SunRise University
Approved by Govt. of Rajasthan vide Sunrise University Act, 2011
Recognized by UGC Act, 1956 u/s 2 (f)

Established by Rajasthan Govt. vide Ordinance No.08/2011 Recognized by UGC u/s 2 (f) of UGC Act, 1956

Syllabus

1st Semester

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
BSFO-111	Introduction to Forestry	2	0	40	10	50	-	100
BSFO-112	Introduction to Agronomy and Horticulture	2	1	15	5	50	30	100
BSFO-113	Principles of Agroforestry	1	1	15	5	50	30	100
BSFO-114	Dendrology	2	1	15	5	50	30	100
BSFO-115	Plant Biochemistry	1	1	15	5	50	30	100
BSFO-116	Information and Communication Technology	1	1	15	5	50	30	100
BSFO-117	Communication Skills and Personality Development	1	1	15	5	50	30	100
BSFO-118	Basic Mathematics	2	0	40	10	50	-	100
BSFO-119	Basic Economics	1	0	40	10	50	-	100
BSFO-1110	Physical Education&Yoga Practice-I (NCC-I/NSS-1)	0	1	-	-	-	100	100
	Total	**10**	**7**	**-**	**-**	**-**	**-**	**900**

Introduction to Forestry

Theory

Forests - definitions, role, benefits - direct and indirect. History of Forestry - definitions, divisions and interrelationships. Classification of forests - High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests - even and uneven aged stands. Basic concepts on Forest types of India. Agroforestry - farm forestry, social forestry, joint forest management - concepts, programmes and objectives. Important acts and policies related to Indian forests. Global warming – climate change- forestry options for mitigation and adaptation - carbon sequestration. Important events/dates related to forests and environment - themes and philosophy.

Introduction to world forests – forest biomes- geographical distribution and their classification, factors influencing global forests distribution - productivity and increment of world forests. Forest resources and forestry practices in different eco-regions of the world. General problems of forest development and economy. Forest based industries in the developed and developing countries. Trade patterns of forest based raw materials. Recent trends in forestry development in the world. National and international organizations in forestry.

Suggested readings

Beazley, M. (1981). The International Book of Forest. Mitchell Beazly Publishers, London.

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, 473p.

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.

Introduction to Agronomy and Horticulture

Theory

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 - Soil productivity and fertility- Crop nutrition – nutrients –classification – Nutrient sources-organic manures –fertilizers – biofertilizers- Integrated Nutrient Management-Importance of water in plant growth- Soil properties influencing moisture availability – texture, structure and organic matter status-Irrigation and drainage. 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- 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. Field exercise on the cultivation practices of important agronomic crops- 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. Nursery and field planting techniques on important plantation crops- techniques of 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

Balasubramaniyan, P and Palaniappan, S.P. (2001). Principles and Practices of Agronomy. Agro Bios (India) Ltd., Jodhpur.

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

Brady, N.C. and Well,R.R. (2002).The Nature and Properties of Soils (13th ed.). Pearson Education, Delhi.

De,G.C. (1989). Fundamentals of Agronomy. Oxford & IBH Publishing Co.,NewDelhi

Havlin, J. L., Beaton, J. D., Tisdale, S.L., and Nelson, W.L. (2006). Soil Fertility and Fertilizers: An Introduction to Nutrient Management (7th ed.). Pearson Education,Delhi.

ICAR.(2006). Handbook of Agriculture, ICAR, NewDelhi.

Nair,P.K.R.(1979). Intensive multiple cropping with coconuts in India.Verlag Paul Pary, Berlin.

Palaniappan, S.P. (1988). Cropping systems in the tropics - Principles and management. Wiley Eastern Limited, NewDelhi

Reddy.T.Y and Reddy, G.H.S. (1995). Principles of Agronomy, Kalyani Publishers, Ludhiana.

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

Sankaran, S. and Subbiah Mudaliar, V.T. (1991). Principles of Agronomy. The Bangalore Printing & Publishing Co., Bangalore.

Tisdale, S. L., W. L. Nelson, J. D. Beaton and J. L. Havlin. (1995). Soil feritility and fertilizers (5th ed). Macmillan Publishing Co., New York.

Principles of Agroforestry

Theory

Overview of the Agriculture scenario – Paradigm shift in Agriculture development- impacts of green revolution – Agrobiodiversity – significance, threats and conservation strategies. Agroforestry – definition and scope – Social, ecological, and economic reasons for agroforestry. History of agroforestry. Components of Agroforestry- Provisioning and regulator services of agroforestry- Nutrient cycling, Soil improvement, Increased production and productivity, Microclimate amelioration and carbon sequestration – Tree-crop interaction in agroforestry– Definition, kind of interaction – Positive interactions-complementarity - compatibility - mutualism, commensalism - Negative interactions – allelopathy and competition-Interaction management - Aboveground and belowground interactions- Manipulation of density, space, crown and roots. Tree Management – structure and growth of trees, crown and root architecture, agroforestry practices to minimize negative interaction – coppicing, thinning, pollarding and pruning – crop planning and management –selection of suitable crops –management of nutrients, water and weeds – Classification of agroforestry systems – National Agroforestry Policy 2014— National and International organizations in Agroforestry.

Practical

Visit to social / Urban / Community forestry plantations and study their impact on socio – economic status of rural people- Traditional agroforestry systems in the country and visits to some of the local agroforestry systems. Agroforestry systems in different agroecological zones- their structural and functional features. Visit to on farm agroforestry models. Studies on fodder banks and live fences. Studies on light and below ground interactions in agroforestry systems- MPTs and Nitrogen fixing trees in agroforestry- Studies on allelopathy- Design & Diagnostics exercise in agroforestry- Land capability classification of various topographic regions- Visit to industrial plantations.

Suggested reading

Huxley, P. A. (1999). Tropical Agroforestry. Wiley: 384p.

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

Nair, P.K.R, Rao MR, and Buck, L.E (eds), (2004). New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry, Kluwer, Dordrecht, The Netherlands.

Nair, P.K.R. (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.

Patra, A.(2013). Agroforestry: Principles and Practices, New India Publishing Agency, 260 p

Raj, A. J. and S. B. Lal (eds.) (2013). Agroforestry-Theory and Practice. Scientific Publishers (India), Jodhpur.

Dendrology

Theory

Introduction- importance and scope of dendrology, Principles and systems of plant classification systems. Detailed study of Benthamand Hooker natural system, its advantages and disadvantages. Plant Nomenclature–objectives, principles and International Code of Botanical Nomenclature. Role of vegetative morphology in identification of woody forest flora. Peculiarities of bole, general form of woody trunk and deviations like buttresses, flutes, etc. Morphology and description of barks of common trees. Characteristics of blaze, bark colour, exudations etc. Morphology of leaf, different types of leaves, colour of young and old leaves in some species as (regular) features of identification. Reproductive morphology of plants with reference to description and identification of reproductive parts.

Detailed study of the families- diagnose the features-floral variations–distribution and economic importance-systematic position as per Bentham &Hooker System of classification -Magnoliaceae, Annonaceae, Clusiaceae, Dipterocarpaceae, Malvaceae, Sterculiaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardiaceae, Fabaceae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae, Bignoniaceae, Lamiaceae, Lauraceae, Euphorbiaceae, Orchidaceae, Palmae and Poaceae. Brief description of the families-Bombacaceae, Santalaceae, Casuarinaceae.

Practical

Morphological description of plant parts and method of collection of plants. Techniques of preparing herbarium specimens. General study of herbarium. Dissection of flowers-making sketches-construction of floral diagrams of one species of the following families:Annonaceae and Guttiferae, Dipterocarpaceae and Malvaceae, Sterculiaceae and Tiliaceae, Rutaceae and Meliaceae, Sapindaceae and Anacardiaceae, Fabaceae - Papilionaceae- Mimosae–Caesalpiniaceae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae and Bignoniaceae, Lamiaceae, Euphorbiaceae, Santalaceae and Casuarinaceae, Orchidaceae, Poaceaeand Pinaceae.

Suggested reading

Bor N. L. (2009). Manual of Indian Forest Botany. International Book Distributors; Reprint of Oxford UP.

Brandis. D. Revised by R. D. Jakarti (2010). Indian Trees. Dehra Dun.

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

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

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

Fyson, F. P. (1877). The flora of the Nilgiri and Pulney Hill-tops. Government of India.

Gamble, J. S. (1915). Flora of the Presidency of Madras Vol-1 to 3. Adlard and Sons. Ltd. London.

Hardin, W., Harrar, E. S., and White, F. M. (1995). Textbook of Dendrology (8th Edition). McGraw-Hill Companies, London 30

Jain S. K. and R. R. Rao. (1977). Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers. New Delhi Lawrence, G.H.M. (1967). Taxonomy of Vascular Plants. Oxford & IBH, New Delhi. Mishra. S. R. (2010). Textbook of Dendrology. Discovery Publishing House Pvt. Ltd. New Delhi.

Naqshi, R. (1993). An Introduction to Botanical Nomenclature. Scientific Publishers. Jodhpur.
Pandey S. N. and S. P. Mishra. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.
Parker, R. N. (1933). Forty Common Indian Trees and How to know them. (Available online PDF)
Pascal, J. P. and Ramesh, B. R. (1987). A field key to the trees and lianas of the evergreen forests of the Western Ghats (India). FIP, Pondicherry.
Pradip Krishnen (2013). Jungle Trees of Central India. Published by Penguin Books India Pvt. Ltd. New Delhi.
Randhawa, M. S. (1957). Flowering Trees in India. Sree Saraswati Press Ltd. Kolkatta.
Sahni, K. C. (2000). The Book of Indian Trees. Bombay Natural History Society. Mumbai.
Singh, G. (2000). Plant Systematics. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Plant Biochemistry

Theory

Chemistry of carbohydrates–classification, mono, di and polysaccharides, anomerism, epimerism, mutarotation, configuration of sugars and inversion. Chemistry of lipids–classification, simple lipids and phosphor lipids. Fatty acids and fat constants, lipids of chloroplast, membranelipids. Chemistry of 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. Enzymes – classification, enzyme kinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes. Metabolism of carbohydrates–glycolysis, TCA cycle, HMP shunt, glyoxylic acid cycle, electron transport chain. Lipids metabolism–beta oxidation and fatty acid biosynthesis. Photosynthesis –light reaction, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3 and C4 plants, CO2 fixation, regulation of photosynthesis. Plant hormones and their mode of action.

Practical

Qualitative tests for carbohydrates, Quantitative estimation of reducing sugars by DNS method, Quantitative test for total carbohydrates by Anthrone reagent, 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, Determination of Michaelis constant of enzymes, Estimation of RNA.

Suggested reading

Conn, E. E. and Stumpf, P.K. (2006). Outlines of Biochemistry, Vth edition. Wiley India (P) Ltd., New Delhi
Nelson, L.D. and Cox, M.M. (2013) Lehninger Principles of Biochemistry. VIth edition. Mc Millan Learning.
Robert, C. B. (1987). Modern concepts in Biochemistry. Allynand BaconInc. London
Salisbury, F. B. and Ross, C. W. (2004). Plant Physiology. Thomson Asia Ptd., Ltd. Singapore.

Taiz, L. and Zeiger, E. (2010) Plant Physiology. Vth edition Sinauer Associates, Inc., Massachusetts
William, H. E. and Daphne, C. E. (2005). Biochemistry and Molecular Biology, Oxford University Press.

Information and Communication Technology

Theory

IT and its importance. IT tools, computer fundamentals; hardware and software; input and output devices; word and character representation; principles of programming- algorithms and flowcharts; Introduction to application software Word Processors, Spreadsheets, Presentation Software, Image Processing Software, Local area network (LAN), Wide area network(WAN), computer programming, Audio visual aids, Internet and World Wide Web, Internet web programming , HTML, CSS, Javascript, Internet security, Mobile technologies.

Practical

Exercises on binary number system,; Familiarization with Hard ware and software, operating system, Application software: MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, algorithms and flowcharts, database management system, internet, operation of Email account; Handling of audio visual equipments.

Suggested reading

Arick, M.R. (1994). The TCP/IP Companion - A Guide for Common User. Shroff Publishers and Distributors Pvt. Ltd., Mumbai.
Balaguruswamy, E. (1998). Programming with ANSI C. Tata McGraw Hill, New Delhi.
Deitel, H.M. (1990). An Introduction to Operating System. Addison Wesley
Desai, B. C. (2000). Introduction to Database Systems. Galgotia Publications, New Delhi.
Freer, J. (1990). Computer Communication and Networks. Affiliated East West Press, New Delhi.
Mansfield,R. (2008). Working in Microsoft office, Tata McGraw Hill
Miller,M. 2007. Absolute Beginner's guide to computer Basics, Fourth Edition, Pearson Education.
Norton, P. (2007). Introduction to computers, Sixth Edition Tata McGraw Hill
Raj, K.(2007). Internet and web Technologies, Tata McGraw Hill
Tanenbaum, A.S. (2003). Computer Networks. Prentice Hall of India, New Delhi.

Communication Skills and Personality Development

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; 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, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences. Transactional skills, group dynamics.

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, precis writing, summarizing, abstracting; individual and group presentations. Transactional analysis, group dynamics.

Suggested Reading

Carroll, B.J. (1986). English for college, Macmillan India Ltd. New Delhi
Hornby, A.S. (1975). Guide to patterns and usage in English. Oxford University, NewDelhi.
James M and Jongeward, D. (1978). Born to Win: Transactional Analysis with Gestalt Experiments. New American Library, New York
Qurik, R and Green baum, S. (2002). A University Grammar of English, London.
Wren P.C. and Martin, H. (2006). High School English Grammar & Composition. S. Chand & Co. Ltd Group.

Basic Mathematics

Theory

Elementary idea of complex number. Arithmetic and Geometric progressions. Elementary idea of permutation and combinations. Matrix of a system of linear equations. Binomial theorem for positive integral index, any index and their applications, addition and substraction formulae. A, B and C, D formulae. Sine and Cosine formulae. Inverse Trignometric functions, ratios and their inter relationships. Limit of functions-differentiations and integrations simple applications-maxima and minima least square techniques- Introduction to matrices and determinants, special type of matrices, addition, substraction and multiplication of matrices.

Suggested reading

Chatterjee SK. (1970). Mathematical Analysis. Oxford & IBH.
Frank, A. (1962). Schaum's Outline of Theory and Problems of Matrices. McGraw-Hill.
Frank, A. (1967). Theory and Problems of Differential Equations. McGraw-Hill.
Gentle JE. (2007). Matrix Algebra: Theory, Computations and Applications in Statistics. Springer. Narayan, S. (1953). A Text Book of Matrices. S. Chand and Company.
Parameswaran,S.(1976).An introduction to mathematics.Oxford & IBH Publishing Co.172 p.
Priestley, H.A. (1985). Introduction to Complex Analysis. Clarenton Press
Walter R. (1976). Principles of Mathematical Analysis.McGraw-Hill.

Basic economics

Theory

Economics- Meaning, definition, subject matter- Divisions of economics -Importance of economics- Agricultural economics- Meaning, definition- Basic concepts - Goods, service, utility, value, price, wealth, welfare- Wants- Meaning, characteristics, classifications of wants, importance. Theory of consumption- Law of diminishing marginal utility, meaning, definition,assumption, illustration, limitations, law of equi-marginal utility-Importance-Consumer surplus- Meaning, definition, importance.
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 elasticity of demand, importance of elasticity of demand – supply- meaning,supply function-Law of supply- factors influencing –Production-Meaning, factors of production- land, labour, capital, organization, entrepreneurship-Inflation: definition, types of inflation- Welfare economics- meaning and basic concepts, Production Economics: concepts, Three production relationships, returns to scale.

Suggested readings

Dewett, K.K., Verma. (2005). Elementary Economic Theory, S.Chand, New Delhi.
Reddy, S.S., RaghuRam, P., Neelakanta Sastry, T.V., Bhavani, D.I. (2009). Agricultural Economics.Oxford and IBH Publishers, New Delhi.

Physical Education & Yoga Practice–I

Concept of Physical Education-Meaning, need & importance, aim, & objectives.Conditioning exercises- warming up, warming down (general & specific), and flexibility exercise. Physical Fitness exercises for speed, strength, agility, endurance and coordination. Posture & Concept -Definition, values of good posture, causes & drawbacks of bad posture, Common postoral deviation, their causes and correct exercises, Kyphosis, Scoliosis, Lordosis, Knock knee & Bowlegs, Flatfoot. Running ABC'S, walking ABC'S - Major games- Rules and regulations of important games, Skill development in any one of the games - Football, Basketball &Ballbadminton. Indoor games - Participation in one of the indoor games - Shuttle badminton & table tennis. Athletic events- Rules & regulations of athletic events, Participation in any of the athletic events–Broad jump,high jump and shortput. Conduct of Health Related Physical Fitness Test (TPFP):One mile run/Beep test, Sit-Up 60 sec,Sit and reach, Modified pull-ups. NOTE: (one to be selected major games, indoor games and Athletic events). Regular basic training in Yoga.

NCC/NSS –I

Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm,order arm, present arm, guard of honour,ceremonial drill.

or

Aims and objectives of NSS. NSS logo, motto etc. Orientation of students in national problems, study of philosophy of NSS, fundamentalsrights,directive principles of state policy, Village adoption.

2nd Semester

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
BSFO-121	Theory and Practice of Silviculture	2	1	15	5	50	30	100
BSFO-122	Plant Physiology	2	1	15	5	50	30	100
BSFO-123	Plant Cytology and Genetics	2	1	15	5	50	30	100
BSFO-124	Wood Anatomy	2	1	15	5	50	30	100
BSFO-125	Wildlife Biology	2	1	15	5	50	30	100
BSFO-126	Forest Survey & Engineering	2	1	15	5	50	30	100
BSFO-127	Geology & Soils	1	1	15	5	50	30	100
BSFO-128	Climate Science	1	1	15	5	50	30	100
BSFO-129	Physical Education&Yoga Practice-II	0	1	-	-	-	100	100*
	Total	**14**	**8**	**-**	**-**	**-**	**-**	**800**

Theory and Practice of Silviculture

Theory

Definitions: Forests and Forestry- Silviculture objectives and scope of silviculture-relation with other branches of Forestry Silvics. Site factors - climatic, edaphic, physiographic, biotic and their interactions. Trees and their distinguishing features, growth and development. Root growth- fine root/functional root production- Direct and indirect benefits-biophysical interactions- trees and buffering functions- C sequestration potential of forests. Silvicultural systems-definition, scope and classification. Systems of concentrated regeneration- systems of diffused regeneration- accessory systems- Clear felling systems-Shelterwood system - Selection system and its modifications- Coppice systems- Culm selection system in Bamboo, Canopy lifting system in Andaman. Silvicultural systems followed in other countries.

Regeneration of forests – objectives - ecology of regeneration- natural, and artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment, requirement for natural regeneration, advance growth, coppice, root sucker, regeneration survey, natural regeneration supplemented by artificial regeneration. Artificial regeneration - object of artificial regeneration - advantages. Factors governing the choice of regeneration techniques. Tree planting- Sowing v/s planting different kinds of pits- tending and cultural operations- weeding- kinds of weeding- release operations-singling, cleaning–liberation cutting.

Practical

Acquaintance with modern silvicultural tools. Visits to different forest areas/types. Study of forest composition. Visiting plantations raised by forest department, Exercise on nursery practice- seed collection, seed pre-treatment- nursery stock preparation- field preparation-marking, alignment and stacking, pit making-planting, various tending operations-weeding, cleaning, singling, pruning, pollarding, lopping, and thinning- fertilization in trees-plant protection and sanitation measures.

Suggested reading

Evans, J. & John W. Turnbull . (2004). Plantation Forestry in the Tropics: The role, silviculture and use of planted forests for industrial, social, environmental and agroforestry purposes. OUP Oxford. 482p.

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

Nyland, R. D. (2016). Silviculture: Concepts and Applications, Third Edition. Waveland Press, 680 pages

Ram Parkash (1991). Theory and Practice of Silvicultural Systems International Books & Periodicals, Dehra Dun, 298 pages

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

Plant Physiology

Theory

Introduction to tree physiology. Photosynthesis - C3, C4 and CAM plants - Photorespiration - Factors affecting photosynthesis. Respiration - energetics of dark respiration. Plant-water relations, Concept of water potential, ascent of sap and water balance. Stomatal physiology - stomatal conductance – resistance. Mineral nutrition - macro-micro nutrients - Arnon's criteria of essentiality – deficiency. Plant growth regulators – classification. Tree structure, Growth and development - growth kinetics. Growth regulation and co-ordination - Plant growth analysis -Canopy architecture. Forest Biomes. Light interactions models of forest canopies - Sun plants and shade plants - shade tolerance. Temperature - temperature influence on forest development - energy budgets - low and high temperature - Physiological adaptations for high temperature - chilling injury. Water stress - Mechanism of drought tolerance and drought resistances - Physiological basis of drought avoidance and tolerance. Water relations of forest trees – Transpiration from forest canopies – Evapotranspiration models of forest stands - Water use efficiency. Salinity stress its effects on tree growth. Resistance to salinity. Forest and microclimate. Carbon balance and dry matter production in forest trees - Dry matter production and partitioning – source/ sink - . GPP and NPP of forest stands -Carbon cycling - Nutrient dynamics and plant growth – Nutrient cycling of C,N,P,S.

Practical

Preparation of solutions. C3 and C4 leaf anatomy. Estimation of transpiration using porometer. Estimation of photosynthesis using IRGA. Extraction and estimation of chlorophyll in plants. Estimation of stomatal index.Demonstration of plasmolysis. Estimation of water potential in plants using Plant water status console. Estimation of leaf area of plants. Plant growth analysis – RGR, NAR, LAR- specific leaf area and leaf weight ratio - LAI - CGR – LAD etc… Measurement of moisture stress tolerance parameters in trees - membrane stability, chlorophyll stability, proline content, wax and cuticle thickness. Measurement of relative water content, leaf water potential, osmotic potential. Measurements of stomatal resistance/stomatal conductance under varying stress condition. Observation on tree architecture of important species.

Suggested reading

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

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

Lambers, H., Chapin, F.S. and Pons,T.L. (2008). Plant Physiological Ecology. IInd edition. Springer Scientific & Business Media inc. New York.

Landsberg , J. and Sands, P. (2011). 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.

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

Pallardy, S.G. (2008) Physiology of woody plants. IIIrd edition. Elsevier Inc. Amsterdam

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.

Plant Cytology and Genetics

Theory

History of genetics. Pre-Mendelian concepts – preformation – pangenesis. Mendels principles of inheritance – segregation – independent assortment. Cell – structure and functions. Cell organelles. Cell reproduction – mitosis – meiosis and its significance. 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 –pleotrophy – polygenic inheritance – penetrance and expressivity – cytoplasmic inheritance. 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. 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 reading:

Fletcher, H. and Hickey, I. (2012). Genetics (4th ed.). Garland Science, Taylor & Francis, U. K. 371p

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 Genetics (7th Ed). Tata McGraw-Hill Education.

Timothy L. White, T.L., Adams, W.T. and Neale, D.B. (2007). Forest Genetics, CABI Publishing, Oxfordshire, UK FB.

Wood Anatomy

Theory

Introduction to wood anatomy. Classification of plant kingdom. Gymnosperms versus angiosperms. Kinds of woody plants. The plant body; a tree and its various parts. Meristems; promeristem, primary meristem, secondary meristem. Simple tissues; parenchyma, collenchyma, sclerenchyma and the vascular tissues. Parts of the primary body; typical stems and roots of dicots and monocots. Secondary growth in woody plants. Mechanism of wood formation in general, and with special reference to typical dicot stem. Ray initials and fusiform initials; anticlinal and periclinal division. Physiological significance of wood formation. The macroscopic features of wood, sapwood, heartwood, pith, early wood, late wood, growth rings, wood rays, etc. Sapwood versus heart wood, anatomical differences. Transformation of sapwood to heartwood; factors affecting. Microscopic features of wood. Prosenchymatous elements, tracheids, vessels, fibers. Parenchymatous elements, parenchyma and rays, resin canals, gum canals, latex canals, infiltrants in wood. Three dimensional features of wood; transverse, tangential and radial surfaces. Elements of wood cell walls. The structure and arrangement of simple pit, bordered pits. Extractives in wood. Comparative anatomy of gymnosperms and angiosperms. Anatomical features of common Indian timbers; classification into porous and non-porous woods, ring porous and diffuse porous woods. Effect of growth rate on wood properties. Juvenile wood and mature wood.

Practical

Study of primary growth in stems of typical dicots and monocots. Study of wood formation in typical dicot stem. Study of vascular bundles in monocots. Parts of the logs (woody trunks), and the three distinctive surfaces of wood (i.e. cross, radial and tangential planes). Timber identification and its importance. Procedures for field identification of timbers. Study of physical features of wood. Study of gross features of wood. Study of anatomical features of wood, pores or vessels, different types. Study of soft tissue in timbers and their different types distributions. Study of wood rays, and their different types. Study of the non-porous woods, their physical and anatomical description. Study of infiltration and inclusions in wood. Anatomical keys and methods to use them. Dichotomous keys, punched card keys and computer aided identification. Field identification of important timbers of Kerala.

Suggested reading

Anoop, E. V., Antony, F., Bhat, K. V., Lisha, D. A. and Babu, L. C. (2005). Anatomical key for the identification of important timbers of Kerala. Kerala Agricultural University, Thrissur and Kerala State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala, India. 126p.

Hoadley, B. (2000). Identifying wood-Accurate results with simple tools. Taunton Press, Newtown, USA. 223p.

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

Rao, R. K. and Juneja, K. B. S. (1992). Field identification of fifty important timbers of India. Indian Council of Forestry Research and Education, New Forest, Dehra Dun. 123p.

Wildlife Biology

Theory

Origin of life; Classification and its significance, nomenclature and basis of classification, Classification of animal kingdom – Phylum Chordata; History of Wildlife studies in India; Classification of Indian Mammals, Characteristic features of mammalian orders such as Order Monotremata, Marsupialia, Edentata, Dermoptera, Tubulidentata, Hyracoideae, and Macroscledidae. Characteristic features and representatives of Indian mammals, their distribution, habitat, food and feeding, ecological niche, conservation status and conservation issues of members of orders Insectivora, Scandentia, Chiroptera, Primates, Carnivora, Cetaceae, Sirennia, Proboscidae, Perissodactyla, Artiodactyla, Pholidota. Rodentia, and Lagomorpha. Animal Physiology: Basic requirements of wildlife – food, water, shelter, space, limiting factors; Food chain, Food web, Ecological pyramids; Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity; Effect of light and temperature on animals; Wildlife Habitat: Niche, Territory, Home Range, Territoriality, Edge, Cruising Radius, Carrying Capacity; Animal behavior: instinctive behavior, learned behavior, dispersal behavior, individual and social behavior and adaptations –cursorial, saussorial, fossorial, scansorial, volant, gliding or passive flight and aquatic adaptations; Communication, Mimicry. Wildlife populations and their interactions – mortality, natality, sex ratio, associations.

Practical

Visit to various protected areas, zoological parks and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals. Familiarize with various equipment's used in Wildlife monitoring and research. Specimen preservation and management of Wildlife museum.

Suggested reading

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

Dasmann, R.F. (1982). Wildlife Biology. Wiley Eastern Ltd. New Delhi.

Johnsingh, A.J.T. and N. Manjrekar. (2014). Mammals of South Asia. Vol. I & II. University Press, 614& 739p

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

Mathur R. (1985). Animal Behaviour. Oxford University Press

Menon V. (2014). Indian Mammals: A field guide. Hachette. 528p.

Mittermeier, RA Rylands, AB and Wilson DE. 2013. Handbook of the Mammals of the World - Volume 3. Lynx Edicions. 952.

Nameer, P.O. (2000). Checklist of Indian Mammals. Kerala Forest Department. 110p.

Prater, S.H. (1971). The Book of Indian Animals. Oxford University press, Bombay. 324p.

Wilson, D. E. Mittermeier, R.A. (2009, 2011, 2013, 2014 & 2015). Handbook of the Mammals of the World - Volume 1 to V. Lynx Edicions.

Forest Survey & Engineering

Theory

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 on sloppy grounds, chaining across obstacles; cross staff surveying, Areas of irregularly bounded fields- different methods; Simpson's, trapezoidal rule, Average ordinate method; compass surveying, chain and compass traversing, magnetic and true bearing, prismatic compass, local attraction. Computation of interior angles and balancing of closed traverse. Plane table surveying; Leveling: terms used types of level. Theodolite and its uses. Contour surveying. Buildings materials- types, strength and characteristics, site selection for building construction, forest roads- alignment, construction and drainage; retaining walls, breast wall, water ways and culverts; bridges- types, selection of site, simple wooden beam bridge, check dams, spurs, farm ponds, earth dams.

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. Design of check dams.

Suggested reading

Kanetkar, T.P. and Kulkarni, S.V. (2010). 24th edition. Surveying and levelling. Vidyarthi Griha Prakashan, Pune.

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

Murthy, V.V.N. (2011).6th edition. Land and water management engineering. Kalyani Publishers, New Delhi.

Parkash, R. (1983). Forest Surveying, International Book Distributors.

Punmia, B.G. (2005). 16th edition. Surveying Vol I. Laxmi Publishers, New Delhi.

Sahani, P.B. (1979). Text Book of Surveying Vol. I & II. Oxford and IBH, New Delhi.

Geology & Soils

Theory

Introduction to geology - its significance, composition of earth's crust, Soil: pedological and edaphological concepts. Rocks -types – igneous, sedimentary and metamorphic. Soil forming minerals. Weathering of rocks and minerals, Soil formation factors - parent material, climate, organism, relief, time. Soil forming processes-eluviations and illuviation. Components of soil. Soil profile, soil physical properties-soil texture, textural classes, particle size analysis, soil structure, classification, soil aggregates- significance, bulk densityand particle density of soils and porosityand their significance and manipulation. Soil colour.Soil water, retention and potentials, soil moisture constants, movement of soil water, infiltration, percolation, permeability, drainage- methods of determination of soil moisture. Thermal properties of soils, soil temperature.Soil air, gaseous exchange,

Influence of soil temperature and air on plant growth. Chemical properties -soil colloids,properties, nature, types and significance; organic- humus-inorganic- layer silicate clays-hydrous oxides and sources of charges. Soil organic matter decomposition - concept of pH - soil acidity -nutrient availability-soil buffering capacity. Ion exchange, CEC & AEC. A brief overview of saline, sodic and calcareous soils. Forest soils- characteristics-distinguishing features- changes in physical and chemical properties compared to agricultural soils.

Practical

Identification of rocks and minerals; Collection and preparation of soil samples; Soil analyses for moisture, colour, bulk density, organic matter, pH, EC; Textural analysis by hydrometer method; Study of soil profile; Study tour for identification of rocks and minerals and profile studies; Practicals on introduction to tensiometer, pressure plate and neutron probe etc.

Suggested reading

Biswas, T.D. and Mukherjee, S. K. (2006). Test Book of Soil Science, Tata McGraw Hill Publishing Co., New Delhi.

Brady, N.C. and Weil, R.R. (2002) The nature and properties of soils, Prentice Hall of India Pvt. Ltd, M-97, Connaught Circus, New Delhi.

Gupta, P,K. (2007). Soil, Plant, Water and Fertilizer Analysis. Published by AGROBIOS (India), Jodpur

Das, D.K. (2002) Introductory Soil Science, Kalyani publisher, New Delhi.

Indian society of soil science (ISSS). (2002). Fundamentals of Soil Science. Published by Indian Society of Soil Science, IARI, New Delhi

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

Pritchett and Fisher R, F. (1987). Properties and Management of Forest Soils. John Wiley, New York.

Climate Science

Theory

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. 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. Evaporation and transpiration. 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. Economic worth of carbon storage in forest – Forest and UN convention on climate change - NATCOM initiatives –Kyoto protocol, awareness about climate change. National action plan for 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 greenhouse gases into atmosphere.

Suggested reading

Adam Markham (Ed.). (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, E. Cochran, V D. and Debra P D. (2001). Climate Change: Science, Strategies, & Solutions. Brill Academic Pub. Pp 393

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) Agrometerology. Oxford &IBH, New Delhi

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.

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

Richard Max-Lino. (2012). Sustainability, climate change, forestry and forest carbon. World Scientific Publishing Co. pp 250.

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.

Physical Education & Yoga Practice–II

Concept of Health -Physical health, mental health, social health, spiritual health, spectrum of health. Fitness & wellness- Motor components. Regular exercises, Amount of training, Scientific way of training, Restand relaxation, conditioning, Good posture, Heredity, Environment, Standard of living, Balance Diet, Stress & tension, Drugs, Intoxication. Means of Fitness Development- Aerobic activities, anaerobic activities, Sports & Games, Yoga, Recreational Activity. Safety Education – Swimming. Yoga-Meaning & importance of Yoga, Role of Yoga in life, Teaching of Yoga. Physical Fitness test – TPFP Fitness test : One mile run /Beep test, Sit-Up 60 sec, Sit and reach, Modified pull-ups. Major games- Rules and regulations of important game, Skill development in anyone of the game- Hockey, Volleyball, Handball and KhoKho. Indoor games- Participation in one of the indoor games– (Table Tennis & Badminton). Athletic events- Rules & regulations of athletic events

participation in any one of the athletic events-Triple jump, Discus throw and Javelin throw. NOTE :(one to be selected, major games, indoor games and Athletic events). Regular basic training in Yoga.

NCC/NSS-ll

Weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush.

or

Socio-economic structure of Indian society, population problems, brief of Five Year Plan.Functional literacy, non-formal education of rural youth, eradication of social evils, village adoption- continued.

3rd Semester

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
BSFO-211	Forest Seed Technology	2	1	15	5	50	30	100
BSFO-212	Forest Mensuration	2	1	15	5	50	30	100
BSFO-213	Ornithology	2	1	15	5	50	30	100
BSFO-214	Environmental Studies and Disaster Management	1	1	15	5	50	30	100
BSFO-215	Forest Ecology	1	1	15	5	50	30	100
BSFO-216	Forest Entomology	1	1	15	5	50	30	100
BSFO-217	Tree Improvement	2	1	15	5	50	30	100
BSFO-218	Wood Science and Technology	2	1	15	5	50	30	100
BSFO-219	Physical Education&Yoga Practice-III	0	1	-	-	-	100	100*
	Total	**13**	**8**	**-**	**-**	**-**	**-**	**800**

Forest Seed Technology

Theory

Importance of seed in present day forestry- seed and fruit development -pollination - seed dispersal. Planning seed collection- determining species, provenances, trees, stands, seed quantities, year of collection and dates for collection. Collection of immature fruits..Methods of seed collection. Fruit and seed handling - maintaining viability and identity- special precautions for recalcitrant seeds. Seed processing- operations prior to extraction- pre-cleaning, methods of extraction- operations after extraction- cleaning, grading and control of moisture level- factors affecting drying of orthodox seeds. Seed storage- definition- purpose, seeds- Harrington's rule of thumb, seed maturity- parental and annual effects. Storage condition and ageing of seeds. Storage methods. Storage containers. Seed dormancy- classification of types of dormancy. Treatments for breaking exogenous and endogenous dormancy - morphological and physiological dormancy, treatments to overcome double dormancy. Seed dressing and pelleting. Seed testing - definition- ISTA rules. Sampling- seed weight- moisture- authenticity- seed health. Germination testing- germination equipment- conditions for selected species. Germination evaluation- germination testing in nursery. Indirect tests of viability. Deterioration of seed- deterioration vs. "vigour". Concepts of seed vigour- measurements of seed vigour and deterioration. Seed Act and seed law enforcement. Seed certification. Emerging trends in tropical seed technology.

Practical:

Identification of seeds of tree species; Seed maturity tests; Physical purity analysis; Determination of seed moisture; Seed germination test – evaluation and interpretation of results; Hydrogen peroxide test; Tetrazolium test for viability; Seed vigour and its measurements; Methods of breaking dormancy in tree seeds; Testing membrane permeability; Study of seed collection and equipments; Planning of seed collection; Seed collection; Seed extraction; Visit to seed production area and seed orchard; Visit to seed processing unit/testing laboratory; Study of seed sampling equipments.

Suggested reading

Agrawal, R.L. (1996) Seed Technology. Oxford - IBH Publishing Co. New Delhi Agrobios

Ahuja PS, Mathur J, Lai N, Mathur A, Kukreja AK (1989). Towards developing artificial seeds by shoot bud encapsulation. In: Kukreja AK, Mthur A, Ahuja PS and Thakur RS (eds), Tissue culture and Biotechnology of medicinal and aromatic plants. Lucknow. India. CIMAP pp. 20-78

Carol C. Baskin and Jerry M. Baskin. 2000. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Academic Press; New edition

Chacko KC, Pandalai RC, Seethalakshmi KK, Mohanan C, Mathew G, Sasidharan N. (2002) Manual of seeds of Forest trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Thrissur, Kerala, India.

Chin, H.F. and Roberts, E.H. 1980. Recalcitrant crop seeds. Tropical Press Sdn. Bhd. Kuala Lumpur - 22-03, Malaysia

Edwards, D. G. W. and Naithani C .S (. 1999) Seed and nursery technology of forest trees.New Age International (P) Limited

Dharmaligam C., Sivasubramaniam K., Yadav Shiv K. **(**2007). A Dictionary of Seed technological Terms. Kalyani Publishers,

Dutta, M. and Saini, G.C. (2009). Forest tree improvement and seed technology International Book Distributors, Dehra Dun 302 p.
ISTA. (2016). International Rules for Seed Testing Rules., http://doi.org/10.15258/istarules.2016.i
Khullar, P., Thapliyal, R.C.;,Beniwal, B.S., Vashasya, R.K. and Sharma, A. (2003). Forest Seed. ICFRE Publication, Dehradun
Leadem, C.L. (1984) Quick tests for tree seed viability. BC Ministry of Forests, Reserach Branch. Land Management Handbook No. 18. 45 pp.
Ramamoorthy. K., K., Sivasubramaniam and A. Kannan (2006). Seed legislation in India, Agrobios
Schmidt, L. (2000) Guide to handling tropical and subtropical forest seed. Danida
Schmidt. L. (2007) Tropical forest seed. Springer New York. 409 p.
Willan, R.L. (1985) A guide to forest seed handling. FAO Forestry Paper 20/2

Forest Mensuration

Theory

Forest Mensuration - Definition and objectives - Scales of measurement- Units of measurements - Precision, bias and accuracy- Diameter and girth measurements- Breast height measurements instruments used- Measurement of height-Definitions- Methods of measurement of height-occular-non instrumental and instrumental methods- Sources of error in height measurements- leaning trees. Tree stem form-Metzgr's theory –form factor-types of form factor-form height for quotient-form class. Volume measurements of standing trees-logs-branch wood- formulae-involved Definitions - Volume tables preparation of volume tables-graphical method-regression method- Determination of growth of trees-Increment-CAI & MAI- increment percent-increment borer- Stump analysis- Stem analysis. Measurement of tree crops-objects-crop diameter-crop height-crop age-crop volume.

Practical

Determination of pace length- Measurements of diameter-girth and basal area of trees using Calipers, Tape, Ruler, Penta Prism Tree Caliper etc. Measurement of height using non instrumental method- Preparation and use of simple height measuring instruments-Christens Hypsometer-Smithies Hypsometer- Modified Smithies Hypsometer-Measurement of tree height using instrumental methods-Abneys level- Haga altimeter-Relaskop- Clinometer- Blumeleiss Hypsometer-Laser Hypsometer- Volume determination of standing and felled trees. Exercise on Stump analysis. Exercise on stem analysis-Annual ring counting using ring borer. Preparation of volume tables- local volume table.

Suggested reading

Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition). KhannaBandhu. Dehra Dun. 364 pp.
Husch, B., Beers, T.W. and Kershaw, J. 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.

Matthews,R. W. and Mackie, E. D. (2006). Forest mensuration: A Handbook for Practitioners. 2006. Forestry Commission Publications. 330 pp.
West, P.W. (2009). Tree and Forest Measurement (2nd edition). Springer. 192pp.

Ornithology

Theory

Introduction. History of ornithology in India. Origin and ancestry of birds. A brief knowledge of bird anatomy, morphology and physiology, digestive, skeletal, respiratory, excretory systems of birds. Skeleton, feathers, skin, beak and taxidermy. Thermoregulation in birds. Bird ecology and behaviour; migration and territorial behaviour, feeding, song and nests. Eggs and egg laying. Water birds, scavenger birds, frugivorous birds, pest birds, pet birds and pollinator birds. Importance of birds to different ecosystems. Birds and man. Bird watching, Bird conservation and management in India. Important Bird areas of India, Red Data Book birds of India. Wetland conservation, Ramsar sites of India. Classification of Indian birds - birds belonging to the Orders Podicipediformes, Procellariformes, Pelicaniformes, Ciconiformes, Phoenicopteriformes, Anseriformes, Falconiformes, Galliformes, Gruiformes, Caradriformes, Columbiformes, Psittaciformes, Cuculiformes, Strigiformes, Caprimulgiformes, Apodiformes, Trogoniformes, Coraciformes, Upupiformes, Piciformes and Passeriformes.

Practical

Familiarisation of major bird families of India. Filed identification of birds of Kerala. Bird watching and drawings. Study of feathers, beak and leg types of different groups of birds. Study of the nest and eggs of birds. Mist netting and tagging/marking of birds for the bird migration studies. Bird census techniques. Visit to different bird habitats.

Suggested reading

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. (1986). Keralathile Pakshikal (Birds of Kerala). Kerala Sahitya Academy, Thrissur.
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, Praveen J., Palot, M.J. and Nameer P.O. (2012). Birds of Kerala, Status and Distribution. Volume 1.
Wallace GJ and HD Mahan. (2005). An Introduction to Ornithology. 3rd Ed. McMillion publishing company. New York.

Environmental Studies and Disaster Management

Theory

Environmental studies Definition, scope and importance, Natural Resources, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, Ecosystems-Concept of an ecosystem, Structure and function of an ecosystem, Biodiversity and its conservation, Value, Environmental Pollution, Solid Waste Management, Social Issues, Environmental ethics, Wasteland reclamation, Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Issues involved in enforcement of environmental legislation. Public awareness, Environment and human health, Natural Disasters, Climatic change, Man Made Disasters, Disaster Management.

Practical

Field work: Rapid environmental appraisal of problem areas - 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 and documentation of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

Suggested reading:

Gupta, H.K. (2003). Disaster Management. Indian National Science Academy. Orient Blackswan.

Hodgkinson, P.E. and Stewart, M. (1991). Coping with catastrophe. Handbook of Disaster Management. Routledge.

Sharma, V.K. (2001). Disaster Management. National Centre for Disaster Management, India.

Forest Ecology

Theory

Historical development of ecology as a science, Levels of biological organization, Forest types of India-Champion and Seth; Forests of W. Ghats- Meher Homji-Forest ecosystem - abiotic and biotic components and their interaction, Nutrient cycling, global production decomposition-trophic levels, food webs, ecological pyramids and energy flow, Population ecology - definition, population dynamics and carrying capacity, Community ecology-species interactions, ecological succession, terminology, basic concepts, theories of succession- climax vegetation types, forest management and succession, Population dynamics– community dynamics- Qualitative and quantitative analysis of communities-Measurement of diversity.

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 - 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 different ecosystems.

Suggested reading

Frankel, O.H., Brown, A.H.D. and Burdon, J.J. (1995). The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p.
Michael, P. (1984). Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub. Co. New Delhi, 404p.
Misra, K.C. (1974). Manual of Plant Ecology. Oxford &IBH Pub Co. New Delhi etc. 491p
Montagnini, F. and Jordan, C.F. (2005). Tropical Forest Ecology: The Basis for Conservation and Management. Springer. 295p.
Odum, E.P. (1983). Basic Ecology. Saunders College Publishing, Philadelphia etc. 613p.
Pascal, (1980). Wet evergreen forests of Western Ghats. FIP.
Sagwal, S.S. (1995). Forest Ecology of India. Pioneer Publishers, India. 368p.

Forest Entomology

Theory

History and importance of Forest Entomology in India. Classification of insect pests of forests: types of damages and symptoms. Principles and techniques of Integrated Pest Management in forests: Mechanical, physical, silvicultural, legal, biological and chemical. Insect pests of forest seeds, forest nursery and standing trees of timber yielding species of natural forest (Tectona, Dalbergia sp., Albizia sp., Sandal, Gmelina, Terminalia, deodar, sal, pines etc); Plantation forest species (eucalyptus, bamboo, Ailanthus). Insect pests of freshly felled trees, finished timbers and their management. Insects of commercial value-honey bees and apiculture; silk- worms and sericulture, lac insect and lac culture.

Practical

Types of damages caused by insect pests. Insect pests of forest seeds; forest nurseries; standing trees; freshly felled trees and finished products. Visit to forest nurseries and plantations. Studies on various species of bees; silkworms and lac insect. Insecticides and their formulations, plant protection appliances.

Suggested Reading

Beason CFC (1941) The Ecology and Control of Forest Insects of India and adjoining countries. Govt. of India, New Delhi.
BerrymanA.A(1986). Forest insects-Principles and practices of population management. Plenum Press, New York & London
David J.H. (1988). Ecological approach to pest management. The Guilford Press, London
Graham S.A and Knight F.B (1965) Principles of Forest Entomology. Mc Graw-Hill, New York.
Mathews G.A (1984). Pest Management. Longman, London.
Nair, M. R. G. K. (1975) Insects and mites of crops in India ICAR, New Delhi. p 404
Nayar K.K, Ananthakrishnan T.N and David B.V. (1985) General and applied Entomology. Tata McGraw-Hill Publishing co. Ltd. New Delhi.

Nair, K.S.S., Sharma, T.K. and Varma, R.V. (Eds) (1996). Impact of diseases and insect pests in tropical forests. Kerala Forest Research Institute, Peechi, Thrissur, Kerala.
Nair, K. S. S. (2007). Tropical forest insect pests – ecology, impact and management. Cambridge Univ. Press, UK.p 393
Vasantharaj D. B. (2001) Elements of Economic Entomology. Popular offset, Chennai.
Wang Haojie, Varma, R.V. and Xutiansen (1998). Insect pest of bamboos in Asia. ISBN, New Delhi

Tree Improvement

Theory

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 varitation - heritability and genetic advance. 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. Breeding for resistance to insect pest's diseases, air pollution and for wood properties. Conservation of forest tree germplasm. Recent techniques in tree improvement. Mutation breeding; Ploidy breeding. Breeding objectives and concepts of breeding in self pollinated cross pollinated and vegetative propagated crops. Breeding of important tree species. 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. Hybrid nomenclature in trees- Future of hybrid in applied tree improvement.

Practical

Floral biology and phenological 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:

Bedell P. E. (2007). Tree Breeding for Genetic Improvement of Tropical Tree Species, Allied Publishers Pvt Ltd., Mumbai.
Surendran, C., Sehgal, R.N. and Parmathma, M. (Eds.) (2003). A text book of Forest Tree Breeding. ICAR, New Delhi.
White, T.L., Adams, W.T. and Neale, D.B. (2007). Forest Genetics, CABI Publishing, Oxfordshire, UK.
Wright, J. (2012). Introduction to Forest Genetics. Elsevier, Amsterdam
Zobel, B. and Talbert, J. (2003). Applied Forest Tree Improvement. Blackburn Press. New Jersey.

Wood Science and Technology

Theory

Kinds of woods; hardwood, softwood, bamboos and palms, merits and demerits of wood as a raw material, the physical features of wood. Electrical, thermal and acoustic properties of wood. Mechanical properties of wood like tension, compression, bending, shearing, cleavage, hardness, impact resistance, nail and screw holding capacities. Suitability of wood for various uses based on mechanical and physical properties. Wood water relationship; shrinkage, swelling, movement, fibre saturation, equilibrium moisture content. Wood seasoning; merits, principles and types; air seasoning, kiln seasoning and chemical seasoning. Refractory classes of timbers, kiln schedules. Seasoning defects and their control. Classification of timbers based on durability. Wood preservation; principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.). 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). Wood machining. Sawing; techniques, kinds of saws; cross cut, edging, cudless, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Various stages in wood working. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

Practical

Mechanical tests on timber. Static bending, impact bending, compression parallel and perpendicular to the grain, hardness, shear, torsion, nail and screw pulling test, brittleness test and calculation of properties. Estimation of combustibility of wood using bomb calorimeter. Estimation of directional shrinkage and swelling of wood. Familiarization of non-destructive wood testing instruments. Visit to wood testing laboratories.

Suggested reading

Bowyer J. L., Shmulsky, R. and Haygreen, J. G. (2007). Forest products and wood science: An introduction. 5th Ed. Blackwell publishing, Ames, IA. 496p.

Brown, H. P. (1985). Manual of Indian wood technology. International books and periodicals supply service, New Delhi. 121 p.

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

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

USDA [U.S. Department of Agriculture]. (1999). Wood handbook - Wood as an engineered material. U.S. Department of Agriculture, Forest Service. Forest Products Laboratory, Madison, WI. 508p.

Physical Education&Yoga Practice-III

Lifestyle diseases & dietary and life style changes that reduce the incidence of chronic diseases. Obesity, Coronary heart diseases (CAD), ischemic stroke Diabetes Mellitus, Blood pressure, Osteo porosis. Injuries –Injuries in sports, Prevention of sports injuries. First aid training in sports -Sprain, Fractures, Burns, Snakebite, Drowning, Unconscious victim, First aid ABC, First aid CPR, Sling and Splint and carrying techniques. Yoga continuation. Major games, Rules & regulation of important games, Skilld evelopment in any one of the game- Cricket, Football, Basketball, Volley Ball and Netball. Athletic events – Rules & regulations of athletic events–participation in any one of the athletic events – short & long distance running. Any one to be selected major games and Athletics events. Adventure training – On Land – Trekking, High Altitude Trekking, Rock Climbing, Mountaineering. In water - River Crossing. Regular basic training in Yoga.

NCC/NSS-III

Field engineering, map reading, conventional signs, grid systems,use of service protractor, prismatic compass and its use,self defence, general principles, precautions and training, attacks and counter attacks, marching and searching, first aid, hygiene and sanitation, civil defence, leadership and NCC song.

or

Awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition, village adoption-continued.

4th Semester

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
BSFO-221	Silviculture of Indian Trees	2	1	15	5	50	30	100
BSFO-222	Forest Nursery Technology	1	1	15	5	50	30	100
BSFO-223	Agroforestry Systems and Management	1	1	15	5	50	30	100
BSFO-224	Soil Biology & Fertility	2	1	15	5	50	30	100
BSFO-225	Forest Management	2	1	15	5	50	30	100
BSFO-226	Forest Pathology	1	1	15	5	50	30	100
BSFO-227	Herpetology	1	1	15	5	50	30	100
BSFO-228	Medicinal and Aromatic plants	1	1	15	5	50	30	100
BSFO-229	Clonal Forestry	1	1	15	5	50	30	100
BSFO-2210	Study Tour of State Forests	0	1	-	-	-	100	100*
	Total	**12**	**9**	**-**	**-**	**-**	**-**	**900**

Silviculture of Indian Trees

Theory

Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices pest and diseases and economic importance of the following tree species of India. Broadleaved species: Tectona grandis, Shorea robusta, Dalbergia latifolia, Dalbergia sissoo, Anogeissus spp, Terminalia spp., Santalum album, Swietenia macrophylla, Albizia spp, Pterocarpus marsupium, Gmelina arborea, Pterocarpus santalinus, Azadirachta indica, Hopea parviflora, Lagerstroemia microcarpa, Bamboos, reeds and rattan, Quercus spp. Conifers: Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii, Pinus wallichiana. Fast growing MPTs: Tropical pines, Eucalyptus spp, Casuarina equisetifolia, Leucaena leucocephala, Ailanthus triphysa, Grevillea robusta, Pongamia pinnata, Melia dubia, Acacia spp, Populus spp. Emblica officinalis Atrocarpus sp.

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 reading

Bebarta. K.C. (1999). Teak: Ecology, Silviculture, Management and profitability, IBD, Dehra Dun

Champion, H.G. and Griffith, A.L.. (1989). Manual for General Silviculture for India, EBD Educational

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

Luna, R. K. (1996). Plantation trees. International Book Distributors, Dehradun 975p. 8. Smith, D.M., Forest

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

Seethalakshmi, K.K. and Kumar, M. (1998). Bamboos of India- a compendium. BIC India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, New Delhi, India, 342 pp

Troup, R.S. (1975). Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest Research Institute and Colleges, Dehra Dun.

Forest Nursery Technology

Theory

Introduction - scope for nursery technology. Nursery establishment - site selection – planning, and layout of nursery area. Bare root nursery techniques - types of nursery beds, preparation of beds, fumigation. Pre-sowing treatments. Methods of seed sowing and mulching, seed size and position of sowing, seedling growth and development, pricking. Watering methods, weeding, hoeing, rotation, organic matter supplements and cover crops, mycorrhizae, fertilization, shading, pruning, root culturing techniques, lifting windows, grading, and packaging. Storing and transportation. Containerized nursery technique - advantages, disadvantages - root deformations - container designs and types/root trainers and rooting media. Conditions/practices affecting survival and early growth, acclimating containerized stock, field handling of containerized stock, planting techniques for containerized stock. Planting bare-root seedlings: advantages, disadvantages, conditions/practices affecting early survival and early growth. Methods for field handling and planting bare-root stock. Type and size of containers. Merits and demerits of containerized nursery. Preparation of ingredient mixture. Nursery practices that influence seedling uniformity, diameter/height and size of root system. Study of important nursery pests and diseases and their control measures. Nursery practices for important tree species. Target seedling concept. Emerging trends in tropical forest nursery management.

Practical:

Preparation of production and planning schedule for bare root and containerized nurseries. Nursery site and bed preparation. Pre-sowing treatments. Sowing methods of small, medium, and large sized seeds. Pricking and transplanting of pricked out stock within nursery in transplant beds. Intermediate nursery management operations. Preparation of ingredient mixture. Filling of containers. Study of vegetative techniques – cutting, grafting etc. Visit to tissue culture laboratory and other forest nurseries.

Suggested reading

Duryea ML, Landis TD (2004) Forest nursery manual: production of bareroot seedlings. Martinus Nijhoff/Dr W Junk Publ, The Hague. http://dx.doi.org/10.1007/978-94-009-6110-4

Evans J and Turnbull W.J. (2004) Plantation forestry in the tropics. Oxford University Press - Oxford. 482p.

Kumar, V. (2006) Nursery and plantation practices in forestry. Scientific publication. Jodhpur.

May, J.T., Belcher, Jr. E. W., Cordell, C.E., Filer, Jr. T. H., David South, and Lantz. C. W. (1985). Southern Pine Nursery Handbook, USDA Forest Service, Southern Region, Cooperative Forestry

Napier, I. and Robbins, M. (1989) Forest seed and nursery practice in Nepal. Nepal-UK Forestry Research Project, Kathmandu

Prakash, R. Chaudhari, D.C. and Negi, S.S. (1990) Propagation practices of important Indian trees. International Book Distributors, Dehra Dun.

Prakash, R. Chaudhari, D.C. and Negi, S.S. (1998) Plantation and NurseryTechniques of Forest Trees. International Book Distributors, Dehra Dun.

Singh V and Lavania S.K. (2003) Forest tree seeds and nursery management. Bishan Singh Mahendra Pal Singh , Dehra Dun

Wilkinson KM, Landis TD, Haase DL, Daley BF, Dumroese R.K. (2014). Tropical Nursery Manual: a Guide to Starting and Operating a Nursery for Native and Traditional Plants. Agric Handbk 732. US Dept Agric Forest Serv, Washington, DC.

Agroforestry Systems and Management

Theory

Land use and land capability classification- prospects of agroforestry as a land use practice in India. Classification of agroforestry systems – structural, functional, agroecological, socio-economic and physiognomic basis. Agrosilvicultural systems – Improved fallows in shifting cultivation – soil dynamics in shifting cultivation – Taungya systems – Alley cropping –structural and functional attributes. Multipurpose trees and shrubs on farmlands, agricultural fields- Plantation crop combinations- commercial crops under shade of planted trees and natural forests- Windbreaks & Shelterbelts. Silvopastoral systems – protein banks, Live fence of fodder trees and hedges, trees and shrubs in pastures. Pastoral silviculture systems- grassland and tree management in the humid, arid and semi- arid regions. Agrosilvopastoral systems – tropical home gardens –structural and functional attributes. Other systems – apiculture, sericulture and mixed woodlots. Industrial agroforestry- agroforestry practices for wasteland reclamation- agroforestry practices for salt affected soils, wetlands and waterlogged areas. Ecosystem services from agroforestry- Soil fertility improvement and water conservation through agroforestry. Climate change mitigation and adaption through agroforestry- carbon sequestration –CDM-LULUCF-REDD+- activities- Socio-economic analysis of various agroforestry systems- evaluation of direct and ecosystem services.

Practical

Study the desirable characteristics of trees/shrubs/grasses for various agroforestry programmes. Assessment of standing stock of tree species in various agroforestry systems such as homegardens. Survey of agroforestry practices in local/adjoining areas. Field observations to characterize the structural, functional and economic attributes of the following agroforestry systems and practices- agrosilviculture systems, silvopastoral systems, pastoral silviculture systems, agrosilvopastoral systems, shelterbelts and windbreaks, live fences; fodder trees and protein banks. Exercise on Diagnosis and Design of agroforestry systems and practices. Assessment of productivity of tree crop combinations. Studying resource partitioning in agroforestry systems - water, light and nutrients. Analysis of soil and plant samples for organic carbon N, P and K.

Suggested reading

Batish,D.R., Kohli, R.K., Jose,S. and Singh, H.P. (2007). Ecological Basis of Agroforestry. CRC Press. 400p. Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya. Huxley, P.A. (1999). Tropical Agroforestry. Wiley: 384p.

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. and Nair, P.K.R. (2004). The enigma of tropical homegardens. 2004. Agroforestry Systems. 61: 135–152.
Montagnini, F and Mark S Ashton, M.S (eds). (2000). The Silvicultural Basis For Agroforestry Systems. CRCNair, 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, PKR (1993). An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
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.
Pathak P.S. and Ram Newaj (eds.) (2003). Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.

Soil Biology & Fertility

Theory

Introduction - forest soils vs. cultivated soils, special features of forest soils, forest soil formation and vegetation development. Pedogenic processes – Podzolization and Laterization. Properties of soils under different forest ecosystems. Forest floor – stratification – types of humus. Essential nutrient elements-occurrence, availability and their functions. Diagnosis of nutrient deficiencies-visual symptoms, soil fertility evaluation methods. Site productivity and nutrient cycling in forest soils. N, P and K, macro and micronutrient fertilizers and their uses. Forest soil - biology-distribution of various microorganisms in soil ecosystem and their interaction effects. Role of microorganisms in soil fertility. Mineral transformations-carbon cycle with reference to organic matter decomposition and humus formation, Microbial degradation of cellulose & lignin. Bio-fertilizers – their importance. Nitrogen fixation-Rhizobium-tree legume symbiosis, Frankia X non-legume symbiosis, asymbiotic and associative N2 fixation. Nitrification and denitrification in forest ecosystems. Microbial transformation of phosphorous, sulphur, and micronutrients. Mycorrhizae: types, biology and importance with specific relevance to tree crops and mobilization of phosphorus and micro-nutrients. Rhizosphere and phyllosphere concept. Fertility management of forest soils. Integrated nutrient management in plantation forestry.

Practical

Study of forest soil profile; Estimation of pH and EC –Organic carbon – available N, P, K, Ca, Mg, S and micronutrients – Determination of CEC and exchangeable cations; Interpretation of soil and plant analysis data for fertilizer recommendation. Basic sterilization techniques; culturing and maintenance of micro organism occurring in soil; Staining methods; Study of decomposition of forest litter by CO2 – evolution method; Estimation of nitrification rate in

soil; Isolation of legume bacteria and Azotobacter; Preparation and inoculation techniques for mycorrhizae and biofertilizers.

Suggested reading

Biswas, T. D. and S. K. Mukherjee (1992). Text book soil fertility. Tata Mc. Grew Hill, Publishing Co., New Delhi.
Brady, N.C. and Weil, R.R. (2002) .The nature and properties of soils, Prentice Hall of India Pvt. Ltd, M-97, Connaught Circus, New Delhi.
Burges, A. and Raw, F. (1967). Soil Biology. Acad. Press, New York
Gupta, P,K. (2007). Soil, Plant, Water and Fertilizer Analysis. Published by AGROBIOS (India), Jodpur
Mengel, K. and Kirkby, E.A. (1987). Principles of Plant Nutrition. International Potash Institute,
New York.
Prasad, R. and Power, J.F. (1997). Soil Fertility Management for Sustainable Agriculture. CRC
Press.
Pritchett and Fisher, R.F. (1987). Properties and Management of Forest Soils. John Wiley, Publication. Switzerland, pp. 687.
Tisdale, S. L., W. L. Nelson, J. D. Beaton and J. L. Havlin. (1995). Soil feritility and fertilizers (5thed). Macmillan Publishing Co., New York.
Wild, A. (1988). Soil Condition and plant growth. 11th ed, ELBS, London.
Yawalkar K.S., Agarwal, J.P. and Bokde, S. (2000). Manures and Fertilizers. Agri-Horti
Young, A. (1989). Agroforestry for Soil Conservation. CAB International, U.K.

Forest Management

Theory

Definition, scope, objective and principles of forest management, organization of state forests sustained yield-definition, principles and limitations.Sustainable forest management-criteria and indicators-Increasing and progressive yields-Rotation - definitions-various types of rotations-length of rotations-choice of type and kind of rotation.Normal forest-definitions basic factors of normality.Factors governing the yield and growth of forest stands-Working plan-preparations-objectives and uses-forest maps and their uses.Joint forest management-concept and principles- Modern tools in forest management. 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-.Social Forestry- definition –NCA report of 1976- need and purpose- Social Forestry for – fodder production – fuel wood – leaf manure –timber

production. Integrated rural development approach – with proper marketing facility – employment generation in raising, tending and harvesting of tree crops. Place of social forestry in the national forest policy of India-role of forest department-Gender dimensions in FM, Introduction to the concept of SFM and multiple use forest management.

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. Field visit to JFM operational areas. Study the different field exercises for data collection for working plan.

Suggestedreading

Balakathiresan, S. (1986).Essentials of Forest Management, Nataraj Publishers, Dehra Dun.
Bhattacharya, P., Kandya, A.K. and Krishnakumar (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.
National Working Plan Code (2014). MoEF, NewDelhi.
Osmaston, F.C. (1984). The management of Forests, International Book distributors, Dehra Dun, India, 384 p.
Prakash, R. (1986).Forest Management, International Book distributors, Dehra Dun, India, 256p.
Recknagel, A.B. and Bentley, J. (1985). Forest Management. International Book distributors,Dehra Dun, India, 269p.

Forest Pathology

Theory

Importance of forest pathology, land marks-Fungi, Definition, nutrition, reproduction and classification - Causes and symptoms -, losses due to forest tree diseases, root diseases (wilt, root-rot), stem diseases, heart rots, stem blisters, rusts, cankers, pink diseases, gummosis and foliar diseases (rust, powdery mildew, leaf spot, needle blight etc.), DiseasesofTectona grandis, Casuarina equisetifolia, Bamboos, Mahogany, Gmelina arborea, Dalbergia latifolia , Bombax ceiba, Acacia auriculiformis, A.mangium,Pinus roxburghii, Grevillea robusta- etiology, symptoms, mode of spread, epidemiology and management including chemical, biological, cultural and silvicultural practices. Nursery diseases of above tree species - their management - chemical, biological, cultural practices.Pathogens affecting timber - Timber decay, white fibrous rot, white pocket rot, brown cuboidal rot, dry rot - their management. Beneficial fungi of forests -Mycorrhizal association of forest trees, their importance in disease management - Edible mushroom from forests and their ecology differentiating characters of edible and poisonous mushrooms. Disease due to physiological causes.

Practical:
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. Students will submit a collection of minimum 15 diseased specimens of important forest trees visit to nurseries and plantations.

Suggested reading:
Agrios, G.N. (2006). Plant Pathology.5th edition, Elsevier Academic press., California, USA, 922 p.
Bakshi, B.K. (1976), Forest Pathology; Principles and Practices in Forestry. Pub. Comptroller of Publications, New Delhi. 400 p.
Boyce, J.S. (1961). Forest Pathology, 3rd edition. McGraw-Hill, New York, 572 p.
Devasahayam, H.L. and Henry, L.D.C. (2009).Illustrated Plant Pathology- Basic Concepts.New India Publishing Agency, New Delhi, 470p.
Dube, H.C. (2015). An introduction to Fungi, 4th edition, Scientific publishers, New Delhi, India, 603 p.
Leelavathy, K.M. and Ganesh, P.N. (2000).Polypores of Kerala. Daya Publishing house, New Delhi, India, 166p.
Mohanan, C. (2011). Macro fungi of Kerala, KFRI, Peechi. 597 p.

Herpetology

Theory

Systematics and zoogeography of amphibians and reptiles of India, with special reference to the Western Ghats forms: Factors affecting distribution and abundance of amphibian and reptilian fauna of Indian sub-continent. Biology of major Indian amphibians, caecilians, fresh water and marine turtles, crocodilians, lizards and snakes. Thermo-regulation, its role, aestivation, hibernation and other ecophysiological adaptations. Role of temperature in sex determination in reptiles. Classification of reptiles - Indian reptiles with special reference to the reptiles of Western Ghats – reptiles belonging to the families such as Acrochordidae, Agamidae, Boidae, Chamaeleonidae, Cheloniidae, Colubridae, Crocodylidae, Dermochelyidae, Elapidae, Gekkonidae, Geoemydidae, Gerrhopilidae, Homalopsidae, Lacertidae, Natricidae, Pythonidae, Scincidae, Testudinidae, Trionychidae, Typhlopidae, Uropeltidae, Varanidae, Viperidae and Xenodermatidae. Classification of amphibians - Indian amphibians with special reference to the amphibians of Western Ghats – amphibians belonging to the families such as Bufonidae, Dicroglossidae, Ichthyophiidae, Indotyphlyidae, Micrixalidae, Microhylidae, Nasikabatrachidae, Nyctibatrachidae, Ranidae, Ranixalidae and Rhacophoridae. An overview of conservation problems and issues of herpetofauna of Indian sub-continent. Methods for herpetofaunal ecological studies. Threats to herpetofaunal biodiversity: global as well as in India. Threatened herpetaufauna of India, with special reference to Western ghats region.

Practical

Field identification of major herpetofauna, collection methods and equipments used in herpetological studies. Herpetofaunal assessment techniques and familiarisation with software.

Suggested reading

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

Biju, S.D. (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. 3636 (2): 257-289.

Biju, S.D. (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.

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.

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.

Smith, M. A. (1931, 1935, 1943). The fauna of British India including Ceylon and Burma: Reptilia and Amphibia. Vol. I, II& III. Sauria. Taylor and Francis, London.

Tikader, B.K and R.C. Sharma. (1992). Handbook of Indian Lizards. Zoological survey of India, Kolkota. 250pp.

Whitaker, R. and Captain, A. (2004). Snakes of India. The Field Guide. Draco Books. Chengalpattu, Tamil Nadu, xiv+479, pls, text-figs.

William E. Duellman and Linda Trueb. (1986). Biology of Amphibians. John Hopkins University Press, Maryland.

Medicinal and Aromatic plants

Theory:

Definition - role of medicinal and aromatic plants in Indian economy - Important essential oil yielding plants in India - Detailed study of lemon grass, citronella, palmarosa, vetiver, japanese mint, eucalyptus, jasmine, patchouli and geranium - botany, climate and soil requirements, planting cultural and manurial 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, Sandal, Acorus, Digitalis, Strychnos, 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. Definition and scope of ethno botany. Ethnomethodology- definition origin-theory and methods.

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.

Suggested reading:
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.
Chopra, A. K. Khanna, D.R., Prasad, G., Malik, D.S. and Bhutiani, R. (2007). Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House, New Delhi.
EIRI Board. (2007). Handbook of Medicinal and Aromatic Plants: Cultivation, Utilisation and Extraction Processes. Engineers India Research Institute, Nai Sarak, Delhi,
Gunther, E. (1975). The essential oils. Robert, K. Krieger Pub. Co., New York.
Jain, S. K. (2010). Manual of Ethnobotany (2nd Ed). Scientific Publishers, India,
Khan, I. A. and Khanum, A. (2005). Medicinal and Aromatic Plants of India; Herbal Wealth for Human Health (1st Ed). Ukaaz Publications, Hyderabad.
Muralia, S. (2006).Medicinal and aromatic plants (1st Ed).Neha Publishers & Distributors, New Delhi

Clonal Forestry

Theory
Clonal Forestry – definition - Basic concepts in clonal forestry –operational use – advantages of clonal forestry- constraints – Selection of CPTs – Propagation methods- auto and hetero propagation methods – rooting of cutting, grafting, layering, budding- micro-clonal propagation methods – Factors controlling propagation . Plant growth substances – Auxins – cytokinins – gibberellins – ethylene – preparation of powder and liquid formulations – Applications in clonal multiplication. Propagation structures – types of Green house – Polytunnels – Mist Chambers – Shade house – Mini garden – Concepts – Method of establishment – Hedge garden - Management of mini and hedge clonal garden – Clonal Multiplication Area (CMA) – Clonal Testing Area (CTA) – Designs of clonal evaluation – Amplified clonal test – Clonal plantation establishment- management strategies – Problem and constraints in clonal forestry – Tophophysis – Plagiotorphic and orthotrophic response – Tophophysis – Cyclophysis – Periphysis.

Practical

Clonal nursery – Study of propagation methods –- Propagation Chambers – Mist chamber – Green house – Cost of establishment – Root trainer technology – Establishment of low cost polytunnels – Cost of establishment and management – Establishment of CMA and CTA – Clonal evaluation – Visit to clonal forests.

Suggested reference

Ahuja, M.R. and Libby, W.J. (Eds.) (1993). Clonal Forestry I- Genetics and Biotechnology. Springer- Verlag., Berlin

Ahuja, M.R. and Libby, W.J. (Eds.)(1993) Clonal Forestry II: Conservation and Application. Springer- Verlag., Berlin

Hartman, H.T., D.E. Kester, F.T. Davies and R.L. Geneve. (2010). Hartmann & Kester's Plant Propagation: Principles and Practices. Prentice- Hall of India Pvt. Ltd., New Delhi.

Parthiban K.T., Paramathma, M., Neelakantan, K.S. (2004). Clonal Forestry. TNAU Publications, Coimbatore.

Surendran, C., K.T. Parthiban, K. Vanagamudi and S. Balaji. (2000). Vegetative propagation of trees- Principles and Practices. .FC&RI Publication, Mettupalayam.

Zobel, B. and J. Talbert. (1991). Applied Forest Tree Improvement. John Wiley and Sons, New York.

Study Tour of State Forests

Study tour of one week duration in the respective States/part of India. To familiarize the students with the fauna, flora and other research activities of SAUs, Research institute, forest industries, Govt. and private organizations of different parts of respective states/ part of India. To expose the students to various national / heritage monuments as part of national integration activity. (One week duration)

5ht Semester

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
BSFO-311	Forest Hydrology and Watershed Management	2	1	15	5	50	30	100
BSFO-312	Forest Protection	1	1	15	5	50	30	100
BSFO-313	Wildlife Management	1	1	15	5	50	30	100
BSFO-314	Anthropology and Tribal Welfare	2	0	40	10	50	-	100
BSFO-315	Wood Products & Utilization	2	1	15	5	50	30	100
BSFO-316	Non-Timber Forest Products	2	1	15	5	50	30	100
BSFO-317	Statistical Methods & Experimental Designs	2	1	15	5	50	30	100
BSFO-318	Experiential Learning/Hands on Training - I	0	5	-	-	-	100	100
	Total	**12**	**11**	**-**	**-**	**-**	**-**	**800**

Forest Hydrology and Watershed Management

Theory

Importance and scope of Hydrology. Definitions- Hydrological cycle. Energy and water balance equations-precipitation- rain and snow hydrology. Interception, infiltration, evaporation and transpiration- paired water sheds, surface water, run off processes and hydrograph. Soil water energy concept, movement, availability and measurement. Watershed management- an approach for sustainable productivity-principles and practices- Methods for water conservation- water harvesting techniques. Role of trees in water conservation- natural terracing- species suitability- Recharging of water springs. Forest treatment and water yield. Application of GIS in watershed delineation.

Practical

Study of hydrological equipment; 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

Bennet, H. H. (1955). 2nd edition. Elements of Soil conservation. McGraw Hill Book Co. Inc. New York.

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.

Singh, G., Joshi, P.B., Sastry, G., Venkataraman, C. (1999). Manual of Soil and Water Conservation. Oxford IBH Publishing Co. New Delhi.

Hamilton, L. S. (1983). Tropical Forested Watersheds: hydrologic and soils response to major uses or conversions. International Book Distributors, Dehra Dun.

Hamilton, L.S. (ed.). (1983). Forest and Watershed Development and Conservation in Asia and the Pacific. International Book Distributors, Dehra Dun.

Hewlett, J.D. and Nutter, W.L. (1969). An Outline of Forest Hydrology. University of Georgia Press, Athens 132p.

Hudson, N. (1981). Soil Conservation. BT Batsford Limited, London 324 p.

Lal, R. (2000). Integrated Watershed Management in the Global Ecosystem. CRC Press, London.

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

Morgan, R.P.C. (2005). 3rd edition. Soil Erosion and Conservation. English Language Book Society, Longman, London.

Murthy, V.N.N. (2011). 6th edition. Land and Water Management Engineering, Kalyani Publishers, New Delhi.

Rama Rao, M.S.V. (1974). Revised edition. Soil Conservation in India, ICAR, New Delhi.

Riedl, O. and Zachar, D. (1984). Forest Amelioration. Elsevier, Amsterdam.

Sutterlund, D.R. (1992). 2nd illustrated edition. Wildland Watershed Management, The Ronald Press Company, New York.
Seshagiri Rao, K. V. (2014). Watersheds, Comprehensive Development. B. S. Publications, Hyderabad.
USDA (1961). A Manual on Conservation of Soil and Water. Oxford and IBH Publishing Company.

Forest Protection

Theory

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 – 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. Major Forest weeds and their management, management of woody climbers, parasites and epiphytes-Forest Health-introduction to the concept and its importance.

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.

Suggested reading

Brown, A.A and K.P. Davis. (1973). Forest fire control and use.McGraw Hill Book Co. New York.
Fuller, M. (1991). Forest fires. Wiley Nature Editions, New York.
Hal, R.B. (1990). Principles and Procedure of Range Management. International Book distributors, Dehra Dun.
Khanna, L.S. (1988). Forest Protection. Khanna Bandhu, Dehra Dun.

Wildlife Management

Theory

Definition, History of wildlife management and conservation in India; values of wildlife - aesthetic, recreational, scientific, educational, commercial, farming, technological and ecological values. Zoogeographic regions of the world – Palearctic region, Nearctic region, Oriental region, Ethiopian region, Neotropical region, Australasian region. Major biomes of the world – polar region, coniferous forests, temperate forests, tropical forests, grasslands, deserts, mountains, inland waters, oceans and oceanic islands. Biogeographic zones of

India - trans-Himalayan, Himalayan, Indian desert, semi-arid, Western Ghats, Deccan peninsula, Gangetic plain, North East India, islands, coasts. Habitat requirements of animals. Red Data Book and redlisting, IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned. Wildlife census: Purpose, techniques. Direct and indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities, block counts, road side counts, dung counts, pug mark census, water hole census, line transect- statistical analysis. Telemetry- transmitters, receivers, analysis of data, visual tagging and marking. Captive wildlife: Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife (Protection) Act, 1972. Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Introduction and reintroduction of species. Wildlife corridors. MAB, CITES. Wildlife Damage - Appraisal, Control and Management. Healthcare, Disease Management and Nutrition in Wild Animals Protected areas concept, wildlife sanctuaries and national parks, biosphere reserves, major protected areas of India.

Practical

Exercise on identification of animals based on indirect evidences. Census methods - direct method - total count, block count, water hole count, capture - recapture method, point transect, and line transect method – use of software for analysis. Exercise on the census methods - indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for other ungulates. Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife. Direct and indirect methods of studying food habits of different wildlife. Studying habitat management and manipulation techniques. Wildlife damage and control: Questionnaire survey. Wildlife photography.

Suggested reading

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

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

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

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,

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.

Anthropology and Tribal Welfare

Theory

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. 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. 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 Kerala. Tribal economy. Tribals and Constitution of India Administration of tribal areas in independent India- appraisal of tribal development - problems of tribal identity and integration in the mainstream. 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 tribal'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.

Wood Products & Utilization

Theory

Uses of wood. Growth of wood based industry in India, effect of globalization. Importance of forest based industries in relation to Indian economy. Wood as a source of energy and chemicals, wood as raw material for industries like pulp, paper, rayon, composite woods and improved woods. Description of different forest based industries - paper and pulp, furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes. Structural uses of Timber – bridges and other super structures. Decorative uses of wood. Introduction to wood modification, its need and scope, chemical modification of wood (acetylation, reaction with

isocyanates, acetates, ethers, epoxides etc.). Primary conversion; sawing and veneering. Composite wood; plywood, laminated wood, core board, sandwich board, fibre board, particle board; manufacturing process, uses and properties. Adhesives used in manufacture of composite wood. Improved wood; compressed wood, impregnated wood etc.; manufacturing process, uses and properties. Nano technology in wood. Pulp and paper making; history, raw materials used. Pulping; mechanical, chemical, semi-chemical and semi-mechanical. Pulp bleaching, stock preparation and sheet formation. Types of paper. Manufacture of rayon and match. Wood carving and handicrafts. Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast. Biochar, technology, bioenergy concepts - short rotation crops as raw materials.

Practical

Estimation of specific gravity and calorific value of wood specimens. Maceration techniques and determination of sizes of fibres, vessels etc. Visits to various wood based industries like, plywood, packing case, paper and pulp, match, tannins, furniture, saw mills etc. to study the manufacturing process. Visit to saw mill to study veneering and different kinds of sawing. Handicraft manufacturing unit. Visit to wood distillation unit. Visit to nearby industrial plantations.

Suggested reading

Baldwin, R. F. (1995). Plywood and veneer-based products: manufacturing practices. Backbeat Books.

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.

Non-Timber Forest Products

Theory

Introduction, methods of collection, management and importance of Non-Timber Forest Products (NTFP). Fodder, canes and bamboos. Essential Oils. Non –essential oils – Gums and resins – Resins and Oleoresins. Tans. Dyes – classification and sources of dyes, Fibers and flosses. Katha and Cutch- sources, extraction and uses. Drugs, wild fruits, spices, edible products, poisons, bio- pesticides and other miscellaneous products. Animal products, lac, honey and wax- fish, trophies like tiger, panthers, elephants etc- minor products. Types of markets for timber and non-timber forest produce, market locations of timber and non-timber forest produce and their features. type and degree of competition in market for services of saw mill and other intermediate wood processing industries, price spreads across different channels of marketing.. Economics of gathering medicinal plants from forests, economics of processing medicinal plants. Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce. Market inefficiencies in timber, non-timber forest produce and measures to check in efficiencies, role of cooperative societies in marketing of timber and non-timber forest produce. Economic policy and regulations of international timber trade. Essentials of

World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and timber certification.

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. 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 produce. Presentation of results on analysis of price and quantity. Study of plant yielding drugs, spices, wild fruits, poisons and bio- pesticides and their collection from nearby forests. Visit to nearby extraction units.

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. (Ed.). (2012). The economics of forestry: modern theory and practice. Springer Science & Business Media.

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.

Statistical Methods & Experimental Designs

Theory

Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution, tables –graphical representation of data, simple, multiple component and percentage bar diagram, pie diagram, histogram, frequency polygon and frequency curve. Average and measures of location- mean, mode, median, geometric mean, harmonic mean, percentiles and quartilesfor raw and grouped data. Dispersion- Range, Quartile deviation, standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative

laws. Theoretical distributions, binominal, poisson and normal distributions. Sampling: basic concepts, sampling vs. Completeenumeration,parameter and statistic, sampling methods, simple random sampling and stratified random sampling. Tests of significance: Basic concepts, tests for equality mean,independent and paired t-tests, chi-square tests for application of attributes and test for goodnessof fit. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of simple linear regression, tests of significance of correlation and regression co-efficient. Introduction to design of experiment- Basic principles of experimental design-replication, randomization and local control. Analysis of variance-assumptions-construction of ANOVA table- conclusions based on ANOVA. Comparisons based on means-critical difference, DMRT. Transformations of data-square root, logarithmic and angular transformations. Completely randomised design-Layout, analysis, advantages and limitations, Randomised block design-layout, analysis, choice of no. of blocks, advantages and limitations. Latin square designs-layout, analysis, applications, advantages and limitations. Factorial experiments: basic concepts, analysis of factorial experiments up to 3 factors. Split plot design.

Practical:

Construction of frequency distribution table and its graphical and diagrammatic representation. Calculation of various measures of central tendency and dispersion for both individual and grouped series. Problems on small sample and large sample tests. correlation and linear regression. Analysis of experimental data in the case of single factor and multi factor experiments.

Suggested Readings

Anderson, R.L. and Bancroft, T.A. (1952).StatisticalTheoryinResearch. Mc.Graw Hill BookCo.,NewYork.

Cochran, W. GandCox, G.M.(1958).Experimental designs. Wiley, NewYork

Das, M.N. and Giri, N.C. (1986). Design and analysis of Experiments. Wiley EasternLtd., NewDelhi.

Federer, W.T. (1955). Experimental Design. Macmillan, NewYork.

Gomez, K.A. and Gomez,A.A. (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons. NewYork.680p.

Goon, A.M., Gupta, M.K. and Dasgupta, B. (1983). Fundamentals of Statistics. Vol.1. The World Press Pvt. Ltd., Calcutta.

Garcia, D., A. and Phillips, D.T. (1995). Principles of Experimental Design and Analysis. Champman and Hall, London.

Gupta, S.C. (2004). Fundamentals of Statistics. Himalaya Publishing House Pvt Ltd.

Kempthorne, O.(1952).The design and analysis of experiments.Wiley,NewYork.

Nigam A.K. and Gupta,V.K.(1979). Handbook on Analysis of Agricultural Experiments. IASRI Publication, NewDelhi.

Panse, V.G.andP.V.Sukhatme. (1967). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, NewDelhi, India.

Petersen Roger G. (1994). Agricultural Field Experiments:Design and Analysis. MarcelDekker, NewYork.

Snedecor, G.W. and Cochran, W.G. (1989). Statistical Methods. Iowa State University Press, Ames, Iowa.

6th Semester

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
BSFO-321	Plantation Forestry	2	1	15	5	50	30	100
BSFO-322	Fundamentals of Conservation Biology	1	1	15	5	50	30	100
BSFO-323	Forest Policy and Law	2	0	40	10	50	-	100
BSFO-324	Geomatics	1	1	15	5	50	30	100
BSFO-325	Forest Inventory and Yield Prediction.3	1	1	15	5	50	30	100
BSFO-326	Forest Biotechnology	2	1	15	5	50	30	100
BSFO-327	Logging and Ergonomics	1	1	15	5	50	30	100
BSFO-328	Forestry Extension	1	1	15	5	50	30	100
BSFO-329	Experiential Learning/Hands on Training - II	0	5	-	-	-	100	100
	Total	**11**	**12**	**-**	**-**	**-**	**-**	**900**

Plantation Forestry

Theory

Plantations-definition and scope. History of plantations, Development of plantation forestry, Plantation organization and structure, Land and plantation development. Plantation planning-National and regional planning-project appraisal and project implementation– feasibility studies. Plantation silviculture - Choice of species- Plantation establishment- Plantation maintenance- Nutrition in plantations- use of fertilizers- Major pest and disease in plantations- sanitation and control measures. Dynamics of stand growth- CCF-MCA- stand density management in plantations- Thinning regimes-improvement fellings, Site quality evaluation, stand basal area- site index concept in plantation forestry- plantation productivity assessment- growing stock assessment- MAI, sustainability of plantations. Plantation records- plantation journal. Industrial plantations-paper and pulp wood- match wood, plywood plantations- Plantations yielding NTFPs-Energy plantation- high density short rotation plantations- petro crops- TBOs. Avenue plantations- Plantations as potential carbon sinks carbon sinks- Economic factors in plantation development- social and cultural considerations .

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 Forest Development Corporation plantations-road side plantations plantation planning- Plantation journal- Choice of species for plantations-economic considerations in plantation- Study of Government vs. private plantations.

Suggested reading

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

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, 467p.

Krishnapillay, B. (2000). Silviculture and Management of teak plantations. Unasylva. 201 (51): 14-21p

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 PlantationForests. Australian Centre for Internat. Agricultural Research. 571p.

Nyland, R.D. (2016). Silviculture: Concepts and Applications, Third Edition. Waveland Press, 680 pages

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

Fundamentals of Conservation Biology

Theory

Introduction to Conservation Biology, Conservation of biodiversity, documenting biodiversity; concepts of biodiversity, levels of biodiversity, valuing biodiversity. Extinctions in geological time. Biodiversity decline. Modern causes of extinction. Conservation Genetics, Management and conservation of genetic variation in natural populations. Ex-situ conservation. Demographic issues, Population viability analysis, ecological restoration, Designing conservation reserve, Management to meet conservation goal; Control of invasive species, scales of management (on population level, habitat and landscape) of management and cultural context.

Practical

Measurement of Biodiversity, Assessment of conservation status of species. Calculations of degree of inbreeding, MVP. Evaluation of existing protected areas from the point of view of principles of conservation biology.

Suggested reading

Bawa, K.S., Primack, R.B. and Oomen, M.A. (2011). Conservation Biology. A primer for South Asia. Universities Press, Hyderabad, India. 589 pp.
Hunter, M.L. (1996). Fundamentals of Conservation Biology. Blackwell
Hunter, L.M. and Gibbs, J.P. (2006). Fundamentals of Conservation Biology, 3rd Edition. Wiley-Blackwell Publications, New Jersey, USA. 516 pp.
Pielou, E.C. (1975). Ecological Diversity. Wiley Inter-science Pub.
Primack, R.B. (1993). Essentials of Conservation Biology. Soiner, MA.

Forest Policy and Law

Theory

National forest policies-scope and importance- comparative analysis of all forest policies - Indian judicial system- Legal definitions, application of penal code to forests, general principles of criminal law, legal principles of punishment, criminal procedure code, the law of evidence and the Indian Evidence Act, 1872 as applied to forestry matters. Indian Forest Act, 1927 general provisions, Code of Civil procedure, 1908. Forest (Conservation) Act, 1980. Brief description about other major forest laws of regional, national and international significance like Wildlife Protection Act 1972 and its amendments, EFL Act 2003 etc. Detailed study of KFA 1961. Biological Diversity bill 2002-discussion of court verdicts on issues of utmost importance to conservation.

Suggested reading

Baden Powell, B.H. (2002). Manual of Jurisprudence for Forest Officers.Materials, and Statutes, Oxford University Press.
Dutta, R. and Yadav, B. (2012). Supreme Court on Forest Conservation. Universal Law Publishing Co., New Delhi, India.
Forest Laws of Kerala, (1975). Ganesh Publications, Kochi.

Handbook of Environment, Forest and Wildlife Protection laws in India (1998). Natraj Publishers, Dehra Dun.
Joy, P. P. (2012). Set up your criminal practice. Swamy Law House, Ernakulam.
Roy P Thomas. (2011). Manual of forest laws in Kerala 3rd Edition. Em tee en Publications.
Shetty, B. J. (1985). A Manual of Law for Forest Officers, Sharda Press, Mangalore.
Divan, S.and Rosencranz, A. (2001). Environmental Law and Policy in India. **Cases.**
Takwani, C. K. T and Thakker, M. C. (2012). Takwani Criminal Procedure. Lexis Nexis Butterwarths, Wadhwa, Nagpur.
Varghese, M. I. (2012). Treatise on Forest Laws of Kerala. Swamy Law house, Ernakulam.

Geomatics

Theory

Remote sensing - classification based on source: Active and passive remote sensing; Aerial and space remote sensing; Interaction of electromagnetic radiation with atmosphere and earth surface; Aerial photographs – types; Photo interpretation - Satellite remote sensing - platforms and sensors; Satellite systems. Indian Remote Sensing Programme; Visual and digital image processing; Application of satellite based remote sensing techniques in forestry - vegetation mapping using satellite imagery-NDVI; Forest cover monitoring and damage assessment; Microwave remote sensing. Introduction to GIS. 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. 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, GLONASS, QZSS, Compass, IRNSS etc., GAGAN.

Practical

GPS handling and working; Scale-Maps; Google Earth-Bhuvan; Introduction to various GIS software – Q-GIS, ERDAS, Arc GIS; Visual interpretation of satellite imagery; Forest cover mapping and land use mapping. Digital image processing; Exercises in viewing, editing, overlay. Preparation maps; Visit to the GIS labs at State level.

Suggested reading

Campbell, J.B. (2002). Introduction to Remote Sensing-Third edition. Taylor and Francis, London.
Environment System Research Institute, (1999). GIS for Everyone. Redlands, CA:ESRI.
Jackson, M.J. (1992). Integrated Geographical Information Systems. International Journal of Remote Sensing, 13(6-7): 1343-1351p.
Joseph, G. (2005). Fundamentals of Remote Sensing-Second edition. Universities Press.
Lillesand, T.M. and Kiefer,W.R. (1994).Remote sensing and Image Interpretation, Fourth edition. John Wiley & Sons, Inc., USA.
Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS & LUP, Nagpur.

Forest Inventory and Yield Prediction

Theory

Yield - In regular forests-In Irregular forests. Estimation of growth and Yield of stands - Forest Inventory - Point sampling Forest Inventory - Definition-objectives- Kinds of enumeration- Tree assessment techniques- Measurement of wood volume, tree volume & tree volume tables - Kinds of sampling -Sampling design - Kinds of sampling units- Fixed area and point sampling units - Plots, strips, topographical units - sampling intensity- Inventory designs used in India - Sampling errors and non-sampling errors- Organisation of field work and conduct of enumeration - Point sampling- Concept of horizontal point sampling . Estimation of growth and yield prediction in forest stands- Stand structure - Growth of stand - Methods of predicting future growth of stands - Stand density - Canopy density -Crown competition factor- Yield tables- definition- Preparation of yield table - Application and use of yield tables - Stand table-definition and use.

Practical

Study the demarcation and alignment of plots, strips etc. Field exercise on Horizontal Field demonstration of various sampling techniques- Simple, stratified, multi stage, multiphase, non- random sampling techniques. Visit forest areas for forest enumerations- point sampling- use of wedge prism and Relaskop - Field exercise on the determination of site quality -Visit to local forest divisions and study the methods of preparation and use of yield tables. Method demonstration on the use of aerial photographs in forest inventory.

Suggested Readings

Chapman, H.H and Meyer, W.H. (2008). Manual of Forest Mensuration: Methods and Techniques. Asiatic Publishing House, New Delhi, 522p.

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

Heindjik, D. (1975). Forest Assessment. International Book Distributors, Dehra Dun, 349p

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

Kangas, A. and Maltamo, M. (2006). Forest Inventory: Methodology and Applications. Managing Forest Ecosystems (Vol.10). Springer.340p.

Philip, M.S. (1994).Measuring Trees and Forest. AB International, UK,310p

Scott,C.T and Gove, J.H. (2002). Forest Inventory. Encyclopedia of Environmetrics (Vol 2), John Wiley & Sons. 814–820p.

Shiver, B.D and Borders, B.E. (1996). Sampling Techniques for Forest Resource Inventory. John Wiley and Sons, New York, 356p.

Spurr, H.S. (1952).Forest Inventory. John Wiley and Sons, New York, 476p.

Forest Biotechnology

Theory

Concepts and history of Plant Biotechnology: Scope and importance in tree improvement: Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures; Techniques of in-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in-vitro culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids,. Applications in tree improvement. Secondary metabolite production. Conservation of germplasm through tissue culture techniques Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants. their applications , achievements and biosafety regulations, Blotting techniques – DNA finger printing and bar coding – DNA based markers – RFLP, AFLP, RAPD, SSR , VNTRS,CAPS, SNPs, ESTs and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in tree improvement. Bio-safety rules and regulations – Intellectual Property Rights – concepts, trade related aspects. Protection of plant and animal genetic resources, biological materials, gene patenting.

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. Springer-Verlag, Berlin. Bajaj, Y. P. S. (Ed) (1989). Biotechnology in Agriculture and Forestry - Trees 2. Springer-Verlag, Berlin. Bajaj, Y. P. S. (Ed) (1991). Biotechnology in Agriculture and Forestry - Trees 3. Springer-Verlag, Berlin. Bajaj, Y. P. S. (Ed) (1996). Biotechnology in Agriculture and Forestry - Trees 4. Springer-Verlag, Berlin. Dhawan, V. (2012) Applications of Biotechnology in Forestry and Horticulture. Springer US, New York

Guptha, P. K. (2000). Elements of Biotechnology. Rastogi publications, Meerut.

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

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

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

Logging and Ergonomics

Theory

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; 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. 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. 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 equipments, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids.

Practical

Equipments 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 etc. 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 Kerala 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. 2nd 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.

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

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

Forestry Extension

Theory

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 programmes. Elements of extension education, man himself man's environment and man's created devices. Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like Lab to Land programme (LLP) National Demonstration (ND), Front Line Demonstration (FLD) KrishiVigyanKendras (KVK), Van VigyanKendras, Technology Assessment and Refinement Programme (TARP) of ICAR/ICFRE. Communication: meaning, definition, elements and selected models. Audio-visual aids: importance, classification and selection. Programme planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA). Classification of group- Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group.

Practical:

Visits to study structure, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/MahilaMandal/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.

Suggested reading

Dahama, O.P. and Bhatnagar, O.P. (1980). Education and communication for development, Oxford & IBH Pub. Co., New Delhi.

Mishra, S.N. and Sharma, K. (1983). Problems and prospects of rural development in India. Uppal Publ. House, New Delhi.

Reddy, A.A. (1978). Extension education. Sree Laxmi Press, India.

Sandhu, A.S. (1993). Text book on agricultural communication: process and methods. Oxford & IBH Pub. Co., New Delhi.

Sandhu, A.S. (1994). Extension programme planning, Oxford & IBH Pub. Co., New Delhi.

Supe, S.V. (1983). An introduction to extension education, Oxford & IBH Pub. Co., New Delhi.

Waghmare, S.K. (1980). Teaching extension education, Prashant Publishers, India.

**Experiential Learning/Hands on Training - I & II,

(in the Vth and VIth semesters & the students' would choose any one of the following)

1. BFEL 311/ BFEL 321 Agro and farm forestry 5 (0+5)
2. BFEL 312/ BFEL 322 Tree inventory 5 (0+5)
3. BFEL 313 / BFEL 323 Raising Quality Planting Materials of tree species 5 (0+5)
4. BFEL 314/ BFEL 324 Mass multiplication through tissue culture 5 (0+5)
5. BFEL 315/ BFEL 325 Mass production and marketing of quality planting materials 5 (0+5)
6. BFEL 316/ BFEL 326 Natural Resource monitoring and mapping via Remote Sensing & GIS 5 (0+5)
7. BFEL 3107/ BFEL 327 Production and Marketing of high value forest produce 5 (0+5)
8. BFEL 3108/ BFEL 328 Biodiversity assessment, documentation and conservation strategies using advanced techniques including GIS 5 (0+5)
9. BFEL 3109/ BFEL 329 DNA fingerprinting - a tool for wild animal forensic/ individualisation and Conservation genetics 5 (0+5)

1. BFEL 311/ BFEL 321 Agro and farm forestry 5 (0+5)

Design and development of farm forestry plan: The programme is intended to equip the student with design and development of tree based farm plans as an economically and ecologically viable land use practice for farmers belonging to various socio-economic classes. Development of multi species, multitier integrated farming systems for small, medium and large farmers.

The project involves diagnostic survey of the selected farm holdings, assessment of existing crop components and biophysical conditions prevailing in the selected land use system. Socio-economic analysis of the existing farm. Discussion on the possible agroforestry interventions in the farm. Identification of compatible tree species- crop species and animal components- feasibility study- socioeconomic analysis- Farm plan preparation: layout and designing a model tree farm- farmer interface for the acceptance and implementation of the farm plan. Implementation of farm plan proposals in the farmer's field. Appraisal and evaluation of farm forestry plan- Project Report & Presentation, Final examination.

2. BFEL 312/ BFEL 322 Tree inventory 5 (0+5)

Project formulation, Tree enumeration- sampling techniques- use of modern instruments in forest inventory- volume assessment at tree and stand level- tree evaluation- pricing- Yield regulation- Monitoring growth of stands- growing stock assessment- volume tables and yield table preparation- Growth increment- age determination- stump and stem analysis. Site quality evaluation- Direct and indirect methods- Site Index method. Density management in even aged stands: Thinning regimes, thinning intensity and thinning cycle- returns from thinning. Project Report & Presentation, Final examination.

3. BFEL 313/ BFEL 323 Raising Quality Planting Materials of tree species 5 (0+5)

Project formulation, Identification of species. Assessment of demand in local /potential markets and institutions. Identification of plus trees. Identification of superior seed sources, seed collection, treatment and storage. Clonal propagation of the selected plus tree through conventional or tissue culture under controlled and ambient conditions. Collection,

Handling, Processing and Storage of seed from the plus trees. Seed treatments. Nursery raising of bare root and containerized seedlings. Evaluation of seedlings. Project Report and Presentation, Final examination.

4. BFEL 314/ BFEL 324 Mass multiplication through tissue culture 5 (0+5)

Project formulation. Establishment of commercial tissue culture laboratory. Tissue culture methods. Explant selection, sterilization, culture establishment, hardening.. Planting out and related problems. Commercial micropropagation. . Problems of in vitro propagation. Production of virus free plants. Somaclonal variation, somatic hybridisation. Tissue culture as a tool in genetic engineering Sub-culturing, Hardening and establishment, Initiation of callus cultures – suspension cultures. Production of artificial seeds. Marketing and cost analysis.

5. BFEL 315/ BFEL 325 Mass production and marketing of quality planting materials 5 (0+5)

Project formulation, Identification of species (Timber & medicinal trees & fodder green manure and wild fruit trees, bamboos- ornamental trees etc) for nursery raising, collection of plant material from selected seed sources, quantity of seed/plant material required, nursery area (open and protected), inputs required, Schedule for intercultural operation-seed treatment, sowing, weeding, fertigation, root hardening treatments. Tree nursery technology – Structures in High tech nursery -Treatment and processing of bare root and containerized seedlings. Assessment of demand in local/potential markets and institutions. Collection, Handling, Processing and Storage of planting material. Project Report and Presentation, Final examination.

6. BFEL 316/ BFEL 326 Natural Resource monitoring and mapping via Remote Sensing & GIS 5 (0+5)

GPS: handling- waypoint marking- tracking- area calculation. Google Earth: downloading, historic imageries, creating vector and raster files. Bhuvan: downloading spatial data from Bhuvan. Map reading. Downloading Aerial photograph, Satellite imagery, visual interpretation, Digital image processing- Image preprocessing - radiometric and geometric correction; Image processing- FCC generation and image enhancement; Geo referencing-image to image registration Extraction- supervised and unsupervised classification-accuracy assessment using commercial softwares-Arc GIS, ERDAS- thematic map preparation – LULCC maps- resource maps. Working with open source software QGIS: Downloading and installing GIS open software, downloading data files, digitizing, geo-referencing, adding – editing layers, processing, NDVI, creating Digital Elevation Model (DEM), map composing. Project Report and Presentation, Final examination.

7. BFEL 317/ BFEL 327 Production and Marketing of high value forest produce 5 (0+5)

Project formulation, Market survey and prioritization of species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to timber markets, saw mills, forest depots etc. Lesser known, but highly utilizable indigenous species of timbers will be given priority. Fast rotation timber species raised under various trials of the University will also be included to the extent possible.

Potential of different species for various end uses will be determined. Timber samples have to be converted into sticks / smaller sizes / macerated through appropriate procedures such as sawing and sizing in a saw mill or maceration in a laboratory. Mechanical tests: Static bending, compressive tests-across and along the grain. Finding out safe working stresses of lesser known or exotic/new species. Wood database currently available in the department will be updated based on the test results. Wood conversion in an integrated saw mill, turnery for handicrafts, joineries and furniture making. Data analysis, report writing, presentation and final examination.

8. BFEL 318/ BFEL 328 Biodiversity assessment, documentation and conservation strategies using advanced techniques including GIS 5 (0+5)

Project formulation, Literature review, the sampling based approach to monitoring, Assessing available resources, Decision making - matching objectives and resources, Preparation of maps, inventories and reports using GIS and Remote Sensing applications. Population monitoring, Conceptual framework, Statistical framework, Kinds of indices Reducing bias, Estimation of relative abundance, Large carnivores, Social organization and land tenure, Ecological determinants of large carnivore density, Survival, mortality and population dynamics, Effect of environmental factors on monitoring, Large carnivore ecology: challenges to monitoring, Need for a unified framework for monitoring. Presence absence surveys, Mapping and spatial distribution, Field surveys, Questionnaire surveys, Organising the survey data for mapping and analysis, Indices of relative abundance for the predator and the prey species, Line transect theory, assumption, survey designs, data analysis, Camera trapping - capture/recapture models, Survey design and considerations.

Mist netting for Volant small mammal surveys, Sherman trapping and pit fall trapping for the non-volant small mammal surveys, Surveying/studying the avifauna, Herpeto-faunal studies, Spatial distribution of the prey and the predators: mapping and the use of GIS. Data sources, Compiling the survey data in GIS Ancillary sources of GIS data. Summarizing data and querying the GIS database, Producing maps of spatial distribution. Analyzing the prey-predator environment relationships. Case Studies, Faunal assessment and documentation of one of the protected areas or reserved forest, Project Report and presentation.

9. BFEL 319/ BFEL 329 DNA fingerprinting - a tool for wild animal forensic/ individualisation and Conservation genetics 5 (0+5)

Project formulation, Literature review, Develop a DNA sequence-based technique for identification of common wild animals found in Kerala. Role of Biotechnology in Forensic Science: Wildlife forensic science - the biological tools or techniques - Accurate identification of confiscated biological samples - application of molecular biology in forensic science – DNA analysis to identify an individual from hairs, bloodstains, and other items - ABO blood typing and its relevance to forensic investigations - DNA profiling - DNA typing - Southern blot hybridization - Polymerase Chain Reaction (PCR) and its application. Molecular genetic markers in Conservation Biology, Development of microsatellite markers to study genetic variation in the big cats, Mitochondrial DNA and wildlife identification: A forensic perspective

Extraction and purification of DNA from tissue samples - solid-surface binding/purification -resin based separation - column based separation – standardization of quantity, quality of the source tissue - PCR-amplification/DNA analysis – Amplification of specific DNA

sequences using PCR - sequences of cytochrome C oxidase subunit 1 (COI), cytochrome-b, and d-loop control region - using appropriate primers. Cloning and sequencing - pGEMT and sequencing.
Case Studies, Development of a database on the common wild animals found in Kerala - unique species specific DNA sequences based on mitochondrial cytochrome c oxidase subunit 1, cytochrome b genes, and d-loop region – for the identification of the species. Project Report and Presentation.

7th Semester

Course No	Course Title	Credit Hours		Maximum Marks				
		T	P	Theory			Practical	G. Total
				Mid Term	Internal Assessment	External Theory		
BSFO-411	Forestry Work Experience	0	20	-	-	-	100	100
BSFO-412	All India Study Tour	0	3	-	-	-	100	100

Forestry Work Experience 20 (0+20)

1. Orientation (10 days)
2. Forest Range Training Programme &Weapon Training and First-Aid Training (50 +8 =58 days)
3. Industrial placement (20 days)
4. Socio-economic Surveys and Village Attachment (20 days)
5. Report writing and presentations (12 days)

Orientation (0+1)
Conducting various exercises for exposing the students on the recent trends in the field of forestry, transactional analysis, personality development, soft skills etc. and to prepare students for the rigours of professional life after completing B.Sc. Forestry programme.

Forest Range Training Programme (0+13)
Visit to modern forest nurseries,herbal gardens and watersheds, study the felling and logging operations, timber lots and important industrial products, study working plan, enumeration, volume and yield calculation & compartment history files, study the 'CAT' (Catchment Area Treatment Plan) and FDA (Forest Development Agencies).Use of forestry equipments/instruments, Study there generation and management of important forestry

tree species, Sample plots, layout studies, stump analysis, preparation of local volume Tables. Study the working of other Forestry related organizations/industries.
At the Wildlife Sanctuaries/National Parks / Tiger Reserves, the student s are expected to earn about the aspects related with the preparation of the Management Plans/Conservation Plans, to undertake and familiarize the various wildlife population enumeration techniques and the biodiversity assessment techniques. To undertake pilot studies on the man-animal conflict and other issues in the forest areas etc.

Weapon Training and First-Aid Training:
Hands on training in the handling of various kinds of weapons and their operation, limitations and precautions during their use. Getting basic knowledge on different first aid practices which are required in case of field emergencies, like snake bite, animal attack, poachers and accidents. Also to learn about the first aid to be given to wild animals in distress and volunteer in ginrural health services.

Industrial placement (0+3)
Attachment with Forest Based Industries like Wood Workshop, Saw Mills,Wood Seasoning and PreservationTreatment Plants,Pulp and Paper Industries,Aromatic and Medicinal Plant Units including AMPRS,Odakkali,Oushadhi, Kottakkal, KAPL,Aluwa, Ayurdhara,etc. Carpentry, bamboo and reed crafts, other Wood Products Industries,rubber, NWFP etc.Works to be undertaken includes study the nature of industrial and business organization–structure,raw material–collection and processing of raw-material, hands on practicals, production and management process, marketing and financial management.

Socio-economic surveys and villageattachment (0+2)
Data collection, use of PRA techniques with respect to village profile including socio-economic and cultural status, farm technology used, homesteads, agroforestry, biodiversity etc., Bench Mark survey of plant resources (cropping pattern, homesteads, agroforestry, biodiversity, yield system etc.), Schedule development, tabulation, analysis and preparing plan of work. Under standing local forestry and other village level institutions (Panchayat, Village Forest Committees, corporations, youth/women group setc.), People's participation in developmental programmes with special reference to forestry. Exercises on the use of extension methods and teaching aids for Transfer of Technology.

Report writing and presentation (0+1)
Compilation of the work/experience detailing the objectives, places and persons visited, work done, experiences/skills gained and suggestions for improvemen to ftraining. Presentation of the report before faculty.The assessment will be based on Project Report evaluation and viva-voce.

8th Semester

A student has to register 20 credits opting for two modules of (0+10) credits each (total 20 credits) from the package of modules in the VIII semester.

Sl. No.	Title of the module	Credits
1	Recreation & Urban Forestry	1+1
2	Restoration Ecology	1+1
3	Certification of Forest Products	2+0
4	Agricultural Informatics	1+1
5	Entrepreneurship Development & Business Management	1+1
6	Forest Economics	1+1
7	Project Work& Dissertation	0+10
	Total	**(7+15=22)**

NOTE: In addition to above ELP modules other important modules may be given to the students by SAUs.