlife sanctuaries and national parks, biosphere reserves, major protected areas of India

Practical Class Outline

Class	Practical
1.	Exercise on the census methods - direct method - total count, block count, water hole count, capture - recapture method, point transect, and line transect method – use of soft ware for analysis-I
2.	Exercise on the census methods - direct method - total count, block count, water hole count, capture - recapture method, point transect, and line transect method – use of soft ware for analysis-II
3.	Exercise on the census methods - indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for other ungulates-I
4.	Exercise on the census methods - indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for other ungulates-II
5.	Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife-I
6.	Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife-II
7.	Direct and indirect methods of studying food habits of different wildlife-I
8.	Direct and indirect methods of studying food habits of different wildlife-II
9.	Studying habitat management and manipulation techniques-I
10.	Studying habitat management and manipulation techniques-II
11.	Wildlife damage and control: Questionnaire survey
12.	Wildlife photography
13.	Visit to zoo

Suggested Reading

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

5. BAS 421**Agricultural Informatics****3(2+1)****Theory**

Computer Programming. General Concepts. Documentation and Program Maintenance, Debugging programs, Errors. Introduction to Visual Basic, Java, Fortran, C/ C++, etc, concepts and standard input/output operations, Variables and Constants, Operators and Expressions, Flow of control, Inbuilt and User defined functions, programming techniques for agriculture/forestry. E-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in agriculture/forestry. ICT for Data Collection, formation of development programmes, monitoring and evaluation of Programmes. Computer Models in agriculture/forestry: statistical, weather analysis and crop simulation models, concepts, structure, inputs, outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation. IT application for computation of water and nutrient requirement of crops, Computer, controlled devices (automated systems) for Agri,input management, Smartphone mobile apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology, concepts, techniques, components and uses for generating valuable agri-information. Decision support systems, taxonomy, components, framework, classification and applications in agriculture/forestry, DSS, Agriculture Information/ Expert System, Soil Information Systems etc for supporting Farm decisions. Preparation of contingent crop, planning and crop calendars using IT tools.

Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix, Linux, Creating, Files & Folders, File Management. Use of MS,WORD and MS Power point for creating, editing and presenting a scientific Document, Handling of Tabular data, animation, video tools, art tool, graphics, template & designs. MS,EXCEL , Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros. MS,ACCESS: Creating Database, preparing queries and reports, demonstration of Agri,information system. Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Introduction of various programming languages such as Visual Basic, Java, Fortran, C, C++, and their components Hands on practice on writing small programmes. Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop,Info/CropSyst/ Wofost. Preparation of Inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools. Use of smart phones and other devices in agro,advisory and dissemination of market information. Introduction of Geospatial Technology, demonstration of generating information important for Agriculture. Hands on practice on preparation of Decision Support System.

Theory Lecture Outline

Lect.	Topic
1	Computer Programming, General Concepts,
2	Documentation and Program Maintenance,
3	Debugging programs,
4	Errors. Introduction to Visual Basic, ,
5	Java, Fortran, C/ C++, etc,
6	concepts and standard input/output operations,
7	Variables and Constants,
8	Operators and Expressions, Flow of control,
9	Inbuilt and User defined functions

10	programming techniques for agriculture/forestry.
11	e-Agriculture, concepts, design and development.
12	Application of innovative ways to use information and
13	communication technologies (IT) in agriculture/forestry.
14	ICT for Data Collection, formation of development programmes,
15	monitoring and evaluation of Programmes.
16	Computer Models in agriculture/forestry: statistical, weather analysis and crop simulation models,
17	concepts, structure, inputs, outputs files, limitation,
18	advantages and application of models for understanding plant processes,
19	sensitivity, verification, calibration and validation.
20	IT application for computation of water and nutrient requirement of crops,
21	Computer, controlled devices (automated systems) for Agri-input management,
22	Smartphone mobile apps in Agriculture for farm advises,
23	For market price,
24	Postharvest management etc;
25	Geospatial technology, concepts, techniques,
26	components and uses for generating valuable agri-information.
27	Decision support systems,
28	taxonomy, components, framework,
29	classification and applications in agriculture/forestry,
30	DSS, Agriculture Information/ Expert System,
31	Soil Information Systems etc for supporting Farm decisions.
32	Preparation of contingent crop, planning and crop calendars using IT tools.

Practical Class Outline

Class	Practicals
1.	Study of Computer Components, accessories, practice of important
2.	DOS Commands. Introduction of different operating systems such as windows, ,
3.	Unix, Linux, Creating, Files & Folders, File Management.
4.	Use of MS, WORD and
5.	MS Power point for creating, editing and presenting a scientific Document
6.	Handling of Tabular data, animation, video tools, art tool, graphics, template & designs
7.	MS, EXCEL , Creating a spreadsheet, use of statistical tools, writing expressions,
8.	Creating graphs, analysis of scientific data, handling macros. MS, ACCESS:
9.	Creating Database, preparing queries and reports, demonstration of Agri, information system. Introduction to
10.	World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Introduction of various programming languages such as
11.	Visual Basic, Java, Fortran, C, C++, and their components Hands on practice on writing small programmes. Hands on practice on Crop Simulation
12.	Models (CSM), DSSAT/Crop, Info/CropSyst/ Wofost. Preparation of Inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools..
13.	Use of smart phones and other devices in agro, advisory and dissemination of market information.
14.	Introduction of Geospatial Technology,

15.	demonstration of generating information important for Agriculture.
16.	Hands on practice on preparation of Decision Support System

7. FOR 421 Project Work & Dissertation 10(0+10)

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