

**Course structure and Syllabus for I to VIII Semesters of
B.Sc. (Forestry)**

4 year degree programme. 2017 and onward Batches

Submitted to

Board of Studies in Forestry

Faculty of Science

Osmania University

Semester-I		
Course code	Course	Credits
BFC 101	Introduction to Forestry	2+0
BFC 102	Dendrology	2+1
BFC 103	Introduction to Agronomy and Horticulture	2+1
BFC 104	Fundamentals of Geology & Soil Science	2+1
BFC 105	Environmental Studies and Disaster Management	2+1
BFC 106	Information & Communication Technology	1+1
BFC 107	Basic Mathematics	1+1
BFC 108	Communication Skills and Personality Development	1+1
BFC 109	NCC/NSS/ Physical Education	0+1
	Total	13+8 = 21

Semester I

1. **BFC 101 -Introduction to Forestry** **2+0**

Theory:

Unit.1

Forests; definitions, role, benefits; direct and indirect. History of Forestry- Forestry- definitions, divisions and interrelationships. Classification of forests- Forest types- Agricultural lands and forests- Agroforestry systems; differences in nutrient cycling, diversity etc.

Unit. 2

Social forestry, joint forest management; programmes and objectives. Important acts and policies related to Indian forests. Global warming; forestry options for mitigation and adaptation- carbon sequestration. Introduction to world forests- Geographical distribution of forests and their classification- Factors influencing world distribution of forests- productivity potential and increment of world forests.

Unit. 3

Forest resources and forestry practices in different regions of the world; Western Europe, North America, Central Africa, Australia, Central America, Russia, Japan, and China.

General problems of forest development and economy at national and Telangana State level.

Unit. 4

Forest based Industries in developed and **developing countries with special reference to India in general and Telangana in particular.** Trade patterns of forest based raw materials. Recent trends in forestry development in the world. National and international organizations in forestry. Important events/dates related to forests and environment-themes and philosophy.

Suggested reading :

Beazley, M. 1981. The International Book of Forest. London

Champion and Seth. 1968. Forest types of India.

Grebner, D.L., Bettinger, P. and Siry, J.P. 2012. Introduction to Forestry and Natural Resources.

Academic Press. 508p (Google eBook).

Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi.

Mitchell Beazly. 1981. The International Book of the Forest. Mitchell Beazly Publishers, London.

Mather, A.S. 1990. Global forest resources. Belhaven, London

Persson, R. 1992. World forest resources. Periodical experts, New Delhi.

Westoby, J. 1991. Introduction to World Forestry. Wiley, 240p.

2. BFC 102 Dendrology 2+1

Theory :

Unit: 1

Introduction to dendrology – history, significance of dendrological studies and applications in tree identification; Botanical Nomenclature – ICBN (International code of Botanical Nomenclature) Rules and Codes of ICBN, Binomial and Polynomials; Systems of classification – Natural, Artificial and Phylogenetic classification. Principles of systematic. Demerits and merits of plant classification as given by Engler and Prantl, Hutchinson and Bentham and Hooker.

Unit: 2

Morphology as a tool for tree identification – Field characters – Branching pattern, Leaf, Fruit and Bark. Role of reproductive characters (Flower types, floral formulas and floral diagrams). Reproductive morphology of plants with reference to description and identification of reproductive parts; General form of woody trunk and deviations like buttresses, flutes, crooks, etc.

Morphology and description of bark of common Indian trees including types of exfoliation patterns in bark; Characteristics of blaze on bark, colour, gums, latex, Resins, Oleo-gum-resins including common trees yielding tannins, gums, resins and other secondary products.

Unit: 3

Methods of Floristic survey and need for botanical explorations; herbarium techniques, collection, processing and preservation of plant material. General study of herbarium, arboretum, Palmetum, Fruticetum, Bambusetum and Xylarium; Allelopathic interactions of forest trees; Endemic, Rare, Endangered, Threatened and Exotic trees of India.

Unit: 4

Study of families, as survey of trees or woody plant resources: Magnoliaceae, Rhizophoraceae, Ebenaceae, Sapotaceae, Caesalpiniaceae, Santalaceae, Mimosaceae, Elaeagnaceae, Fabaceae, Meliaceae, Salicaceae, Lauraceae, Apocynaceae, Betulaceae, Fagaceae, Moraceae, Tiliaceae, Euphorbiaceae, Pinaceae, Dipterocarpaceae, Cupressaceae, Guttiferae (Clusiaceae), Taxaceae, Myrtaceae, Rubiaceae, Sterculiaceae, Bignoniaceae, **Lamiaceae, Cycadaceae** and Combretaceae.

Practical:

Morphological description of plant parts with special reference to identification – Types of leaves, Phyllotaxy, Venation, Inflorescence and bark identification; Methods of plant collections and herbarium preparation; Study of trees and woody plants of Magnoliaceae, Ebenaceae, Caesalpiniaceae, Mimosaceae, Fabaceae, Meliaceae, Tiliaceae, Pinaceae, Myrtaceae, Rubiaceae, Sterculiaceae, Bignoniaceae, Combretaceae, **Moraceae, Lamiaceae, and Cycadaceae**; Visit to Botanical gardens and Arboretum for identification.

Suggested reading:

R. Naqshi. (1993). *An Introduction to Botanical Nomenclature*. Scientific Publishers. Jodhpur.

Ashok Kumar (2001). *Botany in Forestry and Environment*. Kumar Media (P) Ltd. Gandhinagar, Gujarat.

Charles McCann. (1966). *100 Beautiful Trees of India*. D. B. Taraporevala Sons & C. Pvt. Ltd. Mumbai. (Available online PDF)

D. Brandis. Revised by R. D. Jakarti (2010). *Indian Trees..* Dehradun.

D. N. Tewari (1992). *Tropical Forestry in India*. International Book Distributors, Dehradun.

Father H. Santapau. (1966). *Common Trees*. (Available online PDF)

Eric A. Bourdo Jr. (2001). *The Illustrated Books of Trees. A Visual Guide to 250 species*. Published by Salamander Books Pvt. Ltd. London. (Available online PDF)

Gurucharan Singh. (2000). *Plant Systematics*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

K. C. Sahni. (2000). *The Book of Indian Trees*. Bombay Natural History Society. Mumbai.

M. S. Randhawa. (1957). *Flowering Trees in India*. Sree Saraswati Press Ltd. Kolkatta.

N. L. Bor (1990). *Manual of Indian Forest Botany*. Periodical Expert Book Agency. New Delhi.

Pradip Krishnen (2013). *Jungle Trees of Central India*. Published by Penguin Books India Pvt. Ltd. New Delhi.

R. N. Parker. (1933). *Forty Common Indian Trees and How to know them*.
(Available online PDF)

S. K. Jain and R. R. Rao. (1977). *Handbook of Field and Herbarium Methods*.

Today and Tomorrow's Printers and Publishers. New Delhi.

S. N. Pandey and S. P. Mishra. (2008). *Taxonomy of Angiosperms*. Ane Books

India, New Delhi.

S. R. Mishra. (2010). *Textbook of Dendrology*. Discovery Publishing House

Pvt. Ltd. New Delhi.

3. BFC 103 Introduction to Agronomy and Horticulture 2+1

Theory:

Unit: 1

Agronomy, scope and its role in crop production-Major Field crops of India – classification, area, distribution and productivity of major Field crops. Farming and cropping systems – mono, sole and multiple cropping, relay, sequential and inter cropping. Tillage- definition- objectives – types of tillage- tillage implements – tilth - characteristics of good tilth.

Unit: 2

Soil productivity and fertility- Crop nutrition – nutrients –classification – Nutrient sources- organic manures –fertilizers – bio-fertilizers- Integrated Nutrient Management-Importance of water in plant growth- Soil properties influencing moisture availability – texture, structure and organic matter status-Irrigation and drainage.

Unit: 3

Weed control – definition and characteristics of weeds, classification of weeds – damages due to weeds - benefits of weeds. -Control Vs prevention of weeds – methods of weed control- Classification of herbicides–Integrated weed management. Soil and its management Definitions and importance of horticulture- Economic importance and classification of horticultural crops and their culture and nutritive value. **Concepts of Roof gardens, indoor plants and homestead plantations.**

Unit: 4

Area and production- exports and imports- fruit, vegetables, plantation and spice crops-soil and climate–principles-planning and layout- management of orchards- planting systems and planting densities- Principles and methods of pruning and training of fruit, plantation crops- use of growth regulators in horticulture crops-Horticultural zones of state and country.

Practical:

Identification of field crop and tillage implements. Preparation of seed beds, identification of fertilizers and manures – mixing chemical fertilizers – calculating fertilizer requirements. Identification of green manure plants. Identification of important weeds of the region with particular reference to forest plantations. Preparation of weed herbarium. Calculations of spray volume and herbicide concentrations.

Methods of application of herbicides. Identification of horticultural crops-garden tools and implements. planning and layout of orchard and plantations. Digging and filling of pits for fruit and plantation crops-planting systems, training and pruning of orchard trees-preparation and application of regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits-bearing habits and maturity standards, harvesting, grading, packaging and storage.

Suggested Reading:

Balasubramanian, P and Palaniappan, S.P.. 2001. Principles and Practices of Agronomy.

Fundamentals of agronomy. Oxford & IBH Publishing Co., New Delhi

ICAR.2006. Hand book of Agriculture , ICAR, New Delhi.

Reddy.S.R.1999. Principles of Agronomy, Kalyani Publishers, Ludhiana.

Bose, T.K. 1985. Fruits of India- Tropical and subtropical. Naya Prakash, Calcutta

Basic Horticulture by Jitendra Singh

Principles of horticulture by Prasad and Kumar

Basic Concepts of Fruit Science by Neeraj Pratap Singh

Theory:

Unit: 1

Introduction: - Introduction to geology and soil science and their major branches, concept(s) of earth, land and soils. The earth - origin, major division of the earth (atmosphere, hydrosphere and lithosphere), interior of the earth, earth's crust and its elemental composition. Soil- concept, definition, functions and characteristics of soils, major components of soils (volume basis), surface soil, sub soil, cultivated and forest soils. Weathering and soil formation Rocks and minerals and its occurrence, rock cycle, classification of rocks - igneous, sedimentary and metamorphic rocks, classification of minerals, weathering of rocks and minerals, weathering agents and active and passive factors affecting soil formation. Soil profile: - Definition, master horizons, transitional and subordinate horizons, solum and regolith, fundamental and specific pedogenic processes of profile development/soil formation. Soil physical properties: - Importance of physical properties and factors governing it.

Unit: 2

Soil texture - definition, determination of soil texture, methods of determination, Stoke's law and its assumption and limitations, classification of soil separates (sand, silt, clay), characteristics of soil separates and its influence on properties and behavior of soils, textural classes based on textural triangle. Soil structure - definition, formation, classification, factors affecting it and importance of soil structure. Soil consistency - stickiness and plasticity, indices of soil plasticity, Soil crusting, Soil compaction. Soil density and porosity - definition and relationship, calculation of porosity and hectare soil weight, importance of bulk density and porosity and factors affecting it. Soil colour - determination of soil colour and factors affecting it. Soil air and its composition, aeration and importance of soil air in agriculture. Soil temperature - sources and losses of heat, thermal properties of soil and effect of temperature on plant growth.

Unit: 3

Soil colloids: - Description and important properties of soil colloids, classification of soil colloids based on their nature and elemental composition and their explanation and distribution (in short), silicate clay minerals, structure (silica and alumina sheet) and type of silicate clay minerals (1:1, 2:1 and 2:1:1 type), sources of charge on soil colloids. Soil organic matter: - Definition and origin of soil organic matter in the soil, composition of soil organic matter, decomposition of organic matter and factors affecting it, various organisms involved to decompose organic matter, humus formation. Role of organic matter in the soil. Soil reaction (pH): - Concept and definition, importance of soil reaction (pH), reaction of forest soils, buffering capacity of soils. Soil water: - Meaning and importance of soil water, structure and properties of water, potential of soil water, physical and biological classification of soil water, units for water measurement, soil water constants, movement of soil water, entry of water in soils and determination of soil water.

Unit: 4

Soil survey and classification: - Soil survey– definition, objective, type and importance of soil survey. Soil classification- History, comprehensive systems of soil classification, soil orders and its salient features, land capability classification, soils of different ecosystem and their properties. Problematic soils: - Definition, major problematic soils of India viz. acid soils, sandy soils, clay soils, salt affected soils, calcareous soils, water logged soils and compacted soils, their key diagnosis and major constraints for crop production, causes of different problem soils and its impact on soil properties. Quality of irrigation water: Quality parameters and assessment

Practical:

Introduction to soil science laboratory, collection and preparation of soil samples, identification of rocks and minerals, profile study in the field and Excursion tour for identification of rocks and minerals and profile studies, mechanical analysis of soils, determination of bulk density, particle density, porosity, soil colour and soil temperature. Determine soil pH, soil EC and soil organic matter. Determine water soluble and exchangeable cations.

Suggested reading:

Biswas, T. D. and Mukherjee, S. K. 2001. Test Book of Soil Science (2nd Edition), McGraw Hill Education (India) Private Limited, New Delhi.

Brady, N. C. and Weil, R. R. 2010. Elements of the Nature and Properties of Soils (3rd Edition.), Pearson Education, New Delhi

Brady, N. C. and Weil, R. R. 2010. The Nature and Properties of Soils (14th Edition), Pearson Education, New Delhi

Foth, H.D. 1991. Fundamentals of Soil Science (8th Edition), John Wiley & Sons, New Delhi.

Das, D .K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).

Khan, T. O. 2013 Forest Soils: Properties and Management, Springer International Publishing, Switzerland

ISSS, 2002. Fundamentals of Soil Science. Indian Society of Soil Science, IARI, New Delhi.

Pritchett and Fisher RF 1987. Properties and Management of Forest Soils. John Wiley, New York.

Gupta, P.K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), AGROBIOS, Jodhpur (India).

Jaiswal, P.C. 2006. Soil, Plant and Water Analysis (2nd Edition), Kalyani Publishers, Ludhiana.

Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course, Scientific Publisher

5. BFC 105 Environmental Studies and Disaster Management 2+1

Unit: 1

Multidisciplinary nature of environmental studies Definition, scope and importance Natural Resources: Renewable and non-renewable resources Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles. Ecosystems • Concept of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem :-a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit: 2

Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: definition, cause, effects and control measures of :- a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Social Issues and the Environment: From Unsustainable to Sustainable development Urban problems related to energy Water conservation, rain water harvesting, and watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Unit: 3

Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act Wildlife Protection Act Forest Conservation Act Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Program. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

Unit: 4

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels.

International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

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

Suggested reading:

Ghadekar, S.R. (2003) Meteorology, Agromet Publishers, Nagpur

Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi

Mavi, H.S. (1994) Agrometeorology, Oxford&IBH, New Delhi

Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,

Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg

Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi

Adam Markham (Editor).2010. Potential Impacts of Climate Change on Tropical Forest Ecosystems. Amazon publishers.

Bravo, F., LeMay, V., Jandl, R., Gadow, K. von (Eds.).2008. Managing Forest Ecosystems: The Challenge of Climate Change. Springer publication. Pp 324

Charlotte Streck, Robert O'Sullivan, Richard G. Tarasofsky, Toby Janson-Smith.2011. Climate Change and Forests: Emerging Policy and Market Opportunities. Brookings Institution Press.

Claussen, Eileen; Cochran, Vicki Arroyo; Davis, Debra P.; Pew .2001. Climate Change: Science, Strategies, & Solutions. Brill Academic Pub. Pp 393

Peter H Freer-Smith, Mark S J Broadmeadow, Jim M Lynch.2011. Forestry and Climate Change. CABI Publishers.

Peter Thompson. 1991. Global warming – The debate. Strategy Europe Ltd., London, U.K. p. 130.

Richard Max-Lino.2012. Sustainability, Climate Change, Forestry and Forest Carbon. World Scientific Publishing Co. pp 250.

Theory:

Unit: 1

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; word and character representation;

Unit: 2

Features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts;

Unit: 3

Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX
Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP;

Unit: 4

Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation of A.V aids; video conferencing.

Practical: Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual program.

Unit 1

Elementary idea of complex number. Arithmetic and Geometric progressions. Elementary idea of permutation and combinations.

Unit 2 Binomial theorem for positive integral index, any index and their applications, addition and subtraction formulae. A, B and C, D formulae. Sine and Cosine formulae.

Unit 3

Inverse Trigonometric functions. Introduction to matrices and determinants, special type of matrices, addition, subtraction and multiplication of matrices. Inverse of a matrix solution of system of linear equations using Cramer's rule

Unit 4

Matrices method. Measures of central tendency and dispersion. Correlation and Regression.

Elementary idea of probability theory.

Practical:

Problems in Arithmetic and Geometric progressions. Problems in permutation and combinations. Problems in Binomial theorem for positive integral index, any index and their applications. Problems on addition and subtraction formulae. Sine and Cosine formulae.

Problems in Inverse Trigonometric functions. Problems in matrices and determinants, special type of matrices, addition, subtraction and multiplication of matrices. Inverse of a matrix solution of system of linear equations using Cramer's rule. Problems on Measures of central tendency and dispersion. Correlation and Regression. Problems on probability theory.

8. BFC 108 Communication Skills and Personality Development 1+1

Unit 1

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking.

Unit 2

Writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures.

Unit 3

Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations.

Unit 4

Impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences.

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

Semester-II		
Course code	Course	Credits
BFC 110	Plant Physiology	2+1
BFC 111	Plant Biochemistry	1+1
BFC 112	Principles of Silviculture	2+1
BFC 113	Wood Anatomy	1+1
BFC 114	Forest Protection	2+1
BFC 115	Wildlife Biology	2+1
BFC 116	Statistical Methods and Experimental Techniques	2+1
BFC 117	Principles of Plant Cytology and Genetics	2+1
BFC 118	NCC/NSS/ Physical Education	0+1
	Total	14+9 = 23

Semester - II

1. **BFC 110 Plant Physiology** **2+1**

Theory:

Unit 1

Introduction to plant physiology. Water relation in plant, osmosis, diffusion, imbibition-theories of ascent of sap- transpiration- different type of stress- plant nutrition- Seed physiology – physiological maturity – morphological and physiological changes associated with physiological maturity of plants

Unit 2

Seed viability and vigor – factors affecting seed viability and vigor. Seed dormancy- types, breaking dormancy- Morphological, physiological and biochemical changes during seed development.

Unit 3

Physiology of seed germination. Growth and development – definition – types of growth – determinate and indeterminate growth – Measurement of growth – growth analysis – growth characteristics

Unit 4

Translocation of assimilates – phloem loading – apoplastic and symplastic transport of assimilates – mechanism of phloem transport – phloem unloading - Source and sink concept – Plant hormones and their mode of action.

Practical's:

Preparation of solutions – Demonstration of osmosis, diffusion and imbibition- Estimation of chlorophyll - Anatomical difference between C₃ ,C₄ and CAM plants - Methods of breaking dormancy in tree species - Biometric measurement of plant growth; Height, Girth, Biomass - Plant growth analysis – RGR, NAR, LAR - specific leaf area and leaf weight ratio - LAI - CGR – LAD etc.

Suggested reading:

Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.

Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons.
New York

Larcher, W. (2003). Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups. Springer Science & Business Media

Longman, K.A. and Jenik, J. (1987). Tropical Forests and its Environment. ELBS, London
Raven, P., Johnson, G.B., Mason, K.A., Losos, J.B., Singer, S.S. (2014). Biology (10th edition) . McGraw-Hill Education, London

Salisbury, F. B. and Ross, C. W. (2004) . Plant Physiology. Thomson Asia Ptd, Ltd. Singapore.

Taiz, L. and Zeiger, E. (2010) Plant Physiology (5th edition). Sinauer Associates, Inc., Massachusetts.

Theory:

Unit 1

Introduction to plant Biochemistry. Chemistry of carbohydrates – classification, mono, di and polysaccharides, anomerism, epimerism, mutarotation, configuration of sugars and inversion.

Unit 2

Chemistry of lipids – classification. Fatty acids and its classification. Chemistry amino acids, peptides and proteins, classification, levels of protein structure. Chemistry of nucleic acids – bases, sugars, Nucleosides and nucleotides. Structure and function of RNA and DNA.

Unit 3

Enzymes – classification, enzyme kinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes. Metabolism of carbohydrates

Unit 4

Photosynthesis – light reaction, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3 and C4 plants, CO₂ fixation, regulation of photosynthesis -glycolysis, TCA cycle, electron transport chain. Lipids metabolism – beta oxidation and fatty acid biosynthesis.

Practical:

Qualitative tests for carbohydrates, Quantitative estimation of reducing sugars- Qualitative tests for lipids, Determination of Saponification number of oils/fats, Determination of Iodine number of fatty acids- Qualitative tests for proteins/amino acids, Estimation of protein by Lowry's method- thin layer chromatography.

Suggested Readings

Conn, E.E. and Stumpf, P.K. (1989). Outlines of Biochemistry, Wiley Eastern Ltd., New Delhi

Mazur, A and Harrows, B. (1971). Textbook of Biochemistry. W.B. Sanders Publications, New Delhi

Robert, C. B. (1983). Modern concepts in Biochemistry. Allyn and Bacon Inc. London

William , H.E. and Daphne, C.E.(2005). Biochemistry and Molecular Biology, Oxford University Press.

Sadasivam, S and Manickam, A. (2008). Biochemical methods, New age International (P) limited,Publishers.

Theory :**Unit 1**

Definition of forest and forestry. Classification of forest and forestry, branches of forestry and their relationships. Definition, objectives and scope of Silviculture. **Status of Forest of India with special reference to Telangana State.** Role of Forests. History of forestry development in India. Trees and their distinguishing features. Growth and development. Forest reproduction - flowering, fruiting and seeding behavior.

Unit 2

Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of climatic factors. Role played by light, temperature, rainfall, snow, wind, humidity and evapotranspiration in relation to forest vegetation. Bioclimatic and micro climate effects. Edaphic factors - influence of biological agencies, parent rock, topography on the soil formation.

Unit 3

Soil profile – physical and chemical properties, mineral nutrient and their role, soil moisture and its influence on forest production. Physiographic factors - influence of altitude, latitude, aspect and slope on vegetation. Biotic factors - influence of plants, insects, wild animals, man and domestic animals on vegetation. Impacts of controlled burning and grazing. Influence of forests on environment.

Unit 4

Tending and cultural operations- weeding- kinds of weeding- release operations- singling, cleaning–liberation cutting-girdling- chemical treatment-peeling. Thinning-kinds of thinning - improvement felling- salvage cuttings- pruning- pollarding, lopping. Forest types of India and their distribution. Plant- forest succession, competition and tolerance.

Practicals :

Acquaintance with various silvicultural terms. Study about habits of plants and developmental stages of tree growth and its structure. Study about tree morphology- stem, crown and root characters. Vegetative and reproductive phenology. Study of site factors like climatic, edaphic, physiographic and biotic. Study of microclimate and forest soils. Study of forest succession.

Study of different forest types of Telangana State. Various tending operations- weeding, cleaning, singling, pruning, pollarding, lopping and thinning.

Suggested reading :

Baker, F.S. 1950. Principles of Silviculture, McGraw Hill, N.Y.

Champion, H.G. and Trevor, G. 1936. Handbook of Silviculture, Cosmo Publication, New
Delhi

Daniel, T.W., Helms, J.A., Baker, F.S. 1970. Principles of Silviculture, McGraw Hill, N.Y.

Dwivedi. A. P. 1993. Textbook of Silviculture. International Book Distributors.

Evans, J E. 1982. Plantation Forestry in the Tropics. The English Language Book Society
and Clarendon Press – Oxford

Gunter, S., Weber, M, M Stimm, B and Mosandl, R. 2011. *Silviculture in the Tropics*. Springer-Verlag Berlin.

Haig, I. T. Huberman, M. A. and Aung Din, U. 1986. *Tropical Silviculture, Vol. I and II*. Food and Agriculture Organization of the United Nations, Rome and Periodical Experts Book Agency, D-42, Vivek Vihar, Delhi – 110 032.

Khanna, L.S. 1989. *Principles and Practice of Silviculture*. Khanna Bandhu, 7 Tilak Marg, Dehra Dun

Kostler, J. 1956. *Silviculture*. International Book Distributors, P.O. Box 4. Dehra Dun

Lal, J. B. 2003. *Tropical Silviculture, New Imperatives: New Systems*, International Book Distributors, P.O. Box 4. Dehra Dun.

4. BFC 113 Wood Anatomy 1+1

Theory:

Unit 1

Introduction to Wood Anatomy. The plant body–Cell and organelles, Kinds of woody plants–Porous wood and non-porous wood. The plant body; a tree and its various parts. Types of plant tissues–meristems, promeristem, primary meristem, secondary meristem, apical and intercalary meristems. Simple tissues- parenchyma, collenchyma, sclerenchyma. Complex tissues-Xylem and Phloem. Tissue system-vascular bundles/vascular tissue system.

Unit 2

Anatomy of stems and roots of dicots and monocots. The secondary growth in woody plants. Mechanism of wood formation in general, and with special reference to typical dicot stem. Physiological significance of wood formation. General/physical features of wood; colour, hardness, weight, texture, grain, lusture, etc. The macroscopic features of bark, wood, sapwood, heartwood, pith, juvenile wood, mature wood, growth rings-early and late wood.

Unit 3

Transformation of sapwood to heartwood, factors affecting transformation. The microscopic features of wood- tracheids, vessels, fibers, axial parenchyma (soft tissues), wood rays, resin canals, gum canals, latex canals and cell inclusions. Three dimensional features of wood; transverse, tangential and radial surfaces.

Unit 4

Abnormalities in wood- deviation from typical growth form (leaning, bending, crook, fork, buttress), grain deviation, false and discontinuous growth rings. Reaction wood-compression and tension wood. Disruption of continuity of inner wood, shakes, included bark, resin pockets, pith flecks, live knots and dead knots.

Practical:

Study of primary growth in typical dicot and monocot stems; Study of vascular bundles in monocots and dicots; Study of three dimensional features (cross, radial and tangential planes) of logs (woody trunks); Comparative anatomical features of softwoods and hardwoods; Study of general properties of wood. Study of anatomical features of different types of wood pores /vessels; Study of soft tissues in timbers and their distribution; Study of wood rays and their types; Study of non-porous woods, their physical and anatomical description; Study of cell inclusions in wood. Study of gross anatomical features of wood for field identification of *Tectona grandis*, *Dalbergia latifolia*, *Anogeissus latifolia*, *Terminalia alata*, *Santalum album*, *Pterocarpus marsupium*, *P. Santalinus*, *Azadirachta indica*, *Pongamia pinnata* and *Eucalyptus spp.*

Suggested Reading:

Evert R.F. 2006. Esau's plant anatomy-Meristems, Cells, and tissues of the plant body: their structure, function and development.601 pp.

Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.

Pearson R.S. and Brown, H.P. 1981. Commercial timbers of India-Volume1 and 2.1135 pp.

Rao, R. K. and Juneja, K. B. S. 1971. Field identification of fifty important timbers of India. Indian Council of Forestry Research and Education, New Forest, Dehra Dun. 123p.

Chowdhury K.A. 1951. West Bengal commercial timbers-their identification, properties and uses Vol. 1. Indian Forest Records (New series), 96 pp.

5. BFC 114 Forest Protection 2+1

Theory

Unit 1

Introduction – Importance of protection in Indian Forestry – classification of injurious agencies.

Injury to forest due to fires, causes and character of forest fires – fire prevention activity – fire suppression – fire fighting equipment's – fire control policy and objectives. Fire fighting in other countries. Injury to forest due to man, lopping – cutting for fuel wood – Encroachment- different types, control of encroachment illegal felling of trees- method of control legislation. **Live fences with special reference to *Caesalpinia bonduc***

Unit 2

Forest weeds and weed management, management of woody climbers, parasites and epiphytes.

Importance of Forest Pathology, tree disease classification, Principles of tree disease management, - Causes and symptoms- losses due to forest tree diseases, root diseases (wilt, root-and butt rot)

Unit 3

Stem diseases (heart rots, stem blisters, rusts, stem wilt, cankers, pink diseases, gummosis, water blister) and foliar diseases (rust, powdery mildew, leaf spot, leaf and twig blight, abnormal leaf fall, needle blight etc.) of Etiology, symptoms, mode of spread, epidemiology and management, including chemical, biological, cultural and silvicultural practices. Nursery diseases and their management. Disease due to physiological causes. Abiotic diseases. Forest Entomology in India. Methods and principles of pest control: Mechanical, physical.

Unit 4

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

Practical:

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

Suggested reading:

Agrios, G.N., (1997). Plant Pathology. 4thEdn, Horcourt Asia Pvt. Ltd., Singapore.

Basher, A.E.S. (1983).Forest Fires and Their Control. Gulab Primlani Amerind Publishing,
New

Brown, A.A and Davis, K.P. (1973). Forest Fire Control and Use. Mc Graw Hill Book Co.
New York. Delhi.159p.

Elton, C. S. (2000). The Ecology of Invasions by Animals and Plants. University of Chicago Press.

Fuller, M. (1991). Forest Fires. Wiley Nature Editions, New York.

Ghadekar, S.R. (2003) Meteorology . Agromet Publishers, Nagpur

Hal, R.B.(1990). Principles and Procedure of Range Management. International Book Distributors,Dehra Dun.

Johnson,A.E and Miyanishi, K. (2001). Forest Fires: Behavior and Ecological Effects. Academic Press.

Khanna, L.S.(1988). Forest Protection. Khanna Bandhu, Dehra Dun.206p.

Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi

Luna, R.K. (2007). Principles and Practices of Forest Fire Control. International Book Distributors, Dehradun.466p.

Mavi, H.S. (1994) Agrometeorology . Oxford & IBH, New Delhi

Negi, S.S. (1999). Handbook of Forest Protection. International Book Distributors. 271p.

Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,

Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer
Berlin Heidelberg

Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi

Bakshi, B.K., (1976), Forest Pathology; Principles and Practices in Forestry. Pub.
Comptroller of Publications, Delhi. 400p.

Boyce, J.S. (1961). Forest Pathology, 3rd edition. McGraw-Hill. New York, New York. 572
pp

Devasahayam, H.L. and Henry, L.D.C. (2009). Illustrated Plant Pathology- Basic Concepts.
New India Publishing Agency

Mohanam, C. (2011). Macrofungi of Kerala, KFRI, Peechi. p.597

Pathak, V.N., Khatri, N.K. and Manish Pathak. (2000). Fundamentals of Plant Pathology.
Eds. Agribios (India), Jodpur. 356 p.

Singh, R.S (2002). Introduction Principles of Plant Pathology. Oxford & IBH, New Delhi

6. BFC 115 Wildlife Biology 2+1

Theory:

Unit 1

History of Wildlife in India; Values of Wildlife: Ethical, cultural, scientific, economical, aesthetic & negative values; Basic requirements of wildlife – food, water, shelter, space, limiting factors;

Unit 2

Food chain, Food web, Ecological pyramids; Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity; Effect of light and temperature on animals; Zoogeographical regions (Animal Distribution)

Unit 3

Biomes of the world; Wildlife Habitat: Niche, Territory, Home Range, Territoriality, Edge, Cruising Radius, Carrying Capacity; Animal behavior and adaptation; Wildlife census;

Unit 4

Habitat Improvement: Food, Water, Shelter improvement; Captive wildlife: Zoos and safari parks, Captive breeding for conservation, Central zoo authority of India. **Important Protected Areas of Telangana State.**

Practical:

Measuring and mapping habitat variables; Estimating abundance and monitoring of wildlife species and their habitats; Remote Sensing and GIS techniques in Wildlife Conservation; Important protected areas of India; Study of indirect evidence (pugmarks, excreta etc.) of wildlife. **Visit to Nehru Zoological park.**

Suggested reading

Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. Oxford University Press, New Delhi.

Dasman, R.F. 1982. Wildlife Biology. Wiley Eastern Ltd. New Delhi.

Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA.

International Zoo Books, Published by New York Zoological Society, New York

Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press

Lever, C. 1985. Naturalised mammals of the world. John Wiley, London

Mathur R. 1985. Animal Behaviour. Oxford University Press

Mills, L. S. 2013. Conservation of Wildlife Populations Demography, Genetics and Management (Ed.2). Wiley-Blackwell.

Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.

Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun

Sukumar, R. Asian Elephant. Ecology and Management. Oxford University Press
Cambridge.

Wildlife Institute of India (2004) Compendium on the notes on the course Captive
management of Endangered Species. Wildlife Institute of India. Dehra Dun

Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England

Zoos Print and Zoo Zen, Published by Zoo Outreaches Organization, Coimbatore

7. BFC 116 Statistical Methods and Experimental Techniques 2+1

Theory:

Unit 1

Basic concepts, functions of statistics, variables and sources of data. Collection of statistical data - classification and tabulation of data, formation of frequency distribution. Diagrammatical and graphical representation of data. Simple, multiple, component and percentage bar diagram, pie diagram, histogram, frequency polygon and frequency curve. Measures of central tendency - requisites for an ideal measures of central tendency - arithmetic mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles, - its calculation for raw and grouped data, properties, merits and demerits, comparison of different averages. Weighted arithmetic mean. Measures of dispersion – range, mean deviation, standard deviation, standard error of mean, variance, quartile deviation, CV%.

Unit 2

Comparisons of different measures of dispersion and their applications to specific situations. Introduction to skewness and kurtosis. Presentation of bivariate data, scatter diagram, measure of association – correlation coefficient and properties, rank correlation, fitting of simple linear regression, correlation vs. regression, interpretation and application .Elementary ideas on probability – complementary, addition and multiplication laws on probability. Theoretical distributions, binominal, poisson and normal distributions. Normal distribution- properties, application of normal probability integral.

Unit 3

Binomial theorem on probability and Poisson distributions. Sampling, basic concepts, sampling vs. complete enumeration, parameter and statistic, sampling unit, sampling frame, sample size, sampling methods, simple random sampling and stratified random sampling. Tests of significance: concepts, hypotheses, critical region, large and small sample tests for equality of means, applications and assumptions, one and two samples t and Z test, Paired t test. Test of significance of correlation and regression. Chi-square test - introduction, application - independence of attributes and test for goodness of fit for mendalian ratios.

Unit 4

Test for variances - F tests. Introduction- important terms and definitions, need for designing an experiment. Basic principles of experimental design- replication, randomization and local control. Analysis of variance – assumptions, construction of ANOVA table, conclusions based on ANOVA. Randomization and Layout of CRD, RBD and LSD and introduction to preparing of ANOVA table and calculations for CRD, RBD and LSD.

Practical:

Formation of frequency distribution. ; Diagrammatic and graphic representation. Calculation of different measures of central tendency. ; Computation of various measures of dispersion. Calculation for r and b. ;Probability problems.; Simple problems on distributions. ; t, Z, F and Chi-square tests problems.; Randomization and Layout of CRD, RBD and LSD.

8. BFC 117 Principles of Plant Cytology and Genetics 2+1

Theory :

Unit 1

History of genetics. Pre-Mendelian concepts – preformation – pangenesis. Mendel's principles of inheritance – segregation – independent assortment. Cell – structure and functions. Cell organelles. Cell reproduction – mitosis – meiosis and its significance.

Unit 2

Gametogenesis and syngamy in plants. Chromosome theory of inheritance. Evidences for chromosome as bearers of genes. Modification to Mendelian inheritance – multiple alleles – codominance – gene interaction – epistasis – pleiotropy – polygenic inheritance – penetrance and expressivity – cytoplasmic inheritance.

Unit 3

Linkage and crossing over – cytological consequence of crossing over. Detection of linkage and linkage maps. Sex determination – theories. Sex-linked and other sex-related inheritance. Evidence to prove DNA as genetic material. Structure of DNA and its replication.

Unit 4

Chromosomes – its structure and function. Chromosomal aberrations-numerical and structural. RNA its structure function and types. Cytology of polyploids. Molecular structure of gene. Gene action – protein synthesis. Gene expression and their functions. Mutation, its classification and uses. Methods of inducing mutations and CIB technique.

Practical:

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

Suggested Readings:

Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science, 392p.

Garner, E. J., Simmons, M. J. and Sunstad, P. D. (2008). Principles of Genetics (8th edn.). Wiley India (P.) Ltd., Daryaganj, New Delhi.

Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut

Strickberger, M.W. (1996). Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi

Tamarin, R. (2002). Principles of Genetic (7th Ed). Tata McGraw-Hill Education.

White, T.L., Adams, W.T., and Neale, D.B. (2007). Forest Genetics. CABI

Semester-III		
BFC 201	Forest Survey & Engineering	2+1
BFC 202	Fertility of Forest Soils and Nutrient Management	2+1
BFC 203	Forest Ecology & Biodiversity Conservation	2+1
BFC 204	Forest Genetics & Tree Improvement	2+1
BFC 205	Principles of Agroforestry	2+1
BFC 206	Forest Mensuration	2+1
BFC 207	Rangeland and livestock management	1+1
BFC 208	Agricultural Informatics	2+1
BFC 209	NCC/NSS/ Physical Education	0+1
	Total	15+9 = 24

Semester III

1. BFC 201 Forest Survey & Engineering 2+1

Theory

Unit 1

Forest survey, scope and types of surveying, chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check and tie lines; ranging of survey lines; offsets and their types; chain of sloppy grounds, chaining across obstacles; cross staff surveying,

Unit 2

Areas of irregularly bounded fields- different methods; Simpson's, trapezoidal rule; compass surveying, chain and compass traversing, magnetic and true bearing, prismatic compass, local attraction.

Unit 3

Computation of interior angles and balancing of closed traverse. Plane table surveying; plane table and its accessories, methods of plane table surveying. Leveling: terms used types of level. Dumpy levels and its adjustments, booking the staff readings, calculation of reduced levels.

Unit 4

Contour surveying. Buildings materials- types, strength and characteristics, site selection for building construction, Design of check dams. **Concepts of green buildings.** Forest roads- alignment, construction and drainage; retaining walls, breast wall, waterways and culverts; bridges-types, selection of site, simple wooden beam bridge, spurs.

Practical:

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

Suggested reading:

Kanetkar, T.P. and Kuakarni, S.V. (1989). Surveying and levelling. Vidyarthi Griha Prkashan, Pune.

Masani, N.J. (2006). Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.

Parkash, R. (1983). Forest Surveying, International Book Distributor, Dehradun

Negi, S.S. (1997). Hand Book of Forest Engineering, International Book Distributor, Dehradun.

2. BFC 202 Fertility of Forest Soils and Nutrient Management 2+1

Theory:

Unit 1

Introduction:- Forest soils vs. cultivated soils, properties of soils under different forest ecosystem, meanings of soil fertility and productivity and factors affecting it, mineral nutrition of plants, terminology viz. element, compound, nutrient, nutrition, beneficial, and essential nutrients.

Essential nutrients:- Discovery, usable form by plants, average concentration in plant tissue, criteria of nutrient essentiality, detailed classification of essential nutrients based on their source, plant requirement, mobility in the soil and plants and biochemical behavior and physiological functions, relationship between nutrient concentration and plant growth - deficient, hidden hunger, critical limit, sufficient, excessive and toxic, available nutrients, nutrient content, general functions, deficiency and toxicity of essential nutrients and beneficial nutrients. Basic soil-plant relationship.

Unit 2

Basic dynamic processes of nutrient availability – nutrient uptake and removal/mining, nutrient fixation and release, nutrient cycling in the forest soils, mechanism of nutrient transport, major nutrients sources in the root zone and losses of nutrients from the soil system, nutrient transformation and availability in the soils and soil pH and nutrient availability. Ion exchange:- Ion exchange phenomenon - Ion exchange, adsorption, desorption, sorption, cation and anion exchange capacity of soils, base saturation and base un-saturation, ESP, significance of CEC with respect to soil fertility and factors affecting it. Nutrient interactions:-Definition, mechanisms/types of interactions, interaction between macro and micro nutrients, chelates and plant nutrition. Soil organisms:- Forest soil environment, diversity of organisms in the soil- macro and micro organisms and their distribution. Macro organisms- earthworms, Ants and termites and plant roots.

Unit 3

Soil micro animals- nematodes, protozoa *etc.* and their role in soil, Soil microorganisms- prokaryotes (bacteria and archaea), fungi, actinomycetes, cyanobacteria (blue-green algae) *etc.* in the soil ecosystem their distribution, interaction effect and functions in the soil. Factors affecting their growth and activity in the soils- OM, oxygen, temperature, pH *etc.* Atmospheric N fixation by organisms and some tree species and microbial transformation of N, P, S and micronutrients in the soils. Mycorrhizal growth of fungi and plant nutrition. Concepts of rhizosphere, Rhizodeposition and phyllosphere. Soil organic matter:- Decomposition of organic matter and release nutrient in the soils (nutrient cycling), humus formation, microbial degradation of cellulose and lignin.

Unit 4

C : N ratio of organic matter and nutrient availability - mineralization and immobilization, role of organic matter in the soil. Nutrient management:- Explanation, methods of soil fertility evaluation – diagnosis of deficiency symptoms, biological test, soil testing and plant tissue analysis and fertilizers recommendation. Manures and fertilizers:- Definition and comprehensive classification, nitrogenous, phosphatic, potassic, secondary and micronutrient fertilizers, mixed fertilizers, bio fertilizers, time and methods of fertilizer application. Soil fertility management:- Optimum, efficient and balanced use of nutrients, integrated and site specific nutrient management and crop rotation, fortification of consume through nutrient management. Acid, salt affected and calcareous soils - appraisal, characteristics and problems with respect to nutrient availability and their fertility management.

Practical:

Basic requirements for analytical laboratory. Handling and management of laboratory chemicals and basic principles for laboratory safety. Some essential terminology related to analytical laboratory and preparation of different standard solutions for laboratory use. Determine soil organic carbon, available N, available P₂O₅, available K₂O, and micronutrients from the soils and interpretation of their results. Determine water soluble and exchangeable cations CEC by summation method and ESP. Estimate the gypsum requirement of sodic soils and lime requirement of acid soils.

Suggested reading:

Havlin *et al.* 2014. Soil Fertility and Fertilizers: An Introduction to Nutrient Management (8th Edition), PHI Learning Pvt. Ltd., Delhi

Binkley, D. and R. Fisher 2012. Ecology and Management of Forest Soils (4th Edition), John Wiley & Sons Singapore Pte. Ltd., Singapore

Reddy M. V. 2001. Management of Tropical Plantation Forests and Their Soil Litter System-Litter, Biota and Soil Nutrient Dynamics, Science Publishers, U. S.

Khan, T. O. 2013 Forest Soils: Properties and Management, Springer International Publishing, Switzerland

Brady, N. C. and Weil, R. R. 2010. Elements of the Nature and Properties of Soils (3rd Edition.), Pearson Education, New Delhi

Das, D .K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).

ISSS, 2002. Fundamentals of Soil Science. Indian Society of Soil Science, IARI, New Delhi.

Pritchett and Fisher RF 1987. Properties and Management of Forest Soils. John Wiley, New York.

Gupta, P.K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), AGROBIOS, Jodhpur (India).

Jaiswal, P.C. 2006. Soil, Plant and Water Analysis (2nd Edition), Kalyani Publishers, Ludhiana.

Jackson, M. L. 2012. Soil Chemical Analysis: Advanced Course, Scientific Publisher

J. Benton Jones, Jr. 2012. Plant Nutrition and Soil Fertility Manual (2nd Edition), CRC Press, USA

Mengel, et al. 2001 Principles of Plant Nutrition (5th Edition), Springer

3. BFC 203 Forest Ecology & Biodiversity Conservation 2+1

Theory:

Unit 1

Historical development of ecology as a science. Levels of biological organization. Major forest Ecosystem. Forest environment- major abiotic and biotic components and their interaction, Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow.

Unit 2

Population ecology - definition, population dynamics and carrying capacity, preparation of life table and its importance in forest management. Community ecology- species interactions, ecological succession, terminology.

Unit 3

Basic concepts, theories of succession- climax vegetation types, forest management and succession. Island Biogeography. Autecology of important tree species. Perturbation ecology- Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices.

Unit 4

Principles of conservation biology, Ex situ and In situ methods of conservation, Genetic and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide. Introduction to IPR and quarantine laws. Introduction to Biological Diversity Act, 2002, Biological Diversity Rules 2004, Telangana State Biological Diversity Rules 2015. Concepts of Biodiversity Management Committees. Concepts of peoples Biodiversity Register.

Practical:

Study of ecological modifications in plants; Effects of fire on forest ecosystem; Study of population dynamics using model systems; Preparation of life tables; Study of spatial dispersion among plants; Study of Forest composition; Niche analysis; Computation of diversity indices; Measurement of diversity of plants and insects in a nearby forest; Study of succession in field and water bodies; **Visit to Natural Forest Ecosystem, Manmade Forest Ecosystem and Aquatic Ecosystem.** Estimation of growth and productivity of Plantation/site. Field data processing and analysis-Calculation of IVI, Diversity indices Assessment of tree volume and carbon sequestration.

Suggested reading:

Odum EP 1983. Basic Ecology. Saunders College Publishing, Philadelphia etc. 613p.

Misra KC 1974. Manual of Plant Ecology. Oxford & IBH Pub Co. New Delhi etc. 491p.

Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub.Co. New Delhi, 404p.

Montagnini, F and Jordan, C.F. 2005. Tropical Forest Ecology: The Basis for Conservation and Management. Springer. 295p.

Frankel, O.H., Brown, A.H.D., Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p.

Saggwal, S.S. 1995. Forest Ecology of India. Pioneer Publishers, India. 368p.

PD Sharma, 2013. Ecology and Environment. (11th Edition), Rastogi Publications, Meerut.

Kimmins JP. 1976. Forest Ecology. MacMillan.

Nautiyal S & Koul, AK. 1999. Forest Biodiversity and its Conservation Practices in India. Oriental Enterprise.

Theory:

Unit 1

Introduction – history and development of tree improvement – its relation to other disciplines of forestry. Reproduction in forest trees. Anthesis and pollination – their importance in tree breeding. Incompatibility and sterility. Quantitative inheritance. Relevance in forestry. Genetic, environmental and interaction components of variation - heritability and genetic advance.

Unit 2

Genetic basis of tree breeding. Natural variability in trees – types and importance.- forces that change variability. Exotic forestry. Provenance testing. Selection- seed production areas–seed orchards. Progeny trial and improvement of seed orchards. Combining ability and genetic gain – Hybridization in trees – back cross breeding, heterosis breeding.

Unit 3

Mutation breeding; Ploidy breeding. Breeding procedures for development of hybrids, / varieties of various crops. DUS testing, Concepts of Geographical indications. Artificial hybrids in trees crossing in trees-problems and perspectives-crossing hybrids and hybrid breakdown.

Unit 4

Hybrid nomenclature in trees- Future of hybrid in applied tree improvement. Breeding for resistance to insect pests' diseases, air pollution and for wood properties. Vegetative propagation and Clonal forestry. Conservation of forest tree germplasm. Recent techniques in tree improvement.

Practical

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

Suggested reading:

Surendran, C., Sehgal, R.N. and Parmathma, M. (Eds.) (2003). A text book of Forest Tree Breeding. ICAR, New Delhi.

Wright, J. (2012). Introduction to Forest Genetics. Elsevier.

Zobel, B. and Talbert, J. (2003). Applied Forest Tree Improvement. Blackburn Press.

Bedell P. E. (2007). Tree Breeding for Genetic Improvement of Tropical Tree Species (1st Ed). Allied T.L. White and Adams (2010). Forest Genetics.

Theory**Unit 1**

Over view of Indian agriculture- its structure and constraints. Concept of sustainable agriculture and land use management. Agroforestry definition and scope, rising demands of fuel wood, fodder and timber. History of agroforestry- Social, ecological, and economic reasons for agroforestry.

Unit 2

Classification of agroforestry system - structural, functional, socioeconomic, and ecological basis. Traditional agroforestry systems: shifting cultivation, taungya, homegardens. Land use - definition, classification, and planning.

Unit 3

Land capability classification and land use – definition, classification, and planning. Plantation agriculture and plantation forestry. Choice of species for agroforestry - criteria for selection of fodder trees, fuel wood and charcoal trees, food and medicinal uses, pulp wood and round wood used; multipurpose trees, nitrogen fixing trees.

Unit 4

Provisional and regulatory services of agroforestry- Food and nutritional security- Tree crop interactions in Agroforestry-Positive interactions: Increased productivity, Soil improvement, Nutrient Cycling, Microclimate Amelioration-carbon sequestration. Negative interactions: Competition, Allelopathy. Industrial agroforestry concept and importance.

Practical

Study the components, arrangement and functioning of various forest and agro-ecosystems- Collection of information on various tree and agricultural crops on their habitat, growth, tolerance to various climatic and edaphic factors and study their compatibility for integration- Study land capability classification of various topographic regions. Visit to problem sites such as wind prone, mined areas, degraded sites, flood prone areas etc and design suitable land use strategies

Suggested reading :

Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.

Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.

Kumar, B. and Nair, P.K.R. (eds). 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Volume 3 in the Book Series “Advances in Agroforestry”. Springer Science, the Netherlands

Kumar, B.M. 2011. Species richness and aboveground carbon stocks in the homegardens of central Kerala, India. Agriculture, Ecosystems and Environment. 140: 430–440

Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p

Kumar, B.M. and Nair, P.K.R. 2004. The enigma of tropical homegardens. 2004. Agroforestry Systems. 61: 135–152.

Michael P. 1984. *Ecological Methods for Field and Laboratory Investigations*. Tata McGraw-Hill Pub. Co. New Delhi.

Mohan, S., Nair, P.K.R., Long, A.J. 2007. An Assessment of Ecological Diversity in Homegardens: A Case Study from Kerala State, India. *Journal of Sustainable Agriculture*. Volume 29, Issue 4: 135-153.

Nair PKR, Rao MR, and Buck LE (eds), 2004. *New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry*, Kluwer, Dordrecht, The Netherlands.

Nair, P.K.R. *Agroforestry Systems in the Tropics*. Springer. 680p.

Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. *J. Plant Nutr. Soil Sci.* 172: 10–23.

Nair, PKR 1993. *An Introduction to Agroforestry*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Pathak P.S. and Ram Newaj (eds.) 2003. *Agroforestry: Potentials and Opportunities*. Agrobios, Jodhpur.

Theory:

Unit 1

Forest Mensuration- Definition, objectives and scope of forest mensuration. Scales and Units of measurement, error and accuracy. Measurement of individual tree parameters - tree diameter and girth - objectives, standard rules governing measurement at breast height and instruments used. Upper stem diameter measurement- Objective and instruments used.

Unit 2

Bark measurements objectives, bark thickness, bark surface area and bark volume. Crown measurement - objectives, crown diameter, crown height, crown surface area and crown volume. Height measurement – direct and indirect methods. Height measurement principles- geometric and trigonometric principles, height measuring instruments, error in height measurement and height measurement of learning tree.

Unit 3

Trees stem form- theories, classification of form factors and form quotient. Volume tables- definition, classification and preparation. Tree biomass- objective and biomass estimation methods. Age determination of tree- objective and methods. Tree growth measurement – objectives, increment, determination of increment, stump analysis, stem analysis and increment boring.

Unit 4

Measurement of tree crops – objectives, crop diameter, crop height, crop age and crop volume. Stand growth, site quality, site index, stand structure, yield tables, preparation and stand table. Forest inventory – definition objectives, kinds of enumeration. Sampling- definition, advantages, kinds of sampling, random sampling: (simple, stratified, multistage and multiphase sampling). Non-random sampling (selective, systematic and sequential sampling) sampling design, size and shape of the sampling units. Point sampling- horizontal and vertical point sampling.

Practical :

Units of measurement and uses in forestry. Measurements of diameter, girth and upper stem diameter of trees using Calipers, Tape, Ruler, Penta Prism, Criterion Dendrometer etc. Measurement of bark thickness, bark volume, bark area. Measurement of crown diameter, crown area and crown volume. Measurement of tree height using instrumental methods- Abney's level, Ravi Altimeter, Spiegel Relaskop, Clinometer etc. Estimation of form factor. Volume estimation of logs, felled trees and standing trees. Preparation of local volume table. Determination of age of standing trees by increment boring method. Study on stump analysis. Calculation of CAI and MAI. Sampling exercises including point sampling.

Suggested Books

Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition).
Khanna Bandhu. Dehra Dun.364 pp.

Forest mensuration: A Handbook for Practitioners.(2006). Forestry Commission Publications.
330 pp.

Husch, B., Beers, T.W. and Kershaw,Jr. J.A. (2002). Forest Mensuration (4th edition). John
Wiley & Sons, Nature.456 pp.

Laar, V. A. and Akca, A. (2007). Forest Mensuration. Managing Forest Ecosystems
(Vol.13).Springer.384pp.

West, P.W. (2009). Tree and Forest Measurement (2nd edition). Springer. 192pp.

Agarwal, P. (2008). Forest Mensuration- Tree measurement. Bishen Singh Mahendra Pal
Singh Publishers & Distributors of Scientific Books, 220pp.

Panwar, P. and Bhardwaj, S.D. (2005). Handbook of Practical Forestry. Agrobios (India),
191pp.

7. BFC 207 Rangeland and livestock management 1+1

Theory:

Unit 1

Definition, scope and importance – cattle and fodder resources of India, grassland types of India and their distribution – ecological status of Indian grasslands – principles of grassland management for maximizing forage yield and quality. **Creation and Management of fodder plots.**

Unit 2

Feeding habit and grazing behavior of range animals. Carrying capacity – definition, method of calculation. Establishment and management of grasslands – selection of species, planting, cultural practices – liming, fertilizer application, burning, weed control, grazing and cutting intensity.

Unit 3

Storage of fodder – silage and hay – methods of preparation – hay banks, Fodder trees and shrubs, Forest grazing. Definition and importance of Livestock management. Important breeds of important livestock eg. Cattle, buffalo, sheep and goat.

Unit 4

Breeding and reproductive management for higher productivity. Feeding management – types of feedstuffs available for feeding livestock, methods of feeding. Assessing nutritive value of feed and fodder, estimation of digestible nutrients and energy in feedstuffs. Principles of rationing. Prevention and control of diseases.

Practical:

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

Unit 1

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System, definition and types, Applications of MS-Office for creating, Editing and Formatting a document

Unit 2

Data presentation, tabulation and graph creation, statistical analysis, mathematical expressions, Database, concepts and types, creating database, uses of DBMS in Agriculture, Internet and World Wide Web (WWW), Concepts, components and creation of web, HTML coding.

Unit 3

Computer Programming, General Concepts, Documentation and Program Maintenance, Debugging programs, Errors. Introduction to Visual Basic concepts and standard input/output operations, Variables and Constants, Operators and Expressions, Flow of control, Inbuilt and User defined functions.

Unit 4

Programming techniques for agriculture. e-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in Agriculture. Smartphone mobile apps in Agriculture for farm advises, market price, postharvest management etc.

Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Creating, Files & Folders, File Management. Use of MS-WORD and MS PowerPoint for creating, editing and presenting a scientific Document, Handling of Tabular data, animation, video tools, art tool, graphics, template & designs. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system. Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Introduction of various programming languages such as Visual Basic and their components Hands on practice on writing small program. Use of smart phones and other devices in agro-advisory and dissemination of market information.

Semester – IV

BFC 210	Forest Management	2+1
BFC 211	Wood Products & Utilization	2+1
BFC 212	Ornithology & Herpetology	2+1
BFC 213	Seed Technology & Nursery Management	2+1
BFC 214	Ethnobotany, medicinal and aromatic plants	2+1
BFC 215	Plantation Forestry	2+1
BFC 216	Silviculture of Indian Trees	2+1
BFC 217	Tree harvesting and ergonomics	1+1
BFC 218	Study Tour of State Forest	0+1
BFC 219	NCC/NSS/ Physical Education	0+1
	Total	15+10 = 25

Semester IV

1. BFC 210 Forest Management 2+1

Theory:

Unit 1

Definition, Scope, Objective and Principles of Forest Management. Organization of state forests.. Sustained yield-definition, Principles and limitations increasing and progressive yields.

Unit 2

Sustainable Forest Management-Criteria and Indicators- Rotation-definitions-various types of Rotations-length of rotations choice of type and kind of rotation. Normal forest-definitions basic factors of normality.

Unit 3

Growing stock, Estimation of growing stock. Yield regulation- concept, basis and yield regulation models- Estimation of growth and yield prediction in forest stands- Stand structure - Stand density.

Unit 4

Working plan-Working Plan Code 2014- preparations objectives and uses-forest maps and their uses. Joint forest management - Modern tools in forest management. Concept and Importance of Ecotourism, Ecotourism in Indian perspectives.

Practical :

Visit to different forest divisions to study the various stand management aspects including thinning, felling and sale of timber. Study forest organizational set up and forest range administration including booking of offences. Visit to forest plantation- Field Exercise for the estimation of actual growing stock volume. Study the different field exercises for data collection for working plan. Acquaintance with Forest Code, Forest maps and plantation journals.

Suggested reading:

Balakathiresan, S (1986). Essentials of Forest Management, Nataraj Publishers, Dehradun.

Bhattacharya P., Kandya A.K. and Krishna Kumar (2008). Joint Forest Management in India, Aavishkar Publisher, Jaipur.

Desai, V. (1991). Forest Management in India –Issues and Problems. Himalaya Pub. House, Bombay.

Edmunds, D and Wollenberg, E (2003). Essentials of Forest Management, Natraj Publishers, Dehra Dun.

Jerome L Cutter et al. (1983). Timber Management: A Quantitative Approach. John Wiley and Sons

National Working Plan Code (2014). MoEF, New Delhi.

Ramprakash, (1986). Forest Management, IBD, Dehradun.

Mathur, V.P. and Ranganathan, C.R. (1985). Forest Management. Jugal Kishore & Co. (Pub.Div.) Dehradun.

Recknagel, A and Bentley. J. (1988). Forest Management. IBD, Dehradun.

Trivedi, P, R and Sudarshan, K, N. (1996). Forest Management. Discovery publications, New Delhi.

Stephen Wearing, John Neil (1999). Ecotourism: Impacts, Potentials, and Possibilities. REPP Ltd.

Jack Randall (2011). Eco-Tourism, Published by Discovery Publishing House Pvt Ltd. Pp. 232.

2. BFC 211 Wood Products & Utilization 2+1

Theory :

Unit 1

Pulp and paper industry. Introduction and raw material; pulping-mechanical, chemical, semi-chemical and semi-mechanical; pulp bleaching; stock preparation and sheet formation; types of paper; manufacture of rayon and other cellulose derived products.

Unit 2

Manufacture, properties and uses of Composite wood- plywood, fiberboard, particleboard and hard board. Adhesives used in manufacture of composite wood. Improved wood-definition, types (impregnated wood, heat stabilized wood, compressed wood, and chemically modified wood esp. acetylation of wood).

Unit 3

Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast. Uses of wood. Structural uses of Timber. Decorative uses of wood. Wood carving and handicrafts.

Unit 4

Nano technology in wood. Biochar. Short rotation forestry crops. Other forest based industries – veneer, sawn wood, furniture, bamboo, sports goods, pencil making, match box and splint making.

Practical:

Visit to paper industry to study pulp and papermaking. Study and collection of different types of papers. Study of different types of paper boards. Visit to Rayon industry. Visit to plywood industry to study the manufacturing processes. Study of plywood, fiberboards, particleboards, and hard boards. Visit to other wood based industries. Visit to wood distillation unit. Visit to nearby industrial plantations. Study of types of improved wood. Visit to saw mill to study veneering and different kinds of sawing, Visit to wood based handicraft manufacturing unit.

Suggested Reading:

Mehta, T. (1981). A Handbook of Forest Utilization, Periodical Expert Book Agency.

FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

Hoadley, B. 2000. Understanding Wood: A Craftsman's guide to wood technology. Taunton Press. Newtown, USA. 223p.

Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2nd Ed. Miller and Freeman Publication, Inc. USA. 388p.

3. BFC 212 Ornithology & Herpetology

2+1

Theory:

Unit 1

Origin of birds, morphological and physiological adaptations; Classification of Indian birds. Biogeographic patterns of Indian avifauna; Avifauna of Himalayas, Western and Eastern Ghats, Island, waterfowl, desert avifauna.

Unit 2

Birds of Agriculture: Beneficial and Harmful; Economic ornithology; Bird Extinctions; Endangered and threatened birds of India and their conservation; Migration: Kinds of migration in birds; Bird census techniques.

Unit 3

Zoogeography of amphibians and reptiles; Amphibians and reptile of India; Factors affecting distribution of herpetofauna; Biology of major Indian amphibians, turtles, crocodilians, lizards and snakes;

Unit 4

Thermoregulation, aestivation, hibernation and other eco-physiological adaptations; Conservation issues of herpetofauna in Indian

Practical:

Field identification of major birds of Gujarat; Birding: preparation of checklist /inventory

Study of nearby wetland; Species conservation projects

Characteristics and morphological features of herpetofauna of India, Snake rescue techniques and release in natural habitat, Snakebite and its management, Study of role of nearby NGOs in Herpetofauna / snake conservation.

Suggested reading:

Ali, S. 1969. Birds of Kerala. Oxford University press, Bombay.

Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.

Grimmet, R. Inskipp T and Inskipp, I. 2003. Handbook of Birds of Indian subcontinent. Oxford University press

Grimmet, R. Inskipp, T and Nameer, P.O. 2007. Birds of southern India, BNHS series.

Kazmierczak, K. and van Perlo B. 2000. A field guide to the birds of the Indian subcontinent, Yale University Press, New Haven. CT.

Neelakantan, K.K. 1984. "Keralathile Pakshikal". Kerala Sahithya Academy, Thrissur. 584pp.

Rasmussen P C and John C. Anderton. 2012. Birds of South Asia: The Ripley guide. Vol. I and II, Smithsonian Institution and Lynx Edicions, Washington DC and Barcelona.

Sashikumar, C., Praveen J., Palot, M. J., Nameer, P. O., 2011. Birds of Kerala: status and distribution. Kottayam: DC Books. 833 pp.

Wallace GJ and HD Mahan. 2005. An Introduction to Ornithology. 3rd Ed. McMillion publishing company. New York.

Biju SD et al. 2011. A taxonomic review of the Night Frog genus *Nyctibatrachus* Boulenger, 1882 in the Western Ghats, India (Anura: Nyctibatrachidae) with description of twelve new species. *Zoo Taxa*. 3029: 1-96.

Biju SD. et al. 2014. DNA barcoding reveals unprecedented diversity in dancing frogs of India (Micrixalidae, *Micrixalus*): a taxonomic revision with description of 14 new species. *Ceylon Journal of Science (Bio Sci.)* 43 (1): 1-87.

Biju SD. et al. 2013. Taxonomic review of the tree frog genus *Rhacophorus* from the Western Ghats, India (Anura: Rhacophoridae), with description of ontogenetic colour changes and reproductive behaviour. *Zoo Taxa* 3636 (2): 257-289.

Daniel, J C. 2002. The Book of Indian Reptiles. Bombay Natural History Society, Bombay, 141pp.

Das, I. 1995. Turtles and Tortoises of India. Oxford University Press. Bombay. 176pp.

Das, I. 2002. A photographic guide to Snakes and other reptiles of India. New Holland Publishers (UK) Ltd.

Gunther C.L.C Albert 1864. The Reptiles of British India. Published by Oxford & IBH Publishing Co. New Delhi. 452pp.

Gururaja KV. 2012. Pictorial Guide to frogs and toads of the Western Ghats. IISc. Bangalore.

Kentwood D. Wells. 2007. The Ecology and Behavior of Amphibians. The University of Chicago Press, Chicago.

Madurai Kamaraj University, VI (unnumbered) + 132 pp.

Murthy, T.S.N. 2010. The Reptile Fauna of India. Published by B.R. Publishing Corporation, New Delhi.

Pratihari S et al. Diversity and conservation of amphibians in south and south east Asia. Sauria. 36 (1): 9– 59.

Theory :

Unit 1

Introduction; seed technology, role of seed technology in forestry, seed quality. Seed biology; seed structure, fertilization and seed development, types of seeds/fruits. Production of quality seeds; Candidate tree, plus tree and elite seed tree. Seed production areas; establishment and management of SPA. Seed orchards; types of seed orchard, establishment and management of seed orchards. Seed collection; planning and organization, seed collection methods, factors affecting choice of seed collection methods, seed maturity tests, precaution for handling of recalcitrant seeds.

Unit 2

Seed processing-; seed pre-cleaning, precuring, drying, seed extraction, cleaning, grading, pre-storage treatments, begging and labelling, safety precautions during processing. Seed storage; orthodox and recalcitrant seeds, natural longevity of tree seeds, factors affecting longevity in storage, storage conditions, methods and containers. Seed testing; seed sampling and equipments, physical purity analysis, determination of seed moisture, seed germination test, seed viability test, seed vigour test, seed health testing. Classes of tree seeds, certification procedure of tree seeds;

Unit 3

Need for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Establishments of nursery: types of nursery, site selection, planning and layout of nursery area. Nursery growing containers and media. Propagation structures; Mist chamber, greenhouse, glasshouse, cold frames, hotbeds, Poly-house, their uses and maintenance. Vegetative propagation techniques: cuttings, factors affecting rooting of cuttings budding, layering and grafting.

Unit 4

Propagation through specialized organs like bulb, rhizome, corm, runners and suckers. Apomixis, Polyembryony, Chimera ,Bud sport and Micro-propagation; Propagation through seeds; seed germination, types, stages of seed germination, factor affecting seed germination, seed dormancy pre-sowing treatments, seed pelleting, seed beds, methods of seed sowing, pricking, watering, weeding, hoeing, fertilization, shading, root culture technique, lifting windows, grading, hardening, packing, storage and transportation.. Insect/pest/disease control in nursery.

Practical:

Identification of tree seeds, Seed maturity tests , seed sampling and equipments, Physical purity analysis, determination of seed moisture, seed germination test, seed viability test-TTZ test, Hydrogen peroxide test, seed vigour test-conductivity test, accelerated ageing test, seed health testing. Visit to seed processing unit & seed testing laboratory. Use of different types of nursery tools and implements for nursery operations. Preparation and filling of potting mixture, seed priming , pre-sowing treatments, preparation of hormonal mixture for vegetative propagation, seedbed preparation, seed sowing, intermediate cultural operation like transplanting, root pruning weeding, hoeing, watering and fertilization. Practicing cuttings, grafting and layering.

Theory:**Unit 1**

Definition and scope of ethno botany. Man and biological resource of earth with respect to plants. Terms employed in relation to ethnobotany and its relationship with man and domestic animals. Ethnic – people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects. Important plants and their folk uses for medicines, food, dyes, tans, etc. Tools and methods of data collection in the ethnobotanical studies. Ethnobotany of tribals in N.E India, Central India, Southern India, Himalayan region, Andaman & Nicobar Islands. Pharmacognosy and implications.

Unit 2

Ethnomethodology- definition origin-theory and methods. Folk taxonomy. Ethnobotany of the plants from the following families. Guttiferae (Clusiaceae), Malvaceae, Fabaceae, Mimosaceae, Caesalpinaceae, Combretaceae, Umbelliferae (Apiaceae), Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae, Thymeliaceae. Conserving ethnobotanical heritage-role of forest, national parks, botanical gardens and sacred groves. Definition - role of medicinal and aromatic plants in Indian economy

Unit 3

Important essential oil yielding plants in India - Detailed study of lemon grass, citronella, palmarosa, vetiver, japanese mint, eucalyptus, jasmine, patchouli and geranium - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils. Medicinal plants in India and respective states- history, origin, area and distribution, production, botany and varieties - cultivation, extraction of active principles and their uses - uses of different medicinal plants like Atropa, Cinchona, Rauwolfia, Opium, Sandal, Acorus, Cannabis, Digitalis,

Unit 4

Strychnosnux-vomica, Aconitum, Neem, senna,, Dioscorea, Costus, Solanum etc. Conservation and regeneration of medicinal plants and trees in the forests like Gmelina arborea, Terminalia chebula, T. bellerica, Phyllanthus emblica, neem. Cultivation practices of medicinal plants like Adhathoda zylanica, Sida cordifolia, Sterospermum colais, Plumbago zylanica, Tinospora cordifolia, Kaemferia glanga, Indigofera tinctoria. Conservation packages for the medicinal plants collected in wild. Role of NGO's in the conservation of the medicinal plants.

Practical:

Visit to botanical and medicinal garden, Visit to different tribal area to study their ethno-botanical uses. Identification of medicinal and aromatic plants – propagation techniques – Harvesting and oil extraction of aromatic plants – Field visit, collection and preparation of herbarium – Visiting commercial units of medicinal plants. Documentation of ethnobotanical knowledge (traditional knowledge).

Suggested reading:

Cunningham, A. 2014. Applied Ethnobotany: "People, Wild Plant Use and Conservation". Taylor & Francis, 300p.

Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers, Jodhpur, India, 672p.

Jain, S.K. 2010. Manual of Ethnobotany (2nd Ed). Scientific Publishers, India, 242p.

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

Chopra, R.N., Nayar, S.L. and Chopra, I.C. (1956). Glossary of Indian medicinal plants. CSIR, New Delhi.

Gunther, E. (1975). The essential oils. Robert, K Krieger Pub. Co., New York.

EIRI Board. (2007). Handbook of Medicinal and Aromatic Plants: Cultivation, Utilisation and Extraction Processes. Engineers India Research Institute, NaiSarak, Delhi,.

Khan, I.A. and Khanum, A. (2005). Medicinal and Aromatic Plants of India ; Herbal Wealth for Human Health (1st Ed). Ukaaz Publications.

Muralia, S. (2006). Medicinal and aromatic plants (1st Ed). Neha Publishers & Distributors.

Chopra, A.K. (2007). Medicinal Plants: Conservation, Cultivation and Utilization. Daya Books.

Theory:

Unit 1

Plantations-definition and scope- History of plantations- Development of plantation forestry- present status in national and international scenario- Plantation organization and structure- Plantation characteristics-species composition-age class distribution- stocking- Land and plantation development – National land use policy- land use for forestry- Social and economic factors in plantation development finance- economics of plantation development- land availability-labour- infrastructure, economic, marketing, social and cultural effects.-

Unit 2

Plantation planning-National and regional planning-project appraisal and project implementation– feasibility studies- Plantation silviculture - Choice of species-concept of fast growth-exotics vs. indigenous- traditional vs. intensive forest management- Plantation establishment-essentials- ground preparation- Planting- planting stock- planting pattern- spacing-general planting rules-protection and after care of newly planted seedlings.

Unit 3

Plantation maintenance- death of seedling-weed control --cleaning, singling, pruning. Nutrition in plantations- nutrient deficiencies, symptoms of deficiency- use of fertilizers- - Major pest and disease in plantations- sanitation and control measures. Dynamics of stand growth- stand density management in plantations- spacing-planting density regulation- Thinning regimes- improvement fellings- CCF-MCA- Site quality evaluation- stand basal area-site index concept in plantation forestry- plantation productivity assessment- growing stock assessment MAI of different plantations- Modern concepts in plantation forestry.

Unit 4

Plantation records- plantation journal- sustainability of plantations- fast growing plantations-myths and reality- Industrial plantation- paper and pulp wood- Match wood plantation- plywood plantation Plantations yielding NTFPs- Energy plantation- high density short rotation plantations- petro-crops- energy from biomass.-Strip plantation-road side plantation- canal side plantation- railway side plantation- Clonal plantations- development and management of clonal plantation- Plantations as potential carbon sinks- C Sequestration, C Substitution and C Conservation functions; LULUCF and REDD concepts, AR-CDM concepts.

Practical:

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

Suggested Readings:

Evans, J. 1992. Plantation Forestry in the Tropics, 2nd edition. Oxford, UK, Clarendon Press.

Evans, J. and Turnbull, J.W. 2004. Plantation Forestry in the Tropics: The Role, Silviculture and Use of Planted Forests for Industrial, Social, Environmental and Agroforestry Purposes. OUP Oxford, 467.

Nambiar, E.K.S., Cossalter, C and Tiarks.A. 1998. Site Management and Productivity in Tropical Plantation Forests. Workshop Proceedings, South Africa.

Nambiar, E.K.S. and Brown, A.G. 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for Internat. Agricultural Research. 571p.

Bowen, G.D., E. K. S. Nambiar, E.K.S 1984. Nutrition on Plantation Forests. Academic Press, 1984 - Nature - 516 pages

Suzuki, K., Ishii, K., Sakurai, S. and Sasaki, S. 2006. Plantation Forestry in the Tropics. Springer Tokyo.

Krishnapillay.B. 2000. Silviculture and Management of teak plantations. Unasyva. 201. Vol 51. 14-21p

7. BFC 216 Silviculture of Indian Trees 2+1

Theory:

Unit 1

Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, and economic importance of the following tree species of India. Broadleaved species: *Tectona grandis*, *Shorea robusta*, *Dalbergia latifolia* ***bombex ceiba***, *Dalbergia sissoo*, *Anogeissus spp*, *Terminalia arjuna*, *Terminalia alata*, *Terminalia chebula*.

Unit 2

Terminalia bellirica *Santalum album*, *Swietenia macrophylla*, *Albizia spp*, *Santalum album*, *Pterocarpus marsupium*, *Gmelina arborea*, *Pterocarpus santalinus*. ***Holoptelea integrifoli***, ***Givotia rottleriformis***, ***Sterculia urens***, ***Boswellia serrata***, ***Maduca indica***, ***Ailanthus excelsa***, and ***Buchanania lanzan***

Unit 3

Azadirachta indica, *Hopea parviflora*, *Lagerstroemia microcarpa*, *Bamboos*, *reeds and rattan*, *Quercus floribunda*, *Quercus leucotrichophora*, *Quercus semicarpifolia*. Conifers: *Abies pindrow*, *Picea smithiana*, *Cedrus deodara*, *Pinus roxburghii*.

Unit 4

Pinus wallichiana. Fast growing MPTs.; *Tropical pines*, *Eucalyptus spp*, *Casuarina equisetifolia*, *Leucaena leucocephala*, *Ailanthus triphysa*, *Grevillea robusta*, *Pongamia pinnata*, *Melia dubia*, *Acacia spp*, *Populus deltoides*, *Populus ciliata*.

Practical:

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

Suggested Readings:

Bebarta, 1999. Teak: Ecology, Silviculture, Management and profitability, IBD, Dehra Dun

Champion, H.G. and A.L. Griffith. 1989. Manual for General Silviculture for India ICFRE
booklets on tree species

Kadambi, K. 1993. Silviculture and Management of teak. Nataraj Publishers, Dehra Dun. p. 137.

Lamprecht H 1989. Silviculture in the Tropics. GTZ, GmBH, FRG

Troup, RS 1922. Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest
Research Institute and Colleges, Dehra Dun, 1975.

Renuka, C., Pandalai, R.C. and Mohanan, C. 2002 Nursery and silvicultural techniques for
rattan, Kerala Forest research Institute.

Seethalakshmi, K.K. and Muktheshkumar, M.1998. Bamboos of India: a compendium, Kerala
Forest research Institute & International Network for Bamboo and Rattan

8. BFC 217 Tree harvesting and ergonomics 1+1

Theory:

Unit 1

Definition and scope of logging, logging plan and execution. Location and demarcation of the area for logging and estimation of produce available for extraction. Implements used in logging operation.

Unit 2

Traditional and improved tools. Felling rules and methods, Work contracts related to felling and removing (contract system, convener systems) etc. Conversion, measurement and description of converted material. Means of transport of timber; carts, dragging, skidding, overhead transport, ropeways, skylines.

Unit 3

Transport by road and railways. Transport by water; floating, rafting and concept of booms. Non-destructive sampling methods of wood. Grading and storage of timber in the depots for display and disposal, temporary and final storage.

Unit 4

Timber Depots; types, lay out and management. Systems of disposal of timber. Ergonomics: definition, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition. Personal protective equipment's, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids.

Practical:

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

Suggested Reading

Brown, N. C. 2002. Principles and methods of harvesting of timber. Biotech books, Delhi. 430p.

StAAF, K.A.G. and Wiksten, N.A. (1984). Tree Harvesting Techniques. Martinus Nijhoff/DR W. Junk Publishers, Netherlands.

FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

GFC. [Guyana Forestry Commission]. 2002. Code of practice for timber harvest. 2 nd Ed. Georgetown, Guayana. 42p.

Hakkila, P. 1989. Utilization of residual forest biomass. Springer-verlag, Berlin. 567p.

Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.

Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.

Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.

Wakermann, A. E. 2002. Harvesting timber crops. Biotech books, Delhi. 433p.

Semester – V

Course Code	Course	Credits
BFC 301	Forest Hydrology and Watershed Management	2+1
BFC 302	Agrometeorology and Climate Science	2+1
BFC 303	Non-Timber Forest Products	2+1
BFC 304	Economics and Marketing	2+1
BFC 305	Forest Extension & Community Forestry	2+1
BFC 306	Entrepreneurship Development and Business Management	1+1
BFC 307	Student READY	0+6
BFC 308	NCC	0+1
	Total	11+13 = 24

Semester V

1. BFC 301 Forest Hydrology and Watershed Management 2+1

Theory:

Unit 1

Importance and scope of Hydrology, Definitions, Hydrological cycle. Energy and water balance equations. Precipitation - rain and snow hydrology. Interception, infiltration, evapotranspiration, surface water, run off, factor affecting runoff, runoff estimation by rational method. Runoff water measuring devices.

Unit 2

Hydrograph. Soil water energy concept, movement, availability and measurement. Soil erosion, Universal soil loss equation, Agronomical and engineering practices for soil and water conservation, Recharging of water springs. Forest treatment and water yield.

Unit 3

Watershed management - principles (concept), objectives and practices for sustainable productivity, water harvesting techniques and structures – farm ponds, check dams and earthen dams. Water well, aquifers. **Four water Concept.**

Unit 4

Water application methods – surface, sub-surface, drip and sprinkler irrigation system. Drainage – types of drainage system, their selection, design and installation and maintenance. Importance of forests in water conservation, Grassland management.

Practical:

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

Suggested reading:

Dhruva Narayana V. V. 1993. Soil and Water Conservation Research in India, ICAR, New Delhi

Dhruva Narayana V. V., G. Sastry and U. S. Patnaik. 1997. Watershed Management. Indian Council of Agricultural Research, New Delhi, 176 p

Gurmail Singh et al., 1988. Manual of Soil and Water Conservation. Oxford IBH Publishing Co. New Delhi

Michael, A.M. 2008. Irrigation theory and practice, Vikas Publishing House Pvt Ltd. 768p

Michael, A.M. and Ojha, T.P. (1966). Principles of Agricultural Engineering, Jain Brothers, Jodhpur.

Murthy, JVS (1998). Watershed Management, New Age International, New Delhi.

Murthy, V.V.N. (1985). Land and water management engineering. Kalyani Publishers, New Delhi.

Subramanya, K. (2006). Engineering hydrology, Tata McGraw Hill publication.

USDA 1961. A Manual on Conservation of Soil and Water. Oxford and IBH Publishing Company.

Theory:

Unit 1

Agrometeorology – definition, aim and scope. Factors and elements of weather and climate. Composition and structure of atmosphere. Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost. Cyclones, anticyclones and thunder storms.

Unit 2

Solar radiations components and effect on plant growth. Effect of weather and climate on the growth and development of crops. Climatic normals for crops and trees. **Agro climatic zones of India in general and Telangana State in particular.** Evaporation and transpiration.

Unit 3

Climate change: Understanding climate change and its Consequences. Global warming and its effects on Forest. Forest and climate change: Vulnerability and adaptability - Evidence of forest disturbance due to climate change –Climate change influence on agro-forestry- Climate resilient forestry.

Unit 4

Economic worth of carbon storage in forest – Forest and UN convention on climate change - NATCOM initiatives – Decision-making in emission of Green House Gases (GHG). Kyoto protocol, awareness about climate change. National action plan for climate change – Green India mission- Indian Network for Climate Change Assessment (INCCA) - State Action Plans on Climate Change.

Practical:

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

Theory :

Unit

Introduction, methods of collection, management and importance of Non-Timber Forest Products (NTFP). Fodder (grasses and tree leaves), canes and bamboos. Essential Oils – sources, nature of occurrence, methods of extraction, classification, storage and uses. Non-essential oils – nature, occurrence, methods of extraction, classification and uses.

Unit 2

Important fixed oil yielding trees. Gums and resins –definition, classification, sources, collection and uses. Factors affecting gum formation. Important gum yielding plants. Resins and Oleoresins, their formation in plants and classification of resins. Tans- nature, classification, uses and important tannin yielding plants.

Unit 3

Dyes – classification and sources of dyes. Beedi leaves – sources, collection and processing. Fibers and flosses. Katha and Cutch – sources, extraction and uses. Drugs, spices, wild edible plants part like fruits, flowers, roots, tubers, vegetables, leaves and edible products, poisons and bio-pesticides.

Unit 4

Animal products – honey and wax, silk, lac, fish, Wild edible animal products (from birds, reptiles, insects, snail etc.), trophies like tiger, panthers, elephants etc. Mineral products and other miscellaneous products.

Practical:

Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and tree leaves. Study of canes and bamboos and their sources. Study of essential oils and their sources. Study of non-essential oils and their sources. Study of gums and resins and their collection. Study of tans and dyes and their sources. Study of fibers, flosses and their collection from nearby forests. Visit to Herbal Gardens and herbaria to study medicinal plants. Study of plants yielding drugs, spices, wild edible plants, poisons and bio-pesticides and their collection from nearby forests. Visit to nearby extraction units.

Suggested Reading:

Mehta, T. (1981). A Handbook of Forest Utilization, Periodical Expert Book Agency.

FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

Krishna murthi T.(1993) Minor forest products of india, Oxford & IBH Publishing Co Pvt. Ltd.

Krishna murthi T.(2010) Minor forest products of india(Non- Timber Forest Products),
Second edition. BS Publications

Mishra, T.K., Banerjee, S.K and Pal, D.C. (2004). An Omnibus of Non- Timber Forest
Products of India, Prashant Gahlot at Valley Offset Printers and Publishers, Dehra Dun.

Nair, K.K.N. (2000). Manual of Non-Wood Forest Produce Plants of Kerala, Kerala Forest
Department, Government of Kerala, Thiruvananthapuram.

Nautiyal, S and Kaul, A.K.(2003). Non –Timber Forest Products of India, Jyothi- Publishers
and Distributors, Dehra Dun.

4. BFC 304 Economics and Marketing 2+1

Theory :

Unit 1

Economics- Meaning, definition, subject matter- Divisions of economics - Importance of economics- Forest Economics- Meaning, definition- Basic concepts - Goods, service, utility, value, price, wealth, welfare- Wants- Meaning, characteristics, classifications of wants, importance. Theory of consumption- Law of diminishing marginal utility, meaning, definition, assumption, illustration, limitations, law of equimarginal utility-Importance. Consumer surplus- Meaning, definition, importance. **Concepts of Green Accounting.**

Unit 2

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.

Unit 3

Supply- meaning, supply function-Law of supply- factors influencing supply- Production- Meaning, factors of production land, labour, capital, organization, entrepreneurship- Distribution- rent, wages, interest, profit- National Income -definition and concepts .

Unit 4

Marketing- definition – Marketing Process – Need for marketing – Role of marketing —
Marketing functions – Classification of markets – Marketing of various channels – Price spread –
Marketing Efficiency – Integration – Constraints in marketing of agricultural produce. Market
intelligence – Basic guidelines for preparation of project reports- Bank norms – Insurance –
SWOT analysis – Crisis management.

Practical: Library review of studies on marketing, visits to local timber and non-timber markets;
collection and analysis of price and quantity data for various forest products; study of marketing
channels and price spread for important timber and non-timber forestry products.

Suggested Readings:

Dewett, K..K. 2005. Modern Economic Theory. S. Chand, New Delhi.

Dewett,K.K.,Verma. 2004 Elementary Economic Theory, S.Chand, New Delhi

Jhingan,M.L.2012. Macro Economic Theory. Vrinda publishers, New Delhi .

Reddy, S. S., Raghu Ram, P., Neelakanta Sastry, T.V., Bhavani, D. I. 2004. Agricultural
Economics. Oxford and IBH Publishers, New Delhi.

John E. Wagner, 2012, Forest Economics: A Managerial Approach, Routledge , Tylor &
Francis Group, London.

Theory:**Unit 1**

Introduction- human behavior and psychology. Concept, scope, principles, philosophy and objectives of extension education and forestry extension education. Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Forestry extension: process, principles and types of education, Formal, informal non-formal education. People's participation in Forestry programs. Elements of extension education, man himself man's environment and man's created devices. Rural Development: meaning, definition, objectives and genesis.

Unit 2

Transfer of technology programs like lab to land program (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and Refinement Programme (TARP) of ICAR/ICFRE. Communication: meaning, definition, elements and selected models. Audio-visual aids: importance, classification and selection. Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA). Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group, classification of group.

Unit 3

Introduction to the concept of forestry as a common property resource– Definition, Scope and necessity of community forestry. Forests and man: Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment-NFP 1988 and the importance of people in forest conservation. Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups. Gender dimensions in Community forest management. **Concepts of Smirithi Vanam, Nakshtra vanam and theme parks.**

Unit 4

Social Forestry- definition, need and purpose, historic development. Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS. Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation- problems and prospects, Microplan Preparation. JFMs, FDCs, VFCs, CBOs, NGOs and co-operative societies.

Practical:

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

Suggested reading:

FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasyuva - No. 143, Published by FAO.

L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.

D. Sim, H. A. Hilmi (1987), Forestry Extension Methods, FAO Forestry Paper-80, P. 153.

K.A. Jalihal, V. Veerabhadraiah (2007), Fundamentals of Extension Education and Management in Extension, Concept Publishing Company.

Balakathiresan, S. (1986). Essentials of forest management, Nataraj Publishers, Dehradun.

Bullock, R. C. L. and Hanna, K.S. (2012). Community Forestry Local Values, Conflict and Forest Governance. Cambridge University Press.

Gunter, J. (Ed.). (1973). The Community Forestry Guidebook (http://www.forrex.org/sites/default/files/forrex_series/FS15.pdf).

Ojha, H.R., Timsina, N.P., Kumar, C., Banjade, M.R and Belcher, B. (2007). Communities, Forests and Governance: Policy and Institutional Innovations from Nepal. Adroit Publishers, New Delhi, India.

Roy, S.B. and Chatterjee, M.(1994). Joint Forest Management. Inter India Publications

Tiwari, K.M. (1983). Social forestry for rural development. International Book Distributors.

Vyas, G. P.D. (2006). Community Forestry. Agrobios, India.

6. BFC 306 Entrepreneurship Development and Business Management 1+1

Theory:

Unit 1

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment.

Unit 2

Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs.

Unit 3

Export and Import Policies relevant to forestry sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of forestry inputs industry. Characteristics of Indian forestry processing and export industry. Social Responsibility of Business.

Unit 4

Developing Leadership Skills, Encoding and decoding communication skills; Communication skills for entrepreneurship development, Developing Speaking Skills, Developing Listening Skills, Developing organizational skill , Developing Managerial skills, Problem solving skill, Supply chain management and Total quality management, Project Planning Formulation and report preparation.

Practical

Library review of assessment of overall business environment in the Indian economy. Library review of concepts of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; Library review of SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Encoding and decoding communication skills – Speaking, Listening, and organizational, Managerial and Problem solving skill. Project Planning Formulation and report preparation.

Semester-VI

Course Code	Course	Credits
BFC 309	Practices of Silviculture	2+1
BFC 310	Forest Laws, Legislation and Policies	2+0
BFC 311	Remote Sensing & GIS	1+1
BFC 312	Recreation & Urban Forestry	1+1
BFC 313	Restoration of Degraded Lands	1+1
BFC 314	Wood Science and Technology	2+1
BFC 315	Marketing and Certification of Forest Products	1+1
BFC 316	Student READY	0+6
BFC 317	NCC	0+1
	Total	10+13 = 23

Semester VI

1. BFC 309 Practices of Silviculture 2+1

Theory:

Unit 1

Regeneration of forests – objectives, ecology of regeneration- Natural and Artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment. Requirement for natural regeneration. Dieback in seedling with examples. Advance growth, coppice, root sucker. Regeneration survey- Natural regeneration supplemented by artificial regeneration. Artificial regeneration - object of artificial regeneration - advantages. Factors governing the choice of regeneration techniques. Choice of species - factors that govern - hardwoods, softwoods, fast growing, exotic and indigenous species.

Unit 2

Sowing v/s planting - different kinds of sowing. Preparation of planting material- stump preparation- field planting-site preparation- planting density spacing -marking- boundary demarcation, fencing, alignment and staking-kinds of pit making-patterns of planting, Plant protection and sanitation measures, - forest nutrition- fertilization in trees. Artificial regeneration in problematic areas. **Concept, practices & Case studies of Assisted Natural Regeneration.**

Unit 3

Silvicultural system -definition, scope and classification. Even aged and uneven aged forests and their crown classes. Detailed study of the silvicultural systems: Clear felling systems including clear strip, alternate strip and progressive strip systems. Shelterwood system -Uniform system,

Group system, Shelterwood strip system, Wedge system, Strip and group system, Irregular shelterwood system, Indian irregular shelterwood system. Seed tree method. Selection system and its modifications.

Unit 4

Accessory systems. Coppice system -Simple coppice system, Coppice of the two rotation system, Shelterwood coppice system, Coppice with standard system, Coppice-with-reserve system, Coppice selection system, Pollard system. Conversion and its implications. Choice of silvicultural system. Dauerwald concept. Culm selection system in Bamboo, Silvicultural systems followed in other countries - changing concepts and emerging trends in silvicultural systems- case studies.

Practical:

Acquaintance with modern silvicultural tools. Vegetation survey and forest inventory, Assessment of forest composition. Study about stand structure. Assessment of natural regeneration. Planting pattern and planting technique for afforestation and reforestation.

Exercise on nursery practice- seed collection, characterization, seed pre-treatment- nursery stock preparation- field preparation- marking, alignment and stacking, pit making-planting, fertilization in trees-plant protection and sanitation measures. Study of afforestation and reforestation success.

Suggested Reading:

Daniel, T.W., Helms, J.A., Baker, F.S. 1970. Principles of Silviculture, McGraw Hill, N.Y.

Duryea, M.L. and Landis, T.D. (eds.) 1984. Forest Nursery Manual: Production of bare root seedlings. Martinus Nijhoff/Dr W. Junk Publishers. The Hague/Boston/ Lancaster, 386 p.

Evans, J.1982. Plantation Forestry in the Tropics. The English Language Book Society and Clarendon Press - Oxford

Khanna, L.S.1989. Principles and Practice of Silviculture. Khanna Bandhu, 7 Tilak Marg, Dehra Dun

Smith, D.M. 1986. The Practice of Silviculture, Edn 8. New York, John Wiley

Ram Prakash and Khanna, L.S. 1991. Theory and Practice of Silvicultural Systems. Dehra Dun,

International Book Distributors, Dehra Dun.

Trevor, G. Silvicultural Systems. Part II of Manual of Indian Silviculture by H.G. Champion and Sir Gerald Trevor. 1938.

Theory :

Unit 1

Forest Policy: definition, necessity and scope. Legal and institutional approaches to forest resource management. Legal rights- types of legal rights, law of evidence, admission, confession, punishments. Constitutional provisions related to forest conservation.

Unit 2

Indian National Forest Policies-NFP-1894, NFP, 1952 and NFP, 1988, Forest Law: legal definition. Indian Evidence Act, 1872 as applied to forestry matters. Indian Forest Act. Detailed study of IFA 1927.

Unit 3

Forest (Conservation) Act, 1980 and its amendments. The Biological Diversity Act, 2002. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

Unit 4

Brief description about other major forest laws of regional, national and international significance. Indian Penal Code and Criminal Procedure Code related to forests. National Green Tribunal.

Suggested Readings :

Chaturvedi, A.N. (2011). Forest Policy and Law. Khanna Bandhu Publishers, Dehradun.

Negi, S.S. (1997). Forest Policy and Law, IBD, Dehradun.

Bakshi, P.M. (2009). The Constitution of India. 9th edition. Universal Law Publishing Co.Pvt.Ltd. New delhi.

Dutta, R. and Yadav, B. (2012). Supreme Court on Forest Conservation. Universal Law Publishing Co., New Delhi, India

Joy, P. P. (2012). Set up your criminal practice. Swamy Law House,

Ernakulam Shetty, B. J. (1985), A Manual of Law for Forest Officers, Sharda Press, Mangalore

Takwani, C. K. T and Thakker, M. C.(2012). Takwani Criminal Procedure. Lexis Nexis Butterwarths Wadhwa, Nagpur.

Theory:**Unit 1**

Definition, scope, history and development of remote sensing; Electromagnetic radiation (EMR) and electromagnetic spectrum; EMR interaction with atmosphere and earth surface; Types of remote sensing; Principles and applications of optical, thermal & microwave remote sensing; Aerial photographs – types, scale, & resolution; Photo interpretation, Satellite remote sensing - platforms and sensors;

Unit 2

Satellite systems. Indian Remote Sensing Program; Visual and digital image processing; Application of satellite based remote sensing techniques in forestry - vegetation mapping using satellite imagery; Forest cover monitoring and damage assessment; Microwave remote sensing.

Unit 3

Introduction to GIS - Components of GIS, hardware's and software's; Differences between GIS and conventional cartography; Spatial and non-spatial data, Integration of attribute data with spatial data. Spatial data - Raster and Vector data, Thematic over lays in GIS- topology building and calculation of area and length *etc.*

Unit 4

Application of GIS in forestry – using imageries and integration with GIS data. Maps-its projection, Toposheet and Map reading; Global Positioning System (GPS) applications in resource inventory, Global Navigation Satellite System, Galileo, IRNSS.

Practical:

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

Suggested Reading:

Aber, J.S., Marzloff, I., and Ries, J. (2010): Small-Format Aerial Photography: Principles, Techniques and Geoscience Applications, Elsevier, Amsterdam, 268pp.

Campbell, J.B. (2002). Introduction to Remote Sensing (3rd edition). Taylor and Francis, London Environment System Research Institute, (1999). GIS for Everyone. Redlands,CA:ESRI

Campbell, J.B. and Wynne, R.H. (2011): Introduction to Remote Sensing (5th Ed.), Guilford Press, New York, 667pp.

Chang, Kang-tsung. 2002. Introduction to Geographic Information Systems. New Delhi: Tata McGraw-Hill Publishing Company Limited.

DeMers, Michael N. 2000. Fundamentals of Geographic Information Systems (2nd Ed.) (Wiley Student Edition). New York: John Wiley & Sons, Inc.

Jackson, M.J. (1992). Integrated Geographical Information Systems. *International Journal of Remote Sensing*, 13(6-7): 1343-1351

Jensen, J.R. (2006): *Remote Sensing of the Environment: An Earth Resource Perspective* (2ndEd.), Prentice Hall, New Jersey, 608pp.

Konecny, G. (2003): *Geoinformation: Remote sensing, Photogrammetry and Geographic Information Systems*, Taylor & Francis, London, 266pp.

Lillesand, T.M. and Kiefer, W.R. (1994). *Remote sensing and Image Interpretation*, Fourth edition. John Wiley & Sons, Inc., USA

Lillesand, T.M., Kiefer, R.W., and Chipman, J.W. (2007): *Remote Sensing and Image Interpretation* (6th Ed.). Wiley, New Jersey, 804pp.

Morgan, D., and Falkner, E. (2001): *Aerial Mapping: Methods and Applications* (2nd Ed.), CRC Press, Boca Raton, Florida, 216pp.

Theory:**Unit 1**

Forest recreation-Definition and scope-social and environmental aspects of recreation components new approaches in forest recreation. Importance of Phenological studies in Landscaping.

Unit 2

Principles and elements of landscaping -types of landscape designs-formal- Persian and Mughal designs, and informal- british and Japanese. Landscape components- plant and other components- lawn, pergolas, hedges, edges, topiary, baloon, arbours, carpet beds, trees, flower beds, annuals, and climbers.

Unit 3

Practices of landscaping-Tools and implements for landscaping. Specialized gardens-butterfly, water, bog or marsh, terrace, roof, Sunken, Indoor and rock. Planning and planting programs in institutional and industrial complexes, roads, bridges, parking area and other structures.

Unit 4

Urban forestry – definition and scope – uses of urban forests, Management of urban and peri-urban forest Arboriculture, and its importance in urban forestry. Management of tree structure and canopy Architecture. **Concept of vertical gardens and Lung spaces, Institution Plantations, Sacred grooves, Avenue Plantations and indoor planation.**

Practical:

Preparation, planning and designing the planting pattern for parks, sanctuaries and industrial premises. Phenology and planting arrangement in urban forestry; visit to landscaped areas, parks tourist spots and centers, national parks and sanctuaries. Techniques and designs for Urban Forestry and Recreational forestry plantation. Techniques of Nursery raising and Plantation for recreation and urban forestry.

Suggested Reading:

Douglar, J. Hort, R. A and Ranganadhan, S. (1982). Forest Farming. Natraj Publications, Dehradun.

Gopikumar K. (2008). Arboriculture Principles and Practices. Published by Khanna Bandhu, Dehradun

Hamm, W.E and Cale, D.N. (1987). Wild Land Recreation, John Wiley and Sons, New York.

Miller, R.W. (1988). Urban Forestry. Prentice Hall International Ltd. London

Singh, S.P. (1986). Planting of Trees. B.R. Publishing corporation, Delhi.

Gordon Bradley (1995). Urban Forest Landscapes: Integrating Multidisciplinary Perspectives.

Journals: Urban Forestry and Urban Greening, An International Journal aimed at presenting high-quality research with urban and peri-urban woody and non-woody vegetation and its use, planning, design, Elsevier Publications.

Theory:

Unit 1

Degraded lands: Concept, classification, status, extent and causes of degraded lands/wastelands, different types of degraded lands – physical, chemical and biological land degradation. Soil erosion- types, causes and mechanism, measures to control erosion, ravine and sand dune formation and their control measures.

Unit 2

Salt affected soils- classes of salt affected soils, causes, extent and their effects on plant growth and afforestation / reclamation practices. Acid soils- definition, characteristics, causes and afforestation. Water logged areas- explanation, impact on plant growth and Biodrainage techniques.

Unit 3

Afforestation and reclamation of denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas. Desertification- definition, impact and causes, prevention and counter measures (shelter belts and wind breaks). Soil pollution- types, effects and control measures through forestry techniques.

Unit 4

National and state level programs on degraded lands/wasteland development. Role of Government agencies and NGO's in degraded lands/wasteland development program.

Practical:

Tree species suitable for different degraded lands. Identification and study of various degraded lands. Visit to nearby degraded lands and afforestation program.

Suggested reading:

Anil Kumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi

Brady, N. C. and Weil, R. R. 2010. The Nature and Properties of Soils (14th Edition), Pearson Education, New Delhi

Buol, S.W., Kole, F.D. and McGracken, R.J. 1975. Soil Genesis and Classification. Oxford and IBH Publ. New Delhi.

Butler, B.E. 1980. Soil Classification for Soil Survey. Clerneder Press-Oxford Publ. Co., London.

Gregersen, H. Draper, S. and Elz. D.(eds.) 1989. People and Trees- The Role of Social Forestry in Sustainable Development EDI Seminar Series, The World Bank, Washington, D. C. 273p

Hegde NG 1987. Handbook of Wasteland Development. BAIF, Pune 102p.

Hegde NG and Abhyankar 1986 (eds). The Greening of Wastelands. BAIF, Pune 204p

IARI 1960. Soil Survey Manuel, IARI. New Delhi.

ICAR 1977. Desertification and its Control. ICAR, New Delhi 358p. National Commission on Agriculture 1976. Report of the National Commission on Agriculture, Part ix,

Imeson A. 2012 Desertification, Land Degradation and Sustainability, John Wiley and Sons.

Luna, R. K. 1989 Plantation Forestry in India, International book distributors, Dehra Dun. Forestry; Ministry of Agriculture and Irrigation, Govt. of India, New Delhi 457p.

Prasad, V. N. 1985. Principles and Practices of Social-Cum-Community Forestry. International Book Distributors, Dehradun, 108p

Shah, S. A. 1988. Forestry for People. ICAR, New Delhi, 147p

Sharma, SC, Chaturvedi RB and Mishra OP 1990. Utilization of Wastelands for Sustainable Development In India. Concept Publishing Co. New Delhi-59, 488p

Theory :**Unit 1**

Wood as raw material, kinds of woods– hardwood, softwood. Bamboos and canes. Merits and demerits of wood as raw material. The physical properties of wood–density and specific gravity; wood and water relationship-moisture content, shrinkage, swelling, movement, fiber saturation point, equilibrium moisture content; electrical, thermal and acoustic properties of wood.

Unit 2

Mechanical properties of wood- general principles, tension, compression, static bending, impact bending, shear, indentation, torsion, cleavage and nail and screw pulling test. Suitability of wood for various end uses based on mechanical and physical properties. Wood seasoning – Introduction, principles, objectives and importance of wood seasoning; classification of timber based on seasoning behavior; seasoning methods – air seasoning, kiln seasoning, type of kilns and drying schedules, special seasoning methods; seasoning defects and their control.

Unit 3

Wood preservation– principles, processes, need, types of wood preservatives (oil type, organic solvent type, water soluble leachable type, water soluble fixed type.), classification of timbers based on durability, general idea about fire retardants and their usage. Non-pressure methods – steeping, dipping, soaking open tank process, Boucherie process. Pressure methods – full cell process, empty cell process (Lowry and Rueping).

Unit 4

Wood machining: Sawing milling– sawing techniques; Saw mill machineries-cross-cutting machines, head saws (circular, gang, frame and band saws) re-saws. Wood working- wood working machineries (sawing, planing, moulding, boring, mortising, Tenoning and turning machines). Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers. Wood finishing.

Practical:

Different kinds and types of wood available as raw material. Preliminary idea regarding procurement and temporary storage of logs. Nomenclature of sawn material after conversion of timbers into various sawn forms. Estimation of moisture content of wood by oven-dry and moisture meter. Estimation of wood density by various methods. Determination of calorific value of wood. Testing of various mechanical properties of wood. Wood seasoning- air seasoning, kiln seasoning and special seasoning methods. Seasoning defects and their control. Chemicals used in wood preservatives, methods of wood preservation and fire retardant treatments. Various types of wooden joints in timber structures and furniture, Saw mill and wood workshop machineries. Polishing and finishing of wood.

Suggested Reading:

Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.

Walker, J.C.F., Butterfield B.G., Langrish T.A.G., Harris J.M., Uprichard J.M. 1993. Primary wood processing-principles and practices. Chapman and Hall, London.595 pp.

FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.

Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.

Pandey C.N. and Jain V.K. 1992. Wood Science and Technology. ICFRE [Indian Council of Forestry Research and Education],FRI, Dehradun.144 pp.

Kumar S. and Dev I.1993. Wood Preservation in India. ICFRE [Indian Council of Forestry Research and Education],FRI, Dehradun.262 pp.

Rajput S.S., Shukla, N.K., Gupta, V.K and Jain J.D. 1996. Timber mechanics-strength,classification and grading of timber. . ICFRE [Indian Council of Forestry Research and Education],FRI, Dehradun.189 pp.

Thyagarajan C. 2010. A text book of an insight into wood processing technology. AWTC, IWST, Bangalore.254 pp.

Theory :

Unit 1

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 2

Economic features of specialized timber markets in terms of degree and type of competition in buying and selling, price spreads across different channels of marketing, 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.

Unit 3

Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce. Forests produce price analysis. Market integration and 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.

Unit 4

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). Forest Certification process and methods – Advantages and Disadvantages. Marketing management in forest produce.

Practical:

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

Suggested reading:

Gray, J. W. 1993. Forest resource systems in developing countries. Food and agricultural organization. Rome. 259p.

ITTO. [International Tropical Timber Organisation]. 1993. The economic linkages between international trade in tropical timber and sustainable management of tropical forests. London environmental economic centre, International Institute for Environment and Development, London, UK. 330p.

ITTO. [International Tropical Timber Organisation]. 2012. Annual review and assessment of the world timber situation, Yogyakarta, Indonesia. 182p.

Kula, E. 1996. The economics of forestry: Modern theory and practice. Timber press, Portland, Oregon. 182p.

Muraleedharan, P. K. Subramanian, K. K., and Pillai, P. P. 1998. Basic readings in forest economics. Kerala Forest Research Institute and Ford Foundation, Thrissur, Kerala. 177p.

Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers & Publishers), Dehradun, India. 140p.

Semester-VII

Course Code	Course	Credits
BFC 401	Forestry Work Experience (Student READY, FoWE)	0+20
BFC 402	All India Study Tour (30 days)	0+3
	Part – A (South India Tour – 10 days)	
	Part – B (North India Tour – 20 days)	
	Total	0+23 = 23

Experiential Learning Modules (Student READY)

- Nursery Management for Production of Quality Planting Material
- Production and Marketing of high value forest produce
- Apiculture /Sericulture
- Ecotourism
- Wildlife Animal Health Management
- Technical Report Writing, Documentation and Presentation
- Orientation of students towards Research, Models, Data / RS Image analysis and interpretation

Description	Weeks	Credits
Forest work experience	10	10
Industry /NGO Attachment	5	5
Village Attachment	3	3
Report Wring & Presentation	2	2
Total	20	20

Semester-VIII

Course Code	Course	Credits
BFC 403	Forest Tribology & Anthropology	2+0
BFC 404	Forest Biotechnology	2+1
BFC 405	Agroforestry Systems and Management	1+1
BFC 406	Wildlife Management	1+1
BFC 407	Forest Ecophysiology	2+1
BFC 408	Project Work & Dissertation- Student Ready	0+5
	Total	8+9 =17
	Grand Total	86+94 = 180

1. BFC 403 Forest Tribology & Anthropology 2+0

Unit 1

Meaning, scope and development of Anthropology. Relationships with other disciplines. Main branches of Anthropology, their scope and relevance. Human Evolution and emergence of Man. Phylogenetic status, characteristics and geographical distribution.

Unit 2

Principles of Prehistoric Archaeology. Chronology: Relative and Absolute Dating methods. Culture, Society, Marriage, Family, Kinship, Economic and Political Organization, Social Control, Religion, Anthropological theories, Language and Communication, Research Methods in Anthropology. Race and Racism. Applications of Anthropology. Ethno-archaeology in India.

Unit 3

Demographic profile of India. The structure and nature of traditional Indian social system. Caste system in India Definition and characteristics of a tribe. Tribes and aborigines- an anthropological perspective. Racial classification and distribution of tribes. Tribes in India and Telangana with special reference to **Lambada, Koya, Gonds, Yerukala, Pradhan, Bhanjaras, Chenchus etc.** Tribal economy. Tribal's and Constitution of India Administration of tribal areas in independent India- appraisal of tribal development - problems of tribal identity and integration in the mainstream.

Unit 4

Relation between tribes and forests- forest as their immediate environment. Forests as the means of livelihood. Girijan habitat – changes consequent to government control of forests. Forest management and tribal welfare- management conflicts and way forward. Role of forest department in tribal welfare. Role of Non wood Forest products in the economy of tribe's and Tribal cooperative societies. Social forestry and tribal welfare.

Suggested reading :

Furer-Haimendorf, C.V. 1985. Tribes of India – the struggle for survival. OUP. New Delhi

Hasnain, N. 2007. Tribal India. New Royal Book Company

Hasnain, N. 2011. Indian Anthropology. Palaka Prakashan

Sharma, R.N. and Bakshi, S. 1984. Tribes and tribal development. Uppal Publ. House, New Delhi

Sharma, R. N., Sharma, R.K. 1997. Anthropology. Atlantic Publishers & Distributors.

Thakur, D. 1986. Socio-economic development of tribes in India. Deep and Deep Publications, New Delhi

Vidyarthi, L.P. and Rai, B.K. 1985. The tribal culture of India. Concept Publ. Co., New Delhi

Theory:

Unit 1

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in forestry: Totipotency and Morphogenesis, Nutritional requirements of invitro cultures

Unit 2

Techniques of In-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting in-vitro culture; Applications and Achievements; Soma clonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology;

Unit 3

Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in tree improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer

Unit 4

Transgenic plants and their applications. Blotting techniques – DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in crop improvement.

Practical:

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoresis technique.

Suggested reading:

Bajaj, Y.P.S. (Ed) (1988). Biotechnology in Agriculture and Forestry 2. Crops 1. Springer-Verlag, Berlin.

Dhawan, V (2012) Applications of Biotechnology in Forestry and Horticulture. Springer US

EIRI Board. (2007) Hand Book of Biotechnology. Engineers India Research Institute, NaiSarak, Delhi

Gupta, P.K. (2010) Elements of Biotechnology (2nd Ed). Rastogi Publications

Neumann, K.H., Kumar, A., and Sopory, S.K. (2008) Recent Advances in Plant Biotechnology and Its Applications. I. K. International Pvt Ltd

Punia, M.S. (1998). Plant Biotechnology and Molecular Biology. A laboratory manual. Scientific Publishers, Jodhpur,

Rehm, H.J. and Rheed,G. (Ed) (1993). Biotechnology Vol.2, VCH Verlagsgesellschaft, Germany.

Surendran, C., Sehgal, R.N. and Paramathma, N. (Eds.) A Textbook of Forest Tree Breeding, ICAR, New Delhi

Thieman, W.J. and Palladino, M.A. (2009). Introduction to Biotechnology, Second Edition. Pearson Benjamin Cummings, San Fransisco.

3. BFC 405 Agroforestry Systems and Management 1+1

Theory:

Unit 1

Agroforestry systems in different agro climatic zones, components, production and management techniques. Alley cropping- functional and structural attributes of alley cropping, Structural and functional attributes, soil management, choice of species and system productivity of various Agroforestry systems.

Unit 2

High-density short rotation plantation systems, silvicultural woodlots/energy plantations. Different types of Pastoral siculture and silvopastoral systems Silvoagriculture systems- Agrosilviculture, Pastoral silviculture , Silvopastoral and Agrosilvopastoral systems and their mangement; agrihortisilviculture, silvihorticulture, hortipastoral , aquaforestry, shelterbelts and windbreaks - design, aerodynamics and management; live fences; fodder trees and protein banks.

Unit 3

Agroforestry for wasteland development. Canopy management - lopping, pruning, pollarding, and hedging. Diagnosis and design methods and approaches. Biophysical and ecological functions of agroforestry: Nutrient cycling and role of agroforestry in soil and water conservation - micro-site enrichment by trees, N fixation, improvement in soil physico-chemical properties and soil organic matter status, litter and fine root dynamics, nutrient pumping; beneficial effects of species mixture - rhizosphere and phillosphere effects.

Unit 4

Carbon sequestration-Climate change mitigation and phytoremediation. Adverse effects of trees on soils - competition, allelopathy – causes and mechanisms. Soil fertility considerations in Agroforestry – nutrient needs of trees and crops, activities of soil fauna and microorganisms affecting plant growth. People's participation, rural entrepreneurship through Agroforestry and industrial linkages. Financial and socio-economic analysis of Agroforestry systems. Evaluation of tangible and intangible benefits.

Practical:

Study characteristics of trees/shrubs/grasses for agroforestry. Visit prominent agroforestry systems, other plantation crop combinations, homegardens, other integrated multitier agroforestry systems and study their structural and functional attributes. Volume and biomass estimation- C sequestration assessment- Crown measurement, light interception, leaf area index measurements in agroforestry systems. Annual crops/grass growth measurements and yield estimation. Diagnosis and design - methodology. Survey agroforestry practices in local/ adjoining areas. Multistoried cropping system and canopy architecture management

Suggested reading :

Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.

Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.

Kumar, B. and Nair, P.K.R. (eds). 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Volume 3 in the Book Series “Advances in Agroforestry”. Springer Science, the Netherlands

Kumar, B.M. 2011. Species richness and aboveground carbon stocks in the homegardens of central Kerala, India. Agriculture, Ecosystems and Environment. 140: 430–440

Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p

Kumar, B.M. and Nair, P.K.R. 2004. The enigma of tropical homegardens. 2004. Agroforestry Systems. 61: 135–152.

Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub. Co. New Delhi.

Mohan, S., Nair, P.K.R., Long, A.J. 2007. An Assessment of Ecological Diversity in Homegardens: A Case Study from Kerala State, India. Journal of Sustainable Agriculture. Volume 29, Issue 4: 135-153.

Nair PKR, Rao MR, and Buck LE (eds), 2004. *New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry*, Kluwer, Dordrecht, The Netherlands.

Nair, P.K.R. *Agroforestry Systems in the Tropics*. Springer. 680p.

Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. *J. Plant Nutr. Soil Sci.* 172: 10–23.

Nair, PKR 1993. *An Introduction to Agroforestry*. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Pathak P.S. and Ram Newaj (eds.) 2003. *Agroforestry: Potentials and Opportunities*. Agrobios, Jodhpur.

4. BFC 406 Wildlife Management 1+1

Theory:

Unit 1

Principles and practices of wildlife management; Forest and wildlife management in India

Unit 2

Population Management: Capture, handling, bio-telemetry, reintroduction, prey-predator relationship; Species conservation projects: Lion, **Tiger**, elephant, Rhino, Crocodile, Musk deer etc.

Unit 3

Wildlife Management plan for Protected Areas; In-situ and Ex-situ management/ conservation

Man-animal conflict and its management; Red data book and IUCN;

Unit 4

Wildlife Ecotourism: sustainable tourism and people's participation; Agencies in wildlife conservation: IUCN, CITES, WWF, IBWL; Community participation in wildlife management; Case studies; Wildlife policies and legislation, Wildlife (Protection) Act, 1972

Practical:

Study of nearby protected area management; Participation in capture operations; Visit to Zoo/ captivity and studying management practices; Use of collars and radio tracking equipment. Wildlife photography and conservation; Study of wildlife management plan of nearby protected area;

Wildlife based ecotourism model study with special reference to Telangana.

5. BFC 407 Forest Ecophysiology (2+1)

Theory:

Unit 1

Introduction to Ecophysiology – Geographic and climatic factors - Forest ecosystems – Environmental factors influencing forest growth and productivity. Carbon balance - Dry matter production and partitioning – GPP and NPP of forest stands – productivity and biomass in tropical deciduous and evergreen forest ecosystems.

Unit 2

Canopy area - Leaf area index and dry matter production – Interception of solar radiation and tree growth- Shade tolerance and adaptations of trees – Water relations of forest trees – Transpiration from forest canopies – Water use efficiency of forest trees/stands. Nutrient dynamics and plant growth – Nutrient cycling in ecosystem.

Unit 3

Environmental stresses - water stress - physiological changes - adaptation to drought and its amelioration, flooding – mechanism of tolerance to water logging. Temperature stress – Physiological changes - low and high temperature - chilling injury - tolerance – alleviation - salt stress – physiological changes and alleviation,

Unit 4

Air pollution – physiological effects of air pollutants. Ecophysiological responses of forests to atmospheric change – Impact of elevated CO₂, -Leaf gas exchange, Photosynthesis, Plant respiration – Carbon sequestration, Effect of other Green house gases, (CH₄, NO₂, CFCs) - Adaptation and Mitigation

Practical:

Estimation of leaf area and LAI by different methods –Chlorophyll stability index – membrane stability index – Water use efficiency – canopy temperature - Estimation of evapotranspiration and water use efficiency of forest communities – Measurement of photosynthetic production. Translocation studies in plants; Effect of growth promoters on plants; Effect of growth retardants on plants; Use of biocides in tree species; Dormancy and germination studies in tree species; Methods of breaking dormancy in tree species; Studies on senescence in tree species; Regulation of senescence in tree species using agrochemicals; Chemical composition of tree species including shrubs, herbs and wood.

Suggested reading :

Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody plants. John Wiley and Sons. New York

Lambert, Chapin, F.S. and Pons,T.L. (2008). Plant Physiological Ecology. Springer Science & Business Media inc. Newyork.

Landsberg , J.J (2010). Physiological Ecology of Forest Production : Principles, Processes and Models. Academic Press Inc., London

Landsberg, J.J and Gower, S.T. (1997). Applications of Physiological Ecology to Forest Management. Academic Press Inc., London.

Larcher, W. (2003) Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups. Springer Science & Business Media

Longman, J.A. and Jenik. (1987). Tropical Forests and its Environment. ELBS, London.

Nobel P. S. (2005). Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, Amsterdam

Taiz, L. and Zeiger, E. (2010) Plant Physiology (5th edition). Sinauer Associates, Inc., Massachusetts

Wilkins, B.M, (1984). Advanced Plant Physiology. Longman Scientific & Technical.