

COURSE CONTENTS

FOR

**STATE FOREST SERVICE
OFFICERS**

TRAINING COURSE

GENERAL BOTANY/ MATHEMATICS

GENERAL BOTANY

Theory: 20
Practicals: 20
Field Exercise: 2 days

1. **Importance and objectives of teaching Botany to a Forest Officer; different branches of Botany.** (1)
2. **Classification of plant Kingdom** (3)
 - 2.1 Cryptogams-Main divisions under cryptogams–bacteria, algae, fungi, lichens, bryophyta and pteridophyta.
 - 2.2 Phanerogams-Gymnosperms and Angiosperms
3. **External Morphology** (broad characters, details to be taught in practical) (6)
 - 3.1 Root characteristic, functions, form and habit
 - 3.2 Stem functions, form, different types of branching, stem modifications.
 - 3.3 Leaf structure and functions, modifications
 - 3.4 Flower:
 - 3.4.1 Structure and terms for describing flowers
 - 3.4.2 Bracts
 - 3.4.3 Calyx
 - 3.4.4 Corolla
 - 3.4.5 Androecium and Gynoecium
 - 3.4.6 Floral diagrams and floral formulae
 - 3.4.7 Inflorescence
 - 3.4.8 Pollination
 - 3.4.9 Fertilization
 - 3.5 Fruit Morphology:
 - 3.5.1 Dehiscence
 - 3.5.2 Classification
 - 3.6 Seed:
 - 3.6.1 Morphology
 - 3.6.2 Types
4. **Histology:** (10)
 - 4.1 Cell structure, physical and chemical nature of protoplasm, cytoplasm, differences between plant and animal, prokaryotic and Eukaryotic cell.
 - 4.2 Types of Cell Division (basic idea).
 - 4.3 Tissues and their types
 - 4.4 Tissue System of stems
 - 4.5 Secondary growth, annual ring formation etc.

PRACTICALS: (20)

Modification of stem (rhizome, tuber, bulb, corn etc.)
Leaf-types, shape, margin venation, phyllotaxy, stipules and leaf modifications.
Inflorescence types.
Floral Morphology–Parts of Flower
Types of fruits–Classification, dehiscence etc.
Types of Seeds
Transverse section of root, shoot system with particular reference to tissue system and secondary growth.

FIELD EXERCISE (2 Days)

Field visit: General instructions regarding using flora in the field identification.

MATHEMATICS

Theory: 40

1. **Arithmetic:** (12)
 - 1.1 Approximations
 - 1.2 Powers and roots
 - 1.3 Logarithms
 - 1.4 Ratio and proportion
 - 1.5 Simple and compound interest

2. **Algebra** (14)
 - 2.1 Factorization Standard formulae
 - 2.2 Equation-simple, simultaneous, quadratic
 - 2.3 Arithmetic progression
 - 2.4 Geometric progression.
 - 2.5 Permutations and combination
 - 2.6 Binomial theorem
 - 2.7 Trinomials theorem
 - 2.8 Remainder theorem

3. **Trigonometry** (14)
 - 3.1 The ratios, relations between ratios
 - 3.2 Angles more than 90 degree and signs of ratios
 - 3.3 Use of tables
 - 3.4 Solutions of triangles
 - 3.5 Area of triangle

APPLICATION OF MODERN TOOLS AND TECHNOLOGY

Part A- Remote Sensing Techniques in Forestry

Theory: 50
Practicals: 50

1. **AERIAL SURVEY:** (15)
 - 1.1 Introduction to aerial photography and photogrammetry; types of aerial photos; photographic specifications for forestry applications; obtaining, handling and storage of aerial photographs; scale and horizontal measurement; tilt and displacement; stereoscopy; elements and steps involved in photo-interpretation; mapping, map numbering and orthophoto maps; difference between aerial photograph and maps.
 - 1.2 Measurement of height of an object and height difference characteristics of single tree and a stand; area determination and stock mapping; use of aerial photographs in Forest inventory and Forest Management.
 - 1.3 Application of Aerial Photographs for estimation of timber volume and volume increment of a crop using stratified random sampling, line plot and strip sampling and multi-stage sampling methods.

2. **REMOTE SENSING:** (15)
 - 1.1 Introduction to basic principles of remote sensing, spectral reflectance in infrared region, thermal infrared radiation and other spectral band from vegetation, soil and water.
 - 1.2 Introduction to RBV, MSS, LISS, TM, Thermal Images, Radar Technology, SAR Interferometry for generating accurate topographic maps.
 - 1.3 Procurement of satellite data.
 - 1.4 Resolution and form of data from LANDSAT, NOAA, SPOT, IRS 1 B, C and D, IKONOS High Resolution Satellite etc.
 - 1.5 Visual Interpretation and Digital Image Processing of Satellite Data
 - 1.6 Application of remote sensing techniques in forestry and allied subjects and future prospects of remote sensing.
 - 1.7 Use of satellite imagery in multi-stage sampling for forest Inventory and change detection.
 - 1.8 National vegetation mapping.

- 1.9 Use of Global Positioning System for collection of Field data collection
1.10 Methodology for ground validation.

PRACTICALS:

(10)

1. Aerial Survey: Stereo test, Orientation of aerial photographs, determination of photoscales, transfer of points under stereoscopy, construction of Director point measurement of height and crown diameter of single tree, crown density of a stand, stock mapping.
2. Remote Sensing: Digital and visual interpretation of satellite imagery. Multi-stage sampling for volume estimation using satellite imagery and aerial photos.
3. Land use and Soil Capability Classification

PART B- COMPUTER APPLICATION IN FORESTRY

Practicals-20

1. **Introduction to Computers**
Brief history of computers
Hardware & Software
2. **Operating Systems**
Introduction to operating Systems
Introduction to WINDOWS 98 &
WINDOWS 2000
Discussion on other operating systems
Self-learning packages.
3. **Word Processing:**
Introduction to Word Processing
Self-learning package
M.S. WORD: Edit, Save, Print, Block, Mail,
Merge, Spell Checks, Thesaurus
Advance Features, Exercises,
Practice and Quiz,
Comparison of latest word processors.
4. **Spread Sheet:**
Introduction to Electronic Spread Sheet
Application and creation of spreadsheets
M.S. EXCEL: Menus, Graphs, Reports and Printing of Spread sheets
Forestry Applications Practice and Quiz, Self-learning package.
5. **Data Base Management Systems:**
Introduction to Data Base Management
Systems, M.S. ACCESS, Creating
Data Base, Modify, Add and delete records,
Report Generation
Practice and Quiz.
Application in DBMS
Self-learning package.
6. **Graphical packages & Multi Media Applications**
Presentation Tools: M.S. Power Point.
Practice and Quiz
7. **Computer Viruses**
8. **Latest Trends in Computers**
9. **Computers in Wildlife Management,
Making use of Spread Sheets & DBMS for Census etc.
Networking Concepts: LAN; WAN; INTERNET**
10. **Application of Computers in Forestry**

PART C - APPLICATION OF GEOGRAPHICAL INFORMATION SYSTEM

Theory (20)

1. Basic Concepts in GIS (1)
2. Scope of Geographical Information System (2)
3. Principles of GIS (2)
4. Concepts, Spatial and Non-Spatial Information (2)
5. Preparing and developing spatial and non-spatial database for GIS Analysis (3)
6. Methods of data entry in the GIS Domain (2)
7. Analytical Capability of the GIS (3)
8. Applications of Forest and Wildlife Management and allied areas (3)
9. Generating outputs for application in field (2)

PRACTICALS

(20)

1. Exposure to different sources of spatial and non- spatial data
2. Preparation of data inputs for GIS
3. Introduction to hardware and different software available
4. Hands on training in operating basics of the GIS
5. Actual data entry of spatial and non-spatial data
6. Editing, rasterization, labeling of attributes etc.
7. Carrying out theme based analysis to know applications to Forestry, Wildlife and allied areas.
8. Generating outputs useful for Managers of the resources

SILVICULTURE-I PART A

General Silviculture

**Theory: 59
Practical: 20
Excursion: 8days.**

1. **INTRODUCTION:** (1)
Definition, scope and basis of rational Silvicultural practice.
2. **LOCALITY FACTORS:** (5)
 - 2.1 **Climatic factors:** Importance of climate and weather in forestry; elements of climate and factors influencing forests, periodicity of climate, climatic provinces, seasons, solar radiation, temperature, moisture and wind. 1
 - 2.2 **Physiographic factors:** Altitude and its effect; effect of slope and aspects; topography and surface conditions. 1
 - 2.3 **Edaphic factors:** soil condition; soil moisture; influence of soil on vegetation, indicator plants. 1

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| 2.4 | Biotic factors: plant parasites; beneficial & injurious affects of wild and domestic animals; interference by man; beneficial and harmful effects of fire. | 1 |
| 2.5 | Interaction of locality factors in determining vegetation; relative hardiness of species; resistance and tolerance to different climatic factors. | 1 |
| 3. | SITE MAINTENANCE AND IMPROVEMENT: | (3) |
| 3.1 | Site maintenance in regeneration operations | |
| 3.1.1 | Evaluation of site characters for plantation. | |
| 3.1.2 | Structural management of soils. | |
| 3.1.3 | Water Management. | |
| 3.1.4 | Soil working in relation to moisture conservation. | |
| 3.1.5 | Cultural practices | |
| 3.2 | Site maintenance in forest stand | |
| 3.2.1 | Species composition. | |
| 3.2.2 | Controlled grazing. | |
| 3.2.3 | Manures and fertilizers. | |
| 3.2.4 | Soil amendment. | |
| 3.2.5 | Fertility potential of soil. | |
| 4. | GROWTH AND DEVELOPMENT OF TREE: | (9) |
| 4.1 | Tree form: Form of crown, branching, bole & root, root and mycorrhiza-their types and role. | 1 |
| 4.2 | Structure | |
| 4.2.1 | Stem structure-bark | |
| 4.2.2 | Root structure | 1 |
| 4.3 | Water relations. | |
| 4.3.1 | Ascent of sap | |
| 4.3.2 | Conduction | |
| 4.3.3 | Transpiration | |
| 4.3.4 | Moisture availability and growth. | 1 |
| 4.4. | Light relations | |
| 4.4.1 | Photosynthesis. | |
| 4.4.2 | Photoperiod. | |
| 4.4.3 | Leaves and light relations. | |
| 4.4.4 | Ground flora and light. | |
| 4.4.5 | Light demanders and shade bearers. | |
| 4.4.6 | Other effects of light. | 1 |
| 4.5 | Food relations | |
| 4.5.1 | Carbohydrate metabolism | |
| 4.5.2 | Assimilation | |
| 4.5.3 | Respiration | |
| 4.5.4 | Nitrogen assimilation. | |
| 4.5.5 | Major and minor nutrients. | |
| 4.5.6 | Function of mineral nutrients | |
| 4.5.7 | Mineral deficiency | |
| 4.5.8 | Translocation. | |
| 4.5.9 | Accumulation | |
| 4.5.10 | Parasitism. | 2 |
| 4.6 | Growth regulations. | |
| 4.6.1 | Absorption and translocations. | |
| 4.6.2 | Growth promoters. | |
| 4.6.3 | Growth inhibitors and phytocides | |
| 4.6.4 | Other important effects of growth regulators. | 1 |

4.7 **Growth and development**-Period of growth and rest; growth rings; height growth; diameter growth; volume increment; quality increment; Growth in Bamboos.

1

4.8 **Crop Morphology:**

Differentiation of stands by composition and density, crown and canopy; crown classification; crown closure; root competition. 1

5. **CLASSIFICATION OF FOREST TYPES AND THEIR DISTRIBUTION: (5)**

5.1 Basis for classification.

5.2 Forest types of India and their distribution according to Champion and Seth's classification.

Note:

Field study of tree growth and development, study of locality factors, forest stand, succession, study of vegetation in various forest types shall be done during field tours and excursions.

(5 days)

PART B SILVICULTURAL PRACTICES

1. **NATURAL REGENERATION (3)**

- 1.1 Natural regeneration by seed
- 1.2 Natural regeneration by coppice
- 1.3 Natural regeneration by root suckers
- 1.4 Cultural operations

2. **ARTIFICIAL REGENERATION (24)**

2.1 **General Consideration 3**

- 2.1.1 Objects of artificial regeneration; artificial v/s natural regeneration
- 2.1.2 Choice of species in respect of hard-woods, softwoods, fast growing, slow growing, exotics and indigenous species.
- 2.1.3 Sowing v/s planting
- 2.1.4 Pure v/s mixed crops

2.2 **Seed Supply 4**

- 2.2.1 Seed collection; selection of plus trees, their evaluation.
- 2.2.2 Seed orchard; seed stand; seed production areas; seedling seed orchards and clonal seed orchards.
- 2.2.3 Seed testing, certification and storage
- 2.2.4 Pre-sowing treatment of seed including stratification and scarification.

2.3 **Nursery 4**

- 2.3.1 Selection of site, Layout, preparation of beds, fencing
- 2.3.2 Seed requirement; Time and method of Sowing.
- 2.3.3 Protection of seeds and seedlings against diseases, pests and natural calamities.
- 2.3.4 Green and organic manure and fertilizer application; shading; watering and damping off; weed control in the nursery.
- 2.3.5 Weeding and hoeing; Thinning out; culling, shifting grading of seedlings; time and method of transplanting; maintenance of fertility, calendar of operations.

2.4 **Container plants 2**

- 2.4.1 Specification of container
- 2.4.2 Potting Media
- 2.4.3 Container Filling and stacking
- 2.4.4 Time and method of sowing and transplanting

2.5 **Modern Nursery Techniques 4**

- 2.5.1 Comparative performance of planting stock raised from vegetative parts and from seed.
- 2.5.2 Clonal Techniques.
- 2.5.3 Root suckers.

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| 2.5.4 | Stem and branch cutting. | |
| 2.5.5 | Root and rhizome cutting. | |
| 2.5.6 | Layering. | |
| 2.5.7 | Grafting. | |
| 2.5.8 | Budding. | |
| 2.5.9 | Hormone and stimulants for rooting. | |
| 2.5.10 | Green house and mist chamber design and management. | |
| 2.6 | Planting Operations and Techniques | 4 |
| 2.6.1 | Survey and mapping of the plantation area; treatment map; clearing, burning, planting plan; direct sowing; | |
| 2.6.2 | Season of planting | |
| 2.6.3 | Stacking and Carriage to planting site | |
| 2.6.4 | Spacing | |
| 2.6.5 | Size of trench and pits, and soil working; | |
| 2.6.6 | Method of planting of nursery bed and container grown seedlings. | |
| 2.6.7 | Irrigation including water conservation techniques and drainage. | |
| 2.6.8 | Application of fertilizers | |
| 2.6.9 | Use of fungicides and insecticides | |
| 2.6.10 | Nurse and cover crop | |
| 2.7 | Maintenance of plantation | 2 |
| 2.7.1 | Weeding. | |
| 2.7.2 | Soil working and hoeing. | |
| 2.7.3 | Watering. | |
| 2.7.4 | Mulching. | |
| 2.7.5 | Protection from grazing. | |
| 2.7.6 | Replacement of casualties, cutting back. | |
| 2.8 | Plantation Records | 1 |
| 2.8.1 | Site Map and Site Photographs. | |
| 2.8.2 | Treatment Map. | |
| 2.8.3 | Plantation Estimations. | |
| 2.8.4 | Records of various operations. | |
| 2.8.5 | Expenditure incurred. | |
| 2.8.6 | Monitoring and Evaluation Formats, Inspection Notes etc. | |
| 3. | TENDING | (4) |
| 3.1 | Definition | |
| 3.2 | Weeding and cleaning | |
| 3.2.1 | Weed control in natural regeneration areas. | |
| 3.2.2 | Weed control in artificial regeneration areas. | |
| 3.2.3 | Climber control. | |
| 3.2.4 | Cleaning. | |
| 3.2.5 | Thinning in plantations. | |
| 3.2.6 | Thinning in natural regeneration areas. | |
| 3.2.7 | Thinning in irregular crops. | |
| 3.2.8 | Thinning intensity and mathematical checks. | |
| 3.2.9 | Pruning | |
| 4. | GENETICS AND TREE IMPROVEMENT | (3) |
| 4.1 | Mendelian law of heredity. | |
| 4.2 | Provenance delimitations and trials. | |
| 4.3 | Hybridisation, plant breeding including selective breeding and progeny trials. | |
| 4.4 | Biotechnology and tissue culture. | |
| 5. | Seed Orchard Establishment | (1) |
| 6. | Seed collection from superior trees, handling, storage | (1) |
| | PRACTICALS: | (20) |
| 1. | Seed Processing | 2 |
| 1.1 | Extraction | |

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| 1.2 | Cleaning | |
| 2. | Seed Testing | 5 |
| 2.1 | Sampling | |
| 2.2 | Moisture determination | |
| 2.3 | Purity analysis | |
| 2.4 | Germination test | |
| 2.4.1 | First day: Seed counting, preparation of seed beds/ petri dishes, putting the seed for test | |
| 2.4.2 | Fifth day: Counting | |
| 2.4.3 | Fifteenth day: final counting. | |
| 2.5 | Viability test | |
| 2.5.1 | Day one: Counting of seeds, soaking in water and preparation of reagent. | |
| 2.5.2 | Day two: Decoating of seed and putting seeds in test solution. | |
| 2.5.3 | Day three: Evaluation | |
| 3. | Rooting of cuttings | 3 |
| 3.1 | Taking of cuttings and planting in beds | |
| 3.2 | Evaluation after a week and writing report | |
| 4. | Budding, Grafting, & Layering | 3 |
| 5. | Other Methods of Propagation. | 3 |
| 5.1 | Bamboo Propagation | |
| 5.2 | Evaluation of result and reporting. | |
| 6. | Plus Tree Selection | 4 |
| 6.1 | Selection of phenotypically superior quality trees, marking and reporting. | |
| 6.2 | Finalization of trees and its marking | |
| 6.3 | Recording of data and maintenance of records | |
| 6.4 | Collection of reproductive material, its transportation and establishment of germplasm. | |

FIELD EXERCISE:

3 Days

- (i) Preparation of a plantation scheme for a given area including estimates and scheduling various operations and protection of the plantation for five years. (This could be done during Watershed Management Plan exercise).
- (ii) Visits to nursery and plantation sites to study and participate in the operations.

Note: The above experiments are to be carried out under the guidance of Scientists from Seed Testing Laboratory, Plant Physiology and Genetics branches of the Research Institutes of the Indian Council of Forestry Research and Education.

SILVICULTURE II

Part A

Silviculture of Indian trees

Theory: 45
Field Exercises 2 Days

General description dealing with the general value, growth characteristics, natural distribution, phenology, silvicultural characters, autecology, synecology, community environment, natural regeneration, artificial regeneration, seed collection, storage, nursery technology, plantation technology, after care, tending operations and management of the following species:

1. **Common species:** **(15)**
 - 1.1 **Conifers**
 - 1.1.1 *Cedrus deodara*
 - 1.1.2 *Pinus roxburghii*

- 1.2 **Broad leaved.**
- 1.2.1 *Acacia nilotica* & *A. catechu*
 - 1.2.2 *Azadirachta indica*
 - 1.2.3 *Dalbergia sissoo*
 - 1.2.4 *Eucalyptus species*
 - 1.2.5 *Madhuca indica*
 - 1.2.6 *Shorea robusta*
 - 1.2.7 *Tectona grandis*
 - 1.2.8 *Terminalia species*
 - 1.2.9 *Populus spp.*
 - 1.2.10 *Casuarina equisetifolia*

- 1.3 **Bamboos and Rattans:**
- 1.3.1 *Bambusa species*
 - 1.3.2 *Calamus species*
 - 1.3.3 *Dendrocalamus strictus* & other species.
 - 1.3.4 *Melocanna bambusoides*.

2. **Species of regional importance:**

(10)

2.1 **Northern region:**

Abies pindrow
Celtis australis
Diospyros species
Grewia species
Picea smithiana
Pinus wallichiana
Populus spp.
Quercus species
Robinia pseudocacia
Salix spp.

2.2 **Southern region:**

Acacia spp. (wattles),
Anacardium occidentale,
Casuarina spp.,
Dalbergia latifolia
Dipterocarpus spp.
Pongamia species.
Pterocarpus spp.
Santalum album
Swetenia mahogany,
Tamarindus indica.

2.3 **Eastern region:**

Anthocephalus kadamba
Casuarina species
Chuckrassia tabularis
Cryptomeria japonica
Dipterocarpus species
Mesua ferea
Morus lavigata
Pinus kesiya
Shorea assamica
Terminalia myriocarpa

Note: This subject should also be covered during study tour and species of regional importance will be taught to groups of that region.

Part B Silvicultural Systems

1. **Introduction:** 1
Definition, scope and classification, formulation and objectives of systems.
2. **Clear felling system** and its modifications, cutting sections application in India. 1
3. **Shelter wood system:**
 - 3.1 Uniform system- including regeneration period, periodic blocks, their types and importance, regeneration fellings, examples and application in India, Chir, Deodar, Kail, sal, Teak.
 - 3.2 Group system
 - 3.3 Irregular shelter wood system
 - 3.4 Canopy lifting shelter wood system 9
4. **Selection system:** 3
Characteristics, rotation, felling cycle, application in India.
5. **Coppice system;** 2
 - 5.1 Simple coppice system
 - 5.2 Coppice with standards – rotation, selection of standards, yield
 - 5.3 Coppice with reserve
 - 5.4 Pollarding system
6. **Conversion:** 3
 - 6.1 Reasons for conversion and types of conversion
 - 6.2 Conversion to uniform system.
 - 6.3 Conversion from coppice system to high forest
7. **Concept of Dauerwald and Method du controle** 1

Field Exercises

2 Days

Note: Different Silvicultural systems followed for important Indian tree species like sal, Teak, Shisham, Chir, Deodar, Fir, Spruce, Oaks etc, shall be studied during field tours.

FOREST RESOURCE ASSESSMENT

Theory: 45
Practicals: 12
Field Exercise: 16days

PART A-TREE MEASUREMENTS

1. **Diameter and girth measurement:** (1)
 - 1.1 Objects of tree measurements.
 - 1.2 Reference and other points of diameter measurement of standing trees.
 - 1.3 Measurements of forked, buttressed, fluted and abnormal trees.
 - 1.4 Simple instruments such as caliper, tape etc. their use and relative accuracy.
 - 1.5 Various kinds of dendrometres such as Bar and strut pedometer and Tele relascope, their use and relative accuracy.
 - 1.6 Determination of basal area of trees and its uses.
 - 1.7 Various formulae used for basal area.
2. **Height measurement:** (2)
 - 2.1 Objects of height measurements.
 - 2.2 Definition and measurements of various heights such as total, clear bole, merchantable etc.
 - 2.3 Principles of Hypsometers, Principles and use of Abney's level, Altimeters, relascopes and Calinometers.
 - 2.4 Relative accuracy of these instruments and sources of error in measurements.

3. **Crown measurements** (1)
- 3.1 Objects of crown measurements.
- 3.2 Measurements of crown width, crown height, crown area, crown volume etc.
- 3.3 Construction and use of instruments for crown measurements such as mirror type, pun-chun crown meter etc.
- 3.4 Measurement of branch angle, branch diameter and its length.
4. **Volume measurements of logs and felled trees:** (3)
- 4.1 Estimation of volume of log through sectional area, length etc.
- 4.2 Use of various formulae for estimating volume of log such as Huber, Smalian, Newtons etc. and their relative accuracy.
- 4.3 Volume measurements of logs, branch wood etc., by Xylometric method.
- 4.4 Measurement of specific gravity of wood.
- 4.5 Measurement of stack wood and piling coefficient
- 4.6 Concept and measurement of various types of volume of a tree, standard total timber, standard branch wood, sapwood and heartwood volume etc.
- 4.7 Estimation of conversion losses of plywood, sawn logs, poles, pulp etc. from a tree or log.
- 4.8 Determination of cull and assessment of internal defects in felled trees.
- 4.9 FRI procedure for measurement of volume of felled trees.
5. **Bark thickness measurement:** (1)
- 5.1 Need for measurement.
- 5.2 Instruments for measuring bark thickness, their use and accuracy.
- 5.3 Bark percent tables, their construction and use.
- 5.4 Bark quotient and conversion of over bark volume to under bark.
6. **Study of tree form:** (1)
- 6.1 Various theories relating to development of tree taper.
- 6.2 Definition, measurement and use of form factors and form quotients.
- 6.3 Various formulae relating to form of trees and their use.
- 6.4 Taper table, taper curves and their use.
7. **Volume estimation of standing trees:** (4)
- 7.1 Volume estimation by measuring diameter, height and form of trees.
- 7.2 Volume estimation by volume tables:
- 7.3 Definition of volume tables.
- 7.4 Various kinds of volume tables and their uses.
- 7.5 Construction of volume tables by graphical and regression methods.
8. **Age determination of trees:** (1)
- 8.1 By ocular estimate.
- 8.2 From records.
- 8.3 By counting of whorls of branches.
- 8.4 By counting growth rings.
- 8.5 Through successive measurements.
9. **Growth measurement of trees:** (6)
- 9.1 Definition of various kinds of growth i.e. growth in diameter, basal area, height, volume, quality and their characteristics curves.
- 9.2 Increment percent and its determination by Pressler's and Schneider's formulae.
- 9.3 Determination of growth of trees with annual rings.
- 9.3.1 Measurement of diameter growth by stump analysis and increment borer.
- 9.3.2 Measurement of diameter, height and volume growth by stem analysis.
- 9.4 Measurement of growth of trees without annual rings from data of sample plots, linear increment plots etc.
- 9.5 Concept of mean and current annual increments and their relationship.
- 9.6 Factors influencing the volume growth of trees such as site, competition, age etc.

PRACTICALS: (12)

1. Measurement of diameter, girth, height, crown of standing trees and presentation of data in tabular form. 6
2. Use of tele-relascope for calculation of taper-data and also to calculate the volume of standing trees. 6

FIELD EXERCISES:**(10)**

1. Stem and stump analysis to study the growth history of individual trees.
2. Increment boring analysis.
3. Preparation of local volume tables.

PART B- FOREST BIOMETRY**1. Basic statistical methods: (10)**

- 1.1 Importance of statistics in forestry
- 1.2 Grouping and presentation of data
- 1.3 Frequency distribution and its representation
- 1.4 Measures of central tendency – arithmetic mean, median and mode.
- 1.5 Measures of dispersion– standard deviation, variance and coefficient of variation.
- 1.6 Normal distribution and its applications in forestry
 - 1.6.1 Properties of normal distribution
 - 1.6.2 Distribution of errors
 - 1.6.3 Confidence limits
 - 1.6.4 Types of abnormality – skewness and kurtosis
- 1.7 Expected value of mean and standard error
- 1.8 Tests of significance
- 1.9 Correlation and regression
 - 1.9.1 Definitions
 - 1.9.2 Simple linear regression and its fitting by least square method.
 - 1.9.3 Coefficient of determination and its significance
 - 1.9.4 Examples of multiple regression

2. Forest Sampling: (8)

- 2.1 Necessity of sampling in forestry
- 2.2 Complete enumeration v/s partial enumeration
- 2.3 Principal steps in sample surveys
- 2.4 Terminology and concepts
 - 2.4.1 Population, sampling unit and frame
 - 2.4.2 Size of sample/ sampling intensity
 - 2.4.3 Bias, accuracy and precision
 - 2.4.4 Sampling variation and estimation of sampling error
 - 2.4.5 Determination of sample size at a given level.
 - 2.4.6 Classical sampling design used in forest surveys:
 - 2.4.6.1 Simple random sampling
 - 2.4.6.2 Stratified random sampling
 - 2.4.6.3 Systematic sampling
 - 2.4.6.4 Point sampling and use of wedge prism and relascope.
- 2.5 Examples of National Forest Inventory design of India and other countries.
- 2.6 Continuous forest inventory

3. Crop Measurements: (7)

- 3.1 Lay out of sample plots
 - 3.1.1 Objects
 - 3.1.2 Various kinds of sample plots – temporary, permanent, linear increment etc.
 - 3.1.3 Considerations while laying out sample plots number, location, size and shape
 - 3.1.4 Frequency and timing of measurements.
- 3.2 Definition and measurement of crops diameter, crop height, top height and crop age.
- 3.3 Methods of volume estimation of crop
 - 3.3.1 Arithmetic mean tree method
 - 3.3.2 One inch diameter class or Hossfeld's method
 - 3.3.3 Huber's, Ulrich's, Hartig's method and Blocks method
 - 3.3.4 F.R.I. procedure
 - 3.3.5 Graphic method
 - 3.3.6 Abstract sample tree methods–by volume table, volume-curve and Prussian Institute methods.

- 3.4 Growth and yield estimation of stand
 - 3.4.1 Concept of growth of stand in even aged and uneven aged forests.
 - 3.4.2 Factors affecting the growth of stands – site quality, stand density and age
 - 3.4.3 Methods of site classification
 - 3.4.4 Determination of stand density
 - 3.4.5 Preparation of yield tables by graphical and regression methods.
 - 3.4.6 Mathematical models for predicting growth and yield.
 - 3.4.7 Definition, use and projection and stand tables
 - 3.4.8 Money yield tables and their uses.

FIELD EXERCISES

(6)

1. Formulation of a sampling design and carrying out the inventory in the field.
(Use of Computer for processing and analysis of data)
2. Calculation of basal area using Wedge prism and relascope and comparing it with the data obtained through actual enumeration of standing crop.
3. Sample plot exercise–volume calculation and selection of mean tree.
4. Regression equation co-relating volume as a function of diameter and height and its use in local volume table.

FOREST SURVEY

Theory: 40

Practicals: 30

1. **Objects and scope:** (2)
 - 1.1 Introduction – definition, plane and geodetic survey; cadastral, Topographical, geographical, city, route and engineering surveys-Field and office work.
 - 1.2 Principles of surveying
 - 1.3 Error in surveying–cumulative and compensating errors and mistakes
 - 1.4 Scope of surveying in forestry
2. **Scales:** (2)
 - 2.1 Definition, representative fraction
 - 2.2 Construction of scales, requirements of good scale; Simple Diagonal, Vernier and Comparative scales
 - 2.3 Choice of scales and scales generally adopted
3. **Measurement of Distances:** (2)
 - 3.1 Linear measurements; ranging of chain and lines; testing and adjustment of chains, chaining the line on flat ground; chaining on sloping ground and hypotensal allowance; sources of error in ordinary chaining and measures to minimize them; correction of distances and areas measured with incorrect chains.
 - 3.2 Chaining round obstacles
4. **Chain Surveying:** (4)
 - 4.1 Principles suitability, surveys with straight and irregular boundaries.
 - 4.2 Field work; reconnaissance; selection of stations and well conditioned triangles; marking of stations, the base line; tie line, check line and offsets; running a survey line and accuracy of offsets; oblique offsets and offsets to different kinds of objects, such as buildings, fences, river margins etc.
 - 4.3 The field book; single and double line systems methods of recording.
 - 4.4 Method of plotting
5. **Measurement of angle:** (4)
 - 5.1 Objects; triangulation
 - 5.2 Instruments, prismatic compass, construction; use, testing; source of error and corrections; introduction to Theodolite.
 - 5.3 Magnetic bearings; Forward and Back-bearings and their relationship; whole circle bearings and reduced bearings and their relationship.
 - 5.4 The Meridian–True, Magnetic, Grid and Arbitrary meridians; the magnetic declination and its variations- Isogonic and Agonic lines.
 - 5.5 Dip of the Needle and Iso clinic lines
 - 5.6 Local Attraction – Causes and correction.

6. **Chain and Compass surveying:** (7)
- 6.1 Methods of surveying; Radiation, intersection and traversing; the closed and open traverse; comparison with chain survey; applicability.
 - 6.2 Sources of error and measures to minimize them
 - 6.3 Methods of checking closed and open traverse data; interior and exterior angles, latitudes and departures; northings and southings.
 - 6.4 Methods of plotting – parallel Meridian.
 - 6.5 Closing error; its distribution graphically and by computation
 - 6.6 Field problems–To find horizontal distance to an inaccessible point; supplying omission of one side of a closed traverse.
 - 6.7 Laying out a coupe, its demarcation
7. **Plane Table survey:** (6)
- 7.1 Instruments–Plane Table, Alidade, Declinator, Plumbing fork and Plum-bob.
 - 7.2 Centering and orientation.
 - 7.3 Methods of plane tabling–radiation, Intersection, traversing and Resection.
 - 7.4 Three-point problem and its solution–Mechanical trail and error and the Bessels’s graphical solution–The two point problem and its solution.
 - 7.5 Sources of error in plane Tabling
 - 7.6 Advantages and disadvantages of plane Tabling; applicability.
8. **Leveling:** (6)
- 8.1 Introduction; definitions and scope, the level surface, horizontal and vertical planes, Datum surface, and Reduced levels.
 - 8.2 Instruments Abney, Ceylon Ghat Tracer and leveling instruments, construction and use of Dumpy Level, Modern tilting level, temporary adjustments of the Dumpy Level only – leveling staff- Boning rods.
 - 8.3 Difference of levels–Back sight, intermediate sight, fore sight, Height of instrument and change point, Axis of the telescope and line of Collimation – Negative readings.
 - 8.4 Bench-Marks-GTS, permanent, temporary and arbitrary
 - 8.5 Reduction of levels-Rise and fall system and the collimation or H.I. system; their relative merits; arithmetical checks; the level book.
 - 8.6 Effect of Earth’s curvature and refraction correction due to their combined effects.
 - 8.7 Classification of leveling; simple leveling; compound or differential leveling; profile leveling, Cross-sectioning-Reciprocal leveling.
 - 8.8 Sources of errors and precautions
9. **Topographical Surveying and Map Reading:** (7)
- 9.1 Methods of contouring–direct and indirect, by interpolation, indirect contouring by radiant lines; spot height and grids.
 - 9.2 Characteristics of contours
 - 9.3 Uses of contours
 - 9.4 Map Catalogue – How to obtain maps.
 - 9.5 Map reading; orientation of a map, methods of finding true north; finding one’s position on the map.
 - 9.6 Relief and its representation; hachures; hill shading spot heights, contours and form lines-layer tints.
 - 9.7 Computation of areas by planimeter, graph, division of area into graph, division of area into triangles, squares, and trapeziums.

PRACTICALS: (30)

- 1. **Chain Survey of an area; Fieldwork plotting and finishing** 5
- 2. **Chain and compass survey.** 6
 - 2.1 Intersection
 - 2.2 Traversing
 - 2.3 Plotting and distribution of error
 - 2.4 Computation of area by graph, planimeter
- 3. **Plane Tabling** 5
 - 3.1 Surveying and finishing
 - 3.2 Two and three point problems

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| 4. | Leveling | | 5 |
| | 4.1 | Simple leveling and booking | |
| | 4.2 | Survey and Lay out of Terraces. | |
| 5. | Topographical Survey and Map Reading | | |
| | 5.1 | Map Reading | 2 |
| | 5.2 | Topographic Survey | 5 |
| | 5.3 | Use of Survey and Engineering Instruments | 2 |

FOREST POLICY AND LAW

Theory: 62
Field Exercises: 5 days

- | | | |
|----|--|---|
| 1. | FOREST POLICY: | (4) |
| | 1.1 | Necessity of a Forest policy in a country |
| | 1.2 | General basis of formulation, various considerations. |
| | 1.3 | National Forest Policies of 1894, 1952 and 1988 their comparative study, basis of their formulation and after effects. |
| | 1.4 | Constraints in the implementation of Forest Policy in India. Need based law for implementation of policy. |
| | 1.5 | National Forestry Action Program, formulation and constraint in implementation and State Forestry Action Programs |
| 2. | FUNDAMENTAL PRINCIPLES OF LAWS RELATING TO FORESTS AND INDIAN FOREST ACT 1927 | (25) |
| | 2.1 | Basic concepts regarding property, possession, rights and servitudes. Government property and its acquisition (salient features of land Acquisition Act, 1894) |
| | 2.2 | General principles, object and reasons for enactment of special law relating to forests and its produce |
| | 2.3 | Brief history of Forest Legislation in India, coming into force of Indian Forest Act, 1878 and its subsequent replacement by Indian Forest Act 1927. Validity under the new Act of the notifications issued under the Act of 1878. |
| | 2.4 | Constitution of permanent forest estates (Reserved Forests), their need and scope |
| | 2.5 | Constitution of village Forests, their need and scope |
| | 2.6 | Protection of Forests/Wastelands not included in a Reserved Forest (Protected Forests). |
| | 2.7 | Control over Forests and lands, not being the property of the Government. |
| | 2.8 | Legal protection of Forests: Demarcation, settlement of rights, prevention of offences, information and help, forest-offences in Reserved and Protected Forests, grave offences, transit Rules, establishment of checking depots, saw mill Rules, Rules relating to protection from fire and Rules related to hunting etc. |
| | 2.9 | Application of Cattle Trespass Act, 1871 to Forests, scope and limitations. |
| | 2.10 | Legal principles of punishment; the punishment, aggravation of offences, imprisonment and fine, seizure, confiscation as a punishment, properties liable to confiscation. Distinction between confiscation and forfeiture. Disposal of forest produce in respect of which a forest-offence is committed and is the property of the Government and the case where it is not the property of the Government. Disposal of tools, boats, vehicle and cattle used in commission of any forest offence. Procedure when offender is not known, disposal of perishable property. Wrongful seizure. |
| | 2.11 | Power of Forest-Officers under Indian Forest Act: Powers relating to arrest (to be discussed along with the topic at 3.3) and seizure. Powers to confiscate, demand aid, and prevent offences. Powers to compound forest offences, scope thereof and principles, which regulate the exercise of this power. Powers of Criminal courts in relation to issue of search warrants (to be discussed along with the topic at 3.6), holding inquiry into forest-offences and receiving and recording evidences (to be discussed along with the topic at 3.9). Powers of civil courts to compel the attendance of witnesses and production of documents etc. (to be discussed along with the topics at 4.1 to 4.4). Powers to distribute rewards out of the proceeds of fines and confiscations under Indian Forest Act. Powers as receivers of Government revenue. |
| | 2.12 | Indian Forest Act and the State Forest Acts-Comparative study. |
| 3. | CODE OF CRIMINAL PROCEDURE, 1973 | (8) |
| | 3.1 | Definitions. Position of forest-offences as per the First Schedule of the Cr.P.C. Cognizable /non-cognizable and bailable/non-bailable offences. Provisions of Cr.P.C. not applicable where special procedure is prescribed by the Forest Act. (Sec.4) |

- 3.2 Constitution and powers of Criminal courts (Secs. 6 to 15, 20 & 24 to 31)
 - 3.3 Arrest of persons (Chapter V)(included in para 2.11)
 - 3.4 Summons and warrant of arrest (Part A and B of Chapter VI)
 - 3.5 Information to police and their power to investigate. Legal validity of confessions recorded by a Forest Officer (Chapter XII with emphasis on Sec.164 read with Sec.72 (2) of the Indian Forest Act)
 - 3.6 Procedure for issuing search warrants (Sec.93 and Part C of Chapter VII). Form no.10 of Second Schedule (included in Para 2.11)
 - 3.7 Cognizance of offences by Magistrates, prosecution of public servants (Secs.190 and 197)
 - 3.8 Complaints to Magistrates and commencement of proceedings (chapter XV and Secs. 204 to 206). Legal position of complaints made by Forest officers.
 - 3.9 Mode of taking and recording of evidence (Secs.272 to 275 and 277) (included in para 2.11)
 - 3.10 Classification of forest-offences according to mode by which offender is brought. Trial of warrant cases, summon cases and summary trials (chapter XIX, XX, and XXI). Limitation (Chapter XXXVI)
 - 3.11 Appeals and Revisions (Secs. 374 to 378, 397, 399). Criminal and Civil writs (Article 226 and 227 of the Constitution of India).
 - 3.12 Bails and bonds (Secs. 436 and 437) with special reference to Sec.65 of the Indian Forest Act.
 - 3.13 Disposal of property (Secs. 451 and 452). Relevance with regard to Forest cases in view of Secs. 55 to 59 of the Indian Forest Act.
4. **CODE OF CIVIL PROCEDURE 1908** (2)
- 4.1 Summons and discovery (Secs.27 TO 32)
 - 4.2 Issue and service of summon (order V)
 - 4.3 Summoning and attendance of witnesses (order XVI)
 - 4.4 Form no.13 of summon of witnesses (Appendix B to First Schedule of CPC).
5. **INDIAN PENAL CODE, 1860** (4)
- 5.1 Abetment of forest offences (Secs. 108,109 read with Sec.40)
 - 5.2 Offences directly connected with forests and its produce: Theft (Secs.378,379); criminal misappropriation (Sec.403); criminal breach of trust (Secs.405,406); receiving stolen property etc. (Secs. 410,411,413,414);mischief (secs. 425 to 429); criminal trespass (sec. 441); Attempt to commit offences (Sec.511)
 - 5.3 Offences indirectly connected with forest works: Unlawful assembly (Secs. 141 to 144); omitting to give aid and information, or giving false information (secs. 176,177,187,201); giving false evidence (Sec.191); concealing offenders (sec.212)
 - 5.4 Protection extended by law to Forest Officers (Secs.76, 79, and Sacs. 49,43 & 74 of the Forest Act)
6. **FOREST (CONSERVATION) ACT, 1980:** (3)
- 6.1 Need for enactment of the Act.
 - 6.2 Salient features and scope.
7. **Industrial Disputes Act, 1947** (2)
8. **Wildlife (Protection) Act, 1972** (10)
9. **Environmental (Protection) Act, 1986** (1)
10. **Eviction of Public Premises Act, 1986** (2)
11. **Indian Evidence Act** (1)

Field Exercises:

(5 days)

Visit to areas prone to forest offence, preparation and collection of various documents, procedure for arrest, bails and bonds, seizure of property, inquiry and investigations, finalization of charge sheet (Chelan) etc.

FOREST ENGINEERING

Theory: 30
Practicals: 20
Field Exercise: 10 Days.

- 1. **Role and importance of Forest Engineering in Forest Management** (1)
- 2. **Building Material:** (4)
 - 2.1 Characteristics of stones, bricks, tiles and sand for building construction.
 - 2.2 Properties of cement and its storing.

- 2.3 Mortars:
 - 2.3.1 Definition, kinds, proportions, mixing, laying and curing.
 - 2.3.2 Quantities needed for masonry work and brickwork.
- 2.4 Concrete:
 - 2.4.1 Definition, proportion, mixing, laying and curing of concrete.
 - 2.4.2 Water-cement ratio and consistency.
 - 2.4.3 Quantities of ingredients needed for different proportions of concrete.
- 2.5 Reinforced cement concrete:
 - 2.5.1 Definition, principle and advantages.
 - 2.5.2 Location of reinforcement in RCC slabs, beams and pillars/columns.
 - 2.5.3 Bamboo re-inforcement.

3. **Construction:** **(10)**

- 3.1 Considerations for selection of sites.
- 3.2 Drawing and Layout
- 3.3 Foundation:
 - 3.3.1 Safe bearing capacity of soil
 - 3.3.2 Footing foundation
 - 3.3.3 Width of foundation, depth of foundation by Rankine Rule and thickness of concrete bed.
 - 3.3.4 Damp proof courses
 - 3.3.5 Precaution against termite
- 3.4 Super structure:
 - 3.4.1 Scaffoldings
 - 3.4.2 Thickness of walls
 - 3.4.3 Bonds in brick work-kinds, difference between English and Flemish bonds, details of English bond at corners, junctions and inter-section of 1 brick and 1½ brick walls.
 - 3.4.4 Construction of different kinds of masonry walls, Ashlar, Ashlar face, Random and coursed rubble and dry rubble masonry and dry stone revetments.
 - 3.4.5 Method of constructing mud, brick and stone masonry, CGI and wooden walls.
 - 3.4.6 Stone versus bricks
- 3.5 Sills and Lintels:
 - 3.5.1 Kinds of sills and their construction
 - 3.5.2 Lintels and their constructions
 - 3.5.3 Position of reinforcement in RCC lintels
- 3.6 Roofs Types–Sloping and Flat roofs
- 3.7 Types of Roof covering
- 3.8 Floors:
 - 3.8.1 Trench and basement fillings
 - 3.8.2 Stone, concrete and wooden floor
- 3.9 Doors and windows:
 - 3.9.1 Doors, types and sizes normally used, ledged and braced, attened doors, panelled, glazed and wire Gauge, doors, swing doors.
 - 3.9.2 Windows–fanlight, ventilator and clerestory window.
- 3.10 House drainage and sewage:
 - 3.10.1 Sanitary fittings and plumbings–wash basin, sinks–bath tubs–water closets–traps–flushing, cisterns–inspection, chamber– septic Tank–dispersion trenches.
- 3.11 Electrical Fittings

4. **Roads:** **(5)**

- 4.1 Introduction
 - 4.1.1 Necessity of roads
 - 4.1.2 Classification
 - 4.1.3 Cross and longitudinal section
 - 4.1.4 Systems of metalling
- 4.2 Design
 - 4.2.1 Road and land widths
 - 4.2.2 The shoulders
 - 4.2.3 Camber
 - 4.2.4 Gradients
 - 4.2.5 Section on hill road
 - 4.2.6 Drainage of plain and hill roads
 - 4.2.7 Road curves, super-elevation widening and sighting distance.

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| 4.3 | Alignment | |
| 4.3.1 | Reconnaissance | |
| 4.3.2 | Obligatory point | |
| 4.3.3 | Alignment of a plain road | |
| 4.3.4 | Alignment of a hill road | |
| 4.3.5 | Preliminary survey | |
| 4.3.6 | Paper location | |
| 4.3.7 | Demarcation | |
| 4.4 | Retaining wall and breast walls | |
| 4.4.1 | Necessity, material used, forces acting | |
| 4.4.2 | Conditions of stability and thumb rules for design of brickwork. | |
| 7. | Bridges: | (2) |
| | Introduction to various types of forest bridges, Irish bridges, causeway, road siphon, culverts, timber bridges, cantilever bridges and their constructions. | |
| 8. | Conservation Engineering | (4) |
| 8.1 | Structural stability and Construction of: | |
| 8.1.1 | Check dam and its components-head wall- apron, wingwall, spillway, embankment, and Gabion's structure. | |
| 8.1.2 | Spurs, revetments, jetties etc. | |
| 8.1.3 | Embankment (masonry, earthen and Gabion's) | |
| 8.2 | Ecological considerations in designing engineering structures, landscaping etc. | |
| 9. | Estimating and costing | (4) |
| 9.1 | Study of drawings for estimation–plan, sections | |
| 9.2 | Elevations of small buildings, road sections, slab or pipe culvert, stream training structures etc. | |
| 9.3 | Principles and essential parts | |
| 9.4 | Project Report | |
| 9.5 | Specifications | |
| 9.6 | Units of measurements | |
| 9.7 | Procedure and proforma of detailed measurements and bill of quantities for building, roads, culverts, stream training structures etc. | |
| 9.8 | Working out quantities for simple building, roads culverts, stream-training structures etc. | |
| 9.9 | Analysis of rates/SSR (Standard Schedules of Rates) | |
| 9.10 | Abstract of cost estimates | |
| 9.11 | Plinth area and cube rate estimates | |
| 9.12 | Measurement Book | |
| | PRACTICALS: (Drawing and exercise) | (20) |
| 1. | Location of reinforcement in RCC, lintels, slab and columns. | 2 |
| 2. | Earth work, sections, slope, template calculation of volume by trapezoidal, prismatic Rules. | 2 |
| 3 | Foundation of building, standard foundation and designs by Rankine's formula. | 4 |
| 4. | Study of different drawings of buildings, roads, culvert Stream training structures for the preparation of estimates. | 3 |
| 5. | Preparation of estimate of building, road, culvert, and stream training structures. | 8 |
| 6. | Calculation of Earthwork for buildings and roads | 1 |
| | FIELD EXERCISE: | (10) |
| a. | Road alignment exercise including setting out of curve estimating and reporting. | |
| b. | Survey of a nala for construction of soil conservation structures, designing, estimating and reporting. | |

ECOLOGY AND ENVIRONMENTAL SCIENCE

PART A-Ecology

Theory: 50

1. **Basic Concepts** (1)
 - 1.1 Definition
 - 1.2 The need of understanding ecological principles for a forester
 - 1.3 Divisions of Ecology
2. **Population Ecology** (3)
 - 2.1 Definition
 - 2.2 Structure of population
 - 2.3 Dynamics of species population
 - 2.4 Carrying capacity and natural regulation of population size
 - 2.5 Importance of population ecology in Forest Management
3. **Biotic Community** (3)
 - 3.1 Concept
 - 3.2 Ecological dominance, tolerance, aggregation
 - 3.3 Ecotone and Edge Effect
 - 3.4 Vegetation dynamics, Succession (recaptulation only), Palaeoecology
 - 3.5 The plant animal interactions in a biotic community.
4. **Principles of Ecosystem Ecology** (8)
 - 4.1 Introduction and basic parameters of an ecosystem
 - 4.2 Significance of the concept and types of ecosystems
 - 4.3 Ecosystem as a unit existing in space and time
 - 4.4 Components of Ecosystem
 - 4.4.1 abiotic
 - 4.4.2 biotic
 - 4.5 Ecosystem dynamics
 - 4.5.1 Food chains and food webs
 - 4.5.2 Concept of trophic levels
 - 4.5.3 Ecological pyramids
 - 4.5.4 Concept of Habitat & Niche
 - 4.5.5 Energy flow through an ecosystem
 - 4.5.6 significance of shorter food chains in meeting food/energy requirement in context of human population explosion
 - 4.5.7 Nutrient Cycling: concept of biogeochemical cycles-an over view
 - 4.5.8 Concept of bio-magnification and its significance
 - 4.5.9 Concept of limiting factors.
 - 4.6 Ecosystem productivity
 - 4.6.1 Concept of productivity and assessment of productivity in a forest ecosystem
 - 4.6.2 Nutrient/energy budgeting
 - 4.6.3 Effect of forest management on energy/nutrient flow in forest ecosystem.
5. **Ecosystems of the World** (5)
 - 5.1 Terrestrial Ecosystems
 - 5.1.1 The concepts of biome & biotic regions
 - 5.1.2 Major biotic regions of the world
 - 5.1.3 Biotic regions of India
 - 5.2 Major non-terrestrial ecosystems (I) seas (ii) Estuaries and sea shores (iii) Streams and rivers (iv) Lakes, ponds, marshes (note: brief overview only).

PART B-Environmental Conservation and Management

1. **Introduction to Environmental Conservation** (6)
 - 1.1 A brief recapitulation of origin of life; the span of evolutionary time scale, the advent of man; the concept of cultural inheritance vis-à-vis genetic inheritance; the changing face of man-environment interaction in context of technological advancement and its possible future implications on sustainability of life support system on the earth.
 - 1.2 Present status of natural resource utilization and their degradation in the global and Indian context.
 - 1.3 Conservation of natural resources and the concept of sustainable development.

- 1.4 Plant Succession: Concept, type and stages; competition among different species, significance of succession in taking forest management decisions.
- 1.5 Environmental conservation as a deep-rooted tradition of our cultural heritage.
2. **Demographic and Socio-economic factors** (2)
- 2.1 Impact of growing population on environment-a resource or a liability?
- 2.2 The need for regulating human population growth, vicious cycle of poverty and environmental degradation
- 2.3 The inter linkages of affluent consumption patterns and threat to global ecosystem.
3. **Contemporary models of development-A review** (2)
- 3.1 Development projects and their emerging socio-political implications:
(i) multipurpose dams (ii) mining (iii) road construction (iv) urbanization and industrial development (v) irrigation systems (vi) compensatory afforestation etc.
4. **Soil and Chemical Pollution** (2)
5. **Air pollution** (2)
- 5.1 Causes, general impact and control
- 5.2 Role of Forests/Green belts in controlling pollution.
- 5.3 Impact of air pollutants on forests and vegetation.
- 5.3 Acid Rain
- 5.4 Level of tolerance to pollutants of some important tree species
6. **Legal provisions and remedies** (1)
7. **Global Warming and Climatic Change** (3)
8. **Water pollution** (2)
- 8.1 Major causes (including industrial and human waste, wars etc), impacts and control
- 8.2 Eutrophication and death of water bodies
- 8.3 Treatment and utilization of sewerage water and reclamation of other industrial wastes and Solid Waste Disposal Management
9. **Thermal pollution and radiation pollution** (2)
10. **Noise Pollution causes, remedies and legal provisions**
11. **Tools of Environmental Management** (3)
Environmental impact assessment of development projects.
12. **National conservation strategy and policy statement on environment and development (salient features)** (1)
13. **Environmental legislation in India** (2)
14. **Geopolitics of environment** (2)
- 14.1 Environment as an emerging major foreign policy issue; the perceptions of developed and developing countries.
- 14.2 The international conventions on environment; the Rio convention and its outcome and implication.

ADVERSE INFLUENCE ON FORESTS

Theory: 30
Practicals: 5
Local Excursions: 3 Days

1. Susceptibility of forest to damages caused by different agencies. (1)
2. Prevention and protection measures for damages by different agencies: (29)
- 2.1 **Human agency** 3
- 2.1.1 Encroachment, poaching, illicit felling and removal of forest produce.

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| 2.1.2 | Faulty land use practices including shifting cultivation, over grazing. | |
| 2.2 | Forest fires | 3 |
| | 2.2.1 Controlled fires in forest regeneration and habitat management. | |
| | 2.2.2 Types of forest fires and the extent of damages caused by them | |
| | 2.2.3 Preventive Control measures | |
| | 2.2.4 Fire Management Planning | |
| 2.3 | Natural Factors | 2 |
| | (i) frost (ii) snow (iii) hail (iv) storm (v) drought (vi) water logging (vii) floods | |
| 2.4 | Forest pests: | |
| | 2.4.1 Role of insects and pests in forest eco-system | 1 |
| | 2.4.2 Symptoms, extent and nature of damage, preventive and control measures of important insects/pests of: | 5 |
| | a) Seeds | |
| | b) Nurseries | |
| | c) Felled and converted trees | |
| | d) Standing trees (Plantation and natural forests) with special reference to Sal, Teak, Toon, Eucalyptus, Poplar, Chir, Deodar, Bamboo and Sandalwood. | |
| 2.5 | Forest Pathogens: | |
| | 2.5.1 Introduction and importance of forest pathology | 1 |
| | 2.5.2 Symptoms, extent and nature of damage, preventive and control measures of important diseases of: | 4 |
| | a) Seed and nurseries | |
| | b) Root diseases of sissou and khair | |
| | c) Stem diseases of Eucalyptus, Poplars, Sal, Khair, Teak (coppice) and Chir (stem rust) | |
| | d) Foliage diseases of Poplar, Teak | |
| | 2.5.3 Spike disease of sandal wood | |
| | 2.5.4 Mycorrhiza: Importance in Forestry (i) Ecto-Abies, Cedrus (ii) Endo Acacia, Prosopis, Albizia. | |
| | | 2 |
| 2.6 | Protection of Plantations and Regeneration Areas | 5 |
| | 2.6.1 Fencing: | |
| | 2.6.1.1 Types of fencing and their effectiveness | |
| | 2.6.1.2 Cost, construction and maintenance | |
| | 2.6.2 Protection through participation of local people in forestry programmes | |
| | 2.6.3 Protection against fire: | |
| | 2.6.3.1 Annual Fire Management Plan | |
| | 2.6.3.2 Forest Fire forecasting system | |
| | 2.6.3.3 Fire suppression techniques | |
| | 2.6.4 Protection against weeds and climbers | |
| | 2.6.5 Protection against natural calamities/atmospheric agencies | |
| | 2.6.6 Grazing problems | |

PRACTICALS: (5)

1. Visit to Entomology Museum and Entomology insectory to see insect pests and their damages (at the Institutes of ICFRE). This preferably be done before theory class for better understanding of the subject.
2. Methods of insects/pests (especially rodents) control, techniques-demonstration at the Institutes of ICFRE
3. Diagnosis of insect damage of common trees by symptoms in the fields.

FIELD VISITS

1. Local visit to forests to acquaint the Officer Trainees with diseases of common trees, their preventive and control measures.

(3 days)

FOREST UTILIZATION –I

Theory: 50
Practicals: 10
Field Exercises: 4 Days

| | | |
|-------|---|-------------|
| 1. | Wood Harvesting: | (8) |
| 1.1 | Basic logging hand tools and their maintenance | 2 |
| 1.1.1 | Power chain saws and attachments. | |
| 1.1.2 | Felling of trees | |
| 1.1.3 | Cross cutting, delimiting etc. | |
| 1.2 | Off road transportation | 2 |
| 1.2.1 | Ground skidding | |
| 1.2.2 | Use of Tractor | |
| 1.2.3 | Dragging | |
| 1.2.4 | Winches | |
| 1.2.5 | Aerial transport | |
| 1.3 | Major transportation | 2 |
| 1.3.1 | Loading devices | |
| 1.3.2 | Surface transportation | |
| 1.3.3 | Water transportation. | |
| 1.4 | Logging planning | 1 |
| 1.5 | Timber Depot Management | 1 |
| 2. | Wood Technology: | (10) |
| 2.1 | Gross features of wood | |
| 2.1.1 | Pith, heartwood, sap wood | 2 |
| 2.1.2 | Bark, early wood, late wood, growth rings | |
| 2.2 | Minute structure of wood | 2 |
| 2.2.1 | Tracheids, fibres | |
| 2.2.2 | vessels | |
| 2.2.2 | Parenchyma, rays and resin canals | |
| 2.3 | General properties: | 2 |
| | Colour, fluorescence, lusture, odour, weight, hardness, grain, texture and figure. | |
| 2.4 | Identification of timber with key | 2 |
| 2.5 | Properties of wood, defects and abnormalities | 2 |
| 2.5.1 | Physical properties of wood | |
| 2.5.2 | Mechanical properties of wood | |
| 2.5.3 | Factors influencing strength properties of wood | |
| 2.5.4 | Suitability indices and their use | |
| 2.5.5 | Safe working stresses and their valuation. | |
| 2.5.6 | Testing and evaluation of timber products. | |
| 2.5.7 | Classification of defects in wood and their influence on utilization characteristics. | |
| 2.5.8 | Measurement and evaluation of defects. | |
| 3. | Wood Seasoning: | (4) |
| 3.1 | Introduction | |
| 3.2 | Object, need and importance of seasoning | |
| 3.3 | Air seasoning | |
| 3.4 | Kiln seasoning | |
| 3.5 | Special methods of seasoning | |
| 3.6 | Schedules and classification of timber | |
| 3.7 | Design of seasoning kilns | |
| 3.8 | Air-drying sheds and solar kiln | |
| 4. | Wood Preservation: | (5) |
| 4.1 | Need of wood preservation. | |
| 4.2 | Natural durability of timber and wood destroying agencies | |
| 4.3 | Types of wood preservatives, their characteristics, composition and properties. | |
| 4.4 | Preparation of material for treatment | |
| 4.5 | Method of wood preservation | |
| 4.6 | Factors affecting penetration of preservatives | |
| 4.7 | Properties of treated wood | |
| 4.8 | Testing of wood preservatives and treated timber | |

- 4.9 Treatment of timber for different uses including cost aspects.
5. **Wood Based Industries** (10)
- 5.1 A panoramic view of the forest based industries in India.
- 5.2 Demand and supply position of raw material for wood based Industries.
- 5.2.1 Indian tree species whose timbers are suitable for different wood based Industries.
- 5.2.2 Plywood, fibre board, particle board, improved wood- specifications of raw material for such industries; present supply and demand situation, manufacture.
- 5.2.3 Properties and uses of plywood, fiber board particle board.
- 5.2.4 Sandal wood, Katha, Agarwood
- 5.2.5 Wood substitution
- 5.3 Cellulose and paper Industry
- 5.3.1 Demand and supply situation of raw material for paper and Cellulose Industry
- 5.3.2 Manufacture of paper (only outline)
- 5.3.3 Manufacture of rayon (only outline)
6. **Saw Milling.** (5)
- 6.1 Types of saws, saw mill machinery
- 6.2 Design and layout of saw mills and wood workshop
- 6.3 Wood working.
- 6.4 Saw Mill Rules
7. **Grading of Timber And Timber Products** (3)
- Commercial grading, stress grading, existing Indian Standards and grading.
8. **Suitability of Indian Timber for:** (5)
- 8.1 Agricultural implements
- 8.2 Furniture Industry.
- 8.3 Packing case
- 8.4 Coach building and sleeper industry
- 8.5 Sports goods, musical instruments.

PRACTICALS:

1. Identification of timbers with key
2. Assessment of Yield (10)

FIELD VISITS/EXERCICES:

(4 Days)

1. Paper Industry.
2. Plywood Industry.
3. Composite wood and fiber board industry.
4. Saw mill industry.
5. Timber Depot.
6. Assessment of yields for veneer, plywood and saw mills.

FOREST UTILIZATION –II (NON-WOOD FOREST PRODUCTS)

Part – I

**Theory: 40
Practicals:5
Field Exercises-3**

1. **Introduction:** (1)
 - 1.1 Definition.
 - 1.2 Non-wood forest products of India and their importance in rural and industrial economy of the country.
 - 1.3 Survey of non-wood forest products
2. **Fibers and Flosses:** (1)
 - 2.1 Fiber yielding plants
 - 2.2 Methods of cultivation of important fiber yielding plants.
3. **Grasses, Bamboos and canes:** (2)

- 3.1 Various grasses and their uses in village and cottage industries.
- 3.2 Bamboos—their distribution, harvesting and uses, raw material scenario in bamboos.
- 3.3 Canes—their distribution, harvesting, processing and uses.
4. **Essential Oils and their methods of extraction:** (2)
Essential oil bearing plants of commercial importance, methods of their cultivation and exploitation.
5. **Oil Seeds:** (2)
5.1 Important oil seeds obtained from forests
5.2 Methods of collection, processing, packing and storage.
6. **Gums, Resin and Oleoresin:** (2)
6.1 Commercial gums, resins and their oleo-resin and their economical importance.
6.2 Methods of tapping of important gums, resin and oleo-resin.
6.3 Processing, grading, packing and storage of gums, tans and dyes.
6.4 Vegetable tanning materials obtained from forests, their extraction, processing, handling and storage.
6.5 Important dyes.
7. **Edible plants, nuts and spices** (1)
8. **Rubber:** (1)
8.1 Cultivation, and tapping.
8.2 Processing
8.3 Uses of rubber
9. **Charcoal:** (1)
9.1 Various types of kiln used for manufacture of charcoal.
9.2 Charcoal dust briquettes
10. **Miscellaneous products: Determination of yield extraction, procedure, storage marketing** (4)
10.1 Bidi leaves
10.2 Katha
10.3 Products of destructive distillation of wood
10.4 leaf fodder
10.5 Animal products
10.6 Mahua
10.7 Chironji
10.8 Achar
10.9 Dhak Leaves
10.10 Pine Needles
10.11 Phooljharoo
11. **Important Dyes** (3)

PART II Medicinal Plants in India

Section A

1. **Conservation of Medicinal Plants – The Current Scenario** (5)
1.1 Perspective, need and scope.
1.2 Traditional use of Medicinal Plants (ethno Medicines)
1.3 Medicinal Systems and its evolution
1.4 Institutions and agencies involved
1.5 National Policy on Trade, Use and Conservation of important drugs of commercial value
2. **Conservation strategy** (5)
2.1 In-situ and ex-situ conservation
2.2 Nursery Techniques
2.3 Methods of cultivation, harvesting, processing and grading
2.4 Research and Training
2.5 Database generating

Section B

(10)

Following list of medicinal plants will be dealt in the course:

1. *Saussurea costus*
2. Ladies Slipper Orchid (*Paphiopedilium species*)
3. Red Vanda (*Renanthera imschootiana*)
4. *Rauvolfia serpentina* (Sarpagandha)
5. *Ceropegia species*
6. *Frerea indica* (Shindal Manakundi)
7. *Podophyllum hexandrum* (emodii) (Indian podophyllum)
8. *Dioscorea deltoidea* (Elephants foot)
9. *Pterocarpus santalinus* (Red Sanders)
10. *Taxus wallichiana* (Common Yew of Birmi leaves)
11. *Aquilaria malaccensis* (Agar wood)
12. *Aconitum species*
13. *Coptis teeta*
14. *Coscinium fenestratum*(Calumba wood)
15. *Dactyloctenium aegyptium*
16. *Nardostachys grandiflora* (Jatamansi)
17. *Panax pseudoginseng*
18. *Picrorhiza kurroa*
19. *Swertia chirata* (Charayatah)
20. *Chlorophytum tuberosum* (Safed Musali)
21. Blue Vanda (Vandal cue Rulea)

Other species, which are commonly known to have valuable medicinal properties that may be dealt with in details, are as follows:

1. *Anacardium occidentale*
2. *Argemone mexicana*
3. *Azadirachta indica*
4. *Balanites egyptica*
5. *Buchanania lanzan*
6. *Butea monosperma*
7. *Canabis sativa*
8. *Terminalia arjuna*
9. *Citrus limon*
10. *Gliricidia sepium*
11. *Murraya keongii*
12. *Pongamia pinnata*
13. *Terminalia alata*
14. *Terminalia bellerica*
15. *Terminalia chebula*
16. *Emblica officinalis*
17. *Mentha sps.* (mint)
18. *Ocimum sanctum* (Tulsi)
19. *Ferula assafoetida* (Hing)
20. *Herpestis monniera* (Brahmi)
21. *Cinnamomum zeylanicum* (Cinnamum)
22. *Elettaria aromaticum* (Clove)

Practicals

1. Field Identification
2. Surveying for Medicinal Plants
3. Cultivation and Harvesting Techniques

(5)

Field Exercises-

3 Days

FOREST RESOURCE MANAGEMENT

Theory: 40

Field Exercise: 30 days.

(2)

1.

Introduction:

- 1.1 Definition and scope
- 1.2 Management of forests and its peculiarities

- 1.3 Forest management for environmental conservation
- 1.4 Forest management for soil and water conservation
- 1.5 Principles of forest management and their application.

2. **Objects of management:** (2)
 - 2.1 Purpose and policy (passing reference since covered in Law)
 - 2.2 Objectives.
 - 2.3 Owner's attitude and social role of forestry

3. **Sustained yield:** (4)
 - 3.1 Concept and meaning of sustained yield
 - 3.2 Progressive yield
 - 3.3 Sustained yield in relation to environmental management

4. **Rotation:** (1)
 - 4.1 Definition
 - 4.2 Kinds of rotation
 - 4.3 Factors affecting choice of rotation
 - 4.4 Rotation and conversion period

5. **Normal forest:** (4)
 - 5.1 Definition and concept
 - 5.2 Normality in regular forests
 - 5.3 Normality in irregular forests

6. **Growing stock and its increment:** (5)
 - 6.1 General considerations
 - 6.2 Distribution of age gradations or classes in regular forests, normal and actual
 - 6.2 Distribution of age gradations or classes in irregular forests, normal and actual.
 - 6.3 Distribution of age gradations or classes in forests under coppice systems
 - 6.4 Growth estimation and reduction factors for:
 - 6.4.1 density
 - 6.4.2 quality
 - 6.4.3 quality and price increment .

7. **Yield regulation:** (6)
 - 7.1 General principles of yield calculation.
 - 7.2 Silvicultural system in relation to yield regulation.
 - 7.3 General definitions i.e. felling series, felling cycles, cutting series etc.
 - 7.4. Methods of yield regulation:
 - 7.4.1 Yield regulation in regular forests.
 - 7.4.1.1 By area, reduced area and Hufnagl's modification.
 - 7.4.1.2 By volume and increment methods.
 - 7.4.2 Yield regulation in irregular forests.
 - 7.4.2.1 Methods based on growing stock only
 - 7.4.2.2 Von Mantel's formula and its modifications
 - 7.4.2.3 Methods based on volume and increment
 - 7.4.2.4 Austrian method
 - 7.4.2.5 Method based on number of trees in various age classes and time taken to pass from one age class to next
 - 7.4.2.6 Brandis method
 - 7.4.2.7 Hufnagl's method
 - 7.4.2.8 Smithies safeguard formula
 - 7.5 Application of different methods of yield regulations in forest management in Indian forestry.

8. **Management (Working) Plan:** (6)
 - 8.1 Definition, object, scope, sphere, necessity for revisions
 - 8.2 Division of forests into various units
 - 8.3 Maps
 - 8.4 Management (Working)Plan Code

9. **Preparation of Management (Working) Plan:** (10)
 - 9.1 Preliminary Management Plan report
 - 9.2 Field work

- 9.2.1 Stock mapping
- 9.2.2 Checking of maps
- 9.2.3. Compartment description
- 9.2.4 Collection of statistical data
- 9.2.5 Collection of other data
- 9.3 Office work:
 - 9.3.1 Compilation of data
 - 9.3.2 Writing of Management Plan
 - 9.3.3 Control Forms
 - 9.3.4 Deviation Proposals

PRACTICALS

FIELD EXERCISE

(30 days)

Working plan exercise will be conducted in any suitable Sal or other forest covering as many types as possible. Each Officer Trainees will be required to write up a working plan for a forest block.

Breakup of working days will be as follows:

| | |
|---|----------------------|
| Collection of data for Part I----- | 3 days |
| General examination of the working plan and field work- | 3days (Partly at HQ) |
| Field work for enumeration, regeneration survey etc.----- | 9 days. |
| Mapping and compilation----- | 15 days. |

Note: The works to be done will be specified by the in charge concerned of the Management (Working) Plan Exercise.

NATURAL RESOURCE MANAGEMENT

Theory: 50
Practicals: 12
Field Exercise: 20 days

PART A Geology and Soil Science

SECTION –A (7)

- 1. **Types of Rocks** 2
 - 1.1 Igneous rocks
 - 1.1.1 Forms
 - 1.1.2 Types.
 - 1.2 Sedimentary rocks
 - 1.3 Metamorphic rocks
- 2. **Identification of minerals through physical characteristics** 1
- 3. **Important rock-forming minerals** 1
- 4. **Geological structures and their topographic expression** 1
- 5. **Geological history of India:** 2
 - 5.1 Three geologically distinct units of India.
 - 5.2 Physiographical distinctness of three units.
 - 5.3 Main events in geological history of India.

PRACTICALS: (6)

- 1. **Identification of Minerals**
 - 1.1 Physical characters of minerals.
 - 1.2 Important rock forming minerals.
- 2. **Identification of Rocks.**
 - 2.1 Igneous rocks
 - 2.2 Sedimentary rocks
 - 2.3 Metamorphic rocks

SECTION- B (13)

- 1. **Introduction:** 1
 - 1.1 Importance of soil as a factor of plant environment site and soil, soil in relation to forestry, soil as a natural living body.

| | | |
|----|---|----------|
| 2. | Soil Forming processes | 1 |
| 3. | Soil Profile: | 3 |
| | 3.1 Definition | |
| | 3.2 Various horizons, their characteristics and designations in various soil types | |
| | 3.2.1 Development of soil profiles under different conditions of climates, topography and vegetation. | |
| | 3.2.2 General features of forest soil profiles and their comparison with agricultural soils. | |
| | 3.2.3 Special features of various types of pans, e.g. hard lateritic, clay, kankar etc. | |
| 4. | Physical properties: | 2 |
| | 4.1 Soil Texture | |
| | 4.2 Soil Structure | |
| | 4.3 Other properties | |
| | 4.4 Soil moisture and soil water relations | |
| | 4.5 Soil air and temperature. | |
| 5 | Chemical properties: | 2 |
| | 5.1 Organic matter | |
| | 5.2 Silica Sesquioxide ratio | |
| | 5.3 Soil Colloids | |
| | 5.4 Soil pH | |
| | 5.5 Nutrient elements | |
| | 5.6 Soil Nitrogen. | |
| 6. | Biological properties: | 1 |
| | 6.1 Soil microbiology | |
| | 6.2 Soil fauna | |
| 7. | Major Soil Groups | 1 |
| | 7.1 Soil Classification | |
| | 7.2 Soil survey and Soil Mapping | |
| 8. | 8.1 Rock, Soil-Plant relationship | |
| | 8.2 Soil properties influencing forest growth | 2 |

FIELD PRACTICAL: (6)

1. Study of soil profile and recording of relevant field data on soil, and vegetation etc.
2. Determination of physical properties of soil in the field such as structure, texture, hardness, porosity, colour, pH etc. and study of vegetation growth in relation to such physical properties of soil.
3. Writing of a soil survey report and analysing the obtained data for selection of species and further treatment of the soil, if needed.

PART B - LAND USE & WATERSHED MANAGEMENT

SECTION 'A' (4)

1. **Land use problems in India:**
 - 1.1 Agrarian customs, agriculture practices.
 - 1.2 Social customs with reference to use of various resources.
 - 1.3 Forests of India, their distribution.
 - 1.4 Erosion.
 - 1.4.1 Principles
 - 1.4.2 Types of erosion
 - 1.4.3 Agencies of erosion
 - 1.4.4 Kinds and forms of erosion, degree of erosion
 - 1.4.5 Causes and effects of erosion
2. **Institutions for Wasteland development** – their activities, programmes, limitations (Wasteland Development Board etc.) **(1)**
3. **Waste land Management (2)**
 - 3.1 Introduction
 - 3.2 Classification
 - 3.3 Identification and Reclamation of saline-alkali soil

- 3.4 Management of water logged areas
- 3.5 Identification of various types of waste lands.
- 3.6 Development of such Wastelands and techniques adopted.

4. **Range Management:** (4)

- 4.1 Grass land-types and their distribution in India.
- 4.2 Ecological status of Indian grasslands
- 4.3 Principles of grassland management and various measures for maintaining grassland in good condition, (silvipastoral techniques) closures, soil and water conservation measures, application of fertilizers, seeding and planting of improved grasses, weed control and control burning, other operations like silage, hay making, stall feeding, storage of grass, provision of facilities in pastures for even distribution of grazing pressure.

SECTION 'B'

5. **Hydrological cycle:** (2)

- 5.1 Hydrological cycles and its importance.
- 5.2 Rainfall, its measurement, intensity, duration and frequency.
- 5.3 Infiltration, percolation
- 5.4 Evaporation and transpiration
- 5.5 Run-off, peak rate of run off, methods for calculations, Rational and Cook's method.

6. **Soil and water conservation measures:** (7)

- 6.1 Contour cultivation, contour trenching design and lay out
- 6.2 Bunding and terracing
- 6.3 Erosion control and water conservation structures like spill ways, their types, design, construction and maintenance.
- 6.4 Gully control, principles of planning, and safety of works, use, design and maintenance of check dams.
- 6.5 Stream bank erosion control
- 6.6 Torrent control, control measures in catchments and in channel
- 6.7 Land slide control
- 6.8 Control of erosion on highways and railways
- 6.9 Wind erosion control, wind breaks shelterbelts, sand dune fixation

7. **Watershed Management Plan:** (10)

- 7.1 Unit of planning
- 7.2 Codification of watersheds, sub-watershed, micro-catchments.
- 7.3 Demarcation of priority watershed
- 7.4 Soil survey and capability map preparation and problem analysis.
- 7.5 Collection of basic information for soil conservation planning pertaining to soil, climate, land use, crop yields, agronomic practices, engineering and forestry practices, population needs and customs, cattle census and allied details.
- 7.6 Proposed treatment dealing with watershed management practices, agronomic and forestry practices, land treatment, structural measurement, miscellaneous specifications, phasing of project work, provision for cost estimate, cost/benefit ratio and general evaluation.
- 7.7 Agronomic practices in Soil conservation:
 - 7.7.1 Contour farming
 - 7.7.2 Cover crops and legumes
 - 7.7.3 Strip cropping
 - 7.7.4 Composting
 - 7.7.5 Mixed and rotational cropping
 - 7.7.6 Green manuring and mulch farming
 - 7.7.7 Terracing and dry land farming
- 7.8 Forestry Practices in Soil conservation:
 - 7.8.1 Wattling to stabilise debris and landslide
 - 7.8.2 Log Wood check dam
 - 7.8.3 Plantation, ground/ land development
- 7.9 Vegetative measures to check erosion at gully head, road slides, cut slopes, riverbanks, seacoasts etc.

FIELD EXERCISE: (20 days)

Preparation of Watershed Management Plan for a given micro-catchment.

ENVIRONMENTAL ECONOMICS

THEORY: 45

General:

(12)

- | | | |
|----|--|----------|
| 1. | Introduction: Role of economics in forestry and its limitations in decision-making. | 1 |
| 2. | Demand: Theory of demand; essential elements of demand; demand for forest products; demand schedule; elasticity of demand | 1 |
| 3. | Supply: Concepts; law of supply; essential elements of supply; supply of forest products; supply schedule; elasticity of supply. Equilibrium point. | 1 |
| 4. | Utility: Basic concepts and definition; concepts of total and marginal utility; law of diminishing marginal utility: The indifference curve and indifference map. Consumption possibility line. | 2 |
| 5. | Cost: Cost of production; i.e. concept of real, opportunity and money cost; total, average, and marginal cost. | 2 |
| 6. | Production Theory: Concepts of total, average and marginal products. Production function and laws of return i.e. increasing, constant and diminishing returns. Utility theory of production and marginal products in forestry. | 2 |
| 7. | Brief account of pricing factors of production i.e Land-----Rent Labour-----Wages Capital-----Interest | 1 |
| 8. | Market: Main features of market; Forms of market-Perfect, imperfect, monopoly market. Types of competition in the market. Market of various forest products viz. Timber, fuelwood, charcoal, seeds, bidi, bamboo, gums etc. | 2 |

Forest Economics

(10)

- | | | |
|----|--|----------|
| 1. | Economic Structure in Forestry Sector Sources of revenue in forestry sector, Price-size relationship. Value and treatment of time in forestry sector, Risk and uncertainty in forestry sector and its treatment. | 2 |
| 2. | Rotation Concept of Economic rotation- rotation of max. NPV Land Expectation Value (Faustman's formula). | 2 |
| 3. | Factors affecting Economics Economics of spacing, thinning and pruning | 3 |
| 4. | Economics of nature of crop Economics of monoculture, mosaic and mixed culture, species choice Protection, harvesting etc. | 3 |

Environmental Economics

(10)

- | | | |
|----|---|----------|
| 1. | Impotence and Relevance Similarities and Differences between Economics and Environmental Economics | 1 |
| 2. | Economics of air, water, soil and biodiversity resources | 2 |
| 3. | Defining and Identifying non-use values, optional values and existence values of resources. | 1 |
| 4. | Valuation techniques of TEV contingent valuation, willingness to pay, Travel Costs, Hedonic Price | 4 |
| 5. | Environmental Impact Assessment of Projects | 2 |

Project Planning, Evaluation and Analysis (13)

1. **Definitions:** 1
Nature of forestry projects; objectives of forestry projects; Designs of forestry projects; common pitfalls in forestry projects.
2. **Planning** 3
Understanding project planning, Types of planning, levels of planning and phases of planning. Organizational levels.
3. **Evaluation:** 2
Phases i.e. Pre- Evaluation (PROJECT APPRAISAL), Interim evaluation and post evaluation.
4. **Analysis:** 2
Analysis (SCBA). Appraisal criteria (Pay back method, average rate of return, NPV, B/C ratio, IRR)
5. **Case studies in forestry project analysis.** 5

BIODIVERSITY CONSERVATION AND MANAGEMENT

Theory –60
Practical- 10
(10)

Part I

- 1.0 Biodiversity: Definition, gene level, species level and ecosystem level. Value of Biodiversity: ecological, economic and other values. India as a mega diversity country; Biogeographic regions of India, Endemic centers of India and an overview of endemism in flora and fauna. 5
- 2.0 Introduction to Plant and Animal Kingdom 5

Part II

Mega fauna of India; occurrence, distribution, present status and elementary ecology concerning Asian Elephant, Tiger, Rhinoceros, Musk deer, Gaur, Hoolock Gibbon, Nilgiri tahr
An overview of Avifauna in India and Ramsar wetlands in India (5)

Part III

Conservation ethos of India. Wildlife Management definition, concept of carrying capacity, population structure, density and biomass, Home range and territory and an introduction to Ethology. (15)

Need for Protected Area Network; National Parks and Sanctuaries of India with special emphasis on Kanha National Park, Keibul Lamjao of Manipur, Bandipur, Gir, Gulf of Mannar (Coral reef Management), Namdapha National Park, their location, extent, flagship species, habitat description, major conservation measures, man animal conflict and an assessment of sources of threats to those protected areas. The concept of Eco-development.

Part IV

Insitu and exsitu conservation and the role of gene banks. Conservation breeding and Reintroduction. National Institutions involved in conservation. Role of NGOs in conservation of natural resources. Ecotourism. (5)

Part V

Ecological sampling Techniques: belt, quadrat and point techniques for enumeration of plants. Line transect analysis and other popular census techniques for animals. Causes of extinction; habitat destruction and degradation, fragmentation of habitat, introduction of alien species and other factors. Examples of critically endangered biota of India. (15)

Part VI

International conservations concerning biodiversity CITES, CBD, intellectual property rights, Bio piracy. Wildlife Protection Act, 1972 and Forest Conservation Act, 1980 as corner stones of conservation in India. Biodiversity Bill/Act, Environmental pollution, Environmental laws and Environmental Impact Assessment. (5)

Part VII

Biodiversity

- 2.1 Ecological and geopolitical significance of biodiversity
- 2.2 Biosphere reserves with special reference to India.

Practicals- Ecological Census Techniques

(10)

**JOINT FOREST MANAGEMENT,
RURAL AND TRIBAL DEVELOPMENT**

**Theory: 30
Field Exercises: 3 Days**

SECTION 'A'

Introduction to concepts of Joint Forest Management and Participatory Approach.

(2)

1. Community Forestry:

(1)

- 1.1 Definition
- 1.2 Role of Forestry in Rural Development
- 1.3 Necessity-special significance in the context of energy and small timber requirement of India
- 1.4 Environmental pollution and recreation
- 1.5 Place of social forestry in the national forest policy of India.

2. Agro-Forestry:

(3)

- 2.1 Its need and scope on and around agricultural lands.
- 2.2 Role in rural economy and its effect on agricultural practices
- 2.3 Establishment of Agro forestry
- 2.4 Agro Forestry Models with Economic Analysis
- 2.5 Role of forest department.

3. Social Forestry:

(2)

- 3.1 Objectives and scope vis-à-vis Agro forestry
- 3.2 Raising of trees for fodder
- 3.3 Developments of pasture lands.
- 3.4 Avenue plantation.
- 3.5 Canal bank plantation.
- 3.6 Plantations along railway lines
- 3.7 Choice of species
- 3.8 Role of the forest department.

4. Recreation Forestry and Landscaping:

(2)

- 4.1 Scope and need of Recreation Forestry
- 4.2 Ecotourism in relation to generate employment and local economic upliftment and economic development
- 4.3 Concept of integrated town planning and landscaping
- 4.4. Creation, layout and design of parks, green zones/ green belts close to urban centers.

5. Social Forestry for:

(2)

- 5.1 Fodder production
- 5.2 Fuel wood
- 5.3. Leaf manure
- 5.4 Timber production.

6. Extension and Publicity:

(2)

- 6.1 Role of publicity in Social Forestry.
- 6.2 Modes of Publicity
 - 6.2.1 Direct contact with the people
 - 6.2.2 Using mass publicity media-radio, television, posters etc.
- 6.3 Establishing Demonstration and Interpretation centers
- 6.4 Exposure through training, workshops, seminars and exhibitions.
- 6.5 Incentives for tree planting both to landless and land holders.
- 6.6 Competitions and Contests for awareness generation

7. Integrated rural development approach:

(2)

- 7.1 Forestry in support to agriculture, animal husbandry and horticulture
- 7.2 Forest based cottage industry in rural environment with proper marketing facility.
- 7.3 Employment generation in raising, tending harvesting tree crops.
- 7.4 Alternative Sources of energy.

8. **Organization and legislation to support the programmes** (1)

SECTION 'B'

9. **Tribals in India:** (1)

- 9.1 Distribution, groupings and cultural traditions.
- 9.2 Special constitutional provision relating to them.
- 9.3 Specific Provisions and guidelines in the Five Year Plans

10. **Tribals and Forests-a symbiotic relationship** (2)

- 10.1 Forests as their immediate environment, Ethno botany.
- 10.2 Brief appraisals of various religious and cultural myths and legends of tribal related to forests.

11. **Forest as means of livelihood- (with reference to tribals)** (2)

- 11.1 As participant
- 11.2 Dependence on forests: Extent of gap in demand and supply of fuel, fodder, fruit, food, and small timber to them.
- 11.3 Shifting cultivation practiced by tribals.
- 11.4 Role of various forest based industries and Institutions like forest labourers cooperatives societies, Tribal Development Corporations, Forest Development Corporations in various states in the amelioration of poverty among tribals.

12. **Social Forestry, Future prospects, Forest Management.** (5)

- 12.1 Overall involvement of tribals (Past, Present and Scope), Emphasis on variety of Extension Forestry Programmes like Agro-Farm-Forestry, Shelterbelt, other forms of productive forestry.
- 12.2 Social Forestry and various Area Development Programmes.
 - 12.2.1 Family Development based programmes.
 - 12.2.2 Individual Beneficiary programme.
- 12.3 Concept of voluntary agencies and their relevance to tribals with a special attention to various rural and tribal development programmes (IRDP, RLEGP, EGS, NREP, DDP, DPAP and TSP etc.).

13 **Tribals and Five Year Plans** (3)

Preparation of sub-plan for tribal areas. Study of planning commission guidelines.

FIELD EXERCISE:

Preparation of a Micro-plan for Agro-forestry

(3 Days)

HUMAN RESOURCE DEVELOPMENT AND MANAGEMENT

**Lectures 30
(15)**

1. **Institutional:**

- 1.1 Organizational behavior
 - 1.1.1 Structure and suitability
 - 1.1.2 Motivation and recognition
 - 1.1.3 Leadership styles.
 - 1.1.4 Group dynamics.
 - 1.1.5 Management of conflict & stress
- 1.2 Manpower planning
 - 1.2.1 Goals
 - 1.2.2 Strategies
 - 1.2.3 Selection/Recruitment
 - 1.2.4 Career development
 - 1.2.5 Training and Research
- 1.3 Communication skill and management.
- 1.4 Management systems and process.
- 1.5 Organizational culture and managerial ethos
- 1.6 Management of organizational conflicts
- 1.7 Managing change

- 1.8 Organization structure and design
- 1.9 Delegation and interdepartmental coordination
- 1.10 Changing role of Government.
- 1.11 Inter Institutional exchange programs
- 1.12 Anticorruption measures
- 1.13 Output evaluation

2. **Individual** (15)

- 2.1 Role of a Manager
- 2.2 Managerial skills
- 2.3 Decision making models
- 2.4 Decision making techniques and processes
- 2.5 Analyzing interpersonal relations
- 2.6 Media and mob management
- 2.7 Personality development
- 2.8 Aptitude building
- 2.9 Time management
- 2.10 Transparency in working
- 2.11 Accountability.
- 2.12

FOREST ACCOUNT & PROCEDURE

Theory Lectures: 40

GENERAL (1)

Organization of forest department: administrative and executive control. Classification of establishment- permanent, temporary and labour.

CASH ACCOUNT (24)

- General principles of book-keeping by single entry, its origin and advantages; accuracy, neatness and legibility in book-keeping. definitions of important terms in accounts.
- Classification of Government accounts; its necessity. Receipt and payments under various heads and sub-heads. Preparation of Budget and Annual Action Plan.
- Revenue and Capital Expenditure: Essential steps before incurring a revenue expenditure, sanctions, availability of funds, scale of rates etc.
- Definitions of cash and cash book; custody of cash chest and precautions in its use.
- Payment and its methods i.e. cash, cheque book transfer and R.T.R., letter of credit; writing of cheques and maintenance of cheque books; cancelled and lost cheques.
- Advances to contractors, disbursers and others and their accounting; recoveries of cash payment and their entries in the cash accounts.
- Different kinds of voucher for payments; muster rolls, measurement books and their preparation and maintenance. Register of sanctioned works and completion reports. Lost or missing receipt or vouchers.
- Receipt of revenue and its remittance into the treasury, i.e. cash, cheque, postal money-order, book transfer and R.T.R., refund of revenue.
- Forest deposits-Earnest money; Security deposits from subordinates and contractors.
- Maintenance of Cash book, entry of Cash transactions and closing and balancing of cash book; practice in writing cash-book; Divisional and range officer's daily cash account; supplementary accounts and objection statements.
- Contractors and disbursers ledger. Accounting procedure as followed by forest corporations. Treasury system of accounting/ study of different formats, disbursement process, Treasury cash book, Heads of Accounts, D.D.O's functions.

FOREST PRODUCE ACCOUNTING AND YIELD RETURNS (5)

Categories of produce i.e. tree, timber, logs and scantlings; firewood, charcoal and other minor forest produce; Various places of storage i.e. forests, depots, transit and sale depots; separate entries for each category and depot. Agencies of removal: Government, Contractors and others-right holders and free grantees.

Accounts and returns connected with departmental export of produce as under-

-Return showing receipt and disposals in sale depots.

-Return showing receipts and issue of timber and other produce.

-Return showing sale of timber and other produce, including drift and waif wood collected by Government agency.

-Bill and receipt book.

Accounts and returns connected with the removal of produce by purchasers as under:-

-Return showing sale of forest produce, cut and collected by purchasers.

-Return showing outstanding on account of revenue.

-Regulations of movement of forest produce permits and passes.

Accounts and returns connected with the removal of produce by right-holders and free grantees as under:-

- Return showing free grants of timber & other produce.

- Return showing grants to right-holders of timber and produce.

- Permits and passes.

- Accounting of seized and confiscated produce.

Shortage or losses. permissible limits and their accounting.

OFFICE PROCEDURE

(9)

Records of Forests and their maps and boundaries, annual plan of operations.

Damage report register-compensation register and prosecution register. Record of stocks of forms. Forest offence register, Fire occurrence register and Fire maps- posting of.

Record of books-maintenance of books concerning rules and regulations up-to-date.

Custody and maintenance of stock in serviceable condition; its receipt and dispatch; wear and tear, purchase and writing off unserviceable stock and its disposal. Stock register and its maintenance stock receipt books, uniform register, hammer register.

General office procedure, routine correspondence with higher authorities & subordinates; its receipt, dealing and dispatch. List of returns. Reports, Records; files, cases and registers maintained in range office. Rules regarding maintenance of records- classification, preservation and destruction of useless records.

Transfer of charge.

Office Inspection of range offices.

EXECUTION OF "CONSERVANCY AND WORKS"

(1)

Various forms of contracts viz., piece work or petty contracts, schedule rates and lump-sum contracts and connected agreements and departmental execution procedures there of.

(A K Goyal)
Deputy Inspector General of Forests (RT)

3-17/99-RT (I)

21st June 2004