

NATIONAL EDUCATION POLICY-2020

Common Minimum Syllabus for all Uttarakhand State Universities and Colleges for Five Years of Higher Education

PROPOSED STRUCTURE OF UG & PG - FORESTRY SYLLABUS

2021

Curriculum Design Committee, Uttarakhand

Sr.No.	Name & Designation	
1.	Prof. N.K. Joshi Vice-Chancellor , Kumaun University Nainital	Chairman
2.	Prof. O.P.S. Negi Vice-Chancellor , Uttarakhand Open University	Member
3.	Prof. P. P. Dhyani Vice-Chancellor , Sri Dev Suman Uttarakhand University	Member
4.	Prof. N.S. Bhandari Vice-Chancellor, Soban Singh Jeena University Almora	Member
5.	Prof. Surekha Dangwal Vice-Chancellor, Doon University, Dehradun	Member
6.	Prof. M.S.M. Rawat Advisor, Rashtriya Uchchatar Shiksha Abhiyan, Uttarakhand	Member
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**SEMESTER-WISE TITLES OF THE PAPERS
FOR UG & PG FORESTRY COURSE**

YEAR	SEMESTER	PAPERCODE	PAPERTITL E	CREDITSTH+PR
<i>Certificate Course in Elementary Forestry</i>				
1	I	MAJOR-1(FOR/M//SI/01)	Introduction to Forestry	4+2
		Vocational/Skill Development	Nursery Technology	03
	II	MAJOR-1(FOR/M/SII/01)	Forest Ecology	4+2
		Vocational/Skill Development	Watershed Management	03
	I&II	Minor Elective(FOR/ME/SI-II/01)	Ecotourism	4+2
<i>DiplomainPlantation Forestry</i>				
2	III	MAJOR-1 (FOR/M/SIII/01)	Plantation Forestry	4+2
		Vocational/Skill Development	Medicinal and Aromatic Plants	03
	IV	MAJOR-1(FOR/M/SIV/01)	Principles of Silviculture	4+2
		Vocational/Skill Development	Non-Timber Forest Products	03
	III& IV	Minor Elective (FOR/ME/SIII-IV/01)	Remote Sensing and GIS	4+2
<i>BachelorinScience(Forestry)</i>				
3	V	MAJOR-1/FOR/SV/01	Forest Mensuration	4+1
		MAJOR-2/FOR/SV/02	Principles of Agroforestry	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-V	04
	VI	MAJOR-1(FOR/M/SVI/01)	Forest Protection	4+1
		MAJOR-2(FOR/M/SVI/02)	Forest Utilization and Economics	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-VI	04
<i>Bachelor(Research)in Faculty</i>				
4	VII	MAJOR-1(FOR/M/SVII/01)	Biostatistics	4+1
		MAJOR-2(FOR/M/SVII/02)	Forest Management, Legislation and Policies	4+1
		MAJOR-3(FOR/M/SVII/03)	Nursery and PlantationT echnology	4+1
		MAJOR-4(FOR/M/SVII/04)	Environmental Science	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-VII	04
		MAJOR-1/FOR/SVIII/01	Forest Products and Industries	4+1
		MAJOR-2/FOR/SVIII/02	Energy Plantation and Bio-Fuel	4+1

	VIII	MAJOR-3(FOR/M/SVIII/03)	Medicinal and Aromatic Plants	4+1
		MAJOR-4(FOR/M/SVIII/04)	Ecotourism and EIA	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-VIII	04
\\	VII or VI II	Minor Elective (FOR/ME/SVII/01)	Biotechnology Application in Forestry	4+1
		or Minor Elective (FOR/ME/SVIII/02)	or Forest Botany and Taxonomy	4+1
<i>Master in Faculty (Forestry)</i>				
5	IX	MAJOR-1(FOR/M/SIX/01)	Forest Ecology and Biodiversity Conservation	4+1
		MAJOR-2(FOR/M/SIX/02)	Statistical Methods and Experimental Designs	4+1
		MAJOR-3(FOR/M/SIX/03)	Advances in Silviculture	4+1
		MAJOR-4(FOR/M/SIX/04)	Agroforestry Systems and Management	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-IX	04
	X	MAJOR-1(FOR/M/SX/01)	Tree Seed Technology	4+1
		MAJOR-2(FOR/M/SX/02)	Forest Entomology and Pathology	4+1
		MAJOR-3(FOR/M/SX/03)	Forest Economics and Marketing	4+1
		MAJOR-4(FOR/M/SX/04)	Forest Genetics and Tree Improvement	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-X	04

Purpose of the programme

- ✓ Forestry is one of the professional subjects which was introduced in the country and elsewhere due to various reasons depletion, deforestation and climate change as well as increased needs of plant product in nation and community development.
- ✓ In the country it is second major land resources but as per the National Forest Policy the forest should be 1/3rd (33%) forest area but the area is 10% less. To produce competent professional by imparting quality education to meet the industry requirements and for serving the societal needs.
- ✓ Conservation and Scientific Management of the natural resources of the state/country by training forestry students.
- ✓ To meet the growing demand of forestry and environmental professionals in natural resource-based industries, government sector and NGOs.
- ✓ Developing excellence in Forestry Education and Research in the country.
- ✓ To contribute to the advancement of knowledge through teaching, research, publications and dissemination.

- ✓ To strengthen the interface of academia with the government and industry and prepare the next generations of skilled and ethical professionals.
- ✓ Efforts to galvanize the academic fervor and creative instincts of the youth coming from socially and economically backward areas.

Programme Objectives (POs):

PO 1	It will impart basic knowledge and skill of forestry in the students.
PO 2	It will inculcate the forestry knowledge and practical skill among the students for diagnosis and analysis of existing problems in the fields of forest and environmental development.
PO 3	It will impart the professional knowledge of forestry in students and can be so that can be absorbed in different sectors, i.e., private, public, NGOs and other organization.
PO 4	The candidate will be able to identify the problems and solve them.
PO 5	Assessment of various forestry problems and develop methods for their suggest solutions.
PO 6	After completion of PO 4 students will become forestry professional and use knowledge in research and technology.

Programme Specific Objectives (PSO):

<i>CERTIFICATE COURSE IN ELEMENTARY FORESTRY</i>	
YEAR 1	The students will have a basic understanding of forestry and will be able to take up employment in government and private companies.
<i>DIPLOMA IN PLANTATION FORESTRY</i>	
YEAR 2	The student will be able to use forestry knowledge in the management of forest resources and development of forest stands through their knowledge and practical skills.
<i>BACHELOR OF SCIENCE (FORESTRY)</i>	
YEAR 3	<ul style="list-style-type: none"> • Students having knowledge, education, practical skill of forestry will be eligible for competitive examinations and can seek employment in different Sectors, i.e., Private, Public NGOs and Research Institute/Organization. • Students can seek higher degree (PG).

<i>BACHELOR (RESEARCH) IN FACULTY</i>	
YEAR 4	<ul style="list-style-type: none"> • Student having knowledge and research in different environmental and social aspect of forestry which will be beneficial for human as well as other organism. • Create, select, and apply appropriate techniques, resources, and modern technology in assessment and process to enrich professional practice
<i>MASTER IN FACULTY (FORESTRY)</i>	
YEAR 5	<ul style="list-style-type: none"> • Use signal processing concepts and tools to provide solutions to real time problems. • Understand the impact of climate change and GHG on environmental sustainability, demonstrate the knowledge and need for sustainable development of the Earth. • Apply the fundamentals and practical knowledge to solve the complex forestry problems.

Course Objective (CO):

The course objective is to impart forestry education and knowledge and to develop skill in the students so that they could be able in the management of forest resources in the state and other parts of the country. The forestry course will provide the expertise of conservation and development of forests as well as develops skill in the graduate and post graduate students so that forest resources could not be depleted further from their natural growing habitats due the unscientific and illegal extraction of forest resources for different uses. Apart from these, forestry course not only helpful in forest management but also provide the various types of employments to the students in different forest based sectors as well as in other related areas. This course also provides the skills and professional knowledge to the students for combating the growing problems of climate change, environment degradation and loss of biodiversity of state and other areas of the country. Thus the forestry course will develop the knowledge and skill in forestry students at UG and PG forestry courses which will ultimately utilized and served in different developmental sectors of the Uttarkhand state.

Internal Assessment & External Assessment

Internal Assessment	Marks: 25	External Assessment	Marks:75
Attendance of student	05	Written examination conducted by University	
Assessment of subject papers	05		
Objective/short answer questions of subject papers	15		

FORESTRY COURSE FOR UG AND PG PROGRAMMES

Year and semester-wise major, minor elective and vocational/skill development forestry course contents and outlines

YEAR	SEMESTER	PAPER CODE	PAPER TITLE	CREDITS TH+ PR
<i>Certificate Course in Elementary Forestry</i>				
1	I	MAJOR-1 (FOR/M/SI/01)	Introduction to Forestry	4+2
		Vocational/Skill Development	Nursery Technology	03
	II	MAJOR-1(FOR/M/SII/01)	Forest Ecology	4+2
		Vocational/Skill Development	Watershed Management	03
	I & II	Minor Elective (FOR/ME/SI-II/01)	Ecotourism	4+2
<i>Diploma in Plantation Forestry</i>				
2	III	MAJOR-1 (FOR/M/SIII/01)	Plantation Forestry	4+2
		Vocational/ Skill Development	Medicinal and Aromatic Plants	03
	IV	MAJOR-1 (FOR/M/SIV/01)	Principles of Silviculture	4+2
		Vocational/ Skill Development	Non-Timber Forest Products	03
	III & IV	Minor Elective (FOR/ME/SIII-IV/01)	Remote Sensing and GIS	4+2
<i>Bachelor in Science (Forestry)</i>				
3	V	MAJOR-1/FOR/SV/01	Forest Mensuration	4+1
		MAJOR-2/FOR/SV/02	Principles of Agroforestry	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester -V	04
	VI	MAJOR-1 (FOR/M/SVI/01)	Forest Protection	4+1
		MAJOR-2 (FOR/M/SVI/02)	Forest Utilization and Economics	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester -VI	04
<i>Bachelor (Research) in Faculty</i>				
4	VII	MAJOR-1 (FOR/M/SVII/01)	Biostatistics	4+1
		MAJOR-2 (FOR/M/SVII/02)	Forest Management, Legislation and Policies	4+1
		MAJOR-3 (FOR/M/SVII/03)	Nursery and Plantation Technology	4+1
		MAJOR-4 (FOR/M/SVII/04)	Environmental Science	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester -VII	04
	VIII	MAJOR-1/FOR/SVIII/01	Forest Products and Industries	4+1
		MAJOR-2/FOR/SVIII/02	Energy Plantation and Bio-Fuel	4+1
		MAJOR-3 (FOR/M/SVIII/03)	Medicinal and Aromatic Plants	4+1
		MAJOR-4 (FOR/M/SVIII/04)	Ecotourism and EIA	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester VIII	04

	VII or VIII	Minor Elective (FOR/ME/SVII/01 or Minor Elective (FOR/ ME/SVIII/02	Biotechnology Application in Forestry or Forest Botany and Taxonomy	4+1
				4+1
<i>Master in Faculty (Forestry)</i>				
5	IX	MAJOR-1(FOR/M/SIX/01)	Forest Ecology and Biodiversity Conservation	4+1
		MAJOR-2 (FOR/M/SIX/02)	Statistical Methods and Experimental Designs	4+1
		MAJOR-3 (FOR/M/SIX/03)	Advances in Silviculture	4+1
		MAJOR-4 (FOR/M/SIX/04)	Agroforestry Systems and Management	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-IX	04
	X	MAJOR-1 (FOR/M/SX/01)	Tree Seed Technology	4+1
		MAJOR-2 (FOR/M/SX/02)	Forest Entomology and Pathology	4+1
		MAJOR-3 (FOR/M/SX/03)	Forest Economics and Marketing	4+1
		MAJOR-4 (FOR/M/SX/04)	Forest Genetics and Tree Improvement	4+1
		Industrial Training/Survey/Research Project	It is based on Major Papers of Semester-X	04

Forestry Course Syllabus for NEP 2020 To be implemented from academic session-2022-23

SEMESTER-I

MAJOR-1 Title of paper-I

INTRODUCTION TO FORESTRY

Course Code:

(FOR/M/SII/01)

Total Credits: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction and definition of forestry; Forest and plantation; Concept of forestry education; Brief history of forestry; Branches of forestry; Legal classification of forests: Reserved forest, protected forest, un-classified forest, village forest and community forest (van panchayat); Forest area and forest cover in the state, country and world; Category of forest on the basis of origin: Primary forest and secondary forest; Forest acts and policies; Importance of forests for community, environment, climate change and sustainable development.	15
Unit II	Forest composition; Basis of forest classification; Basic principles of silviculture: Introduction, definitions, objects, scope and importance; Regeneration of forests: Afforestation and reforestation; Methods of regeneration; Relation of silviculture with other branches of forestry; Tree morphology, different forms and growth of trees, stem, root and other parts; mycorrhiza, lignotubers and root nodules; High forest, coppice forest, closed forest, open forest, normal forest and abnormal forest.	15
Unit III	Introduction and definitions of forest mensuration; Principles of tree measurement: Height, diameter, circumference, basal area and volume; Measuring instruments in forestry: Christian's hypsometer, tree calliper, Ravi multimeter, Abney's level, Haga altimeter, meter tape, Gunter chain, wedge prism, weighing machine and Pressler's increment borer.	15
Unit IV	Basic principles of forest management; Introduction, definition and scope of forest management; Participatory forest management and joint forest management (JFM); Forest products: Important timber and non-timber products; Forest protection; Introduction and definition; Important insect: Pests and diseases; Shifting cultivation; Encroachment; Illegal felling; Grazing and Forest fire.	15

Practical

1. Field visit in different forest sites.
2. Identification of tree species and their local and botanical name.
3. Introduction about instruments used in forestry (Christian's Hypsometer, tree calliper, Ravi multimeter, Abney's level, Haga altimeter, meter tape, Gunter chain, wedge prism, weighing machine, Pressler's increment borer, soil pH meter, soil thermometer, Swedish bark gauge, seed germinator, oven, balance etc.).
4. Measurement of tree height, diameter, basal area, circumference.
5. Nursery development, preparation of nursery layout, nursery beds, uses of different container, planting material seeds and vegetative parts, raising of plants of different tree species.

Suggested Readings:

1. *Ecology and Environment* by P. D. Sharma
2. *Principles and Practices of Silviculture* by L.S. Khanna
3. *A text Book of Silviculture* by A.P. Dwivedi
4. *Forest Management* by Ram Prakash

5. *Forest Mensuration, A.N. Chaturvedi*
6. *Theory and Practices of Silviculture by L.S. Khanna*
7. *Forest of Himalaya by JS Singh and SP Singh*
8. *Plantation Forestry in India by R.K. Luna*
9. *Nursery and Plantation Practices by Vinod Kumar*

SEMESTER-I VOCATIONAL/SKILL DEVELOPMENT: NURSERY TECHNOLOGY

Total Credit: 03

Theory	Topics
Unit I	Introduction, importance and objectives of nursery; Classifications, nursery sites, area and seed bed; Methods of sowing, quality of seeds, time of sowing, shading, watering, damping off and their control measures.
Unit II	Weeding and their controlled measures; Soil working and transplanting; Nursery material and tools; Plant containers; Potting media; Timing-out and culling.
Unit III	Green manuring; Organic compost/manure; Farm yard manure (FYM); Bio-fertilizers; Mycorrhiza and fertilizer application; Plant propagation: Macro-propagation and micro-propagation techniques.
Unit IV	Green house/mist chamber; Hormones and stimulants for rooting.

SEMESTER-II

MAJOR-1 Title of paper-I

FOREST ECOLOGY

Course Code:

(FOR/M/SII/01)

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction and definition of ecology; Types of ecology; Forest ecology: Definition and its importance in forest ecosystem management; Introduction, structure and components of ecosystem; Types of ecosystem: Forest, grassland, desert and aquatic ecosystem; Ecological concept of ecosystem: Tropic structure, ecological pyramids, food chain, food web, and energy flow.	15
Unit II	Introduction, definition, scope and importance of biodiversity; Threats and conservation methods of biodiversity; Species composition, species diversity, forest population and forest community; Niche; Methods of forest vegetation analysis, biomass, productivity, litter fall, forest floor biomass (standing state biomass), major nutrients (c, n, p, k), litter decomposition, nutrient cycling and nutrient use efficiency.	15
Unit III	Climatic factors: Light, atmospheric temperature, moisture, wind and their effects; Topographic factors: Altitude, slope, aspects and exposure and their effects; Edaphic factors: Soil, its formation, soil profile, physico-chemical properties of soil and their effects; Soil organic matter; C:N ratio; Mycorrhiza and its types; Soil microorganism; Biotic factors: Relation between plant and plant, plant and animal, plant and man and their influences; Competition, symbiotic association, parasites, epiphytes, climbers and weeds.	15
Unit IV	Forest composition, distribution and major forest type in India and world; Classification of forests (Champion and Seth, 1968); Forest area, forest cover, growing stock and carbon stock of forests in India (as per forest survey of India); Succession: Introduction, definition, causes and mechanism of succession; Types of succession and concept of climax.	15

Practical

1. To determine the minimum size of quadrates.
2. To determine density of tree species in forest.
3. To determine frequency of tree species in forest.
4. To determine abundance and A/F ratio of tree species in forest.
5. To determine relative density, relative frequency and relative dominance and Important Value Index (IVI) of tree species in forest.
6. To determine basal area of tree species in forest.
7. To draw the population structure of tree species in forest.
8. To determine species diversity in forest by Shannon-Weiner Index.

Suggested Readings:

1. *Ecology, Environmental Science and Conservation* by J.S. Singh, S.P. Singh and S. R. Gupta
2. *Ecology and Environment* by P. D. Sharma
3. *Fundamental of Ecology* by E.P. Odum
4. *Concept of Ecology* by E.J. Kormondy
5. *Ecology* by M.P. Arora
6. *Ecology* by S.N. Jha
7. *Concept of Modern Ecology* by P.C. Tewari

SEMESTER- II**VOCATIONAL/SKILL DEVELOPMENT: WATERSHED MANAGEMENT Total Credit: 3**

Theory	Topics
Unit I	Introduction, objectives and importance of watershed; Watershed characteristics; Degradation of watershed; Soil and water erosion and their conservation measures.
Unit II	Hazards in watershed: Flood, drought, sedimentation and their management; Monitoring and evaluation of watershed projects.
Unit III	Role of forests in watershed management. Role of community in watershed management and PRA tools and techniques used for Watershed development.
Unit IV	Holistic approach of integrated watershed management; Deforestation and its impacts on watershed; Hydrologic cycle; Application of remote sensing and GIS tools in watershed management.

SEMESTER-I & II**MINOR ELECTIVE :****ECOTOURISM**

Course Code:

FOR/ME/SI-II/01

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Major ecosystems of the world; Eco-tourism: History of tourism, identify various forms of tourism and evolution of ecotourism; Dimensions of tourism and essential conditions for tourism; Differences between tourism components mass tourism versus ecotourism.	15

Unit II	Understand dimensions of ecotourism and the criteria to qualify for ecotourism; Ecotourism indicators and conceptual differences between developing and developed countries; Organized tours and free independent travellers.	15
Unit III	Ecotourism in practices in an important protected area: Corbett National Park, Nanda Devi Biosphere Reserve, Kanha National Park, Kaziranga National Park, Gir National Park, Rajaji National Park.	15
Unit IV	Participation of local people in ecotourism; Limitations and problems; World tourism organization; Problems with definition of ecotourism and criticisms; International organizations and NGOs promoting ecotourism; Sociological implications of eco-tourism.	15

Practical

1. Make a list of nearby eco-tourism place.
2. Visit the nearby eco-tourism sites.
3. Visit Corbett National Park, Nanda Devi Biosphere Reserve, Kanha National Park, Kaziranga National Park, Gir National Park, Rajaji National Park.
4. Visit nearby wild life Sanctuaries.
5. Visit nearby birds' sanctuaries.

Suggested Readings:

1. *Indian forestry* by K. Manikandan
2. *Eco-tourism and livelihood* by A.K Bhattacharya
3. *Tourism, Environment and Man: Sustainable Tourism* by Brigadier, B.P.S Khati
4. *Tourism in india Challenges and Opportunities* by Ruchi Ramesh and Sudhir Kumar Singh

SEMESTER-III

MAJOR-1 Title of paper-I

PLANTATION FORESTRY

Course Code:

FOR/M/III/01

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction and definitions of forest and plantation, objectives, concept, scope and importance; Types of forest plantations: Commercial, industrial, production, protection, social forestry and agroforestry; Introduction, definition, importance of nursery; Types of nursery; Nursery bed preparation; Containers and its types; Seedlings development; Planting stock (seedlings with naked roots, and seedling with ball of earth); Planting and pattern of planting; Stump planting; Beating up; Singling; Season of planting (monsoon, pre monsoon, winter and spring).	15
Unit II	Plantation organization and structure; Nursery and plantation site development; Nursery and plantation layout; Planting materials; Seeds and vegetative parts and their collections from different provenances/sites/agencies/forest research institutes/centres; Seed source and seed orchards; Storage techniques of seeds and other vegetative parts.	15
Unit III	Preparation of land in plantation sites; Pit digging and its types; Plantation techniques of tree species from seeds, seedlings, ETPs and other vegetative parts i.e. cuttings/stumps/roots; Uses of FYM; Organic manure; Vermicompost and inorganic fertilizers; Insecticides and fungicides; Tending Operations (weeding, cleaning, thinning, girdling, pruning, bud pruning and	15

	climber cutting); Nurse crop, cover crop and mulching; Fencing and types of fencing; Soil and water conservation measures; Bio-fuels and Energy plantations.	
Unit IV	Important forest tree species: Indigenous tree species: Teak (<i>Tectona grandis</i>), Mulberry (<i>Morus alba</i>), Bhimal (<i>Grewia optiva</i>), Bamboo (<i>Dendrocalamus strictus</i>), Sevan (<i>Gmelina arborea</i>), Surai (<i>Cupressus torulosa</i>) and Van Peepal (<i>Populus ciliata</i>), Exotics tree species: Eucalypt (<i>Eucalyptus tereticornis</i>), Poplar (<i>Populus deltoides</i>), European nettle tree (<i>Celtis australis</i>) and exotic pine species; Afforestation techniques of tree species in problematic sites: Saline, alkaline, drought prone, waterlogged, sandy soil, marshy land and mining sites/areas; Success of tree plantations; Reasons of failure of plantations and their remedial techniques.	15

Practical

1. Selection of important fast growing, short rotational and multipurpose tree species: Indigenous (conifers and broad leaved- Chir-pine, Deodar, Cupress and Quercus species) and exotic species (Poplar and Eucalypt).
2. Collection and storage techniques of tree seeds/vegetative parts.
3. Preparation techniques of seedlings for above tree species.
4. Spacing and number of plants in a unit area.
5. Pit digging techniques and mulching methods.
6. Tree species used for energy/fuel wood.
7. Tree species in paper, ply wood and match industries.
8. Selection of tree species planted in different problematic sites.

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Suggested Readings:

1. *Plantation Forestry* by R. K Luna
2. *Plantation Trees* by R.K. Luna
3. *Principles and practices of Silviculture* by L.S. Khanna
4. *Propagation Practice of Tree Improvement Indian Trees* By Ram Prakash, D.C. Chaudhary and S.S. Negi
5. *Plantation Forestry In tropics* by J. Evans
6. *Forestry in India* by A.P. Dwivedi
7. *A text book of Silviculture* by A.P. Dwivedi

SEMESTER-III

VOCATIONAL/SKILL DEVELOPMENT: MEDICINAL AND AROMATIC PLANTS Total Credit: 3

Theory	Topics
Unit I	Ecology and biology of plant resources of medicinal value; Medicinal and aromatic plant diversity in the Indian gene center; Plant exploration, introduction and exchange.
Unit II	Conservation of medicinal and aromatic plants; Its techniques: In situ, ex- situ and biotechnological; Evaluation and breeding techniques of important medicinal and aromatic plants: <i>Picrorhiza kurrooa</i> , <i>Swertia chirayita</i> , <i>Valeriana jatamasi</i> , <i>Viola</i> species, <i>Gloriosa superba</i> , <i>Rauwolfia serpentina</i> , <i>Plantago ovata</i> , <i>Cassia angustifolia</i> , <i>Ocimum sanctum</i> , <i>Withania somnifera</i> .
Unit III	Distinctiveness, uniformity and stability testing; Drug descriptors for medicinal and aromatic plants.
Unit IV	Cultivation of commercially importance medicinal and aromatic plants: <i>Picrorhiza kurrooa</i> , <i>Aconitum heterophyllum</i> , <i>Podophyllum hexandrum</i> , <i>Swertia chirayita</i> , <i>Valeriana jatamansi</i> , <i>Asparagus recemosus</i> , <i>Phyllanthus emblica</i> , <i>Terminalia chebula</i> , <i>Terminalia bellirica</i> and <i>Rheum emodi</i> .

SEMESTER-IV

MAJOR-1 Title of paper-I

PRINCIPLES OF SILVICULTURE

Course Code:

FOR/M/SIV/01

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction, definition, and scope of silviculture; Objects of silviculture; Form and growth of trees; Tree morphology: stem, root system, form of roots, adaptability, mycorrhiza, lignotubers and root nodules; Tree growth: stages of growth, phenology, germination and establishment; Seasonal progress of growth; Height and diameter growth.	15
Unit II	Forest Regeneration: Introduction, definition and types of regeneration; Natural regeneration: Definition, methods of natural regeneration (from seeds and vegetative parts); Seed production; Seed dispersal; Seed germination; Seedling establishment; Germination by root suckers and coppice; Artificial regeneration: Definition and objectives; Essential preliminary considerations (choice of species, site selection, composition of plantation, choice of sowing, planting staff and labour); mechanization operations (soil preparation, ploughing, harrowing, ridging, pit digging, transport of items, protection from fire and irrigation); Assisted Natural Regeneration (ANR).	15
Unit III	Forest types of India; Classification of silviculture systems, management; Clear felling system, shelter wood system, uniform system, group system, irregular shelter wood system, strip system, selection system, group selection system, accessory system, coppice system and coppice selection system and coppice with standard system.	15
Unit IV	Silviculture of importance tree species; Silvicultural characteristics; Phenology and regeneration; Growth, management and economic of Conifers: <i>Abies pindrow</i> , <i>Picea smithiana</i> , <i>Cedrus deodara</i> , <i>Pinus</i> species and Broadleaf species: <i>Quercus</i> species, <i>Acacia catechu</i> , <i>Acacia nilotica</i> , <i>Dalbergia sissoo</i> , <i>Shorea robusta</i> , <i>Eucalyptus</i> species, <i>Populus</i> species, <i>Tectona grandis</i> , <i>Casuarina equisetifolia</i> and Bamboo species.	15

Practical

1. Identification of Forest (Local/regional) Tree Species
2. Study of tree morphology for forms growth and root systems.
3. Phenology and silviculture characteristics of selected tree species.
4. Germination of plants from seeds/ vegetative parts.
5. Identification of mycorrhizal association of tree species.
6. Silviculture Systems.
7. Tending Operations.

Suggested Readings:

1. *Principle and practice of silviculture* by L.S. Khanna
2. *A text book of silviculture* by A.P. Dwivedi
3. *Manual of silviculture* by W.M. Sunlich
4. *Silviculture* by R.D. Nyland
5. *The practices of silviculture* by D.M. Smith
6. *Theory and practice of Indian silvicultural systems* by L.S. Khanna
7. *Silviculture of important Indian trees* by R.S. Troup

SEMESTER- IV

VOCATIONAL/SKILL DEVELOPMENT : **NON-TIMBER FOREST PRODUCTS** Total Credits:03

Theory	Topics
Unit I	Types of markets for timber and non-timber forest produce; Market locations of timber and non-timber forest produce and their features; Demand forecasts; Price determination in timber and non-timber forest produce.
Unit II	Economic features of specialized timber markets in terms of degree and type of competition in buying and selling; Price spread; Costs of marketing functions involved like pre-commercial thinning, commercial thinning, harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in teakwood, rosewood, matchwood, pulpwood, sandalwood, veneers; Type and degree of competition in market for services of saw mill and other intermediate wood processing industries; Price spreads across different channels of marketing.
Unit III	Economic features of specialized markets in terms of degree and type of competition for bamboo, canes, lac, gums, resins, hides and skins; Economics of gathering medicinal plants from forests; Economics of processing medicinal plants; Domestic demand and trade in timber and non-timber forest products.
Unit IV	International demand and trade in timber and non-timber forest produce; Market inefficiencies in timber, non-timber forest produce and measures to check in efficiencies; Role of cooperative societies in marketing of timber and non-timber forest produce; Economic policy and regulations of international timber trade; Essentials of World Trade Organization; GATT; Dunkel proposals; Intellectual property Rights and Patenting; International Timber Trade Organization (ITTO) and timber certification.

SEMESTER-III and IV

MINOR ELECTIVE:

REMOTE SENSING AND GIS

Course Code:

FOR/ME/SIII-IV/01

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction, definition and importance of remote sensing; Basic of remote sensing; Platform and sensor remote sensing (active and passive system).	15
Unit II	Remote sensing satellite, image and ground truth; Systems for data collection and analysis.	15
Unit III	GIS: Basic concept, tools and components; GIS application in forestry; GPS and its uses; Advantages of RS and GIS in future prospect.	15
Unit IV	Collection, storage, analysis, data and information of forest resources through remote sensing; Software used in remote sensing and GIS.	15

Practical

1. Uses of various photo-grammetry instruments.
2. Ground truthing and satellite images.
3. GPS data collection.
4. Hands on practice on remote sensing and GIS software.
5. Visual and digital interpretation of satellite image.
6. Recognition and identification of objects on photography, compilation of maps and their interpretation.

Suggested Readings:

1. *Textbook of Remote Sensing and Geographical Information Systems* by M. Reddy

2. *GIS Fundamentals Applications and Implementations* by K. Elangovan
 3. *Fundamentals of Remote Sensing* by George Joseph.
 4. *Remote Sensing of the Environment: An Earth Resource Perspective* by J.R. Jensen
 5. *Remote Sensing and Image Interpretation* by T. Lillesand, R.W. Kiefer and J. Chipman
 6. *Remote Sensing: Principles and Interpretation* by F.F. Sabins
 7. *Text Book of Remote Sensing and Geographic Information Systems* by K.C. Sahu
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SEMESTER-V

MAJOR-1 Title of paper-I

FOREST MENSURATION

Course Code:

FOR/M/SV/01

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Forest mensuration; Definition and objectives; Scales of measurement; Units of measurements; Precision, bias and accuracy.	15
Unit II	Diameter and girth measurements; Breast height measurements; Instruments used; Measurement of height; Definitions; Methods of measurement of height ocular; Non instrumental and instrumental methods; Sources of error in height measurements leaning trees.	15
Unit III	Tree stem form; Metzgr's theory; Form factor; Types of form factor; Form height for quotient; Form class; Volume measurements of standing trees, logs and branch wood; Formulae involved; Definitions; Volume tables; Preparation of volume tables; Graphical method; Regression method.	15
Unit IV	Determination of growth of trees; Increment; CAI and MAI; Increment percent; Increment borer; Stump analysis; Stem analysis; Measurement of tree crops; Crop diameter; Crop height; Crop age; Crop volume.	15

Practical

1. Determination of length, measurements of diameter, girth and basal area of trees using callipers, tape, ruler, penta prism, tree calliper etc.
2. Measurement of height using non instrumental method.
3. Preparation and use of simple height measuring instruments: Christens hypsometer, Smithies hypsometer.
4. Measurement of tree height using instrumental methods: Ravi Altimeter, Abney's level, Haga altimeter, relaskop, clinometer, blumeleiss, hypsometer, laser hypsometer.
5. Volume determination of standing and felled trees.
6. Exercise on stump analysis.
7. Exercise on stem analysis, annual ring counting using ring borer.
8. Preparation of volume tables and local volume table.

Suggested Readings:

1. *Forest Mensuration and Biometry* by A. N. Chaturvedi and L.S. Khanna
2. *Forest mensuration: A Handbook for Practitioners* by Forestry Commission Publications
3. *Forest Mensuration* by B. Husch, T.W. Beers and Kershaw
4. *2007. Forest Mensuration* by V.A. Laar and A. Akca
5. *Indian Forestry* by K. Manikandan and S. Prabhu
6. *Tree and Forest Measurement* by P.W. West
7. *Forest Mensuration* by C. Husch, C.I. Miller and T.W. Beers

SEMESTER- V

MAJOR-2 Title of paper-I

PRINCIPLES OF AGROFORESTRY

Course Code:

FOR/M/SV/02

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction, definition, objectives, scope and importance of agroforestry and social forestry; History of agroforestry, traditional practices of agroforestry; Choice and characteristics of species for agroforestry; Multipurpose tree (MPTs) in Agroforestry; Potential and constraints of agroforestry systems.	15
Unit II	Agroforestry systems: Forest based agroforestry systems, agriculture-based agroforestry systems, and pasture-based agroforestry systems; Shifting cultivation; Taungya system; Alley cropping; Home gardens; Agri-silvicultural system; Agri-silvipastoral system ; Agri-horticultural system; Agri-horti-pastoral system; Tree-crop interaction.	15
Unit III	Diagnosis and design techniques; Socio-economic and ecological aspect of Agroforestry; Economic aspects of agroforestry; Cost, benefit, benefit-cost ratio; Land equivalent ratio (LER); Protein banks; Fodder species; Lopping cycle; Fodder values of trees; Alley cropping/hedge cropping; Ecological aspects of agroforestry; Species diversity of plant components; Soil fertility and Productivity aspect; Soil and water conservation aspects in Agroforestry.	15
Unit IV	Management of trees in agroforestry; Important tree species of agroforestry systems: Eucalyptus, poplar, Gmelina, Bamboo etc; Legume trees species: Subabul, Causaurina, Sesbenia, Grewia, Kachnar, Celtis, Ficus etc and Important fruit plants; Farm crops; Cereals: wheat, maize, rice, millets etc; Pulses: gram, pea, soyabean, urad, moong, arhar, lentil etc; Medicinal and aromatic plants; Spices; Vegetables and Grasses: Barseem (<i>Trifolium alexandrinum</i>), Paragrass (<i>Bracharia mutica</i>), Napier (<i>Penecitum perpureaum</i>), Sorghum (<i>Sorghum vulgare</i>) and other farm crops used as grasses.	15

Practical

1. Introduction of various agroforestry systems prevailing in the region.
2. Identification of major tree species used in agroforestry practises.
3. Characteristics of multipurpose tree species used in agroforestry.
4. Various D&D techniques of agroforestry

Suggested Readings:

1. *Agroforestry by A.P. Dwivedi*
2. *An introduction of Agroforestry by P.K.R. Nair*
3. *Textbook of Agroforestry by D.S. Chundawat and S.K. Gautam*
4. *Agroforestry hand book by S.S. Negi*
5. *Agroforestry: theory and practices by A.J. Raj and S.B. Lal*
6. *Manual by Agroforestry and social forestry by M.L. Sen, R.C. Dadheech and L.K. Deshora*
7. *Perspective of social forestry by B.L. Sharma and R.L. Vishnoi*
8. *Principles and practices of socialcum community forests by V.N. Prasad*

SEMESTER- V

INDUSTRIAL TRAINING/SURVEY/RESEARCH PROJECT

Course Code:

Total Credit: 4

Course Outline:

It is based on the major papers

- Measurement of various height, diameter and volume parameters.
- Study of forest organizations and classification.
- Tree and crop components combination and intercropping.
- Study of agroforestry systems, cost, benefit and benefit: cost ratio.
- Assessment of important tree species used in agroforestry.
- Study of fodder, fuel, small timber, medicinal plants.
- Uses of exotic tree species in different industries.
- Field survey in forest and agriculture systems.
- Collection of important data for research project.

SEMESTER- VI

MAJOR-1 Title of paper-I

FOREST PROTECTION

Course Code:

FOR/M/SVI/01

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction of forest pathology and forest entomology; Introduction of various plants pathogens: Fungi, bacteria, viruses etc; Symptomatology and identification of plant diseases.	15
Unit II	Classification of forest tree diseases and their control; Common diseases in forest trees: Root rot, heart rot, wilt, stem canker, stem rust, die-back, galls, leaf spots, leaf blight, powdery mildew and leaf rust; Nursery diseases; Diseases caused by phanerogamic plant parasite like <i>Dendrophthoe</i> , <i>Acanthobium</i> , <i>Loranthus</i> etc; Principles of tree diseases control: Cultural, chemical and biological control methods.	15
Unit III	Protection against injuries to plants by defoliating, sap sucking and mites; shoot, twig, root, seed, cone, wood boring insects and gall markers; Methods of control against insects and pests: Silvicultural, biological and chemical.	15
Unit IV	Forest fire; Encroachment; Shifting cultivation; Illicit felling; Grazing/browsing.	15

Practical

1. Identification and symptoms of different forest tree diseases.
2. Various pathogenic and non-pathogenic disease of forest tree species.
3. Forest fire and their types.
4. Various disease of Sal, Shisham, Teak, Chir, Deodar, Eucalyptus and Khair.
5. Various insects of Sal, Shisham, Teak, Chir, Deodar, Eucalyptus and Khair.

Suggested Readings:

1. *Forest protection* by L.S. Khanna
2. *Hand book of forest protection* by S.S. Negi
3. *Forest Entomology* by K.C. Joshi
4. *Forest fire* by S.S. Negi
5. *Forest fire control* by R.K Luna

SEMESTER- VI**MAJOR-2 Title of paper-I FOREST UTILIZATION AND ECONOMICS**

Course Code:

FOR/M/SVI/02

Total Credit: 6(Th04+Pr02)

Theory	Topics	Lectures
Unit I	Introduction, Definition, scope and importance of forest utilization; Important forests products: Major timber, non timber products, fuel wood; Agriculture implements; Small timber and classification of minor forest produce: Grass oil, seed oil, tans and dyes, gum, resin, rubber, fibre and flosses, grasses, katha and cutch, latex, nuts, bead seeds, leaves, honey, wax, animals products, minerals and other miscellaneous products.	15
Unit II	Logging practices: Felling, extraction, season of felling, method of felling and conversion and tools used in forest logging; Transportation: Major and minor transportation; Storage and depots; Management and disposal of timber.	15
Unit III	Introduction, definitions, objectives and scope of forest economics; Application of microeconomics in solving forest resource problems; Emphasis on forest products; Demand and supply; Production theory; Forest products marketing; Forest capital theory; Concept of cost and benefits; Trade of timber and non-timber forest products (NTFP's).	15
Unit IV	Valuation of NTFPs and non-market goods and economics; Ecosystem services and market-based mechanism; Forest certification, sustainability Analysis and SWOT Analysis; Role of forest economics in public, private and community level.	15

Practical

1. Identification and uses of various (local) NTFP's.
2. Extraction of grass oil, distillation unit.
3. Extraction method of lac cultivation.
4. Extraction method of resin and rosin.
5. To visit the cutch and katha industries.
6. To visit the pulp and paper industries.
7. To visit the different timber depot.
8. To determine the SWOT analysis.
9. To determine the demand and supply curve.
10. Law of equilibrium.

Suggested Readings:

1. *Forest Utilization FRI Publication*
2. *A handbook of forest utilization by T. Mehta*
3. *Forest product and their utilization by S.S. Negi*
4. *Forest: the non-wood resources by A.P. Dwivedi*
5. *Forestry for Economic development by M.M. Pant*
6. *Forest Economics: Principle and Application by J. C. Nautiyal*

SEMESTER -VI

INDUSTRIAL TRAINING/SURVEY/RESEARCH PROJECT

Course Code:

Total Credit: 4

It is based on the major papers

- Identification and collection of important insect-pests.
 - Identification and collection of diseased plants.
 - Forest fire control techniques.
 - Training for protection of forest from biotic factors.
 - Silvicultural, biological and chemical methods of forest protection.
 - Survey for identification of forest products (major and minor).
 - Tree products assessment used by industries and communities.
 - Assessment of demand and supply of forest products.
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SEMESTER- VII

MAJOR-1 Title of paper-I

BIostatISTICS

Course Code:

FOR/M/SVII/01

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Biostatistics: An introduction, sampling, data collection and recording; Central tendency: Arithmetic mean, mode, median for ungrouped and grouped data.	15
Unit II	Measures of dispersion: Absolute and relative measures; Range, standard deviation variance, quartile deviation and coefficient of variability; Difference among means, skewness and kurtosis.	15
Unit III	Hypothesis testing and significance; Correlation; Linear models; Correlation coefficients; Regressions and multiple regressions.	15
Unit IV	Probability: Normal, poisson and binomial distribution; t and chi square test; f-test; One-way ANOVA and two ways ANOVA; Experimental design: CRD, RBD, LSD, split plot designing and strip plot.	15

Practical

1. To determine the mean by different methods.
2. To determine the median by different methods.
3. To determine the mode by different methods.
4. To determine the standard deviation.
5. To calculate the t-test and chi-square test.
6. To calculate the one-way ANOVA and two ways ANOVA.

Suggested Readings:

1. *Statistical Theory in Research* by R.L. Anderson and Bancroft
 2. *Experimental designs* by W.G. Cochran and G.M. Cox
 3. *Design and Analysis of Experiments* by M.N. Das and N.C. Giri
 4. *Experimental Design* by W.T Federer and Macmillan
 5. *Statistical Procedures for Agricultural Research* by K.A. Gomez and A.A. Gomez
 6. *The design and analysis of experiments* by O. Kempthorne
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SEMESTER- VII

MAJOR-2 Title of paper-I **FOREST MANAGEMENT, LEGISLATION AND POLICIES**

Course Code:

FOR/M/SVII/02

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Definition, scope, objective and principles of forest management; Classification of forest; Organization of state forests; Sustained yield: Definition, principles and limitations; Sustainable forest management: Criteria and indicators; Increasing and progressive yields; Rotation: Definitions, various types of rotations, length of rotations, choice of type and kind of rotation; Normal forest: Definitions, basic factors of normality.	15
Unit II	Distribution of age classes and age gradation in even and uneven aged forest and growing stock; Normal forest: Basic factors of normality, kinds of abnormality in regular and irregular forest; CAI and MAI curves and increment percent; Yield regulation: Definition, principle and method of yield, area method, von mental method for yield regulation.	15
Unit III	Constitutional and legislative provisions: Fundamental norms, divisions of legislative authority, environmental legislation and article 253; Forest policy: Relevance and scope; National Forest Policy-1894, 1952 and 1988; Forest laws; Indian Forest Act-1927; Forest Conservation Act-1980; General provision and silent features; Forest (Conservation) rules and amendments.	15
Unit IV	Wildlife Protect Act-1972 and amendments; The Biological Diversity Act-2002; National Green Tribunal Act- 2010; Important forest rules and guidelines; Silent features and national biodiversity authority; Environmental (Protection) Act-1986; National Environmental Policy-2006; Forest Right Act-2006.	15

Practical

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

Suggested Readings:

1. *Essentials of Forest Management* by S. Balakathiresan
2. *Joint Forest Management in India* by P. Bhatta charya, A.K. Kandya and Krishna Kumar
3. *Forest Management in India- Issues and Problems* by V. Desai
4. *Timber Management: A Quantitative Approach* by Jerome L Cutteretal
5. *National Working Plan Code* by MoEFCC, New Delhi.
6. *Forest Management*, IBD, Dehradun.
7. *Forest Management* by P.R. Trivedi and K.N. Sudarshan
8. *Forest Policy and Law* by A. N. Chautervedi
9. *Forest Policy and Laws* by S.S. Negi
10. *Forest Laws and Policies in India* by A.K. Poddar
11. *Compilation of Forest Policy and Laws* by C.A. Rahman
12. *Indian Forest Act 1972* by Vinod Rishi
13. *Legal forestry* by S. Mehra

SEMESTER –VII

MAJOR-3 Title of paper-I **NURSERY AND PLANTATION TECHNOLOGY**

Course Code:

FOR/M/SVII/03

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Introduction and importance: Type of nursery including the modern quality seed collection (Seed stand, SPA, seed orchard), processing, storage, sowing, germination, Pre-sowing treatments.	15
Unit II	Vegetative propagated Nursery; Selection of superior phenotype; Methods of propagation (Cutting, budding, grafting and layering); Hormones used for rooting; Factors affecting rooting of cuttings; Methods of micro-propagation.	15
Unit III	Containerized nursery: Type and size of container including root trainers, potting media; Types of green house and mist chamber; Mist propagation; Shade houses; Nursery irrigation: Drip, sprinkler, spot and flood irrigation.	15
Unit IV	Growing medium; Fertilizers (bio & chemical); Manure and compost; Sanitation; Integrated nutrient management; Nursery production and management; Soil and water management; Soil amendments; Pricking; Watering including drip irrigation, weeding and hoeing.	15

Practical

1. Layout of forest nursery.
2. Tools used in forest nursery.
3. A visit of forest nursery in their region.
4. To prepare the potting mixture.
5. To prepare the stump cuttings.

Suggested Readings:

1. *Nursery and plantation practices* by V. Kumar
2. *Plant nursery management* by P.K. Ray
3. *Nursery management* by J. Mason
4. *Nursery and landscaping* by L.C. Dey
5. *Principles and practices of silviculture* by L.S. Khanna
6. *Plantation forestry in India* by R.K. Lun

SEMESTER -VII

MAJOR-4 Title of paper-I

ENVIRONMENTAL SCIENCE

Course Code:

FOR/M/SVII/04

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Introduction and definition of Environment Science; Factors affecting the environment; Interactions with organisms in specific environment; Various strategies for sustainable environment; History of environment at different regional levels: Past and present status; Type of pollution and pollutants.	15
Unit II	Different types of pollutions: Air, water, soil and noise pollution, causes, source and control measures; Acid rain; Global warming; Ozone layer depletion; Sewage and waste water management; Impact of different pollutions on humans and other organisms; Biological magnification; Toxins and Eutrophication.	15

Unit III	Prevention and control of pollution: Technological and sociological measures and solutions: Indian and global efforts; Case studies; Analysis on environmental disasters and their remedial measures; International and voluntary agencies for environmental conservation; Mandates, activities and environmental ethics.	15
Unit IV	Causes of environmental degradation: Deforestation and anthropogenic pressure; Explosion of human population, ecological and economic issues; National and International conventions and summits and their major achievements; Environmental policy and legislation in Indian perspective; Role of forest for sustainable environment.	15

Practical

1. To identify the environmental problems in local region.
2. To estimate the water and air quality.
3. Comments on pollution and their control measures.

Suggested Readings:

1. *Ecology and environmental* by P.D. Sharma
2. *Ecology, environmental science and conservation* by J.S. Singh, S.P. Singh and S.R. Gupta
3. *Environmental laws and policies in Indian* by S. Devan
4. *Essential of environmental studies* by S.P. Mishra and S.N. Pandey
5. *Environment Impact Assessment* by A.K. Srivastava
6. *A text book of environmental studies* by D.K. Asthana and M. Asthana.
7. *Report of the National Forest Commission. Govt. of India, New Dehli*
8. *Global Environmental Crisis* by K.L. Barik
9. *Natural resource conservation and Management* by S.C Tewari, P. P. Dabral
10. *Environmental Impact Assessment* by A.K. Srivastava
11. *Environmental Impact Assessment* by P.R. Trivedi

SEMESTER- VII

INDUSTRIAL TRAINING/SURVEY/RESEARCH PROJECT

Course Code:

Total Credit: 4

It is based on major papers

- Estimation of Volume of logs.
- Identification of Nursery Plants.
- Methods of tree raising in Plantation.
- Study of Pollution and Pollutants.
- Methods of height and diameter measurements.
- Assessment of JFM, CAMPA, and FDA programmes.
- Survey in Forest, Nurseries, Plantation site and Industries.

SEMESTER- VIII**MAJOR-1 Title of paper-I****FOREST PRODUCTS AND INDUSTRIES**

Course Code:

FORM/SVIII/01

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Introduction, scope and importance of forest-based industries in relation to Indian economy; Brief description of types of forest-based industries in India.	15
Unit II	Pulp and paper industry: Types of paper, raw material, pulping (mechanical, chemical and semi-chemical), beating, bleaching, sizing and sheet formation; Description about rayon and other cellulose derived products.	15
Unit III	Composite wood, plywood, laminated wood, core board, sandwich board, particle board and their manufacturing processes; Properties and uses. Principles of destructive distillation of hardwood and softwood; Preparation of wood alcohol, acetic acid, acetone, charcoal and allied chemicals; Scarification of wood chemistry and processes; Production of wood molasses, alcohol yeast and other by products from wood hydrolysis and wood substitution.	15
Unit IV	Manufacture of katha and cutch; Rhododendron flower and its importance and uses of berberis plant; NTFP based industries drugs and essential oils (medicine), bidi, resin, turpentine, rosin, oleoresin, gum-resin, lac and shellac, tans, dyes, leaves and fodder of various tree species, honey, wax, silk, soap, fibers, nuts, fruits, flowers, oil yielding plants and grasses, minerals, medicinal and aromatic plants and spices.	15

Practical

1. Identification and uses of various (local) NTFP's.
2. Extraction of grass oil, distillation unit.
3. Extraction method of lac cultivation.
4. Extraction method of resin and rosin.
5. To visit the cutch and katha industries.
6. To visit the pulp and paper industries.
7. Identification of different types of wood.

Suggested Readings:

1. *Wealth of India* by CSIR
2. *Year book of forest products* by FAO
3. *Forest: the non-wood resources* by A.P. Dwivedi
4. *Forest products and their utilization* by S.S. Negi
5. *A handbook of forest utilization* by T. Mehta
6. *Handbook of paper and pulp technology* by W. Britt and Kenneth
7. *The chemistry of solid wood* by R. Rowell

SEMESTER- VIII

MAJOR-2 Title of paper-I

ENERGY PLANTATION AND BIOFUEL

Course Code:

FOR/M/SVIII/02

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Selection of site for planting operations, arrangement of staff, organization of plantation work, planting activities and maintenance of plantations; Choice of species adopted; Characteristics of fodder and fuel-wood; Optimizing energy fixation.	15
Unit II	Problems, techniques and suitable species for afforestation in desert, water logged area, saline and alkaline soils, degraded hills, mine spoil; Energy and biomass consumption pattern in India; Environment impact of biomass energy.	15
Unit III	Assessment of bio-energy programs in India; Power generation from energy plantation; High Density Energy Plantation (HDEP); Land and biomass availability for sustainable bio energy; Petro- crops; Criteria for evaluation of different species for energy plantation.	15
Unit IV	Impact of energy efficiency in power sector; Need for research and development on environment friendly and socio-economically relevant technologies; Network of NGOs in renewable energy use; Energy from plants its Problems and prospects; Recent energy technologies in the production of bio-fuels.	15

Practical

1. Comment and assignments on the above topics.
2. To study the techniques of plantation.
3. Visit to nearby energy plantation area.

Suggested Readings:

1. *Plantation forestry in India* by R.K. Luna
 2. *Nursery and plantation practices* by Vinod Kumar
 3. *Plantation and nursery techniques of forest trees* by Ram Prakash
 4. *Jatropha carcus for biodiesel, organic farming and health* by Shyam Sunder
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SEMESTER- VIII

MAJOR-3 Title of paper-I

MEDICINAL AND AROMATIC PLANTS

Course Code:

FOR/M/SVIII/03

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Definition; Role of medicinal and aromatic plants in Indian economy; Important essential oil yielding plants in India; Detailed study of lemon grass, citronella, palmarosa, vetiver, Japanese mint, eucalyptus, jasmine, patchouli and geranium its botany, climate and soil requirements; Planting cultural and manorial practices; Harvesting, curing and extraction of essential oils.	15
Unit II	Medicinal plants in India and Uttarakhand; History, origin, area and distribution; Production, botany and varieties; Cultivation, extraction of active principles and their uses. Cultivation practices of medicinal plants; Medicinal and aromatic plant diversity in the Indian gene center.	15
Unit III	Plant genetic resources; General perspectives; Ecology and biology of plant resources of medicinal value; Plant exploration, introduction & exchange; Evaluation and breeding techniques of important medicinal and aromatic plants: <i>Picrorhiza kurrooa</i> , <i>Swertia chirayita</i> , <i>Valeriana jatamasi</i> , <i>Viola</i> species, <i>Gloriosa superba</i> , <i>Rauwolfia serpentina</i> , <i>Plantago ovata</i> , <i>Cassia angustifolia</i> , <i>Ocimum sanctum</i> , <i>Withania somnifera</i> ; Distinctiveness, uniformity and stability testing.	15
Unit IV	Drug descriptors for medicinal and aromatic plants; Cultivation of commercially importance medicinal and aromatic plants: <i>Picrorhiza kurrooa</i> , <i>Aconitum heterophyllum</i> , <i>Podophyllum hexandrum</i> , <i>Swertia chirayita</i> , <i>Valeriana jatamansi</i> , <i>Asparagus recemosus</i> , <i>Phyllanthus emblica</i> , <i>Terminalia chebula</i> , <i>Terminalia bellirica</i> and <i>Rheum emodi</i> .	15

Practical

1. Identification of different medicinal and aromatic plants.
2. To visit the nearby medicinal and aromatic plant nurseries.
3. To study the different regeneration techniques.
4. Field visit to different regions to gain ethno botanical knowledge and the inter-relation between plant and people.
5. Survey and identification of plants used by the local people for medicine, food and other social purposes.
6. Collection and preparation of herbarium specimens of the above plants.
7. Harvesting and oil extraction of aromatic plants.

Suggested Readings:

1. *Endangered Medicinal plants* by A.B. Chaudhari
2. *Medicinal plants of Uttarakhand* by K.P. Singh, Anuj Kumar and Upendra Kumar (Volume I)
3. *Medicinal plants of Uttarakhand* by K.P. Singh, Anuj Kumar and Upendra Kumar (Volume II)
4. *Medicinal plants of Uttarakhand* by K.P. Singh, Anuj Kumar and Upendra Kumar (Volume III)
5. *Cultivation and utilization of medicinal plants* by C.K. Atul and B.K. Kapur
6. *Glossary of Indian medicinal plants* by R.N. Chopra, S.L. Nayara and I.C. Chopra
7. *Applied Ethnobotany: People, Wild Plant Use and Conservation* by A. Cunningham
8. *Handbook of Medicinal and Aromatic Plants: Cultivation, Utilisation and Extraction* by EIRI Board
9. *Ethnobotany. Principles and applications* by C.M. Cotton

SEMESTER -VIII

MAJOR-4 Title of paper-I

ECOTOURISM AND EIA

Course Code:

FORM/SVIII/04

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Major ecosystems of the world; Eco tourism: Study history of tourism, identify various forms of tourism and evolution of ecotourism; Dimensions of tourism and essential conditions for tourism to occur; Differences between tourism components; Mass tourism versus ecotourism; Understand dimensions of ecotourism and the criteria to qualify for ecotourism; Ecotourism indicators and conceptual differences between developing and developed countries.	15
Unit II	Organized tours and free Independent Travelers; Ecotourism in practices in important protected areas: Corbett National Park, Nanda Devi Biosphere Reserve, Kanha National Park, Kaziranga National Park, Gir National Park, Rajaji National Park. Participation of local people in ecotourism limitations and problems. World Tourism Organization; Problems with definition of ecotourism and criticisms; International organizations and NGOs promoting ecotourism; Sociological implications of eco-tourism.	15
Unit III	Introduction, principle and purpose of EIA and its significance for the society; Environmental components of EIA: Air, water, land, noise and ecological environment; Cost and benefits of EIA.	15
Unit IV	EIA involvement during project life cycle; EIA management; Principles and management of EIA; Main stages in EIA processes: Screening, scoping, prediction, mitigation and alternatives auditing; EIA techniques, checklists, matrices, network method.	15

Practical

1. Comment and assignment on the above topics.
2. Visit the nearby eco- tourism sites.
3. Comment upon EIA procedures.

Suggested Readings:

1. *Indian forestry* by K. Manikandan
2. *Eco-tourism and livelihood* by A.K Bhattacharya
3. *Tourism, Environment and Man: Sustainable Tourism* by Brigadier and B.P.S Khati
4. *Tourism in india Challenges and Opportunities* by Ruchi Ramesh and Sudhir Kumar Singh

SEMESTER -VIII**INDUSTRIAL TRAINING/SURVEY/RESEARCH PROJECT**

Course Code:

Total Credit: 4

It is based on major papers

- Identification of tree products and uses in industries and other areas.
- Assessment of tree species used in fuel, fodder and other uses.
- Study of medicinal and aromatic plants of the region.
- Role of ecotourism in socio-economic and ecological development .

SEMESTER -IX**MAJOR-1 Title of paper-I FOREST ECOLOGY AND BIODIVERSITY CONSERVATION**

Course Code.:

FORM/SIX/01

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Concept of ecology and environmental sciences; Major issues and challenges; Origin of earth; Composition of atmosphere, lithosphere, hydrosphere and biosphere; Classification of world vegetation and vegetation forms of India; Biogeographic regions of world and India; Methods of sampling of community: quadrat, line transect, point frame method and vegetational analysis (qualitative and quantitative characters).	15
Unit II	Forest ecosystem: major ecosystems of the world, structure, biotic and abiotic components of ecosystem; Biomass, productivity, litter fall and litter decomposition; Forest nutrient and cycling-input, accumulation (storage) and output (ecosystem loss) and nutrient use efficiency; Disturbance in forest ecosystem, nature of disturbance, fire, wind, flood and invasive species and restoration of degraded ecosystems; Ecological succession: mechanism and ecosystem change during succession, succession models and concept of climax.	15
Unit III	Concept of biodiversity, importance, use and threats to biodiversity; Causes of biodiversity loss and the IUCN red list; Assessment of biodiversity: inventory, monitoring, REDD, REDD+; Natural resources: Types, degradation and conservation, in-situ and ex-situ, hotspot areas, protected area network, wildlife sanctuaries, national parks, biosphere reserves, zoo, botanical gardens, arboretum etc. and conservation of sacred groves.	15
Unit IV	Role of community in biodiversity conservation; Indigenous knowledge of biodiversity; Biodiversity conservation and community development, biodiversity and ecosystem services; International efforts for conservation of biodiversity; International union for conservation of nature and natural resources; United Nations Environmental Program; Convention on biodiversity; World heritage convention; Conference on parties; Convention on international trade of endangered species; World wide fund for nature and natural resources.	15

Practical

1. Map preparation of world vegetation and mapping of different biogeographic regions of world and India.
2. Vegetational analysis of different plant communities.
3. Experiments on sapling methods used in ecological research.
4. Estimation of biomass and net primary productivity in different forest types.
5. Estimation of litter production and decomposition rate of different forest types.
6. Field inventory for biological diversity and determination of minimum size of sampling unit for trees, shrubs and herbs.
7. Collection, identification and herbarium preparation of plant species.
8. Calculation of different indices of biodiversity, evenness, concentration of dominance, similarity and α , β and γ diversity of a landscape index.
9. Visit to National Parks, wildlife sanctuaries, botanical gardens and arboretum.
10. List of IUCN indexed plants of India.

Suggested Readings:

1. *Basic Ecology* by E.P. Odum
2. *Manual of Plant Ecology* by K.C. Misra
3. *Ecological Methods for Field and Laboratory Investigations* by P. Michael
4. *Tropical Forest Ecology: The Basis for Conservation and Management* by F. Montagnini and C.F. Jordan
5. *The Conservation of Plant Biodiversity* by O.H. Frankel, A.H.D Brown and J.J Burdon
6. *Forest Ecology of India* by S.S. Sagwal

SEMESTER- IX**MAJOR-2 Title of paper-I****STATISTICAL METHODS AND EXPERIMENTAL DESIGNS**

Course Code.:

FOR/M/SIX/02

Total Credit: 5(Th04+Pr01)

<u>Theory</u>	Topics	Lectures
Unit I	Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data; Construction of frequency distribution, tables – graphic presentation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve average and measures of location, mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles for raw and grouped data.	15
Unit II	Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data; Probability: Basic concept, additive and multiplicative laws; Theoretical distributions, binominal, poisson and normal distributions, sampling, basic concepts, sampling vs. complete enumeration parameter and static, sampling methods, simple random sampling and stratified and om sampling; Tests of significance: Basic concepts, tests for quality mean, chi-square tests.	15
Unit III	Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of sample linear regression, tests of significance of correlation and regressions-efficient; Introduction to design of experiment-Basic principles of experimental design-replication, randomization and local control.	15
Unit IV	Analysis of variance-assumptions-construction of ANOVA table–conclusions based on ANOVA; Comparisons based on means-critical difference, DMRT; Transformations of data square root, logarithmic and angulartrans formations; Completely and omized design-Layout, analysis, advantages and limitations; Rand omised block design-layout, analysis, choice of no. of blocks, advantages and limitations; Latin square designs-layout, analysis, applications, advantages and limitations.	15

Practical

1. Formation of frequency distribution. Diagrammatic and graphic representation. Calculation of different measures of central tendency.
2. Computation of various measures of dispersion.
3. Calculation of coefficient of variation-coefficients of skewness and kurtosis.
4. Computation of product moment correlate on coefficient-rank correlation, coefficient-and coefficient of concordance.
5. Fitting of linear egression models for prediction. Simple problems on probability fitting of binomial distribution. Fitting of poisson distribution, problems on normal distribution.

6. Selection of simple random sample – estimation of parameters – sample size determination.
7. Large sample tests. Small sample tests, t and F tests, Chi –square test, test of goodness of fit test of independence of attributes in a contingency table - computation of mean – square contingency.
8. Analysis of variance-construction of ANOVA table of one-way classified data. Analysis of variance-construction of ANOVA table of two-way classified data.

Suggested Readings:

1. *Statistical Theory in Research* by R.L Anderson and Bancroft
2. *Experimental designs* by W.G Cochran and G.M. Cox
3. *Design and Analysis of Experiments* by M.N. Das and N.C Giri
4. *Experimental Design* by W.T. Federer and Macmillan
5. *Statistical Procedures for Agricultural Research* by K.A. Gomez and A.A Gomez
6. *The design and analysis of experiments* by O. Kempthorne

SEMESTER- IX

MAJOR-3 Title of paper-I

ADVANCES IN SILVICULTURE

Course Code.:

FORM/SIX/03

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Definition of forest and forestry; Silviculture systems as a plan for management; Timber harvesting and silviculture; Champion and Seth’s classification of forest types of India and its limitations; Influence of forests on environment; Site factors: climate, edaphic, physiographic and biotic factors; Interaction of site factors- Leibig’s law of minimum, Shelford’s law of tolerance, hardness and tolerance.	15
Unit II	Concept and objectives of regeneration, advantages and disadvantages of different regeneration methods, preparation, maintenance and management of site and factors affecting regeneration. Ecology of regeneration: Natural and artificial regeneration; Natural regeneration: Seed production, seed dispersal, germination and establishment, requirement for natural regeneration, advance growth, coppice, root sucker, regeneration survey, natural regeneration supplemented by artificial regeneration.	15
Unit III	Natural regeneration under clear felling, uniform shelter wood, irregular shelter wood, group and selection systems and methods obtaining assisted natural regeneration. Artificial regeneration and its objectives and methods of artificial regeneration, selection of species-kinds of mixture, pattern of mixture, choice between natural and artificial regeneration; Factors governing the choice of regeneration techniques.	15
Unit IV	Tree planting; Sowing v/s planting different kinds of pits; Tending and cultural operations; Weeding, kinds of weeding; Release operations, singling, cleaning, liberation cutting weeding, cleaning, thinning and improvement, salvage and sanitation cuttings.	15

Practical

1. Study of harvesting operations practiced in nearby forest area.
2. Inventory and assessment of natural regeneration of given species.
3. Mapping and comments on different forest types of India and Uttarakhand.

4. Collection, preservation and identification of plant specimens of different states of India.
5. Observe and analyze regeneration under different silvicultural systems.

Suggested Readings:

1. *Principles of Silviculture* by F.S. Baker
2. *Handbook of Silviculture* by H.G. Champion and G. Trevor
3. *Principles of Silviculture* by T.W. Daniel, J.A. Helms and F.S. Baker
4. *Forest Nursery Manual: Production of bareroot seedlings* by M.L. Duryea and T.D. Landis
5. *Text book of Silviculture* by A.P. Dwivedi
6. *Plantation For estryinthe Tropics* by J.E. Evans
7. *1986. Tropical Silviculture* by I.T. Haig, M.A. Huberman and U. Aung Din
8. *Principles and Practice of Silviculture* by L.S. Khanna
9. *Silviculture* by J. Kostler
10. *The Practice of Silviculture* by D.M. Smith

SEMESTER- IX

MAJOR-4 Title of paper-I AGROFORESTRY SYSTEMS AND MANAGEMENT

Course Code.:

FOR/M/SIX/04

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Agroforestry: Concept, scope, objectives and importance; Social, ecological and economic reasons for agroforestry; Selection of tree species and crop/inter crop in different agro-climatic zones of India; Conservation and management of soil and water; Soil organisms, nitrogen fixing tree species, nutrient cycling and budgeting; Production and productivity in different agroforestry systems.	15
Unit II	Agroforestry potentials and constraints, land capability classification and land use pattern; Agroforestry systems: shifting, taungya, alley cropping, shelter belts, wind breaks, home gardens, agriculture-based systems, forest-based systems, pasture based and horticulture-based systems.	15
Unit III	Principles of harvesting, post-harvest handling, marketing of agroforestry products; Economic of agroforestry, net present value, internal rate of return, cost benefit analysis. Recent trends in research, diagnosis and design in agroforestry; Components of Agroforestry-Provisioning and regulator services of agroforestry; Nutrient cycling; Soil improvement; Increased production and productivity.	15
Unit IV	Tree-crop interaction in agroforestry: Definition, kind of interaction – compatibility, mutualism, commensalism, allelopathy and competition; Interaction management: Aboveground and belowground interactions; Manipulation of density, space, crown and roots; Agroforestry practices to minimize negative interaction: Coppicing, thinning, pollarding and pruning; Crop planning and management: Selection of suitable crops, management of nutrients, water and weeds; Classification of agroforestry systems; National Agroforestry Policy 2014; National and International organizations in Agroforestry.	15

Practical

1. Survey and analysis of land use systems in the adjoining areas.
2. Design and plan of suitable models for improvement.

3. Mineral nutrient analysis of soil and plants.
4. Study of crop –weed association and fertilizer response in different crops. Preparation and application of herbicides.
5. Application of various methods in formulation and appraisal of agro-forestry projects.
6. Nutrient analysis of forages derived from fodder trees/shrubs. Digestibility of some agro-forestry forages.
7. Benefit-cost ratio estimation of agroforestry systems.
8. Case studies on harvesting, post-harvest management and marketing of agroforestry products.
9. Visit to nearby agroforestry practicing area and interaction with the practicing farmers.

Suggested Readings:

1. *Plant Research and Agroforestry* by P.A. Huxley
2. *Tropical Agroforestry* by P. Huxley
3. *Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry* by B.M. Kumar and P.K.R. Nair
4. *Ecological Methods for Field and Laboratory Investigations* by P. Michael
5. *New Vistas in Agroforestry* by P.K.R. Nair, M.R. Rao and L.E. Buck
6. *An Introduction to Agroforestry* by P.K.R. Nair
7. *Agroforestry Systems in the Tropics* P.K.R. Nair
8. *Agroforestry as a strategy for carbon sequestration* by P.K.R. Nair, B.M. Kumar and D.N. Vimala
9. *Agroforestry: Potentials and Opportunities* by P.S. Pathak and Newaj Ram

SEMESTER- IX

INDUSTRIAL TRAINING/SURVEY/RESEARCH PROJECT

Course Code.:

Total Credit: 4

It is based on major papers

- Vegetation analysis of different forest types.
- Physical analysis of different forest soil.
- Chemical analysis of different forest soil.
- Conservation of wild life strategy.
- Suitable agroforestry system.
- Statistical tools used in forestry.
- Agroforestry practices in different forest and land sites.

SEMESTER -X**MAJOR-1 Title of paper-I TREE SEED TECHNOLOGY**

Course Code.:

FOR/M/SX/01

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Introduction and history of seed industry in India; Definition of seed, classes-types of seed and its importance; Differences between grain and seed; Role of seed technology in nursery stock production; Production of quality seed, identification of seed collection areas-seed orchards, maintenance of genetic purity, isolation and rouging, seed source (provenance and stands).	15
Unit II	Selection of seed tree (genotypic and phenotypic selection), plus tree (pure stands, elite seed tree, isolated tree and their location); Seed Collection: Planning and organization, collection methods, factors affecting seed collection and seed maturity; Seed processing: Seed extraction, drying, blending, cleaning, grading, treating, bagging, labeling and storage; Orthodox, intermediate and recalcitrant seeds, precautions of handling of recalcitrant seeds, natural longevity of tree seeds, factors affecting longevity.	15
Unit III	Seed testing (sampling, mixing and dividing, determination of genuineness, germination, moisture, purity, vigor, viability); Seed dormancy, classification and breaking of seed dormancy; Different viability and vigor tests, seed pelleting, seed health; Classes of tree seeds, certification and procedures of tree seeds certification.	15
Unit IV	Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging and seed extraction; Field and seed standards and seed legislation.	15

Practical

1. Identification of seeds of tree species, Seed maturity tests.
2. Physical purity analysis.
3. Determination of seed moisture.
4. Seed germination test.
5. Hydrogen peroxide test.
6. Tetrazolium test for viability.
7. Seed vigor and its measurements.
8. Study of seed structure, colour size, shape and texture.
9. Harvesting and seed extraction.
10. Methods of seed production.
11. Seed processing machines.
12. Visit to seed production units.

Suggested Readings:

1. *An introduction of seed technology* by J.R. Thompson
2. *Techniques in seed science and technology* by P.K. Agrawal and M. Dadlani
3. *Principles of seed technology* by P.K. Agrawal
4. *Seed Technology* by R.L Agrawal

SEMESTER- X**MAJOR-2 Title of paper-I FOREST ENTOMOLOGY AND PATHOLOGY**

Course Code.:

FOR/M/SX/02

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	Introduction of entomology and pathology including classification, identification and symptoms; Importance insect-pests of seed, nursery and plantation; Important defoliators, skeletonizers, shoot borers and wood borers of Sal, Shisham, Khair, Teak, Poplar, Eucalyptus, Oak, Pine and Deodar.	15
Unit II	Categories of pests; Concept of IPM; Practices, scope and limitations of IPM; Classification of insecticides, toxicity of insecticides and formulations of insecticides; Chemical control importance, hazards and limitations; Recent methods of pest control, repellents, anti-feed ants, hormones, attractants, gamma radiation; Insecticides Act 1968-Important provisions; Physical, cultural, chemical and biological control methods of insects; Use of attractions and repellants, male sterility techniques principles and methods of integrated pests managements.	15
Unit III	Insect Ecology: Introduction, environment and its components; Effect of abiotic factors: Temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents; Effect of biotic factors: Food competition, natural and environmental resistance; Abiotic agents of tree diseases and their relationship with hosts; Disease of forest nurseries and plantations- root, heart diseases, physiological disorders.	15
Unit IV	Major diseases of Sal, Sissoo, Khair, Teak, Acacia, Eucalyptus, Poplar, Deodar and Pine; Method of disease control: Cultural, biological and chemical; Seed pathology and plant quarantine.	15

Practical

1. Collection, preservation and identification of different insects.
2. Collection, preservation and identification of different fruiting bodies of pathogenic and non-pathogenic fungi.
3. Inspection and collection of insect damaged materials.
4. Identification and use of plant protection equipments.
5. Preparation of different concentration of pesticides.
6. Symptoms and identification key of important disease of natural forest and Plantations.
7. Preparation of fungicidal concentration and their application in forest and plantation.
8. Identification of nursery insects and disease and their control measures.
9. Collection and preservation of butterflies and moths.

Suggested Readings:

1. *Plant Pathology* by G.N Agrios
2. 1996. *Principles of Insect Pest Management* by G.S. Dhaliwal and R. Arora
3. *Plant Pathology* by R.S. Mehrotra and A. Aggarwal
4. *Plant Diseases* by R.S. Singh
5. *Introduction to Principles of Plant Pathology* by R.S. Singh
6. *Principles of Plant Pathology* by E.C. Stakman and J.G. Harrar
7. *Introduction to general and applied entomology* by V.B. Awasthi
8. *General entomology* by M.S. Mani
9. *Modern Entomology* by D.B. Tembhare

SEMESTER- X**MAJOR-3 Title of paper-I****FOREST ECONOMICS AND MARKETING**

Course Code.:

FOR/M/SX/03

Total Credit: 5(Th04+Pr01)

Theory.	Topics	Lectures
Unit I	Forest Economics: Meaning, definition; Basic concepts: Goods, service, utility, value, price, wealth, welfare; Wants: Meaning, characteristics, classifications of wants, importance; Theory of consumption: Law of diminishing marginal utility, meaning, definition, assumption, illustration, limitations, law of equi-marginal utility, importance; Consumer surplus: Meaning, definition, importance.	15
Unit II	Demand: Meaning, definition, kinds of demand, demand schedule, demand curve, law of demand, extension and contraction vs increase and decrease in demand; Elasticity of demand: Types of elasticity of demand, degrees of price elasticity of demand, methods of measuring elasticity, factors influencing demand, elasticity of demand, importance of elasticity of demand; Supply: Meaning, supply function; Law of supply: Factors influencing supply; Pricing of timber and non-timber products; Economics of timber and non-timber forest products.	15
Unit III	Forest planning, forest policy and development; Production: Meaning, factors of production-land, labour, capital, organization, entrepreneurship; Distribution-rent, wages, interest, profit; National Income: Definition and concepts.	15
Unit IV	Marketing definition; Marketing Process; Need for marketing; Role of marketing; Marketing functions; Classification of markets; Marketing of various channels; Price spread; Marketing Efficiency; Integration; Constraints in marketing of agricultural produce; Market intelligence; Basic guidelines for preparation of project reports; Bank norms; Insurance; SWOT analysis and Crisis management.	15

Practical

1. Techno-economic parameters for preparation of projects.
2. Preparation of Bankable projects for various agricultural products and its value-added products.
3. Identification of marketing channel.
4. Calculation of Price Spread.
5. Identification of Market Structure.
6. Visit to different Markets.
7. SWOT analysis.
8. Demand and Supply curve.

Suggested Readings:

1. *Modern Economic Theory* by K.K. Dewett
2. *Dewett, K. K., Verma. 2004 Elementary Economic Theory* by K.K. Dewett and K. Verma
3. *Macro-Economic Theory* by M.L. Jhingan
4. *Agricultural Economics* by S.S Reddy, P. Raghu Ram, T.V. Neelakanta Sastry and D.I. Bhavani

SEMESTER- X

MAJOR-4 Title of paper-I

FOREST GENETICS AND TREE IMPROVEMENT

Course Code.:

FOR/M/SX/04

Total Credit: 5(Th04+Pr01)

Theory	Topics	Lectures
Unit I	General concept of forest tree breeding, tree improvement and forest genetics; Reproduction in forest trees, dimorphism pollination mechanisms; Pollen dispersion distance, pollinators and their energetic; Attractants for pollinators; Pollen handling forced flowering for seed orchard manipulation; Pollination mechanisms; Variation in trees importance and its causes.	15
Unit II	Natural variation as a basis for tree improvement; Geographic variations: Ecotypes, clines, races and land races; Selective breeding methods: Mass, family, within family, family plus within family; Plus tree selection for wood quality, disease resistance and agroforestry objectives; Selection strategies and choice of breeding methods and progress in selective breeding in forest trees; Indirect selection for biotic and abiotic stresses; Progeny and clone testing.	15
Unit III	Seed orchards: Type, functions and importance; Estimating genetic parameters and genetic gain; Heterosis breeding: Inbreeding and hybrid vigour; Manifestation and fixation of heterosis; Species and racial hybridization; Indian examples- teak, sal, shisham, eucalyptus, acacias, pines and poplars; Polyploidy, aneuploidy and haploidy in soft and hard wood species; Induction of polyploidy.	15
Unit IV	Marker assisted selection; Breeding methods for wood quality, agroforestry, diseases and pest resistance, drought and salt resistance; Tree improvement case histories; Hardy-weinberg law, null hypothesis, wohlund's principle; Mutation breeding and Economics of tree breeding.	15

Practical

1. Observation of modes pollination and reproduction in forest trees.
2. Estimation pollen viability and controlled pollination experiment.
3. Field practice in emasculation, crossing and selfing in local plants.
4. Manipulation of flowering through hormonal application.
5. Identification of ecotypes, races and land-races in natural forest.
6. Marking of candidate trees, plus trees and elite trees.
7. Induction of polyploidy through colchicines treatment.
8. Successful case studies of tree breeding.
9. Visit to seed orchard.

Suggested Readings:

1. *Forest Genetics* by T.L. White, W.T. Adams and D.B. Neale
2. *Text book of Forest Tree Breeding* by C. Surendran, R.N. Sehgal and M. Parmathma
3. *Introduction to Forest Genetics* by Wright
4. *Applied Forest Tree Improvement* by B. Zobel and J. Talbert
5. *Principles of Genetics* by E.J. Garner, M.J. Simmons and P.D. Sunstad
6. *Cytogenetics* by P.K. Gupta
7. *Genetics* by M.W. Strickberger
8. *Principles of Genetic* by R. Tamarin

SEMESTER -X

INDUSTRIAL TRAINING/SURVEY/RESEARCH PROJECT

Course Code.:

Total Credit: 4

It is based on major papers

- Maturity indices of different forest tree species.
 - Physical purity analysis forest tree seeds.
 - Determination of seed moisture and seed germination test.
 - Tetrazolium test for viability.
 - Collection, preservation and identification of different insects.
 - Inspection and collection of insect damaged materials.
 - Symptoms and identification key of important disease of natural forest and Plantations.
 - Identification of nursery insects and disease and their control measures.
 - Collection and preservation of butterflies and moths.
 - SWOT analysis.
 - Analysis of timber market.
 - Field practice in emasculation, crossing and selfing in local plants.
 - Experiment of manipulation of flowering through hormonal application.
 - Identification of candidate trees, plus trees and elite trees.
 - Successful case studies of tree breeding.
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In Professional Forestry Course (B.Sc. Forestry, four year degree), Expert Committee unanimously reached in conclusion that the syllabus of forestry is appropriate, there is no need to change, as it was prepared, modified and approved as per the ICFRE, UGC and ICAR guidelines and passed by Board of studies. Thus can be applied for NEP 2020. In case of minor elective, vocational/skill development courses, students have a options to opt any course from own faculty and or from other faculties.
