

**SYLLABUS  
(Credit based)**

**FOR**

**MSc. Programme**

**In**

**“Forestry”**

**AT**

**FOREST RESEARCH INSTITUTE  
DEEMED UNIVERSITY**

**DEHRADUN- 248006**

**Forest Research Institute (Deemed) university**

**M.Sc. Forestry**

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**Programme Objective:** Master in Forestry programme aims to provide opportunity to the students wishing to pursue professional careers in the management and policy of forest resources and to make themselves aware about the problems related to forest across the span of urban to rural environments. The syllabus draws from coursework in the natural and social sciences and focuses on the complex relationships among the science, management and policy of forest resources. The structure of the curriculum is designed to synthesis of knowledge in multiple disciplinary exposures in the biological and social sciences. The goal is to prepare students to manage forest resources for various public and private values within a complex social, political and ecological environment. These professional opportunities can be private or public sector forest management, corporate or consulting, government conservation of forest resources or education. Students are also expected to improve their capacities as leaders and managers through summer internships, professional skills courses and other opportunities.

**Programme structure:** The Programme consists of courses and other requirements worth a total of 90 credits. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week. Each semester consists of 18 to 20 weeks of academic work equivalent to 90 actual teaching days. The programme structure and respective credits are given below as:

<b>Programme Structure</b>	<b>Credit</b>
Core courses	: 54
Foundation courses	: 5
Elective courses	: 5
Synopsis	: 1
Master's thesis	: 17
Master thesis seminar	: 2
Term paper I	: 2
Term paper II	: 2
Study tour	: 2
Total	: 90

### **Allotment of credits to different courses**

#### **FIRST SEMESTER**

Course Code	Course	Credit	
		Theory	Practical
<b>Foundation Course</b>			
<b>FMS 101</b>	Elements of Mathematics and Statistics	1	1
<b>FCR 102</b>	Computer Application, Remote Sensing and GIS	1	1
<b>FOF 103</b>	Overview of Forestry	1	-
<b>Core course</b>			
<b>FBS 111</b>	Elements of Biological Science	1	1
<b>FFF 112</b>	Fundamentals of Forest Ecology	2	1
<b>FSC 113</b>	Silviculture – I	2	1
<b>FGS 114</b>	Basic Geology and Soil science	2	1
<b>FMB 115</b>	Forest Mensuration and Biometry	2	1
<b>FHV 116</b>	Forest Health and Vitality	2	1
<b>FTP 117</b>	Term Paper I	2	-
<b>Total credits in first semester: <math>14^a+8^b+2^c=24</math></b>			

### SECOND SEMESTER

Course Code	Course	Credit	
		Theory	Practical
<b>Core course</b>			
<b>FPL 211</b>	Forest Policy and Law	2	-
<b>FLM 212</b>	Landscape Approach to Management	2	1
<b>FRU 213</b>	Forest Resource Utilization – I (NTFP)	2	1
<b>FFE 214</b>	Forest Economics	2	1
<b>FFP 215</b>	Forest and People	2	-
<b>FRM 216</b>	Natural Resource Management	2	-
<b>FSC 217</b>	Silviculture–II	2	1
<b>FSN 218</b>	Seed and Nursery Technology	1	1
<b>FTP 219</b>	Term Paper II	2	-
<b>Total credits in first semester: <math>15^a+5^b+2^c=22</math></b>			

### THIRD SEMESTER

Course Code	Course	Credit	
		Theory	Practical

<b>Core course</b>			
<b>FRM 311</b>	Resource Survey and Forest Management	2	1
<b>FWD 312</b>	Wildlife and Eco Development	2	1
<b>FRU 313</b>	Forest Resource Utilization – II (Wood)	2	1
<b>FGT 314</b>	Forest Genetics and Tree Improvement	2	1
<b>FFC 315</b>	Forest Certification	2	-
<b>FCC 316</b>	Forest, Society and Climate Change	2	1
<b>FST 317</b>	Study Tour	2	-
<b>Elective</b>		5	
<b>Total credits in first semester: <math>12^a+5^b+2^d+5^e=24</math></b>			

#### **FOURTH SEMESTER**

<b>Code</b>	<b>Particulars</b>	<b>Credit</b>
<b>FSY 441</b>	<b>Synopsis</b>	<b>1</b>
<b>FMT 442</b>	<b>Master's thesis</b>	<b>17</b>
<b>FTS 443</b>	<b>Master thesis seminar</b>	<b>2</b>
<b>Total</b>		<b>20</b>

#### **LIST OF ELECTIVE COURSE**

<b>Course Code</b>	<b>Elective Course</b>	<b>Credit</b>	
		<b>Theory</b>	<b>Practical</b>
<b>FGB 321</b>	Forest Genetics and Biotechnology	3	2
<b>FRG 322</b>	Remote Sensing and Geographic Information System	2	3
<b>FWH 323</b>	Wildlife and Habitat Management	3	2
<b>FSM 324</b>	Sustainable Forest Management	3	2
<b>FAF 325</b>	Agro forestry	4	1
<b>FFP 326</b>	Forest Pathology	2	3
<b>FFE 327</b>	Forest Entomology	2	3
<b>EIA 328</b>	Environmental Impact Assessment	4	1
<b>FPT 329</b>	Plantation Technology	4	1
<b>PTN 330</b>	Plant Taxonomy	2	3

*a: Theory, b: Practical, c: Term paper, d: Study tour, e: Elective paper.*

*One lecture credit comprises of one hour teaching of the course in a week, while one practical credit comprises of two hours of practical/assignment work in a week*

#### **Descriptions of Course Code**

**The courses of M. Sc. programme are divided into four series:**

- ❖ 100-series courses pertain to first semester
- ❖ 200-series courses pertain to second semester
- ❖ 300-series courses pertain to third semester
- ❖ 400-series courses pertain to fourth semester
- ❖ Credit for Synopsis, Master's thesis and Master thesis seminar is designated by code no. 441, 442 and 443 respectively

**Course code is formulated as:**

- First alphabet shows programme
- Second and third alphabet shows course name
- First digit shows semester number
- Second digit shows course type (0= foundation, 1= core, 2= elective)
- Last digit shows course number

# 1<sup>st</sup> SEMESTER

## FOUNDATION COURSE

### FMS 101 ELEMENTS OF MATHEMATICS AND STATISTICS

**LEARNING OBJECTIVES:** The objective of this course is to develop an understanding of basic mathematics and statistics and their applications in Forestry.

#### **MODULE I BASIC MATHEMATICS**

- Fundamentals of arithmetic, algebra, geometry, mensuration, arithmetic and geometric series progression
- Functions- polynomial, logarithmic, exponential, absolute value, trigonometric
- Use of graphs, simple, simultaneous and quadratic equations; numbers, variables, parameters and constants
- Basics of differential and integral calculus and theory of probability (Elementary idea)

#### **MODULE II COORDINATE GEOMETRY**

- Simple coordinate geometry, equation of straight line, parabola, ellipse and rectangular hyperbola, their graphs

#### **MODULE III BASIC STATISTICAL METHODS AND IMPORTANCE IN FORESTRY**

- Collection and representation of data-compilation, tabulation
- Frequency distribution; measure of central tendency mean, median, mode for grouped and ungrouped data
- Measure of dispersion, standard deviation, variance, coefficient of variance, skewness, correlation and regression; correlation coefficient, coefficient of determination, simple regression analysis, examples of multiple regression

#### **MODULE IV ANALYSIS OF VARIANCE**

- One way classification (fixed effect model), two-way classification (fixed effect model)

#### **MODULE V SAMPLING TECHNIQUE AND DESIGN OF EXPERIMENT**

- Necessity of sampling in forestry, complete-enumeration vs. partial enumeration, principle steps in sample surveys, population, sampling modules, size of sample

(sampling intensity), bias, accuracy and precision. Classical sampling design-simple  
Random sampling stratified random sampling, systematic sampling

- Principles of experimental design, CRD, RBD, LSD, Factorial experiments  
introduction to incomplete block design

### **PRACTICAL**

- Computer based Statistical techniques such as SPSS
  - Experimental and Sampling designs
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## **FCR 102      COMPUTER APPLICATION,REMOTE SENSING AND GIS**

**LEARNING OBJECTIVES:** The main objective of the course is to familiarize students about computer operating systems and its application like Microsoft office, Adobe and Access. The courses also endeavor to explain the basic concepts of remote sensing, aerial photographs and images and their interpretation and application with special reference to Forest.

### **MODULE I COMPUTER APPLICATION**

- **Handling the system tools:** Disk cleanup, Disk defragmenter, Driver converter (FAT 32), Maintenance wizard, Scan disk, System file checker
- **Microsoft office:** Word, Excel and Power Point
- **Access:** Introduction, Blank access database, Primary key, Table, Datasheet view, Design view, Table wizard, Import table, Relationships, Query, Design view, Simple query wizard, Design view, Report, Report wizard

### **MODULE II REMOTE SENSING**

- Basic principles, type and scope of remote sensing.
- Introduction to aerial photography and photo grammetry. Measurements from aerial photographs, photo-interpretation, area determination and thematic mapping
- Introduction to various types of satellites and sensors, resolution and form of data available. Acquisition and interpretation of satellite data for forestry purpose, vegetation mapping

### **MODULE III GEOGRAPHICAL INFORMATION SYSTEM**

- GIS and its use in Forest management
- Forest inventory planning, design, alternatives, execution, compilation and reporting
- ERDAS Imagine

### **PRACTICAL**

#### **Computer application**

- Word, Excel, Power Point and Access
- Adobe Photoshop, Coral Draw
- Video editing

#### **RS and GIS**

- Digital and visual interpretation of satellite image
  - Field application of G.I.S. Use of GPS, ERDAS
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**FOF 103**

### **OVERVIEW OF FORESTRY**

**LEARNING OBJECTIVES:** The objective of the course is to give brief introduction of forestry in terms of education and managerial organizations in the forest development.

### **MODULE I FORESTS AND FORESTRY**

- History of management of forests, emerging trends
- Forest geography of the world- factors influencing the distribution of forests, critical analysis of forest resources
- Forest map of India
- Forestry education, research and training
- Different international conferences/commission/conventions and institutions, their relevance to Indian context
- Different organizations relevant to forestry on global basis

### **CORE COURSE**

**FBS 111**

### **ELEMENTS OF BIOLOGICAL SCIENCE**



**LEARNING OBJECTIVES:** This course is meant to introduce basic botany and zoology to the students. The course exposes the students to basic and applied aspects of botany and zoology including Histology, Morphology and Phenology of plants and distinguish features of animal kingdom.

### **MODULE I INTRODUCTION TO BOTANY**

- **Structure of plants:** Histology- Cell, Tissues, Cell division, Histology of stems, root and leaf. Secondary growth in woody species
- **Morphological characteristics:** Parts of plants and their functions. Types of leaves, flowers, inflorescence and fruits
- **Nomenclature and classification:** Systems of classification, Bentham and Hooker system. Important families and their characteristics.
- **General classification of plants:** Angiosperms, Gymnosperms, Pteridophytes, Bryophytes, Fungi, Algae and lower forms. Classification on the basis of habit and habitat
- **Phenolog:-** Habitat Foliage, Cauliflorae, Cleistogamy, Protoandry and Protogyny. Flowering and Fruiting behavior- Sporadic, Cyclic, Erratic, Gregarious and proliferation. Germination types

### **MODULE II INTRODUCTION TO ZOOLOGY**

- Classification of animal kingdom, economic importance and distinguishing features of different classes

### **MODULE III TREE PHYSIOLOGY**

- Photosynthesis and Respiration. Concept of C<sub>3</sub> and C<sub>4</sub> plants

### **PRACTICAL**

- Classification, important families (Angiosperms and Gymnosperms) of forestry with distinguishing characters under microscope
  - Botanical and Zoological Excursions
  - Identification of Bamboo species and important forestry species
  - Sampling Techniques and Laying of Quadrates
  - Use of flora for plant identification
  - Herbarium – Collection, pressing preservation & mounting, classification
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**LEARNING OBJECTIVES:** The course is planned to impart the knowledge of ecology and ecosystem with special reference to forestry. It also describes the conservation and management practices.

### **MODULE I INTRODUCTION**

- History, scope, principles and concepts of forest ecology, ecology of tropical and temperate forests
- **Ecosystem:** Components and structure, communities, populations, groups and individuals, plant - microbe-animals inter-relationships

### **MODULE II FOREST ECOLOGY**

- **Forest biomes:** Desert – cold and hot deserts, grass lands, tidal forests, wetlands, secondary forests, terrestrial and aquatic ecosystem
- **Principal forest types:** Introduction, classification and distribution in relation to other countries, Factors affecting vegetation: Locality factors, climatic factors, edaphic factors, ecological and physiographic factors, biotic factors, influence of plant competition, parasites, epiphytes, climber- weeds on forests
- **Forest productivity:** Energy and its flow in ecosystem, food chain and food web, biogeochemical cycles, autecology of important tree species, population ecology, ecological genetics, synecology in different forest types
- **Succession and climax:** Kinds of succession, invasive alien species, plant and animal adaptations, mono-climax and poly-climax theories. Ecological adaptation and evolutions, Climate, vegetation types, phyto-geographical zones and zoo-geographical zones of India, Ecological indicators

### **MODULE III ECO SYSTEM ANALYSIS**

- Eco system modelling, survey and mapping of forest cover, forest change detection, forest damage assessment and monitoring, land evaluation for forestry and forest

inventory, Spatial Pattern analysis, Species abundance relationship, species affinity, community classification, community ordination, community interpretation

#### **MODULE IV ENVIRONMENT CONSERVATION**

- Environment, its components and importance. Principles of Environmental conservation. Environmental education, policy and legislation in India. Impact of deforestation- forest fires, mining and other disturbances on environment
- Wetland ecosystems and their environmental significance. Introduction to climate change, Global warming, Ozone layer depletion, Acid rains, Environmental impact assessment of projects. Concept of sustainable development, strategy for sustainable energy use

#### **PRACTICAL**

- Monitoring of micro-meteorological parameters, relative humidity, Wind speed and wind direction, solar radiation, preparation of wind rose diagram
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**FSC 113**

#### **SILVICULTURE I**

**LEARNING OBJECTIVES:** The aim is to impart knowledge of basic concepts of silvicultural practices especially regeneration of tree species and plantation technology.

#### **MODULE I INTRODUCTION**

- Definition and objectives of silviculture
- **Forest Regeneration:** Natural and artificial regeneration, techniques of obtaining regeneration, need and objectives of reforestation and afforestation, choice of species, spacing and related aspects
- **Tree forms:** Crown, Canopy structure and Stratification; Branching pattern, Bole, Buttress, Burrs, Barks- Outer and inner color, texture

#### **MODULE II PLANTATION FORESTRY**

- **Plantation Forestry:** Need for manmade plantations. Native vs exotics. Single species plantations vs mixed plantations vs multiple purpose tree (MPT) plantations
- Selection of planting stock. Pruning – need, timing, intensity and economics
- Theory and demonstration of tending operation in the natural forests/plantations including weed management cleaning, thinning and pruning
- **Failure of plantations** – Reasons (i.e. unsuitable species, non –application of standard techniques). Plantation layout and designs. Care for seedling establishment

### **MODULE III PLANTATION TECHNIQUES IN SPECIAL AREAS**

- Plantation techniques in arid, coastal and hilly areas, water- logged, cold desserts ravines, saline/alkaline areas, sand dune areas, mining areas and salt affected sites, landslide affected and other degraded/vulnerable sites

### **PRACTICAL**

- Preparation of seed collection and scheduling
- Preparation of seedling schedule for tree species of economic value
- Report Preparation

## **FGS114      BASIC GEOLOGY AND SOIL SCIENCE**

**LEARNING OBJECTIVES:** The course is designed to provide knowledge to the students about the properties of soil including fertility and nutrients requirement and classification. The course also explains the basic geology and its role in soil science.

### **MODULE I BASIC GEOLOGY**

- Geological structure and their topographic expressions. Mineral constituent for various rocks and their effect on soil properties, weathering of rocks and minerals, weathering indices, land forms- parent material- climate organism relief time soil forming process- eluviations and illuviation formation of various soil, Munsell color chart: factor influencing parent material, soil moisture, organic matter, soil consistency plasticity- Atterberg's constant

- Soil air -air capacity- composition factors influencing amount of air space soil air renewal, soil temperature source and distribution of heat factors

## **MODULE II SOIL PROPERTIES**

- Concept and definition of soil, soil structure, definition and classification: clay prism like structure factors influencing genesis of soil structure, Soil profile and its development under different climate, topography and vegetation
- Soil texture, structure, particle density, bulk density, water, air and temperature, their importance and management. Inorganic and organic colloids; Sources of charges on soil particles; Soil pH and its effect on nutrients availability; Colloidal control and Buffer capacity; Cation and anion exchange phenomenon; Percent Base Saturation; Soil organic matter and its impact on soil fertility, composition and steps of decomposition, humus: properties, and role, C: N Ratio.
- Source, importance and management of soil organic matter

## **MODULE III SOIL FERTILITY AND NUTRIENTS**

- Occurrence and distribution of microorganism in soil and their classification
- Soil fertility: factors affecting soil fertility, methods of soil fertility evaluation, methods of soil evaluation, chemical and biological methods
- Essential plant nutrients – N, P and K and their transformation in soil, their role and deficiency symptoms; Fertility management through organic and inorganic fertilizers.
- **Nitrogen cycle:** Biological nitrogen fixation, nitrogen cycle, ammonification, nitrification, denitrification and carbon cycle

## **MODULE IV SOIL CLASSIFICATION**

- Methods of soil survey and their utility; Preparation of soil survey map; Systems of soil classification in general and USDA classification system in particular, its principles and nomenclature at different levels
- Soil types of India, extent, distribution, constraints and technology for afforestation of wastelands

## **PRACTICAL**

- **Combined Geology and Soil Field Excursion:** Selection of representative sites for soil and geological study, Recording land features (elevation, aspect, slope, vegetation, rocks etc.) of study site, Digging of soil profile and its study (morphological features), collection of soil profile samples and their labeling
- Soil map preparation with the help of Arc GIS software
- **Laboratory Analysis:** Processing of samples for analysis, estimation of texture, nitrogen, phosphorus, potassium, moisture, pH, organic matter, bulk density, porosity, Identification of important rocks and minerals

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**FMB 115      FOREST MENSURATIONS AND BIOMETRY**

**LEARNING OBJECTIVES:** The objective is to familiarize the students with tools and techniques for efficient measurements in forests.

**MODULE I BASIC MEASUREMENTS**

- Tree diameter, height, girth, bark thickness, weight, density, tree cross-sectional area, form, crown width, empirical formulae, errors, their elimination, comparison
- Height measurement: Methods, principles - ocular, instrumental, non-instrumental. Christen's, Smythies hypsometer, improvised callipers. Abney's topographical Abney's level-theory demonstration. Haga altimeter, Spiegel relaskop, error sources correction, height of leaning tree, problem solving
- **Tree stem form** - Metzger's theory, form factors, quotient height, taper table, volume measurement of felled trees, stacked logs - empirical formulae and problem solving
- **Volume measurement-** Methods, concept, classification, application, calculation of log volume, volume estimation of standing trees, stack of logsvolume tables, bark and cull methods, preparation of volume tables - graphical method, local volume table from general volume table, regression equation method, problem solving
- **Measurement of age:** Methods of estimation, concept of growth rings, incrementand growth of trees
- **Stump and stem analysis:** Theory, demonstration and problem solving

- **Site maintenance in forest stands:** Tree height as a measure of site quality, site index curves, Direct and indirect methods of site quality evaluation

## **MODULE II FOREST BIOMETRY**

- Measurement of forest crop - diameter, height, age and volume, calculation of current annual increment and mean annual increment of stand, yield tables, mathematical models
- Stand structure—even aged and uneven aged, management of sample plots
- Forest inventory—planning and design, alternatives, sampling, execution, compilation and reporting
- Forest sites-classification and evaluation, quality classes and site index models, stand growth and its current estimation and production – various methods

## **MODULE III PLANT AND ANIMAL BIOMASS ESTIMATION**

- Basic concepts, simple indices of biomass, actual biomass estimation, sample counts

## **PRACTICAL**

- Measurement of forest crop—diameter, height, age and volume, Inventories and enumeration

## **FHV 116      FOREST HEALTH AND VITALITY**

**LEARNING OBJECTIVES:** Objective of this course is to acquaint the learners regarding principal of forest protection against pests and pathogens. It also explains the causes and factors affecting forest health such as insects, pest and pathogens.

### **MODULE I      BASIC PRINCIPLES**

- Principles of forest protection, factors affecting forest health , outbreak of diseases and insect attack, droughts and floods, anthropogenic activities, pollution, biotic pressures, urbanization and industrial expansion
- Susceptibility of forest to damages, destructive agencies, nature of damage, cause, prevention and protection measures
- Forest fires, harmful and beneficial effects, control measure against fire

- Fencing and its economics, injurious plants / weeds, climbers, noxious pests and their control

## **MODULE II ENTOMOLOGY**

- Introduction to forest Entomology in relation to forests and forest produce
- Insect and pests of nurseries, natural and plantation forests, standing and felled trees, timber in storage (broad leaved and conifers)
- Biology and ecology of the key pests of tree species of economic value and forest nurseries and their management

## **PRACTICAL**

- Visit to insectary, diagnosis of insect attack by symptoms; how to report and send specimens(insect/infested parts) for advice. Spraying equipment and demonstration of spraying. Pesticide application techniques in forest eco-system
- Entomological collection: specimen's preparation and preservation techniques

## **MODULE III PATHOLOGY**

- Types of diseases, symptoms and Koch postulates, nursery diseases and their management; damping off, leaf blights, seedling blights, rusts, mildews, leaf spices
- Major Diseases: Ganoderma root rot of Khair (*Acacia catechu*) and black wattle(*Acacia mangium*), Root and wilt rot of Deodar (*Cedrus deodara*), wilt of Sissoo (*Dalbergia sissoo*) and Casuarina (*Casuarina equisetifolia*), pink disease of Eucalyptus, stem rust of Pine (*Pinus roxburghii*). Disease of natural stands, heart rots, polyporusroot rot of Sal (*Shorea robusta*). Sandal (*Santalum album*) spike disease
- Environmental factors and disease incidents
- Forest fungi: Major species, common characters, Phenomena of parasitism-host and parasite relationship
- Mycorrhizae-characteristics features and economic importance. Other useful microbes- Rhizobia, Frankia

## **MODULE IV DISEASE PREVENTION AND INTEGRATED MANGEMENT**

- General principle of integrated pest management (IPM), Importance of plant protection and quarantine, environment friendly control of insects' e.g. biological control, microbial control, kairomones and pheromones
- Role of microbes and fungi in plant nutrition



## **PRACTICAL**

- Study of the types of decay in timber- white fibrous rot; white pocket rot; brown cubodial rot, dry rot
  - Study of rust diseases of conifers- *Crohatiumhimalayends* on Chir; *Peridermiumcedri* on Deodar
  - Local excursions to acquaint with common tree diseases on Sal, Shisham, Khair and other hard woods
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## **FTP 117                      Term paper I**

**LEARNING OBJECTIVES:** The objective of the term paper is to develop the skill of research writing. In this course generally students have to review of literature in their field of interest related to forestry. They have to prepare a project report on a particular topic under the supervision of faculty and submit it to the university.

**2<sup>nd</sup> SEMESTER**  
**CORE COURSE**

**FPL 211**

**FOREST POLICY AND LAW**

**LEARNING OBJECTIVES:** The course imparts the thorough knowledge about the national forest policy and laws related to forest and environment as well as various international agreements like CITES, CBD, ITTA, UNFCCC, UNFCCC, Kyoto protocol, TRIPS

**MODULE I FOREST POLICY AND LAW**

- Forest Policy; Foundation, need and scope. National Forest policies of 1894, 1952 and 1988; salient features
- Forest Law: Legal definitions, objectives of special forest law. Indian Forest Act 1927; Forest (Conservation) Act 1980 and Rules 2003, Indian Biological Diversity Act 2002
- Tribal rights and forest dwellers Act
- Important case studies relating to Acts above stated with preliminary idea of Indian Penal code, Cr P.C and other enactments in India

**MODULE II ENVIRONMENTAL POLICY AND LAW**

- Pollution policy in practice, Environmental quality standards, Environmental Guidelines, Regulations and Rules, Environmental (Protection) Act 1986, Introduction to The Air (Prevention and Control of Pollution) Act, 1981 and The Water (Prevention And Control Of Pollution) Act, 1974

**MODULE III INTERNATIONAL AGREEMENTS AND CASE STUDIES**

- Major International Agreements: CITES, CBD, ITTA, UNFCCC, UNFCCC, Kyoto Protocol TRIPS etc.
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## **FLM 212      LANDSCAPE APPROACH TO MANAGEMENT**

**LEARNING OBJECTIVE:** The objective of the course is to create the awareness regarding soil and water conservation and their management practices.

### **MODULE I SOIL AND WATER CONSERVATION**

- Types, causes and factors affecting soil erosion. Land capability classification, general practices for soil and water conservation, mulching, windbreaks, shelterbelt, contour farming, strip cropping, terracing, bounding and grassed waterways, gully control, water harvesting tanks

### **MODULE II LANDSCAPE MANAGEMENT**

- Concept and characteristics of watershed management, their role and importance in management plan, restoration of deteriorated watershed. Biological aspects: soil management, crop management, alternate land use in agro forestry. Engineering approaches in watershed management
- **Tree landscaping:** Elements of bio-aesthetic planting and landscaping, choice of species and sites

### **MODULE III RANGE MANAGEMENT**

- Grass lands and ranges of India. Sources, gap between optimal requirement and present availability. Principle and practices of range land management.
- Vegetation manipulation – control of undesirable vegetation, burning, fertilization, soil and water conservation and protection, carrying capacity, fodder banks and livestock management
- Grazing systems (rotational, nomadic, trans- humans, paddock, closure cycle, cut and carry cycle). Resources – input – output flows and system sustainability. Fodder from trees/shrubs and their nutritive value
- Different methods of control against grazing and browsing animals. Effect of wild animals on forest regeneration

### **PRACTICAL**

- Preparation of an Integrated Watershed Management Plan for a micro-watershed
  - Field Excursions and Exercise
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**LEARNING OBJECTIVES:** The course is meant for exposing the students to importance and use of non-timber forest products such as medicinal plants, oil, bio-fuels, resin, tannin drugs, lac and shellac including their importance in rural, tribal and national economy.

**MODULE I INTRODUCTION**

- Non-timber forest products of India and their importance in rural and industrial economy; fiber and flosses, grasses, bamboos, medicinal plants and canes. Their distribution, cultivation, harvesting, processing and uses

**MODULE II PLANT BASED NTFP PRODUCTS**

- Essential oils, commercial use and the methods of cultivation of soil bearing plants. Oil seeds- important oil seeds obtained from forests
- Gum, Resin and Oleoresin
- Tannin and dyes- vegetable tanning materials obtained from forests
- Drugs, Poisons and Insecticides
- Rubber, Charcoal, charcoal dust briquettes
- Miscellaneous products: leaf fodder; Lac and shellac; silk and tassar
- Bio fuels

**MODULE III ANIMAL BASED NTFP PRODUCTS**

- Composition of animal products- Honey, Lac, Ivory, Horns, Hairs, Musk, Oils, vermin compost etc.

**PRACTICAL**

- Field execution/ identification of plants
- Extraction of principal compounds at least two species in chemistry labs
- Nursery techniques of 20 species (Tropical-10 and Temperate 10)

**LEARNING OBJECTIVES:** The course is designed to explain the role and application of economics in management of forest, wildlife and environment.

**MODULE I FUNDAMENTALS OF ECONOMICS**

- Micro and Macro Economics, utility and marginal analysis, demand–supply of forest products, Law of diminishing marginal utility, Market equilibrium, Production Possibility curve, Production theory as applied to forestry, Production function
- Role of markets, open market economy, different forms and types of market competitions, regulation, cases studies of forest products
- Costs and revenues, Opportunity Cost, Interest, Rent, Wages
- Investment criteria, Benefit cost analysis, Internal rate of return (IRR), Sensitivity analysis and their applications

**MODULE II FOREST RESOURCE ECONOMICS**

- Goods and services from forests, measuring forest ecosystem values and benefits, Monetization of intangible services from forest
- Soil expectation value
- Total Economic Valuation, Models for direct and indirect benefit estimation market price method, productivity method, Travel Cost Method (TCM), Hedonic Pricing Method (HPM) and Contingent Valuation Method (CVM) and other cost based methods of economic valuation and their application
- Contribution of goods and services from forests to national GDP, Natural Resource Accounting
- Economics of air, water and energy resources
- Economics of carbon sequestration

**MODULE III PROJECT FORMULATION, IMPLEMENTATION, MONITORING AND EVALUATION**

- Assignments and case studies to demonstrate the economic valuation of different components of environment
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**LEARNING OBJECTIVE:** The basic objective of course is to involve the local communities in forestry activities and collective management of land to produce forest products and meet the needs of local people.

**MODULE I INTRODUCTION**

- Strategy and objectives of social forestry, concept of SFM and participatory approach to SFM, vis-a-vis NFP. Fuel, fodder and timber crisis in developing countries. Mitigation strategies

**MODULE II SOCIAL AND COMMUNITY FORESTRY**

- **Forest dwellers-** Tradition of forest consecration, rights and concessions
- **Social and community forestry** – Concepts, variation, and their role in rural, tribal and urban development. Choice of species and management of social forestry plantations: energy blocks, wood lots, green belts, sound barriers, smoke and smog reducers, silvi–pastoral systems
- **Management of community lands** – Waste lands and marginal lands. Tree and land tenure issues, conflicts. Parks and recreational sites, Ecological and land use constraints

**MODULE III JOINT FOREST MANAGEMENT**

- Concept, principles and application, strategies, micro-level planning and participatory, rural appraisal. Rural development, employment generation and distribution of benefits of JFM. Monitoring and evaluation of JFM

**MODULE IV FORESTRY EXTENSION**

- Communication, extension work; programme planning and methods. Management of extension organizations. Role of voluntary organizations / NGO's and national and international agencies

**LEARNING OBJECTIVES:** The course is aimed to provide knowledge of natural resources available and its sustainable management.

**MODULE I    INTRODUCTION**

- Natural resource systems, Elements, Components, Types of natural resources, Non-renewable and renewable resources allocation, Theoretic aspects of resource management

**MODULE II FOREST BIODIVERSITY ASSESMENT**

- Forest Biodiversity and its significance in N.R.M. Floristic and Faunistic diversity, Broad classification – Bio-geographical and phyto-geographical assessment of diversity (Genetic and Species) Gene pool, Interdependent elements. Loss of Biodiversity and causes Threat and Conservation value assessment IUCN, Norms of threat Categories Establishment of Conservatories forest Herbaria, Botanical and Zoological gardens and Arboreta. Eco tourism

**MODULE III ESTIMATION OF FOREST CARBON**

- Carbon(C) cycle in the forest; carbon related definitions e.g. C-pool, C-stock, C-flux, C-sink, C-source, Sequestration/uptake. Measurement of Carbon in forest ecosystems, Eddy covariance. A broad view of assessment of C in Indian forests

**PRACTICAL**

- Preparation of EIA report of a site
-

**LEARNING OBJECTIVE:** The objective of the course is to develop understanding about silvicultural system for the production as well as protection benefits from the forests. The course also introduces the silvicultural practices of some important timbers species.

**MODULE I INTRODUCTION**

- Classification of silvicultural systems. High forests and coppice systems. Changing concepts in silvicultural systems

**MODULE II MAJOR SILVICULTURAL SYSTEMS**

- Clear felling system and its modifications
- Shelter wood system, uniform system, regeneration period, periodic blocks, and group system. Irregular shelter wood system
- Selection system – characteristics, rotation, felling cycle. Application in India. Coppice system: simple coppice system, coppice with standards, pollard system
- Change of systems, types of conversions, conversion from coppice system to high forest

**MODULE III SILVICULTURE OF IMPORTANT SPECIES**

- Teak, Sal, Shisam, Deodar. Eucalyptus, Casuarina, Poplar, Khair, Babool, Chir Pine, Bamboo, *Melia dubia*, Sandal wood

**MODULE IV AGROFORESTRY**

- **Designing of agro forestry systems-** Cropping – mixed, intercropping, and alley cropping. Elements of modeling: model building

**PRACTICAL**

1. Visit of logging operations at a govt. site (UKFDC) and Depot Management
- 

**LEARNING OBJECTIVES:** The aim of course is to teach students about seed morphology, nursery practices and propagation houses/shades.

**MODULE I SEED TECHNOLOGY AND MANAGEMENT**



- **Seed morphology:** Morphology and structuring of seeds, Major types of forest seed, Recalcitrant, Orthodox, Encapsulated and Eglutanized seeds
- **Management of Forestry Seeds:** Seed source, collection, processing, storage, testing and pre-sowing treatments. Seed certification

## **MODULE II NURSERY TECHNIQUES AND MANAGEMENT**

- **Nursery practices:** Site selection, type, design and layout, Nursery soil and water management. Seed bed preparation and sowing. Seeding early tending – watering, weeding, and shading
  - Nursery soil fertility management. Rhizobial and mycorrhizal associations
  - Container and bare-root seedlings. Pricking out, transplanting, lifting, packing and transportation. Media and mixtures
- 
- **Propagation structures:** Shade house, poly house, mist chambers Glass houses, net houses and growth chambers.

### **PRACTICAL**

- Seed Quality Testing, Seed viability, pre-treatment and sowing techniques
  - Nursery Techniques: Poly bag, Nursery raising, lifting, grading and packing of nursery stock, nursery layout, Mist chamber, Glass house, Net house
- 

## **FTP 219**

## **Term paper II**

**LEARNING OBJECTIVES:** The objective of term paper is to make students to aware about, how to write a scientific research paper/technical report. It helps the student to develop ability to do logical arguments and thought process and also helps students to learn to relate their thoughts in a concise manner. It will also develop the communication and report writing skills.

# 3<sup>rd</sup> SEMESTER

## CORE COURSE

### FRM 311 RESOURCE SURVEY AND FOREST MANAGEMENT

**LEARNING OBJECTIVES:** The objective of the course is to develop the skills regarding the working principles of forest management.

#### **MODULE I INTRODUCTION**

- Introduction, object and Principles. Resource base-present and future demands, current practices. Ecological, Economics and Environmental valuation and Appraisal methods
- Forestry sector and national economy. Goods and services from forests. Demand estimation-non timber product economics

#### **MODULE I OBJECTIVES AND PRINCIPLES**

- History of forest management, Principles and practices of forest management

#### **MODULE II YIELD MANAGEMENT**

- **Sustained yield:** Production period or rotation; normal forest; growing stock and its increment; yield and its regulation

#### **MODULE III VALUATION AND APPRAISALS**

- **Forest valuation:** Valuation principles, interest and investment, valuation of forest land and timber stand, valuation of stumpage, tree, non-wood forest outputs, valuation of financial alternatives
- **Appraisal of forest damage:** Valuating intensive management decision- spacing and thinning; working plans- preparation and control

#### **MODULE IV MANAGEMENT AND WORKING PLANS**

- Working plan-preparation and control
- National Working Plan Code
- Management plans

#### **PRACTICAL**

- Preparation of working plans
- Field visit for observing application of working plans

**LEARNING OBJECTIVES:** The course is designed to develop the understanding of concept and importance of biodiversity, wildlife and their management in support of conservation.

### **MODULE I WILDLIFE MANAGEMENT**

- Biodiversity and Wildlife. Principles of management, animal-habitat studies, conservation biology, management of animal communities, habitat management. Wildlife Management Plan

### **MODULE II CONSERVATION STRATEGIES**

- Wildlife behavior studies, Man animal conflict,
- Conservation strategy – Objects of Conservation, life support systems, ex situ and in situ, protected area network, agencies for conservation, human dimension, wildlife in managed forests
- Wildlife (Protection) Act, 1972 and amended Act 2002

### **MODULE III ECO- DEVELOPMENT**

- Eco development in support of conservation & protected area management, animal habitat studies, Scope of eco development, thrust areas in eco development, planning and implementation
- Eco development: Macro and micro planning, Case studies

### **PRACTICAL**

1. Field Visits and Field Exercises, Audio video Demonstrations
  2. Case studies related to man animal conflict, habitat development and biodiversity conservation
-

**FRU 313      FOREST RESOURCE UTILIZATION-II (Wood)**

**LEARNING OBJECTIVE:** The course is planned to acquire the knowledge of wood products and advanced technology of seasoning, preservation and composites.

**MODULE I WOOD SEASONING AND PRESERVATION**

- Introduction – object, need and importance of seasoning and preservation; general principles of seasoning; air and kiln seasoning, solar dehumidification, steam heated and electrical kilns. Types of wood preservatives and treatment methods

**MODULE II WOOD ADHESIVES AND COMPOSITE WOOD**

- Adhesive preparation, properties, uses
- Composite wood manufacturing, properties and uses of plywood, fiber boards, particle boards, MDF(Medium Density Fiber board)

**MODULE III WOOD BASED INDUSTRIES**

- Status of composite wood industries in India and future expansion plans, classification and grading of Indian timbers for various wood based products. Wood substitution utilization of plantation wood; problems and possibilities

**PRACTICAL**

- Exposure to wood seasoning, preservation, composite wood
  - Determination of wood physical and mechanical properties
- 

**FGT314      FOREST GENETICS AND TREE IMPROVEMENT**

**LEARNING OBJECTIVES:** The objective of the course is to develop of concept of genetics and biotechnology in relation with quality improvement of forests.

**MODULE I TREE GENETICS**

- Introduction to genetics and its application to plant improvement, Micro and macro propagation, Biochemical characterization, Basic Concepts of DNA finger printing, Transgenic, Elements of tissue culture, Chloroplast transplanting, fundamentals of Genomics

## **MODULE II FOREST BIOTECHNOLOGY**

- Introduction, definition and scope in tree improvement, variation: causes and kinds of variation, variation in natural and artificial stands, forces that shape variation, uses of variation
- Quantitative characters, heritability (broad sense and narrow sense), genetics advance, genetics gain and combining ability and their application
- Tree Improvement: Species and provenance testing, plus tree selection, progeny trials and elite trees. Quality seeds and seed certification. Seed orchards and seed production areas, their establishment and management. Advanced generation seed orchards. Vegetative propagation
- Techniques of tree breeding: Definition and scope of tree breeding, its objectives and application. Selective methods of breeding. Clonal testing and clonal selection polybloidy and mutation breeding. Controlled pollination and hybrids and tree improvement. Breeding for wood properties, resistance to insect and diseases. Concept of ideotype

## **PRACTICAL**

- Tissue Culture, Vegetative propagation methods
  - Techniques of selecting superior trees in natural stands
  - Controlled crossing techniques
  - Seed orchard designs. Visit to seed production areas, seed orchards, clonal banks, provenance trials
  - Estimation of heritability and phenotypic and genotypic coefficient of variation
- 

**FFC 315**

**FOREST CERTIFICATION**

**LEARNING OBJECTIVES:** The objective of the course is to introduce concept and importance of forest certification and its programmes in India.

## **MODULE I INTRODUCTION**

- Forest certification: concept, definition, origin, evolution, relevance and needs and limitation of forest certification, Scope and opportunity, Emerging issues, trends and

schemes, certification and labelling, type of certification- Detail about FM, CoC, fact and figures of certification(Global and India)

### **MODULE II FOREST CERTIFICATION PROGRAMME**

- Standards, certification process, accreditation, auditing, managing audit, organizational process, national and international schemes, certificate processes at global level, Bhopal-India Process

### **MODULE III CERTIFICATION OF FOREST PRODUCTS**

- NTFPs and their role in forest management, certification of NTFPs, issues, merits and demerits of NTFPs certification, Need of certification for wood based Industries

### **MODULE IV SUSTAINABILITY, CHALLENGES AND POTENTIAL OF FOREST CERTIFICATION**

- Framework for forest certification in India, Government policies and their objectives, Indian forest certification agencies, Standards of certification for sustainable utilization, and management of forest resources, progress of certification in India, stakeholder expectation and economics of forest certification, Visit to certified Industry/Govt. Organization

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**FCC 316**

### **FOREST, SOCIETY AND CLIMATE CHANGE**

**LEARNING OBJECTIVES:** The course is designed to develop understanding of social dimensions on climate change, climate vulnerability and its assessment.

### **MODULE I SOCIAL DIMENSIONS ON CLIMATE CHANGE**

- Community social structure, status and role, norms and values, Concepts of equality, inequality, exclusion, poverty and deprivation, Social Stratification (class, status groups, gender, ethnicity and state, citizenship, democracy, civil society, ideology)
- Land use and Forest Cover Change
- Sociological issues related to climate change- Social causes, consequences, conflicts over resources etc.
- People and forest interface in managing natural resource and Common property resources, gender perspective and priorities in relation to resource use and management, Gender impact analysis, Social drivers of Climate Change

## **MODULE II CLIMATE CHANGE ISSUES AT GLOBAL AND NATIONAL LEVEL**

- Global environmental and social issues such as acid rain climate change disaster management, Global regional and local common resources
- Policies and initiatives related to global climate change, Montreal Protocol, UNFCCC, Kyoto Protocol, REDD +  
Regulations and policies for environment and social safeguards in selected national contexts

## **MODULE III RESPONSE TO CLIMATE CHANGE**

- The concept of Mitigation and Adaptation
- Climate vulnerability exposure, sensitivity, **resilience** and adaptive capacity of society
- Role of forests, Trees outside forests and agro forestry in climate change resilience and adaptation

## **MODULE IV METHODS AND TOOLS FOR ASSESSING VULNERABILITY AND ADAPTATION POTENTIAL**

- Participatory process, Stakeholders and SWOT Analysis
- Introduction of approaches for qualitative data collection and synthesis: Rapid Rural appraisal (RRA)
- Communicating and connecting to people on social and environmental concerns
- Data and Information: Data types, population and sample, methods for collecting information; development of field survey questionnaire; data collection, processing, presentation and interpretation
- Spatial and non – spatial data handling using Geographic Information Systems (GIS)  
Criteria for selecting study area; Analysis and interpretation using GIS;  
Data base creation tools for handling large data sets
- Analysis of trends and scenarios
- Methods for assessing climate change vulnerability and adaptation potential
- Scientific writing of results

## **PRACTICAL**

- Assignment
  - Data collection from field for opted problem
  - Data analysis, report writing, presentation and communication of important findings
-

**FST 317****STUDY TOUR**

**LEARNING OBJECTIVES:** A study tour is organized every year for the students of M.Sc. Forestry to acquaint themselves with the knowledge in the relevant fields. The study tours are intended for giving actual field exposures to students. It provides them an opportunity to visualize the professional efforts and measures taken by different industries and institution in tackling the problems of forest.

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**ELECTIVE COURSE****FGB 321      FOREST GENETICS AND BIOTECHNOLOGY**

**LEARNING OBJECTIVES:** The course is designed to impart advance knowledge of plant tissue culture, molecular biology and genetic engineering.

**MODULE I PLANT TISSUE CULTURE**

- Principles, history and development, fields of application, progress and prospects with special reference to tree crops. Components and preparation of culture medium. Collection, handling and surface sterilization of explants. Inoculation and incubation. Culture conditions. Stages of micro propagation
- Essential features of tissue culture laboratories. Low cost techniques for micropropagation. Commercial micro propagation
- Problems and progress in *In vitro* propagation of tree crops
- Production of virus free plants. Somaclonal variation, factors influencing, exploitation for crop improvement. Haploid culture and production of homodiploids, protoplast isolation, culture and regeneration; Protoplast fusion for somatic hybridization and its application. Techniques for direct gene transfer to protoplasts

**PRACTICAL**

- Preparation and storage of stock solutions, preparation of culture media
- Collection, handling and pre-treatment of explants
- In vitro propagation of crops via different route
- Ex vitro establishment of plantlets. Production of synthetic seeds
- In vitro pollination and fertilization
- Protoplast isolation and culture. Haploid culture



## **MODULE II MOLECULAR BIOLOGY**

- History and development of molecular biology
- Nucleic acids – DNA and RNA as genetic materials. Nucleosides and nucleotides, DNA double helix- properties of DNA-absorbance, ionic interaction, denaturation and renaturation, sedimentation. Secondary structure of single stranded DNA – inverted repeat sequences, alternative structures of duplex DNA. C value and concept of sea fish DNA, cell organelle DNA chloroplast and mitochondrial DNA. DNA replication – semi-conservative replication. Organization in prokaryotes and eukaryotes. DNA polymerases, replicon, theta, rolling circle and D-loops, nick translation, okazaki fragments, DNA ligase. Replication of bacteriophage T4, OZ 174 and RNA viruses. Reverse transcriptase, primase, helicase, topoisomerases, gyrases, methylases and nucleases. DNA sequencing

## **PRACTICAL**

- Estimation of DNA and RNA. Isolation of total nucleic acids from bacteria. Large-scale preparation of total plant DNA. Isolation of total RNA. Agarose gel electrophoresis. Denaturation of DNA. Ethidium fluorescent assay of nucleic acids. Estimation of C value. Binding of polyamines to DNA. Assay of DNA polymerase. DNA sequencing

## **MODULE III PLANT GENETIC ENGINEERING**

- Genetic engineering – principles, methods and application, Identification and isolation of genes. DNA cloning strategies. Characteristics of vectors. Plasmids, phages and cosmids as cloning vehicles. PCR techniques for cloning. Separation and isolation of nucleic acids and proteins – their sequencing. Enzymes for molecular cloning – ligases, nucleases, DNA polymerases. Restrictions and DNA methylation. Preparation and screening of genomic and cDNA libraries, cDNA cloning. Structural and regulatory genes
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**LEARNING OBJECTIVES:** This is the advance course designed to focus on fundamental characteristics of electromagnetic radiation and their application in forestry and allied areas through RS and GIS.

**MODULE I    REMOTE SENSING**

- Introduction to Remote Sensing, Electromagnetic Energy, Sensors and Scanners
- Aerial Cameras, Visual Image Interpretation, Digital image Classification, Image Enhancement and Visualization, Geometric Aspects
- Software of remote sensing, Application of remote sensing in forestry and allied fields. Ground truthing and accuracy assessment

**MODULE II    GEOGRAPHIC INFORMATION SYSTEM**

- Introduction to GIS, Spatial and non-spatial database for GIS analysis
- Use of global positioning system, Data entry and processing system, Data analysis and visualization
- Application of GIS in Forestry and allied subjects

**PRACTICAL**

1. Stereo text, determination of photo / imagery scale, orientation of stereo model, identification of features on stereo pair and aerial photograph
2. Interpretation of colored details on multispectral and monochromatic images
3. Remote sensing data acquisition
4. Software operation for image stretching, histogram equalization, rationing, filtering and principal component analysis. Image classification
5. Training in operating software on basics of GIS. Geo referencing, geocoding and mosaicing
6. Entry of spatial and non – spatial data
7. Rasterization and labeling of attributes
8. Measuring height and crown diameter of a tree
9. Forest cover and density mapping
10. Land use and land cover
11. Multistage sampling for change detection

**LEARNING OBJECTIVES:** This course aims to provide a comprehensive understanding of wildlife and their conservation strategies with ecosystem development.

**MODULE II INTRODUCTION**

- Objective of wildlife conservation and wildlife biology, biological basis for conservation of wildlife. Review of biology of major groups of vertebrates, fish, amphibians, reptiles, birds and mammals with emphasis on importance in wildlife management
- The IUCN categories of conservation status of species. Importance of invertebrate conservation

**MODULE II WILD LIFE BEHAVIOUR**

- Animal habitat interactions, pattern of habitat utilization, feeding ecology of herbivores, carnivores, insectivores and omnivores, temporal and spatial variation in food resources, animal body conditions, reproductive ecology, dispersion, pattern of growth, study of signs and symptoms of wildlife presence, role of minerals in animal health, adaptation with respect to temperature and water
- Wildlife behavior – Instinct and learning Behavioral ecology, study method and significance for conservation, Group living in animals, Territory in animals, Social organization
- Management of Wildlife Animals in Distress - Causes of distress; trapping, snaring, accidents, injuries, affected by disease and physical disability. Orphaned young, Approach to the handling of animals in distress in consideration to safety of humans and animals concerned, crowd control, techniques for animal capture, restraint and immobilization

**MODULE III ECO DEVELOPMENT AND HABITAT MANAGEMENT**

- Habitat Ecology – Major Wildlife Habitats, forests, grasslands, wetlands, deserts, Wildlife cover requirement, Edge effect and interspersions, physical and biological features of habitats. Grassland habitats, Habitat Dynamics, Habitat Evaluation Procedures, Forage quality and quantity
- Definition and classification. Wetland values and functions, wetland degradation and loss. Wetland management principles. Identifying major problems and setting

objectives and priorities. Management of wetland habitats for ecological processes and wildlife

- Rationale for undertaking eco-development, Basic concepts, significance of commodities participation in eco-development, significance of Local Traditional Knowledge in conservation, dependencies of local communities on PA's/ Natural resources, Stakeholders in conservation and their conflicts, SWOT Analysis, Linkage between conservation and development, Livelihood strategies in context of eco-development, Protected areas , mutual impact zone analysis, participatory tools and methods for gathering data for planning eco-development, Micro-planning
- Significance of research in wildlife, wildlife habitat management -- creation of water sources, wallows and saltlicks. Vulnerability of resources and protection, fire as a management tool, livestock grazing, weeds eradication

#### **MODULE IV WILDLIFE TOURISM**

- Translocation and reintroduction. Tourism in protected areas. Development of Interpretative facilities, visitor characteristics, expectations and motivations, sustainability in Wildlife Tourism

#### **MODULE V POPULATION DYNAMICS**

- Population dynamics, Population estimation, Meta-population, Census techniques, Wildlife health management, Need for wildlife health management, History of wildlife diseases in India, Importance of wildlife health monitoring, problems and solutions, Determinants of disease, Infectious and non-infectious diseases

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**FSM 324**

### **SUSTAINABLE FOREST MANAGEMENT**

**LEARNING OBJECTIVES:** The course will develop the skills of students to manage forest and natural resources.

#### **MODULE I FOREST IN RURAL DEVELOPMENT**

- Forest – People symbiotic linkage; forest and employment generation, Management of local commodities action, forest management strategies of social forestry programme and Joint Forest Management (JFM). Various strategies of micro level planning and participatory rural appraisal (PRA). Behavioral dimensions in people centric forest management

## **MODULE II NATURAL RESOURCE MANAGEMENT**

- Land Management and Agro-forestry (LMAS)
- Natural resource poverty and development, Conflict Resolution in NRM (Natural Resource Management), Natural Resource Accounting, Plantation Management, Sustainable Forest Management and Certification (SFM) , Multi-stakeholder Partnerships in managing forest resources, NTFP (Non Timber Forest Product) based Micro-Enterprises, Management and Business Models, Economics of Forest and Forest based Industries. Marketing Research, Finance, Micro Finance

## **PRACTICAL**

- Study of working plans and natural resource management control systems through preparation of field work reports on Preliminary Working Plan, Micro – plan
  - Formulation of an integrated watershed development project comprising various sectoral development plans, forest products marketing research and field work, Stock mapping
  - Checking of maps, compartment description, sample plot lay out, collection of statistical data, collection of other data, and evaluation of management alternatives; socioeconomic survey
- 

### **FAF 325**

### **AGROFORESTRY**

**LEARNING OBJECTIVES:** The course aims to provide concept of agroforestry and tree management techniques.

## **MODULE I INTRODUCTION**

- Agro forestry- definition, meaning, objectives, importance, potential and impediments
- Goals, objectives and strategies of National Agro forestry Policy 2014
- Land capability classification and land use, agro-climate zones of India
- Concepts of community forestry and social forestry
- Elements of Agronomy (cultural practices of agro forestry crops and compatibility with tree)
- Elements of horticulture in forestry

## **MODULE II AGROFORESTRY SYSTEMS**

- Classification of agro forestry systems: structural, functional and socio-economic
- Major agro forestry practices, their characteristics and examples
- Overview of important agro forestry systems in temperate zone
- Characteristics of agro forestry trees; Multipurpose tree species ,nitrogen fixing trees;C3,C4 and CAM plants
- Important agroforestry trees, shrubs, grasses and medicinal plants in different regions of India for various uses (fodder, fuel, industrial wood, medicines, fruit , wasteland development, urban landscaping )
- Design and diagnosis, criteria of good agro forestry design
- Example of improved agro forestry models

## **MODULE III MANAGEMENT AND TECHNIQUES**

- Tree management (Planting pattern, nutrient, irrigation and weed management, pruning, coppicing)
- Tree-crop interactions
- Calculation of volume of standing trees
- Measurement of felled trees, volume and weight tables
- Estimation of volume of felled trees through sectional areas

## **MODULE IV ECONOMICS**

- Basic principles of Economics applied to Agroforestry
- Optimization techniques, Planning, Budgeting and Functional analysis
- Market intelligence, Demand study, MIS
- Marketing of agro forestry products including benefit sharing
- Agro forestry potential under REDD regimes
- Economic security and incentives to tree growers- Access to credit, insurance,
- Support prices, Taxes etc.

## **MODULE V PEST AND DISEASE MANAGEMENT**

- Insect-pest problems in agro forestry systems

- Basic principles and practices of integrated pest management in agro forestry ecosystems with emphasis on cultural practices
- Disease Management in Agro forestry models

### **PRACTICAL**

- Visit of agro forestry sites with different crop combinations
  - Harvesting and marketing of agro forestry produce
- 

**FFP 326**

### **FOREST PATHOLOGY**

**LEARNING OBJECTIVES:** The course is designed to impart knowledge of tree disease and its management.

#### **MODULE I INTRODUCTION**

- Disease concept – definition, disease square, parasitism and pathogenicity, classification of tree diseases

#### **MODULE II DIAGNOSIS AND TYPES**

- Diagnosis of tree diseases – symptomatology, signs, methods for identification of diseases
- Pathogenesis – events of disease development and epidemiology
- Plant defense mechanisms
- Non-infectious diseases - moisture stress, temperature stress, pollutants - phytotoxic gases – point surface pollutants, diffuse oxidants, particulates and aerosols
- Seed pathology of forestry species – seed borne infections and their management
- Heart rots in natural forests – damage caused, external indicators, infection courts, factors favouring heart rots in trees; cull factor; CODIT (compartmentalization of decay in trees), concept; management of heart rot in natural stands

#### **MODULE III BIODETERIORATION**

- Biodeterioration of stored non-wood forest products with special emphasis on medicinal plant produce, types and hazards of mycotoxins; management of fungal deterioration in stored products Molecular tools in forest pathology
- Biodegradation of wood – microscopic and chemical effects of white rot, brown rot and soft rot; wood discolouration – sap stain and moulds

## **MODULE IV MANAGEMENT OF DISEASE**

- Tree disease problems in urban plantations and their management
- Principles of disease management
- Disease control through genetic resistance – disease resistance breeding programme with trees; methods of inheritance of resistance
- Integrated disease management for nurseries and plantations - cultural, chemical and biological control strategies, plant quarantine

## **PRACTICAL**

1. Isolations of fungi, maintenance of cultures and their identification
  2. Disease survey and preparation of herbarium
  3. Management of nursery diseases – seed treatment, soil treatment and foliar application
  4. Assessing heart rot and root rot diseases in plantations
  5. Extraction of nematodes from soil and roots
  6. Extraction of spores of Arbuscular mycorrhizal (AM) fungi from soil and assessment of mycorrhizal root infection
  7. Fungal DNA extraction, RAPD-PCR, Data analysis, use of molecular tools in fungal taxonomy
- 

**FFE 327**

## **FOREST ENTOMOLOGY**

**LEARNING OBJECTIVES:** The course is formulated to enrich the knowledge with the information about insect, insect-pest of economically important trees and timber species and their management along with industrially important insects.

## **MODULE I GENERAL ENTOMOLOGY**

- **Introduction:** Definition and scope, Importance of insects in Forestry: History and development of forest entomology in India
- **The Insects:** Classification of class insect, biological success of insects and adaptation
- **Development and Growth:** Life-cycles and types of metamorphosis of insects
- **Economic losses by forest insects:** Type of injury (direct and indirect), estimation of economic losses by forest insects



- **Cone and tree seed insect pests:** Factors influencing insect infestation, insect pests of seeds under field conditions, insect pests of seeds and grains in storage, economic losses, preventive and remedial measures of control
- **Nursery pests:** Major nursery pests (white grubs, chafer beetles, cut worms, surface caterpillars), Minor nursery pests (defoliators, sap suckers, non-insect pests, management practices)

## **MODULE II TREE DEFOLIATORS**

- Bio ecology of the pest, life history, nature of damage, natural enemy complex, management of different tree defoliators *i.e.* Ailanthus (*Atteva fabriciela*, *Eligma narcissus*), Deodar, Gamhar, Kadam, Poplar, Shisham, Teak etc.

## **MODULE III TREE BORERS**

- Bio ecology of the pest, life history, nature of damage, natural enemy complex, management of different tree borers *i.e.* Babul, Meliaceae, Poplar, Sal heartwood, Semul etc.

## **MODULE IV INSECT INDUCES DEFORMITIES**

- Malformations and plant galls in forest trees, teak canker grub, gall insects, teak stem galls, bamboo aphid, tendu leaf gall, bio ecology of the pest, nature of damage and its management.

## **MODULE V TERMITES IN FORESTRY**

- Recognition of termite infestation, distribution and sociobiology, termite classification, termite relationship with other insect including cochroaches, ants etc., termite canabalism, wood dwellers, damp-wood termites, dry-wood termites, economic importance, termites as pests of forestry and their management, termite damage in buildings and human dwellings, pre-constructions and post-construction control measures

## **MODULE VI TIMBER ENTOMOLOGY**

- **Borers of felled and harvested wood** – Bio ecology of borers, nature of damage and its management, ecological succession of borer attack, borers of freshly felled timber, Ambrosia and bark beetles, Buprestid borers, cerambycid borers, curculionid borers, powder, post beetles
- **Bamboo ghoon borers:** Borers of felled and stored bamboos and their management. Insects pests of imported wood

## **MODULE VII ECONOMIC ENTOMOLOGY**

- **Honey Bee:** Fauna; its community, social organization; development, division of labour, swarming, communication, bee keeping, economic importance
- **Lac and Lac insect:** History definition and composition, life cycle, strains of lac insects, host plants, lac cultivation, natural enemies, control measures
- **Silk and silk worms:** History of sericulture, definition and composition, mulberry silk worm, univoltine and multivoltine species, wild silk worms, sericulture, silk production

## **MODULE VIII INSECT PEST MANAGEMENT**

- Natural control of insect pests: Climatic control, nutritional restrictions, host resistance, biotic factors etc.
- Integrated Pest Management: Definition, scope, population dynamics, factors affecting natality/mortality of insect pests, economic threshold, economic injury level etc.
- Methods of pest management: Mechanical, silvicultural, chemical, bio logical, behavioral and genetic control.
- Mechanical methods of pest controls: Hand picking, trapping, barrier, tree bands, debarking, pruning, heating, submersion in water etc.
- Silvicultural control: Food web; crop rotation; mixed crops; clear felling; choice of silvicultural system.
- Chemical control: **Insecticides and plant origin** – pyrethrum; nicotine; rotenone; neem products
- **Synthetic organic insecticides** – Chlorinated hydrocarbon insecticides; organo phosphate insecticides; carbonate compounds; synthetic pyrethroids.
- **Insecticide formulations** – Contact insecticides; systemic insecticides; stomach poisons; fumigant insecticides.
- **Insecticide application** – Insecticide application equipment; safer dosages of pesticides; mode of action; aerial spraying of insecticide.
- **Bio logical control approach / strategy:** Survey for presence or absence of bio control agents; selection of promising bio control agents; Mass rearing / mass culture of bio control agents; release of promising bio control agents in deficient areas; post release study – establishment of released bio control agents; effect on pest population

- **Microbial control:** Entomo pathogenic fungi, bacteria, virus, protozoans, nematodes etc, mass production technique of entomo pathogen; quantification of effective doses, field application; post release studies etc.
- **Behavioral control** – Pheromones; Sex pheromone; aggregation pheromones; trail pheromones; Kairomones; allomones; phago deterrents etc.
- **Insect growth regulators** – Juvenile hormones; moulting hormones precocenes.
- **Genetic control**
- Breeding resistant trees / clones; male sterilization technique, radiation sterilization; chemosterilization
- **Quarantine regulations**
- Legislation – Quarantine laws; import quarantine regulations – importers obligations, quarantine transit facilities; post-entry quarantine regulations; export quarantine inspection and certification system.

## **PRACTICAL**

- Insect collection and Identification
- **Methods of insect collection and preservation** – Hand picking of crawling and walking insects, using butterfly nets, scissors nets; collection of aquatic insects by water nets insect killing, pinning and drying, leveling; collection of at least 50 insects belonging to at least 10 different order, their preservation and display in insect collection box and submission at the time of practical examination for evaluation.
- **Dissection** – Study of mouth parts of insects, dissection of mouth parts and preparation of temporary (glycerin) slides.
- **Study of insect pests of standing trees** – systematic position, morphological / taxonomical characters, damaging behavior and method of control; study of sal – heartwood borer; teak defoliator; teak canker insect; toon flower, seed and shoot borer; mahogany collar borer; shisham defoliators; babool stem and root borer; poplar stem borer; semul shoot borer; ailanthus defoliator, champ bug; gambar defoliators; termites – different casts; termite nests; bark beetles; pine shoot borers; bamboo shoot borer.
- **Nursery pests** – cutworms; cockchafer grubs; crickets etc.
- **Seed pests** – bruchid weevils, microlepidoptera etc.

- **Wood boring insects:** Insect pests of felled timber; bark beetles; pin hole borers; ambrosia beetles; sapwood borers; heartwood borer; dry wood borers etc.
  - **Beneficial insects:** Systematic position, diagnostic / taxonomical characters, economic importance etc – **parasitoids** – wasps and flies; **predators** – praying mantids; predatory bugs beetles and wasps; **lac insect, honey bees, silkworm** etc.
  - Visit to entomology museum, nursery and plantation, felling site, timber depots etc. – study and collection of insect and to maintain a field notebook recording details of site, insect damage, and condition of nursery / plantation etc. diagnosis of insect attack by symptoms.
  - How to report insect damage and sent insect specimen to Forest Research Institute for identification and advise.
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**FEI 328**

## **ENVIRONMENTAL IMPACT ASSESSMENT**

**LEARNING OBJECTIVES:** To acquaint students about the importance of strategic environmental assessment in cumulative, regional and landscape level impact assessment.

### **MODULE I METHODS FOR EIA**

- Elaboration of steps in traditional EIA process

### **MODULE II STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)**

- The importance of SEA as a tool for assessing impacts of policy, plan and programmes. Relevance of SEA as a global tool for addressing cumulative, regional and landscape level impacts.
- Examples of SEA and SEA like approaches from India; Key example of good SEAs from around the world. Introduction to tools and techniques.

### **MODULE III ENVIRONMENTAL ECONOMICS**

- Introduction to some recent approaches of economic valuation of impacts and their application in impact assessment and presentation of case studies.

### **MODULE IV ADVANCED LEARNING ON MITIGATION STEPS**

- Principles and concepts of offsets, type of offsets, examples of bio-banking and wetland banking and market based mitigation strategies.
- Comparison of EIA approaches in other countries in South Asia.
- Life Cycle Assessment Approach in Impact assessment.
- Impact Assessment for addressing climate change.



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|----------------------|--|
| Plantations          | plantation   |
| • Energy Plantations | Energy consumption pattern, properties of fuel wood, choice of species, energy from biomass              |
| • Strip Plantations  | Avenue plantations, canal- bank plantations, plantation along railway line, wind breaks and shelter belt |
| • Crop mixtures      | Agriculture and Horticulture   |

### **MODULE III MANAGEMENT**

- Silvicultural systems applicable, coppices systems clear felling systems. Management of specific plantation systems, thinning, need for thinning and types of thinning, improvement felling. Rotation
- Pest and Disease management. Control of pest and diseases at nursery and plantations

### **MODULE IV PLANTATION MENSURATION**

- Measurement of felled trees. Estimation of volume of felled trees through sectional areas. Calculation of volume of standing trees. Volume Table: Kind of volume table. Different methods to prepare volume table. Sample Plots: Details of sample plots, object of sample plots, laying process and use of observations from sample plots.

### **MODULE V ECONOMICS**

- Economics of Plantations (tree crops), Monitoring and evaluation of plantations, budgeting for Harvesting, Depot and Transportation. Marketing

### **MODULE VI HARVEST AND POST HARVEST OPERATIONS**

- Harvest and post harvest operations
- Saws: Peg-toothed, raker toothed, bow Saw, maintenance tools. Wedges
- Depot Management :- Depot planning, depot types, functioning, landings, duration and system of storage, systems of loading and unloading, grading, layout, depot planning, staffing and management
- Transportation: - Transport system. Problems of transport in India. Type of transport. Basis of classification. Off road transportation. Present practices.

### **MODULE VII PLANTATION MANAGEMENT OF IMPORTANT SPECIES**

- Plantation management of important species e.g. Poplar, Eucalyptus, Casurina, Bamboo, Kadamb, Gmelina

### **MODULE VIII LEGAL AND POLICY ISSUES**

- Legal issues. Laws of transportation, Exim policies, Agriculture Income Tax, IPR, NPV.

### **PRACTICAL**

Visit to:

- Timber Depot and felling Area in Uttarakhand
  - Plantation Areas of Poplar/Eucalyptus (Haryana/Rudrapur)
  - Timber Markets of Haryana and Uttarakhand
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**PTN 330**

### **PLANT TAXONOMY**

**LEARNING OBJECTIVES:** The objective of the course is to impart knowledge about nomenclature and classification of genus, species and variety and to develop skills and abilities to identify plants in the field.

#### **Practical**

- Description of different types of stems; different types of leaves; flowers; inflorescences and different types of fruits.
- Floral parts, dissection and characteristics of one specimen each of ten families with identification, drawing of floral parts with floral formula and floral diagram of species with the help of local flora
- Field botanization, collection and making herbarium for identification of plant or tree species during various tours with the help of flora/
- Virtual Herbariums (Use of Digitalization Flora)

#### **Theory**

### **MODULE I INTRODUCTON**

- Importance of plant taxonomy
- History of Plant Taxonomy in India
- Taxonomy in relation to: Anatomy, Chemotaxonomy, Numerical taxonomy, Cytotaxonomy, Molecular Taxonomy/ Phylogeny, Palynology, Ecology
- Phytogeography, GIS Tools use in Taxonomic explorations
- Plant conservatories ( Herbarium, Botanical Garden etc)
- Taxonomic Keys (Dichotomous & polyclave keys)
- History of the classification of Angiosperms, Classifications propose by Bentham and Hooker, Engler and Prantl, De candolle, Hutchinson, Takhtajan, Cronquist. Their

merits and demerits. APG classification (*Angiosperm Phylogeny Group* system of plant *classification*)

### **MODULE II BOTANICAL NOMENCLATURE**

- International code of Botanic Nomenclature (ICBN and ICN); principles; Rules and recommendations; priority; typification; Rules of effective and valid publications; retention and choice of names.

### **MODULE III DESCRIPTION OF IMPORTANT FAMILIES**

- Dendrology
- Description of families viz. Magnoliaceae, Dipterocarpaceae, Meliaceae, Sterculiaceae, Leguminosae, Rosaceae, Lythraceae, Myrtaceae, Rhizophoraceae, Rubiaceae, Lauraceae, Fagaceae, Verbenaceae, Euphorbiaceae, Coniferae, Poaceae (Bamboo)

### **MODULE IV ETHNOBOTANY**

- Ethnobotany and its importance.
- Ethnobotany of important forest species

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## **4<sup>th</sup> SEMESTER**

**FSY 441**            **Synopsis**

**FMT 442**        **Master Thesis**

**LEARNING OBJECTIVES:** In final semester students have full six month to conduct their own experiments and conclude the findings as thesis reports. Students work on research problem and hypotheses under the supervision of a concerned faculty. It equips the students to pursue the goal in academic area or R and D section. They learn methods, techniques of research writing. This provides them an opportunity about identifying challenges and opportunities and helps them in solving problems through research and experimentation

**FTS 443**        **Master Thesis Seminar**