DEPARTMENT OF FORESTRY

B. Sc. Forestry

(Self-Financed)

(Semester System)

SYLLABUS

4-Year Programme

KUMAUN UNIVERSITY

NAINITAL

B. Sc. Forestry Self Finance Four Year Degree Course
Department of Forestry and Environmental Science
Course Outline

Paper code	Semester - I Title	Max. Marks
KUF 111	Introductory Biology	50 (35+15)
KUF 112	Elementary Mathematics	50 (35+15)
KUF 113	Forest Ecology	50 (35+15)
KUF 114	Principles of Silviculture	50 (35+15)
KUF 115	Nursery Technology	50 (35+15)
	Practical	50 (35+15)
	Semester – II	
KUF 121	Social Forestry	50 (35+15)
KUF 122	Silviculture of Important Trees	50 (35+15)
KUF 123	Plantation Technology	50 (35+15)
KUF 124	Forest Soils	50 (35+15)
KUF 125	Biodiversity and Forest types	50 (35+15)
	Practical	50 (35+15)
	Semester –III	
KUF 231	Forest Mensuration and Biostatistics	50 (35+15)
KUF 232	Silvicultural Systems	50 (35+15)
KUF 233	Principles of Agroforestry	50 (35+15)
KUF 234	Forest Management and Working Plan	50 (35+15)
KUF 235	Wildlife Management	50 (35+15)
	Practical	50 (35+15)
	Semester - IV	
KUF 241	Forest Policies and Laws	50 (30+20)
KUF 242	Forest Logging	50 (30+20)
KUF 243	Range Land Management	50 (30+20)
KUF 244	Forest and Tribals	50 (30+20)
KUF 245	World Forestry	50 (30+20)
	Practical	50
	Semester -V	
KUF 351	Tree Physiology	50 (30+20)
KUF 352	Environmental Sciences	50 (30+20)
KUF 353	Forest Protection	50 (30+20)
KUF 354	Forest genetics and Tree Improvement	50 (30+20)
KUF 355	Participatory Forest Management	50 (30+20)
	Practical	50

	Semester - VI	
KUF 361	Forest Survey and Land use	50 (30+20)
KUF 362	Forest Utilization	50 (30+20)
KUF 363	Wood Science and Technology	50 (30+20)
KUF 364	Forest Economics	50 (30+20)
KUF 365	Watershed Management	50 (30+20)
	Practical	50
	Semester - VII	
KUF 471	Urban Forestry and Ecotourism	50 (30+20)
KUF 472	Biotechnology	50 (30+20)
KUF 473	Climate Change and Mitigation	50 (30+20)
KUF 474	Forest Tree Seeds	50 (30+20)
KUF 475	Computer Application in Forestry and Biostatistics	50 (30+20)
	Practical	50
	Semester - VIII	
KUF 481	Natural Resource Management	50 (30+20)
KUF 482	Remote Sensing and GIS in Forestry	50 (30+20)
KUF 483	Forestry Extension Education	50 (30+20)
KUF 484	Cultivation and Conservation of Medicinal and Aromatic Plants	100 (70+30)
	Practical	50

Note: 1. New ordinance effective from session 2018-19 onwards

Each Subject paper will be of 50 marks (internal: 15 marks, external 35 marks)
Practical carry total 50 marks: (internal: 15 marks, external 35 marks)

2. Old ordinance will remain as such for up to 2017-18 sessions students

Each Subject paper will be of 50 marks (internal: 20 marks, external 30 marks)
Practical carry total 50 marks: (no internal but external carry 50 marks)

I SEMESTER

PAPER I: KUF 111: INTRODUCTORY BIOLOGY

Introduction, importance and scope of biology, living and non-living components, branches of biology. Five kingdom classification (Whittaker classification). Cell: cell structure, plant and animal cell, prokaryotic and eukaryotic cell, cell division- mitosis and meiosis. Tissues: plant tissues. Morphology: stem, leaf and root and modification of stem, leaf and root. Anatomy: dicot and monocot stem, leaf and root; secondary growth. Reproduction of plant: structure of flower, types of inflorescence, types of pollination, vegetative (cutting, grafting, layering, tissue culture) and sexual reproduction in plants; double fertilization. Fruits and types of fruits. Seed, type of seeds, seed germination and its types. Elementary idea of plant taxonomy, basis idea of Bentham and Hooker and Hutchinson classification.

PAPER II: KUF 112: ELEMENTARY MATHEMATICS

The trigonometrically ratios of multiple and submultiples angles, to find the trigonometrically ratios of angles, relation between the sides and the trigonometric ratios of the angles of any triangle. Circle- general equation of a circle, tangent and normal to a circle, parabola, equation of a parabola, ellipse- equation of an ellipse, hyperbola, equation of a hyperbola. Cartesian system of rectangular coordinates (rectangular coordinate axis, Cartesian coordinates of a point, quadrants), distance between two given points, area of a triangle, condition for co linearity of three points, section formulae, centroid of a triangle, slope or gradient of a line, equation of a straight line in intercept form, equation of a line in slope form, equation of a line in general form, angle formed by intersecting lines, condition of parallelism of lines, condition of perpendicularity of lines, equations of a line parallel to a given line and perpendicular to a given line, point intersection of two lines.

PAPER III: KUF 113: FOREST ECOLOGY

Introduction, division, scope and importance of ecology and basic concept of forest ecology. Ecosystem, structure, components and important ecosystems (forest, agriculture, grassland, desert and pond ecosystem). Ecological energetic- concept of energy flow, tropic structure, food chain, food web and ecological pyramids. Forest communities: Vegetation analysis, biomass, net primary productivity, litter fall, forest floor and nutrient cycling. Climatic factors: Solar radiation, temperature, precipitation, rainfall, snow, frost and its damages, moisture, atmospheric humidity and wind. Topographic factors, biotic factors: influence of plant, competition, parasite, epiphytes, climbers, weeds, influence of wild animals, influence of man and his domestic animals. Succession, causes, mechanism of succession, various types of succession and climatic climax, ecological adaptation and evolution.

PAPER IV: KUF 114: PRINCIPLES OF SILVICULTURE

Introduction of forest, forestry, silviculture and silvics. Importance, scope of silviculture and its classification Relation of silviculture with forestry and its branches. Form and growth of trees- Tree morphology: root system, form of root, adaptability and mycorrhizae, crown, branches and foliage, stem- buttressing and fluting. Tree growth: stages of growth, phenology, germination and establishment, seasonal progress of growth, height and diameter growth and reproduction. Forest regeneration: Natural regeneration, methods of natural regeneration, artificial regeneration, methods of artificial regeneration. Tending operations: weeding, cleaning and thinning.

PAPER V: KUF 115 NURSERY TECHNOLOGY

Introduction, importance and objectives of nursery, classifications, nursery sites and area, seed bed, methods of sowing, quality of seeds, time of sowing, shading, watering and damping off. Weeding, soil working and transplanting, nursery material and tools, plant containers, potting media, timing-out and culling. Green manuring, organic compost/manure, farm yard manure

(FYM), bio-fertilizers, mycorrhiza and fertilizer application, macro-propagation and micro-propagation techniques. Green house/mist chamber. Hormones and stimulants for rooting.

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

II SEMESTER

PAPER I: KUF 121: SOCIAL FORESTRY

Introduction, objectives, concept, scope and types of social forestry. Social forestry practices. Income and employment, important social forestry tree species and their characteristics, exotic species and their nurseries (Eucalypt and Poplar). Role of social forestry in rural economy, social forestry in relation to agriculture and environment. Social forestry projects in India, factors effecting success of social forestry projects, urban forestry and small-scale industries.

PAPER II: KUF 122: SILVICULTURE OF IMPORTANT INDIAN TREES

Growth characteristics, distribution, phenology, Silvicultural characters, regeneration methods, management and economic importance of the following species: Conifers: *Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii, P. wallichiana* and *Cupressus torulosa*. Broad leaved: *Quercus sp., Acacia arabica, A. catechu, Dalbergia sissoo, Shorea robusta and Tectona grandis.* Bamboos: *Dendrocalamus strictus*. Exotics: Importance, role in forest economy, purpose of introduction, ecological factors; Establishment and management of Eucalyptus, poplar and exotic conifers (*Pinus* spp.).

PAPER III: KUF 123: PLANTATION TECHNOLOGY

Introduction, aims and objectives of plantation Forestry. Plantation organization and structure. Failures of plantations- reasons for failure and remedial techniques. Seed stands, seed collection, storage and supply of seeds. Stump plantation and advantages of stump planting, patterns of planting. Nurse crops, cover crops and mulching. Fencing and types of fencing, digging of pits and water conservation measures for different sites. Energy plantations. Afforestation of problematic sites-drought prone, arid, marshy, waterlogged area, saline land, sandy soils and suitable species for plantation on these sites.

PAPER IV: KUF 124: FOREST SOILS

Classification of rocks and their characteristic, igneous, sedimentary and metamorphic rocks. History of soils and plant science. Parent materials and soil formation, soil profile, classification of soil, physical and chemical properties of forest soil. Soil water and plant nutrients. Soil amendments and structural management of soils. Saline and alkaline soil. Soil erosion and conservation.

PAPER V: KUF 125: BIODIVERSITY AND FOREST TYPES

Definitions, scope and importance of biodiversity. Regions of biodiversity. Assessment of biodiversity, threats to biodiversity. Biodiversity loss; causes and consequences, Hotspots areas. Biodiversity conservation, botanical gardens, herbal gardens, arboretum, biodiversity parks and herbarium. Red data book and world heritage sites, Classification of forest-basis of classification, Champion and Seth's classification of Forest types of India and Forest types of Uttarakhand Himalaya.

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

III SEMESTER

PAPER I: KUF 231: FOREST MENSURATION AND BIOSTATISTICS

Forest Mensuration: Definition, importance and principles of measurements, System of units and accuracy implied in their expression. Measurements of diameter, girth (circumference) of trees and standard rules of breast height measurement. Bark thickness and tree height measurement and their instruments, principles of height measurement and its measurement at different field conditions. Method of studying tree stem, form- form factor, form quotient, form point and taper table. Volume of tree: definition, object and measurement of volume of felled and standing trees, classification and use of volume tables. Age of trees: object and methods of determination of age of standing and felled trees. Growth of tree, measurement of growth by increment borer and growth curves. Increment, increment percent, CAI and MAI curves.

Biostatistics: Scope and importance of biostatistics in forestry, collection, presentation and summarization of statistical data, frequency distribution, diagrammatic and graphical representation of data. Measures of central tendency (mean, mode and median), measures of dispersion, mean deviation, standard deviation and standard error. Simple correlation and regressions. Elementary idea on probability- binomial and normal distribution. Test of significance: based on normal, t and X^2 test. Sampling techniques: Simple, random, stratified and systematic sampling.

PAPER II: KUF 232: SILVICULTURAL SYSTEMS

Introduction and classification of silvicultural systems, Clear felling systems, shelter wood system, uniform system, group system, irregular shelter wood systems, strip system, selection system, group selection system, accessory system, coppice system, coppice selection system coppice with standard and conversions. Silvicultural systems of important tree species: *Shorea robusta*, *Pinus roxburghii*, *Eucalyptus* spp, *Tectona grandis*, *Cedrus deodara*, *Dalbergia sisoo* and *Populus deltoides*.

PAPER III: KUF 233: PRINCIPLES OF AGROFORESTRY

Definition, objectives, importance and scope of agroforestry, selection of agroforestry tree species and its characteristics. Multipurpose trees (MPTs) in agroforestry, protein bank and fodder tree species, tree-crop interaction, soil productivity aspect of agroforestry, economic aspect of agroforestry, socio-economic and ecological aspects of agroforestry. Agroforestry systems- shifting cultivation, taungya, home garden/homestead garden, hedgerow/alley cropping, agri-silviculture, silvo-pastoral, agri-silvi-pastoral, agri-horticulture, aqua-forestry, etc. Management of trees in agro forestry: lopping, pruning and tending practices. Diagnosis and design techniques in agroforestry.

PAPER IV: KUF 234: FOREST MANAGEMENT AND WORKING PLAN

Definition and scope, management of private forest vis-a-vis public forests, objects of management. Forest organization: Geographical and ecological classification, functional classification, legal classification, territorial classification, administrative classification and Silvicultural classification. Sustained yield, increasing and progressive yield, and arguments for and against sustained yield principles. 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. Yield regulation, concept and principles. Rotation, concept of rotation, types of rotation and conversion period. Working plan: objectives and scope of working plan, unit of working plan, WPO (Working Plan Officer) and preparation of working plan of forest division.

PAPER V: KUF 235: WILDLIFE MANAGEMENT

Definition, concept and history of wildlife management in India, conservation ethics and wildlife values. Population estimation direct and indirect methods. Rare, threatened and endangered species of India. In-situ and ex-situ conservation. Wildlife sanctuaries, National Parks, Zoological parks and Biosphere reserves, Conservation reserve, community reserve, game

reserve and protected area management. Project tiger, project elephant. Human-wildlife conflicts. National Tiger conservation authority, Elephant corridors, Various Government and private agencies involved in wildlife conservation. Wildlife Action Plan and wildlife legislation, Wildlife protection act 1972 and its amendments.

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

IV SEMESTER

PAPER I: KUF 241: FOREST POLICIES AND LAWS

Introduction and background of forest policy, law and act. Forest policy:1894, Indian forest policy: 1952, National forest policy, 1988 and its modification in brief. Indian Forest Act 1927 and 2006, Forest (Conservation) Act 1980, Biodiversity conservation (Bill) 2002, elementary idea of Forest Right Act (FRA) 2006.

PAPER II: KUF 242: FOREST LOGGING

Introduction, scope and logging in Indian and other countries. Forest ergonomics, felling and conservation, logging tools, season of felling, method of felling and conversion. Transportation–transport by land, water, overhead, storage and types of depots of timber, their management, extraction and disposal of timber. Forest labor, labor organization and timber grading.

PAPER III: KUF 243: RANGELAND MANAGEMENT

Introduction, classification of rangeland/grassland, characteristics and adaptability, grassland types of India. Suitable grasses and legumes for improving village grazing land. Culture practices for improvement grassland, fertilization and weed control. Grazing management of pasture and grasslands. Potential of silvipasture system and wasteland development. Role of grasses and legumes in livestock management and soil conservation.

PAPER IV: KUF 244: FORESTS AND TRIBALS

Introduction, characteristics of tribes, tribal life and livelihood. Tribal demography and administration. Social organization: races of Indian tribes, major Indian tribes–Gonds, Santhal, Bhils, Tharu, Bhotia, Van Rawat and other tribes of Uttarakhand. Tribal economy, policies and act of tribal welfare. Tribal in relation to forests.

PAPER V: KUF 245: WORLD FORESTRY

Introduction, world distribution of forests and their classification. Important forest of the world, North America, South America, Europe, Africa, and Asia. Critical examination of world forest resources. Major forest-based Industries of the world. International forestry organizations and agencies. Trade patterns in forestry raw materials. Employment opportunities in forestry sectors.

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

V SEMESTER

PAPER I: KUF 351: TREE PHYSIOLOGY

Introduction and practical application in forestry. Soil-water, absorption of water, water conducting system, transpiration, water stress and drought. Photosynthesis- pigments, mechanisms and factors affecting photosynthesis. Respiration- mechanism, glycolysis and Kreb's cycle, anaerobic respiration and respiratory quotients. Growth and relative growth rate, growth regulators/plant hormones-auxins, gibberellins, cytokinin, ethylene and abscisic acid. Essential and non-essential elements and their deficiency symptoms.

PAPER II: KUF 352: ENVIRONMENTAL SCIENCE

Introduction and components- atmosphere, hydrosphere, lithosphere and biosphere. Natural resources and their management - Forest, wildlife, water, and land resources. Environmental pollution- Types of pollution and pollutants, control and prevention of air, water and noise pollution. Global warming, greenhouse gasses, ozone layer depletion and acid rains, climate change; weather and climate. Role of trees and forest in environmental conservation. Environmental monitoring and concept of sustainable development. Environmental policy and legislation in India- Water (Prevention and Control of pollution) Act 1974, the Air (Prevention and Control of Pollution) Act 1981 and Environmental protection act 1986. Environmental impact assessment.

PAPER III: KUF 353: FOREST PROTECTION

Introduction, kinds of forest protection measures, Protection against injuries by man, deforestation, illicit felling, encroachment, mining, shifting cultivation and forest fire. Introduction of various plant pathogens- fungi, bacteria, viruses, mycoplasm etc. Symptomology and identification of plant diseases. Classification of forest tree diseases and their control. Root, stem and leaf diseases of *Cederus deodara, Pinus roxburghii*, *Acacia catechu*, *Dalbergia sissoo*, *Shorea robusta*, *Tectona grandis* and Poplars. Protection against injuries by insects, major

skeletonizer, defoliators, heart wood and root borers of Sal, Teak, Shisham, Poplar, Toon, Deodar and Pine. Methods of control against insect-pests and diseases; silvicultural, biological, chemical and mechanical.

PAPER IV: KUF 354: FOREST GENETICS AND TREE IMPROVEMENT

Introduction, Mendel's law of inheritance, qualitative- and quantitative characters-Polygenes, lethal genes, complimentary, supplementary, epistasis, inhibitory factors. Tree breeding- control pollination, vegetative propagation, hybridization, polyploidy and mutation. Plus trees and progeny trials, seed orchards, types and management of seed orchards and seed production area. Application of genetics in tree improvement.

PAPER V: KUF 355: PARTICIPATORY FOREST MANAGEMENT

Concept, history and scope, types of participatory management, JFM, Forest Development Agency (FDA), Compensatory Afforestation Management fund and Program Authority (CAMPA), Van panchayat, community forestry, user groups and NGO's. Van panchayat rules and modification, Van panchayat in Uttarakhand, success and failure of JFM. Role of community in natural resource management (NRM). Rapid rural Appraisal (RRA) and Participatory rural appraisal (PRA).

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

VI SEMESTER

PAPER I: KUF 361: FORESTRY SURVEY AND LAND USE

Introduction, classification of survey, chain surveying- principle, instrument used and errors in chain survey. Compass surveying-types and uses, measurement of bearing in WCB and QB systems. Plain table surveying –methods, two point and three point problems and their solutions and error in plane tabling. Leveling, differential leveling, booking and reduction of levels. Topographic survey, map and map reading. Land use survey, soil survey and land capability classification. Soil survey techniques and soil sampling techniques. Land suitability evaluation in major agro-ecological zones of India and its application in land use planning and natural resources protection.

PAPER II: KUF: 362 FOREST UTILIZATION

Introduction, minor forest produce, Importance of non-wood forest products, grass and other products, distillation and extraction of products like grass oil, seed oil, tans and dyes, gum, resin, rubber, fiber and flosses, animals and minerals and other miscellaneous products. Medicinal plants-drugs spices, edible and poisons. Important medicinal plants of Uttarakhand. Important forest industries- Paper and pulp, cutch and katha, lac, Turpentine, bidi, furniture, sport goods, pencils, toys, match and composite wood.

PAPER III: KUF 363: WOOD SCIENCE AND TECHNOLOGY

Wood structure-gross structure of wood, bark, sap wood, heartwood and pith, early wood, late wood, growth rings, grain, texture and identification of wood. Physical properties of wood-weight, density, reaction of heat, sound, light and electricity on wood, thermal expansion, moisture content, porosity, colour, permeability and wood working qualities. Mechanical properties of wood- influencing factors strength, hardiness, flexibility, elasticity, fissility and combustibility. Defects of wood during processing, manufacturing, seasoning; wood destroying

agents; Seasoning of wood- principles and methods, air, solar and kiln seasoning; Wood preservation-causes and methods. Different preservatives and their properties.

PAPER IV: KUF 364: FOREST ECONOMICS

Introduction, definition and scope, micro and macroeconomics. Demand and demand curves and supply and supply curves. Market, market equilibrium, market forms and classification. Production, production theory, production function. Law of diminishing returns, opportunity cost, sunk cost, Net present value, cost-benefit analysis. Economics of timber production.

PAPER V: KUF 365: WATERSHED MANAGEMENT

Introduction, objectives and importance of watershed, Watershed characteristics. Degradation of watershed, soil and water erosion and their conservation measures. Hazards in watershed -flood, drought, sedimentation and their management. Monitoring and evaluation of watershed projects. Role of forests in watershed management. Role of community in watershed management. Holistic approach of Integrated watershed management. Impact of deforestation on watershed and hydrologic cycle. Application of remote sensing and GIS tools in watershed management.

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

VII SEMESTER

PAPER I: KUF 471: URBAN FORESTRY AND ECOTOURISM

Urban forestry: Introduction and concept of urban forestry. Importance and scope of urban forestry. Urban forestry benefits, climatic amelioration, engineering, architectural and recreational uses of urban forestry. Areas available for urban forestry and trees suitable for each such areas in landscaping, desirable characteristics of trees for urban planting, management of urban forest and tree guards. Whole tree transplantation and its technique, responses and adaptation of trees to pollution, climatic variations and urban forests, tree maintenance, tree felling in cities, beneficiaries of products obtained from urban forests. Ecotourism: definition of ecotourism, difference between tourism and ecotourism, role of ecotourism in biodiversity conservation and environment development. Impact of ecotourism: ecological, economical and social impact ecotourism. Afforestation in picnic corners, zoo gardens, camping sites, riding and boating sites and historical places. Pre-historic animals- elephants and ponies for joy rides and transport to picnic corners.

PAPER II: KUF 472: BIOTECHNOLOGY

Introduction, scope and applications. Environmentally sound biotechnology. Genetic engineering and crop improvement, biotechnology of nitrogen fixation, bio-fertilizers and crop production. Biological control of insect-pest diseases, aquaculture, sericulture and vermiculture. Hybridomas and its application, fermentation technology, single cell protein and mushroom technology. Biotransformation and bioleaching, bioenergy and fuels, biodegradation and biodeterioration, new perspectives and problems in biotechnology and bio-information.

PAPER III: KUF 473: CLIMATE CHANGE AND MITIGATION

Climate change an introduction. Greenhouse gases, greenhouse effect, possible effects of global climate change on various ecosystems. Tools to study the global climate change, approaches to deal with global climate change. International initiatives for mitigating global climate change

and India's initiatives for mitigating climate change. Wetlands, types and conservation of wetlands. Relationship between climate and Forestry.

PAPER IV: KUF 474: FOREST TREE SEEDS

Seed, seed biology and seed production. Seed sources, seed collection and handling. Seed testing, Seed storage, seed dormancy. Seed germination and seedling establishment. Seed certification and quarantine. Seed act and International seed testing agencies, seed requirement and exchange. Seed pathology. Important seed insects and pests.

PAPER V: KUF 475: COMPUTER APPLICATION IN FORESTRY AND BIOSTATISTICS

Basic computer organization (input/output, storage unit, ALU, CU, CPU), memory storage. Operating system, basic concept of computer software. Biostatistics -scope and importance in forestry, collection presentation and summarization of statistical data, frequency distribution, diagrammatic and graphical representation of data. Measures of central tendency, measures of dispersion, mean deviation, standard deviation and standard error. Simple correlation and regressions. Elementary idea on probability- binomial and normal distribution. Test of significance- based on normal, t and X^2 test. Sampling techniques – Simple, random, stratified and systematic sampling.

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

VIII SEMESTER

PAPER I: KUF 481: NATURAL RESOURCE MANAGEMENT

Definition, classification of natural resources. Interrelationships among different types of natural resources. Renewable and non-renewable natural resources-availability and distribution; sustainable management and conservation. Forest resources- definition, forest biodiversity and ecosystem conservation, grassland and their distribution. Wetland ecology- management and conservation. Water resources- major pool of water, distribution, availability, water foot print, advantages and disadvantages of river valley projects. Threats, management and conservation of mangroves and coral reef resources. Mineral resources- types, use and exploitation, environmental effects of extracting and using mineral resources. Resource management planning, protecting traditional knowledge, green business and green ethics, Corporate Social Responsibility as a tool for sustainable NRM based industries.

PAPER II: KUF 482: REMOTE SENSING AND GIS IN FORESTRY

Basics of remote sencing- platform and sensor remote sensing. Remote sensing satellites, image and groung truth. Systems for data collection and analysis. GIS- basic concept and GIS tools and components. GIS application in forestry. GPS and its uses. Advantages of RS and GIS future prospect.

PAPER III: KUF 483: FORESTRY EXTENSION EDUCATION

Introduction, Frame work for forestry extension- organization setting, extension models, problems solving model, linkage model, social interaction model, strategies for extension and problem in extension. Planning and implementing extension campaigns. Technology transfer, identification of leaders and formation local association, extension communication process, mass media, television, radio, poster and group discussion. Tree farmers excursion. PRA and RRA tools, Follow up of extension, consultancy, evaluation of quality assessment of returns, marketing products and case studies in extension.

PAPER IV: KUF 484: CULTIVATION AND CONSERVATION OF MEDICINAL AND AROMATIC PLANTS

Definition. History of medicinal plant cultivation. Medicinal Plants of different climatic zones of Uttarakhand. Some rare, endangered and threatened medicinal plant species of Uttarakhand. Study of some following commercially important aromatic and medicinal plants: Trees: *Terminalia chebula, Terminalia bellerica, Phyllanthus emblica Rhododendron species, Taxus baccata /wallichiana, Azadirachta indiaca, Syzygium cumini.* Shrubs: *Vitex negundo, Juniperus communis, Woodfordia fruticosa, Cinnamomum tamala.* Herbs: *Picrorhiza kurroa, Aconitumbalfourii/ heterophyllum, Valeriana jatamansi, Rheum emodi, Swertia chirayita, Ocimum sanctum, Mentha sp., Rauwolfia serpentina and Withania somnifera.* In-situ and ex-situ conservation of medicinal of plants. Uses of medicinal and aromatic plants. Methods of cultivation of some medicinal and aromatic plants. Role of medicinal and aromatic plants in livelihood and income generation.

Practical

- Practical will includes all the exercises as given by respective subject teachers covering all the theory papers.

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