Course curriculum and syllabi (revised) 2009

Master's programmes in Forestry

Approved by
111th Meeting of the Academic Council
held on 16-7-09

KERALA AGRICULTURAL UNIVERSITY
KAU (PO), Thrissur 680 656

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MSc (Forestry) Programme: Revised syllabi 2009

DEPARTMENT OF SILVICULTURE AND AGROFORESTRY

Code	Course Title	Credits
SAF 501*	Silviculture	2+1
SAF 502*	Forest Seed Technology	2+1
SAF 503	Plantation Forestry	2+1
SAF 504*	Agroforestry Systems	2+1
SAF 505	Modern Nursery Technology	1+1
SAF 506	Ecology and Management of Wildland Soils	2+1
SAF 507	Energy Plantations and Biofuels	1+1
SAF 508	Climate Change Mitigation Through Land Use Management	2+0
SAF 509	Forest Hydrology	1+1
SAF 510	Watershed Management	2+1
SAF 511	Socioeconomics of Agroforestry System Management	1+1
SAF 512	Agroforestry and Reclamation of Degraded and Problem Areas	2+0
SAF 591	Master's Seminar	0+1
SAF 599	Master's Research	0+20

* Compulsory for Master's programme

The advisory committee at its discretion may decide on additional courses from other departments of the college as "major courses" depending on the research needs of the student concerned and the availability of such courses.

1. SAF 501 SILVICULTURE 2+1

Objective

To provide insights on forest ecosystem management, major tropical forest formations, stand dynamics, forest succession and productivity.

Theory

UNIT I

History of Silviculture, major tropical forest formations- vegetation dynamics- species richness of tropical forests- cover types

UNIT II

Ecosystem structure and functions - nature of competitive interactions- competition-density effect - stages of stand development - density dependent mortality- self thinning rule- principle of tolerance. Succession - models of succession- monoclimax and polyclimax theories. Mechanism of succession in natural communities - facilitation, tolerance, and inhibition. Plant communities- association and continuum concepts.

UNIT III

Morphology of trees- flowering and seed production- cambial development, crown and root system development. Stand development - height, diameter, basal area and volume growth of even aged and uneven aged stands - stand physiognomy and canopy architecture of tropical trees. Forest influences - radiation, temperature, precipitation patterns, and wind.

UNIT IV

Site quality and factors affecting it - direct and indirect measures of site quality- site index - stand density- stand density indices - Reineke's stand density index. Crown-competition method - Maximum Crown Area - Crown Competition Factor.

Practical:

Visit to forest areas to study forest composition, classification, factors of locality, site quality, form and growth of forest trees- study plant succession- study stand density changes on productivity- thinning effects

Suggested Readings

Daniel, Helms and Baker, 1979. *Principles of Silviculture* McGraw-Hill Book Company

Lamprecht, 1986. *Silviculture in the Tropics*-. Verlag Paul Parey, Hamburg und Berlin. P-296

Khanna LS. 1996. *Principle and Practice of Silviculture*. International Book Distributors.

Julius Evans, 1992. Plantation *Forestry in the Tropics*.

Smith DM, Larson BC, Ketty MJ and Ashton PMS. 1997. The Practices of Silviculture-Applied Forest Ecology. John Wiley & Sons.

2. SAF 502 FOREST SEED TECHNOLOGY 2+1

Objective

To impart knowledge and develop understanding about tree seed development, harvesting, processing, storage, dormancy, germination of tropical, sub-tropical and temperate species, their testing and certification.

Theory

UNIT I

Introduction, trends and development in tropical, sub-tropical and temperate forestry and their influence on seed demand. Seed problems, limiting factors in tree propagation and afforestation.

UNIT II

Reproductive biology in seed plants - development and maturation of seed bearing organs and seeds - morphology of fruit and seed - seed dispersal - ecological fruit and seed types - seasonality and periodicity of flowering and fruiting - reproductive age - influence of external factors on seed production. Seed structure and chemical composition – development and maturation – germination – breakdown of storage products – endogenous hormonal regulation – effect of stimulators and inhibitors– dormancy – its causes and breakage specific problems of seeds of woody plants.

UNIT III

Modes of seed dispersal. Determining optimal harvest maturity indices. Factors influencing choice of collection methods. Methods of seed collection and processing, storage methods – loss of viability during storage. Dormancy and pre-treatment. Germination and seedling establishment and seed testing techniques.

UNIT IV

Quality seed production technologies - seed certification.

UNIT V

Eco-physiological role of seed storage. Classification of seed storage potential. Factors affecting seed longevity. Pre-storage treatment. Physiological change during ageing. Viability and vigor. Storage of orthodox, recalcitrant and pre-storage intermediate seeds, Fumigation and seed treatment.

Practical:

Identification of forest seeds. Seed sampling, different storage methods, Seed quality testing-purity, viability and germination, collection and processing of seeds/ fruit. Tests of viability viz., cutting, hydrogen peroxide, excised embryo, tetrazolium, seed health testing primarily to the presence or absence of disease-caused organisms such as fungi, bacteria, virus and animal pests, recording, calculation and use of results of seed treatment.

Suggested Readings

Baldwin, H.I. 1942. *Forest Tree Seed of the North Temperate Regions*. Periodical Experts Book Agency, Delhi.

Chin, H. F. and Roberts, E. H. 1980. *Recalcitrant crop seeds*. Tropical Press Sdn. Bhd. Malaysia.

Hong, T. D. and Ellis, R. H. 1996. *A protocol to determine seed storage behaviour*. IPGRI Technical Bulletin No. 1. (J. M. M. Engels and J. Toll, vol. Eds.) International Plant Genetic Resources Institute, Rome, Italy.

Khullar, P. et. al. 1992. *Forest seed*. ICFRE, New Forest, Dehra Dun.

Leadem, C.L. 1984. *Quick Tests for Tree Seed Viability*. B.C. Ministry of Forests and Lands, Canada.

Schmidt, L. 2000. *Guide to handling of tropical and subtropical forest seed*. DANIDA Forest Seed Centre, Denmark.

STA. 1993. *International Rules for Seed Testing*. International Seed Testing Association, Zurich, Switzerland.

Willan, R. L. 1985. *A guide to forest seed handling*. FAO Forestry Paper 20/2, DANIDA Forest Seed Centre, Denmark and FAO, Rome.

3. SAF 503 PLANTATION FORESTRY 2+1

Objective

To familiarize various aspects of plantation development such as project formulation, planning and implementation, silvicultural tools of plantation management, nutritional aspects, ecological and economic factors of raising forest plantations.

Theory

UNIT I

Role of plantation forestry in meeting the wood demand – plantation forestry in India and abroad, purpose of plantations, factors determining scale and rate of plantation, land suitability and choice of plantation species - site quality and site - species suitability - project formulation - planning and implementation.

UNIT II

Production technology for quality planting stock - preliminary site preparation for establishing plantation, Planting programme, time of planting, planting pattern, spacing, planting method.

UNIT III

Nutritional dynamics and irrigation of plantation, Mechanization in plantation, Protection and after care of plantation, Pruning and thinning of plantation for quality wood production, Rotation in plantation, Failure of plantations, Impact of interaction and integration of plantation forestry.

UNIT IV

Protective Afforestation, afforestation of inhospitable sites, Ecological factors and long term productivity, Sustainable yield from plantation. Plantations as potential Carbon sinks- Carbon credits- Afforestation/ reforestation based CDM projects for climate change mitigation

UNIT V

Plantation pests and diseases- IPM and INM in plantations.

UNIT VI

Case studies in plantations of teak, mahogany, eucalyptus, casuarina, poplars, acacias, pine, silver oak, gmelina, sandal, bamboo, etc. Wasteland afforestation, Industrial Plantations, Mixed plantations.

Practical:

Analysis of plantation problems in Asia and India – Preparation of plantation calendar – Preparation of Plantation project- Economic analysis of plantation programme. Preparation of Preliminary arrangement for a plantation programme – Planting geometry and calculation of planting stock – Study of different cultural operations and site preparation for plantation – Studies on wood based industries – Problems and prospects – Management of eucalyptus, casuarina, teak, sal, poplar, acacias and bamboo plantations – Production technology for energy plantations – INM in plantations – Irrigation and plantations – Economics of pulpwood, timber and energy plantations.

Suggested Readings.

Evans J. 1982. *Plantation Forestry in the Tropics*. Clarendon Press, Oxford.

Dwivedi AP. 1993. *Forestry in India*. Surya Publ.

Luna RK. 1989. *Plantation Forestry in India*. International Book Distributors, Dehra Dun.

Kumar V. 1999. *Nursery and Plantation Practices in Forestry*. Scientific Publishers.

Ram Prakash, Chaudhari DC and Negi SS. 1998. *Plantation and NurseryTechniques of Forest Trees*. International Book Distributors, Dehra Dun.

4. SAF 504 AGROFORESTRY SYSTEMS 2+1

Objective

To gain insights on the concept of agroforestry as a sustainable land use activity- Agroforestry intervention methods including diagnosis & design methodologies.

Theory

UNIT I

Definition– land use systems related to agroforestry- classification of agroforestry systems structural, functional, ecological and socio-economic basis for grouping. Principles of species selection for agroforestry- criteria for species selection- indigenous vs., exotic- intraspecific variations- crown architecture of tropical trees- ideotype- criteria for selection of multipurpose trees. Multipurpose tree species- case studies for different Agroforestry systems – N fixing trees.

UNIT II

Role of trees in soil productivity and conservation– micro-site enrichment- litter and fine root dynamics, N fixation and nutrient pumping. Soil productivity and management in agroforestry for sustained yields.

UNIT III

Plant management in Agroforestry – manipulation of trees, population densities and mixture of trees and herbaceous crops- ecosystem structure and functioning- interactions relevant to agroforestry. Economic aspects of agroforestry.

UNIT IV

Diagnosis and Design of agroforestry systems and practices– methodology- Trends in Agroforestry systems research and development.

UNIT V

Climate change and Kyoto Protocol- Role of Agroforestry in mitigating climate change- carbon trading- REDD- C sequestration potential of common trees.

Practical:

Survey and analysis of land use systems in the adjoining areas. Diagnosis and Design exercise for the selection and refinement of relevant agroforestry systems and practices. Visit to successful agroforestry system models and study their functional dynamics.

Suggested Readings

Nair PKR. 1993. *An Introduction to Agroforestry*. Kluwer Academic Pub.

Nair PKR, Rai MR and Buck LE. 2004. *New Vistas in Agroforestry*. Kluwer

Ong CK and Huxley PK. 1996. *Tree Crop Interactions – A Physiological Approach*. ICRAF.

Young A. 1997. *Agroforestry for Soil Management*. CABI.

Thampan PK. 1993. *Trees and Tree Farming*. Peekay Tree Crops Development Foundation.

Nair PKR and Latt 1998. *Directions in Tropical Agroforestry Research*, Kluwer.

Buck LE, Lassoie, Fernandes ECM 1999. *Agroforestry in Sustainable Agri. Systems*, CRC Press.

5. SAF 505 MODERN NURSERY TECHNOLOGY 1+1

Objective

To impart technical know-how on modern nursery techniques for mass production of quality planting materials from seed and vegetative methods for important tropical forest tree species.

Theory

UNIT I

Introduction and importance of nursery. Types of nurseries. Bare root, containerized and vegetatively produced nursery.

UNIT II

Nursery site selection - physical properties of forest-nursery soils - soil fertility in forest nurseries - nursery soil organic matter - management and importance. Water management - irrigation systems - frost protection, controlling heat and seedling dormancy with irrigation, common drainage problems and their remedies- modern nursery design and layout.

UNIT III

Bare root nursery- nursery soil and water management, bed preparation, pre-sowing seed treatments, seed sowing and intermediate operations viz., pricking, watering, fertilization, weeding and hoeing. Physiology and nursery environment interaction affecting seedling growth. Root culturing techniques. Lifting windows, grading, packaging and storing and outplanting.

UNIT IV

Containerized nursery - Type and size of container including root trainers, selection of growing medium.

UNIT V

Biological nitrogen fixation and bio-fertilizers. Farm yard manure and other organic fertilizers. Mycorrhizal associations and their significance. Economic implications of nutrient management. Importance of renewable waste and their recycling.

UNIT VI

Principles of weed control. Methods of weed control - cultural, biological, mechanical and chemical. Principles and methods of integrated pests management – physical, cultural, chemical and biological methods. Use of attractants and repellants. Male sterility techniques. Diseases of forest nurseries and plantations. Methods of disease control – exclusion, cultural, biological and chemical.

Practical:

Introduction and identification of modern equipments and tools used in nursery. Pre-sowing seed treatments. Preparation of nursery beds and growing media for containerized nursery. Sowing of seed and other intermediate nursery management operations. Maintenance of nursery records. Identification of nursery insects and diseased and their control measures. Visit to nurseries.

Suggested Readings

Chaturvedi AN. 1994. *Technology of Forest Nurseries*. Khanna Bandhu.

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

Evane JW. 1989. *Insect Pest and their Control*. Samir Book Center, Delhi.

Evans J. 1982. *Plantation Forestry in the Tropics*. Clarendon Press, Oxford.

Kumar V. 1999. *Nursery and Plantation Practices in Forestry*. Scientific Pub.

Liegel, L.H. and Venator, R. 1987. *A technical guide for forest nursery management in the Carribean and Latin America.* Gen. Tech. Rep. SO-67, New Orleans, LA, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 156p.

Luna RK. 1989. *Plantation Forestry in India*. International Book Distributors.

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

Phillip DM. 1982. *Diseases of Forest and Ornamental Trees*. Macmillan.

Prakash, R. 1990. *Propagation practices of important Indian trees*. International Book Distributors, Dehra Dun.
Ram Prakash, Chaudhari DC and Negi SS. 1998. *Plantation and Nursery Techniques of Forest Trees*. International Book Distributors.
Speight MR. 2000. *Insect Pest in Tropical Forestry*. RoseWilley Pub.

6. SAF 506 ECOLOGY AND MANAGEMENT OF WILDLAND SOILS 2+1

Objective:
To impart information on the soil types and properties of soils under different forest ecosystems, chemical and biological dimensions of soil fertility, and forest soil fertility evaluation and management.

Theory

UNIT I

Forest soils – distinguishing features - soils and vegetation development, physical and chemical properties- Types and properties of soils under different forest ecosystems.

UNIT II

Forest floor - Organic horizons- litter dynamics- humus – types- organic matter decomposition-mineralization and immobilization of organic matter- nutrient cycling-significance of C:N ratio, soil pH.

UNIT III

Forest soil biology - soil fauna - nitrogen fixation - rhizobium-tree legume symbiosis, *Frankia* x non-legume symbiosis, nitrification and denitrification in forest ecosystems. Micorrhizal associations in forest soils.

UNIT IV

Nursery soils, problem soils, mineral nutrition, acidic deposition effects, fire Effects and management interventions of forest soils.

Practical:
Study of the soil profile, mechanical analysis, determination of pH, organic C, CEC and available, nutrients-NPK, manurial schedules for different soils.

Suggested Reading:
Fisher R.F. and Binkley D. 2000. *Ecology and Management of Forest Soils*. John Wiley & Sons, Inc. New York, 489p.
Brady N.C., and Weil R.R. 2007. *The Nature and Properties of Soils*. 14th Ed., Prentice Hall, New Jersey, 980p.
Tisdale, L.S., Nelson, L.W. and Beaton, J.D. 1985. *Soil Fertility and Fertilizers*. Macmillan Publishing Company, New York

7. SAF 507 ENERGY PLANTATIONS AND BIOFUELS 1+1

Objective
To develop insights about the prospects and possibilities of raising bioenergy plantations, biofuel production, and conversion technologies.

Theory

UNIT I

Introduction and advantages of energy plantations. Energy and biomass consumption patterns in India. Environmental impacts of biomass energy.

UNIT II

Assessment of bio-energy programmes in India. Power generation from energy plantation, biomass gasification- producer gas. High Density Energy Plantations (HDEP).

Land and biomass availability for sustainable bio energy. Impact of energy efficiency in power sector.

UNIT III

Biofuels- introduction- TBO's- potentials and advantages- bio-diesel- trans-esterification- Important biofuel species and their silvicultural management.

UNIT IV

Need for research and development on environment friendly and socio economically relevant technologies. Energy from plants-problems and prospects. Petro-crops. Criteria for evaluation of different species for energy plantation.

UNIT V

Advanced energy technologies in the production of biofuels.

Practical:

Identification of important fuel woods and petro-crops. Study on different bio fuels used in India. Determination of calorific value, moisture and ash content in biomass. Study of energy consumption pattern in rural and urban areas through survey. Visit to nearby Bio-energy units.

Suggested Readings

Kumar V. 1999. *Nursery and Plantation Practice in Forestry*. Scientific Publications.

Luna RK. 1989. *Plantation Forestry in India*. International Book Distributors.

Chaturvedi AN. 1994. *Technology of Forest Nurseries*. Khanna Bandhu

8. SAF 508 CLIMATE CHANGE MITIGATION THROUGH LAND USE MANAGEMENT 2+0

Objective

To impart a global perspective on land use changes, forestry and climate change

Theory

UNIT I

Definition of climate change – Historical perspective- Scientific evidence, process and consequences for society and ecosystems. A global perspective of climate change- global warming- Green house gases- evidences- IPCC initiatives in climate change mitigation- COP- Various mitigation mechanisms- Kyoto protocol- strategies- Global commitments.

UNIT II

Overview on carbon cycle; biogeochemical cycles of green house gases, sources and sinks, carbon accounting, carbon balance of ecosystems. Climate change and implications for sustainable forest management. Impact of climate change on Indian forest - Adaptation of forest trees to climate change - Evolutionary mechanisms – Different concepts of adaptation to climate change – Case studies on the management of certain tree species in India.

UNIT III

Global and regional strategies to combat climate change. Action around the world – European Union: A review of five national programme – US climate policy: Factors and constraints – Climate change mitigation in Japan – Climate change mitigation programs in India. LULUCF activities and CDM projects - and sustainable development, Implications of the Kyoto Protocol.

UNIT 1V

New opportunities to reduce deforestation. Kyoto Protocol, carbon financial markets (compulsory and voluntary). Payment for environmental services (PES), CDMs, Reduced Emissions from Deforestation and Degradation" (REDD) projects. Carbon

accounting. The Satoyama conservation initiatives of Japan as a model for conserving common pool resources and for providing ecosystem services.

Suggested Reading:

Watson et al 2000. *A Special Report of the Intergovernmental Panel on Climate Change*. 6 vols. Cambridge Univ. Press, UK

Claussen E, Cochran VA and Davis DP. 2001. *Climate Change: Science, strategies and Solutions*. Pew Centre on Global Climate Change, USA.

Committee on Abrupt Climate Change. 2002. *Abrupt climate change: Inevitable Surprises*. National Research Council, Ocean Studies Board, National Academics Press, Washington.

Koskela J, Buck A and Teissier du Cros E. 2007. *Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe*. 2007. Biodiversity International, Rome, Italy.

Zbinden S. and Lee D.R. 2005. Paying for environmental services: an analysis of participation in Costa Rica's PSA Program. World Development 33(2): 255–272.

Nair, P.K.R., Kumar, B.M., Nair, V.D. 2009. Agroforestry as a strategy for carbon sequestration. J. Plant Nutri. Soil Sci. 172: 10–23.

Nair P.K.R., Nair V.D., Kumar B.M., Haile S.G. 2009. Soil carbon sequestration in tropical agroforestry systems: a feasibility appraisal. Environ. Sci. Policy, doi:10.1016/j.envsci.2009.01.010.

9. SAF 509 FOREST HYDROLOGY 1+1

Objective

To impart knowledge and understanding among the students on hydrological cycle, resource inventory of soil, land use planning, pressurized irrigation, surface runoff, hydrograph, rain water budgeting, hydrological processes affected by forests.

Theory

UNIT I

Hydrological cycle and characteristics of small and medium watersheds precipitation, infiltration, run-off (run-off hydrographs) total and peak, soil moisture, hydrograph, ground water recharge and evapotranspiration.

UNIT II

Resources inventory soil, land, water and Biota. Soil survey and land use planning –soil types, fertility, productivity, erosion and conservation practices. Water resource development, water availability, pressurized irrigation, crop water requirements and water use efficiency.

UNIT III

Forest features of hydrologic significance – soil organic matter, plant roots, plant and animal life and sheltering. Hydrological processes affected by forest lands – storage and drainage, overland flow, erosion and sedimentation. Hydrological evaluation of land treatment. Evaluation by infiltration procedure– multiple regression, regional analysis and hydrographic analysis.

Practical:

Rain water budgeting – run off and soil loss, infiltration, soil moisture, deep percolation and ground water recharge, rainfall measurements hydrograph. Techniques for measuring subsurface flow on hill slopes. Filed study of hill slope flow processes

Suggested Readings

Baumer 1989. Agroforestry for watershed management. ICRAF, Kenya

Dhruva Narayana VV 1993. Soil and water conservation research in India, ICAR, New Delhi
Dutta SK. 1986. *Soil Conservation and Land Management*. International Book Distributors, Dehra Dun.
Hamilton IS. 1987. *Forest and Watershed Development and Conservation in Asia and the Pacific*. International Book Distributors, Dehra Dun.
Hamilton IS. 1988. *Tropical Forest Watersheds. Hydrologic and Soil Response to Major Uses of Conservation*. International Book Distributors, Dehra Dun.
Hewlett, JD and Nutter, WL 1969. An outline of forest hydrology. University of Georgia Press, Athens.
Moorthy VVN. 1990. *Land and Water Management*. Kalyani Publishers.
Morgan 1984. Soil Conservation. Nataraj Pub, Dehra Dun.
Murty JVS 1995. Watershed Management in India. Wiley Eastern, New Delhi.
Oswal MC. 1999. *Watershed Management* (For Dryland Agriculture), Associated Publishing Co., New Delhi.
Rajora R. 1998. *Integrated Watershed Management*. Ravat Publ., New Delhi.
Rama Rao. 1980. *Soil Conservation*. Standard Book Depot, Bangalore.
Satterlund, DR. 1972. Wildland watershed management. The Ronald Press Company, New York.

10. SAF 510 WATERSHED MANAGEMENT 2+1

Objective

To impart knowledge on watershed characteristics, watershed survey, leveling, contour maps, design of soil and water conservation structures and water harvesting.

Theory

UNIT I

History of watershed management, attributes of water yield, rate regime, quality, hydrological cycle and water balance. Physiographic features of watersheds, infiltration, soil water storage– pore space, available water, evapotranspiration, stream flow.

UNIT II

Forest Management and water yields. Water quality impacts and timber harvests – yarding, skid trials, roads. Stream zone management– temperature– buffer strips. Fire effects on watershed values.

UNIT III

Soil conservation in India – problem, programmes and achievements. Land management problems in India. Soil survey and capability maps – agronomical practices and land management, rotational grazing, dry land farming.

UNIT IV

Compass, Surveying, Plane table surveying, Leveling, Preparation of contour maps of watershed. Terraces and bunds- types & design. Soil and water conservation and water harvesting structures – types & design. Sedimentation- sources, estimation of, sediment bank treatment techniques.

UNIT V

Application of GIS in watershed delineation – monitoring water yield, erosion and run off using GIS techniques.

Practical:

Survey of watershed, Preparation of micro-plan and planning of watershed for effective implementation. Preparation of contour maps, Estimation of earth work, Design of check

dams, Acquaintance with water lifting devices, Use of measurement, Conveyance and control structures. Watershed delineation using GIS techniques.

Suggested Readings

Baumer 1989. *Agroforestry for watershed management*. ICRAF, Kenya

Datta SK. 1986. *Soil Conservation and Land Management*. International Book Distributors, Dehra Dun.

Dhruva Narayana VV 1993. Soil and water conservation research in India, ICAR, New Delhi

Hamilton IS. 1987. *Forest and Watershed Development and Conservation in Asia and the Pacific*. International Book Distributors, Dehra Dun.

Hamilton IS. 1988. *Tropical Forest Watersheds. Hydrologic and Soil Response to Major Uses of Conservation*. International Book Distributors Dehra Dun.

Hewlett, JD and Nutter, WL 1969. An outline of forest hydrology. University of Georgia Press, Athens

Moorthy VVN. 1990. *Land and Water Management*. Kalyani Press

Morgan 1984. Soil Conservation. Nataraj Pub, Dehra Dun

Murty JVS 1995. Watershed Management in India. Wiley Eastern, New delhi.

Oswal MC. 1999. *Watershed Management* (For Dryland Agriculture), Associated Publishing Co., New Delhi.

Rajora R. 1998. *Integrated Watershed Management*. Ravat Publ., New Delhi.

Rama Rao. 1980. *Soil Conservation*. Standard Book Depot, Bangalore.

Satterlund, DR. 1972. Wildland watershed management. The Ronald Press Company, New York

11. SAF 511 SOCIOECONOMICS OF AGROFORESTRY SYSTEM MANAGEMENT 1+1

Objective:

To impart knowledge on the socio-economic interpretations of agroforestry products and services.

Theory

UNIT I

Multiplicity of Agroforestry products and services- ecological and economic and cultural considerations- gender equality- preservation of indigenous knowledge. Socioeconomic benefits of agroforestry.

UNIT II

Smallholder livelihood and the role of agroforestry- Food and nutritional security- Fulfillment of food, fodder, fuelwood and shelter based needs- income generation vs. subsistence production.

UNIT III

Marketing of tree products- The 'black box' of agroforestry markets- characteristics of small and local markets- prospects and challenges- Marketing strategies for NTFPs: Co-operative Societies.

UNIT IV

Exploring market expansion through value addition by improved post-harvest processing-value addition methods- organic products- processing of bamboos and fruits.

UNIT V

Adoption of AF- Determinants of adoption: feasibility, profitability, and acceptability. Adoption behavior influenced by risk, biophysical, and resource factors: land, labor,

income, inputs, experience, social capital, training and membership in farmer cooperatives. Self-efficacy in farmer decision-making - policy aspects.

Practical:

Agroforestry product inventorization- Local surveys on agroforestry markets- product out flow- inflow regulatory mechanisms- Lab Exercise on familiarization of multipurpose tree databases.

Suggested Readings

Dwivedi AP. 1992. *Agroforestry: Principles and Practices*. Oxford & IBH.
Nair PKR, Rai MR & Buck LE. 2004. *New Vistas in Agroforestry*. Kluwer.
Nair PKR. 1993. *An Introduction to Agroforestry*. Kluwer.
Ong CK & Huxley PK. 1996. *Tree Crop Interactions – A Physiologica Approach*. ICRAF.
Thampan PK. 1993. *Trees and Tree Farming*. Peekay Tree Crops Development Foundation.
Young A. 1997. Agroforestry for Soil Management. CABI.

12. SAF 512 AGROFORESTRY AND RECLAMATION OF DEGRADED AND PROBLEM AREAS 2+0

Objective

To give insights into the agroforestry options for productivity enhancement in problem soils.

Theory

UNIT I

Sustainability of land use systems- soil conservation and sustainability-agroforestry for soil conservation- soil restoration- need and reclamation of degraded soils, flood prone areas. Mine spoils and ravines- selection of species and techniques - agroforestry for maintenance of soil fertility, ecological balance and conservation of biodiversity. Management innovation in agroforestry systems of the tropics.

UNIT II

Phytoremediation to cleanup metals pesticides, solvents, explosives crude oil, polyaromatic hydrocarbons, landfill leachates, and salt affected soils. Treating metal contaminants - phytoextraction, rhizofiltration and phytostabilization. Treating organic contaminants - phytodegradation, rhizodegradation and phytovolatization. Hydraulic control of contaminants. Riparian corridors or buffer strips as applications of phytoremediation.

UNIT III

Agricultural non-point source (NPS) pollutants to watercourses. Riparian buffers as bioassimilation strategy to remove nutrients, sediment, organic matter, pesticides, bacteria and pathogens, and other pollutants from surface runoff and groundwater. Multi-species riparian buffer. Species and management considerations.

UNIT IV

Agroforestry for maintenance of soil fertility, ecological balance and conservation of biodiversity. Management innovation in agroforestry systems of the tropics.

Suggested Reading:

Garrett, Rieteveld, Fisher: 2000 *North American Agroforestry*, ASA, Madison, USA.
Buck, Lassoie, Fernandes 1999. *Agroforestry in Sustainable Agri. Systems*, CRC Press.
Gordon and Newman: 1997 Agroforestry Systems in the Temperate Zone, CAB Int'l.

Nair, P.K.R., Rao, M.R. and Buck L.E. (eds.) 2004. *New Vistas in Agroforestry. A Compendium for the 1st World Congress of Agroforestry*. Kluwer Academic Publishers, Dordrecht, The Netherlands
McDicken and Vergara: 1990 *Agroforestry*. Wiley, New York
Mayer, P.M., Reynolds, S.K., McCutchen, M.D., Canfield, T.J., 2007. *Meta-analysis of nitrogen removal in riparian buffers*. Journal of Environmental Quality 36, 1172-1180.
Schultz, R.C., Isenhart, T.M., Simpkins, W.W., Colletti, J.P. 2004. *Riparian forest buffers in agroecosystems - lessons learned from the Bear Creek Watershed, central Iowa, USA.* Agroforestry Systems 61, 35-50.

SAF 591 SILVICULTURE SEMINAR **0+1**

SAF 599 MASTER'S RESEARCH **0+20**

DEPARTMENT OF FOREST MANAGEMENT AND UTILIZATION

Code	Course Title	Credits
FEM 501*	Forest Management	2+1
FEM 502*	Forests and People	2+0
FEM 503	Forest Resource Management and Economics	1+1
FEM 504	Forest Protection	1+1
FEM 505	Environmental Impact Assessment	2+0
FEM 506	Forests and Environmental Policies, Laws and International Conventions	2+0
FEM 507	Advances in Nursery Management	2+1
FEM 508	Non Timber Forest Produce	1+1
FEM 509	Measurement and Assessment of Vegetation	1+1
FEM 510	Principles and Practices of Arboriculture	1+1
FEM 591	Master's Seminar	0+1
FEM 599	Master's Research	0+20

*Compulsory courses

The advisory committee at its discretion may decide on additional courses from other departments of the college as "major courses" depending on the research needs of the student concerned and the availability of such courses.

1. FEM 501 FOREST MANAGEMENT 2+1

Objective

To provide knowledge about forest management, ecosystem management, productive and protective management, sustained yield, yield prediction, site quality evaluation, stand density & forest valuation.

Theory

UNIT I

Forest management – an art and science – importance of forest management in relation to industries and agricultural management – areas and objectives of management- productive and protective management- complimentary and competitive strategies- Balanced management and Priority issue management strategies- tangible and intangible aspects of management – complexity and multiplicity – quality attributes. management strategies according to old and new policies.

UNIT II

Sustained yields – progressive sustained yield –yield regulation -rotation – principles and practices – physical, silvicultural, technical. Income, problem solving rotation –normal forest – growing stock and increment. Increment percentage-Yield prediction and regulation in different types of forests – various methods, Von-Mentals formula and its modifications – Massons method, Brandis method – Howards, Burmas, Smithies, Simmonds - methods merits and demerits.

UNIT III

Site quality evaluation and importance. Stand density, classical approaches to yield regulation in forest management, salient features and strategies.

UNIT IV

Forest valuation and appraisal in regulated forests.

Practical:

Visit to selected forest areas to study the management practices. Preparations of new working plan for a selected range or division by incorporating all modern management strategies including market demand, price fluctuations etc.

Suggested Readings

Bentley, J., Recknagel, A.B. 1985. *Forest Management*, International book distributors, Dehra Dun.

Edmunds, D and Wollenberg, E 2003. *Local Forest Management*, Earthscan Publications, London.

Fugomori, T. 2003. *Ecological and Silvicultural strategies for sustainable forest management*. Elsevier, Amsterdam

Kathiresan, 1986. *Essentials of Forest Management*, Natraj Publishers, Dehra Dun.

Pulparambil, J (2002) *Forest Management – an HRD approach*. Uppal Publishing House, New Delhi

Raison, R.J., Brown, A.J and Flimn, P.W. *Criteria and Indicator for sustainable Forest Managemen*t. CABI, Publications, UK.

Smith DM, Larson BC, Ketty MJ and Ashton PMS. 1997. *The Practices of Silviculture-Applied Forest Ecology*. John Wiley & Sons.

2. FEM 502 FORESTS AND PEOPLE 2+0

Objective

It will help students to understand socio-economic, cultural and ecological relationship between forests and people. It will acquaint students with the role of people in forest management through analysis of need dependence and traditional interactions between forests and society.

Theory

UNIT I

Forests and its importance, forest societies, interactions between forests and people, importance of forests in traditional farming systems, livestock economy and forests, social and cultural factors of forest management, man in ecosystem in relation to ecophilosophy.

UNIT II

Afforestation programmes and forest conflicts, wildlife and human conflicts, peoples movement in forest conservation like Chipko Movement, Gender dimension of forest management, tribals and forests. Pastoralists and their dependence on forests. Forests and economic security of tribals.

UNIT III

Management of Commons and Common Property Resources (CPRs) and open access resources, forest management and sustainable livelihood strategies, forests and food security, eco-tourism and local development, land use change and forestry.

UNIT IV

Forest rights, customary rights of people, community participation, biodiversity and ethnobotany, Joint Forest Management, global environmental change and land use; dams, forests and resettlement of tribals and non-triabals – case study, poverty alleviation and forests, tourism and forest management, role of NGOs and other CBOs community based organization in forest management.

Suggested readings

Annamalai R. 1999. *Participatory Learning Action and Microplanning for JFM*. Dean SFRC, Coimbatore.

FAO. 1978. *Forestry for Local Community Development*. FAO Publ.

Shah SA. 1988. *Forestry for People*. ICAR.

Tiwari KM. 1988. *Social Forestry and Rural Development*. International Book Distr.

Vyas GPD. 1999. *Community Forestry*. Agrobios.

3. FEM 503 FOREST RESOURCE MANAGEMENT AND ECONOMICS 1+1

Objective

To develop understanding of students about forest resource management and economics management decisions, natural and environmental resource accounting.

Theory

UNIT I

Application of microeconomics in solving forest resource problems. Emphasis on forest products demand and supply analysis, forest products marketing, forest capital theory.

UNIT II

Inter-regional and international trade in forest products. Impact of economics and physical variables upon forest appraisal and management decisions. Externalities and property rights.

UNIT III

Natural and environmental resource accounting –methods and implications. Application of operations research tools in evaluating forest management alternatives in public and private forest planning.

Practical:

Exercises on estimation of demand and supply functions; biodiversity valuation, valuation of non-marketed forest products. Exercises on financial and economic appraisal of forestry projects. Exercises on marketing of forest products and international trade competitiveness. Computer applications for using programming techniques in evaluating forest management alternatives.

Suggested Readings

FAO 1986. *Guidelines to Practical Project Appraisal*. Natraj Pub.

Kerr JM, Marothia DK, Singh K, Ramaswamy C and Beritley WR. 1997. *Natural Resource Economics : Theory and Applications in India*. Oxford & IBH.

Nautiyal JC. 1988. *Forest Economics – Principles and Applications*. Natraj Publications, Dehra Dun.

Sharma LC. 1980. *Forest Economics, Planning and Management*. International Book Distributors, Dehra Dun.

4. FEM 504 FOREST PROTECTION 1+1

Objective

To provide knowledge to students about forest protection through diseases & pest management.

Theory

UNIT I

Important diseases and insect pests of nurseries, farm forestry, plantations, avenue trees and their management. Assessment of losses due to diseases, insect pests, vertebrate pests, adverse weather, forest fires and weeds. Insect pests and mycoflora of seeds of forest trees and their management.

UNIT II

Biodegradation of wood – microscopic and chemical effects of white rot, brown rot, soft rot and wood discoloration. Heart rots – factors affecting heart rots, damage caused, compartmentalization of decay in trees and management of heart rots. Role of mycorrhiza in tree health.

UNIT III

Theories of natural regulation of insect populations. Wildlife damage in nurseries, plantations and their management. Weed problems in nurseries, plantations and their control. Adverse climatic factors, acid rains and air pollutants in relation to forest tree health.

UNIT IV

Biological control of insect pests and diseases of forest trees. Molecular tools for developing disease resistance trees.

Practical:

Collection, identification and preservation of important insect pests and disease specimens of forest plants. Detection of insect infestation and seed borne mycoflora. Assessment of losses due to diseases, insect pests etc. Habitat management of vertebrate pests. Laboratory tests for estimating decay resistance in wood. Fire control methods and devices, Familiarization with the meteorological and plant protection equipment, Application of pesticides and bio-control agents in the management of insect pests,

weeds, diseases in nurseries and plantations, Extraction of spores of arbuscular mycorrhizal (AM) fungi from soil and assessment of mycrorrhizal root infection.

Suggested Readings

Bakshi BK. 1976. *Forest Pathology*. Controller of Publications, GOI.
Jha LK and Sen Sarna PK. 1994. *Forest Entomology*. Ashish Publ. House.
Manion PD. 1991. *Tree Diseases Concept*. Prentice Hall.
Stebbings EP. 1977. *Indian Forest Insects*. JK Jain Bros.

5. FEM 505 ENVIRONMENTAL IMPACT ASSESSMENT 2+0

Objective

To train the students in planning and evaluation projects.

Theory

UNIT I

Introduction; Principles and purposes of IEE and EIA and its significance for the society, Cost and benefits of EIA; EIA involvement during project life cycle.

UNIT II

EIA management; principles & management of EIA, main stages in EIA processes; screening, scooping, prediction, mitigation and alternatives auditing.

UNIT III

EIA techniques, checklists, matrices, network method, remote sensing and GIS. Public consultation and participation in EIA process. EIA guidelines and review process. EIS formulation. New approaches to EIA and SEA (strategic environmental assessment).

Practical:

Preparation of EIA & SEA reports.

Suggested Readings

Anonymous 2006. *Report of the National Forest Commission*. Govt. of India, New Delhi.
Claussen E, Cochran VA and Davis DP. 2001. *Climate Change: Science, Strategies and Solutions*. Pew Centre on Global Climate Change, USA.
Committee on Abrupt Climate Change. 2002. *Abrupt Climate Change: Inevitable Surprises*. National Research Council, Ocean Studies Board, National Academics Press, Washington.
Koskela J, Buck A and Teissier du Cros E. 2007. *Climate Change and Forest GeneticDiversity: Implications for Sustainable Forest Management in Europe*. Biodiversity International, Rome, Italy.

6. FEM 506 FORESTS AND ENVIRONMENTAL POLICIES, LAWS AND INTERNATIONAL CONVENTIONS 2+0

Objective

To impart knowledge about various legislations and acts concerning environmental policy, laws and conventions.

Theory

UNIT I

Environment and Development Policies: Land and Agricultural Policies; Land Use Policy, Industrial Policy, Policy on resettlement and rehabilitation, Forest Policies in India; National Forest Policy 1952 and 1988. National Environment Policy 2006, Policy on abetment of Pollution, National Eco tourism Policy, National Tourism Policy, National Trade Policy, National Water Policy.

UNIT II

Bio-Diversity Related Laws: The Indian Forest Act 1927 and subsequent amendments; Forest Conservation Act 1980 and Rules; Wild Life Protection Act 1972 and Rules, Wild Life Protection Amendment Act 2002, Biodiversity Act 2002, Biodiversity Rules 2004, National Biodiversity Strategic Action Plan, Plant Varieties Protection and Farmer's Rights Act 2001, Geographical Indications of Goods Act 1999. The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act 2006, Case Law.

UNIT III

Pollution Control Laws: Public Nuisance – S.133 Cr. P.C; Law of Strict Liability, Public Liability Insurance Act 1991. Water (Preventing and Control of Pollution) Act 1974; Water Cess Act 1977; Air (Prevention and Control of Pollution) Act 1981; Environment (Protection) Act 1986 and Rules 1987; Subsequent allied Rules Environment Impact Assessment, Quality Control and Auto regulation and Environment Audit, Energy and Environment, Mining and Environment.

UNIT IV

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Ramsar Convention on Wet Lands, The Basel Convention on the Control of Trans-boundary Movement of Hazardous Wastes and their Disposal, The Montreal Protocol ,International Tropical Timber Agreement.

UNIT V

Convention on Biological Diversity 1992 (CBD) Cartagena Protocol on Bio-Safety 2000 (CPB), United Nation Framework Convention on Climate Change, Kyoto Protocol, WTO and Environment, TRIP and Patenting Issues.

Suggested Readings

Anonymous 2006. *Report of the National Forest Commission*. Govt. of India, New Delhi.

Claussen E, Cochran VA and Davis DP. 2001. *Climate Change: Science, Strategies and Solutions*. Pew Centre on Global Climate Change, USA.

Committee on Abrupt Climate Change. 2002. *Abrupt Climate Change: Inevitable Surprises*. National Research Council, Ocean Studies Board, National Academics Press, Washington.

Huxley P. 1999. *Tropical Agroforestry*. Blackwell Science.

Koskela J, Buck A and Teissier du Cros E. 2007. *Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe*. Biodiversity International, Rome, Italy.

7. FEM 507 ADVANCES IN NURSERY MANAGEMENT 2 + 1

Objective

To impart knowledge on modern nursery techniques about types of nursery, vegetative propagation, use of green house, mist chamber and fertilizer use.

Theory

Unit I

Basic concepts in the establishment of modern nursery – Nursery planning – site selection- layout – development - Equipment for Forest Nurseries - – Principles of ergonomics in nursery management.

Unit II

Methods of reproduction - Asexual and sexual commercial production of seedlings – Collection, processing, testing, storage of seeds and other propagules - containers and root trainers in nursery techniques - Rooting media and transplanting techniques – growth attributes of seedlings - Monitoring and effects on seedling growth – Assuring seed quality for seedling production.

Unit III

Managing the Soil and Water- Soil Fertility in Forest nurseries - Methods of water management - Irrigation in tree nurseries - Cultural Practices on seedling quality- Biological and chemical methods of disease and pest management – Weed Management in Forest Nurseries.

Unit IV

Nursery structures – mist chambers, glass house, net house, temperate, light and humidity control systems- Seedling certification - Lifting, Grading, Packaging and Storing - Assessing seedling quality- Sales and customer relations – Nursery record systems.

Practical:

Anatomical studies for estimation of graft and bud joint, identifying the stages of union by microscopic techniques, seed dormancy estimation using X rays and scanning methods, estimation of endogenous hormones and studying the formative effects.

Suggested reading

Ahuja, M.R and Libbey, W.J 1993. *Clonal Forestry*. Springer-Verlag, London

Edwards, D.G.W and Naithani, S.C. 1999. *Seed and nursery Technology for Forest Trees*. New Agri. International Publishers, New Delhi.

Gurumurthy, K., Mcena, D and Bhandari, H.C.S 1989.*Vegetative Propagation*, IFGTB, Coimbatore

Hartmann, H.T.,Kester, D.E, Davies, F.T and Geneva, R.L 1997. *Plant Propagation-Principles and Practices*, Prentice hall of India, Pvt. Ltd, New Delhi

Duryea ML. and Landis TD. (eds). 1984. *Forest tree nursery manual: Production of bare root seedlings.* Martinus Nijhoff/Dr W. Junk publishers, 385p.

Sagwal, S.S. 1994. *Trees on marginal lands*. Scientific Publishing Company, Jodhpur.

Surendran, C., Parthiban, K.T., Vanangamudi, K and Balaji, S. 2000. *Vegetative propagation of trees- Principles and Practices*, Tamil Nadu Agricultural University, Coimbatore.

8. FEM 508 NON-TIMBER FOREST PRODUCE 1+1

Objective

To provide knowledge about non-timber forest produces, their harvesting and conservation issues.

Theory

UNIT I

Importance and nomenclature of non-timber forest produce (NTFP) – importance in state, national and International economy. Role of NTFP in industrial economy as a source of revenue- NTFP for sustainable forestry- Trade and development of NTFP in India- Characteristics of NTFP- Policy and legal issues- Management requirements - research needs.

UNIT II

Methods of survey of NTFP –classification, collection, processing and methods of utilization of fibres , flosses , grasses bamboo, canes, reed – collection of fatty oils and waxes – nature and chemistry of essential oils, oleoresins, gums, resins etc.

UNIT III

Tannin and dye extraction – importance of medicinal plants – various types and classes – economic parts- extraction and isolation of active principles- edible plants – miscellaneous NTFP – animal products and mineral products.

Practical:

Collection, identification and processing of NTFP – familiarize the methods of storage and marketing – extraction of oil, oleoresins etc. Collection of medicinal plants- visits to forest areas to study working of Girijan societies in the marketing of NTFPs.

Suggested Reading

Gupta T., Gularia A. 1992. *Non Wood Forest products in India*: *Economic Potentials*. Oxford and IBH publishing Co. New Delhi.

Mehta T., Khanna L.S. 1981. *Handbook of Forest Utilization*, Periodical book Agency, Dehra Dun.

Mishra T.K, Banerjee, Pal, D.C. 2004. *An Omnibus of Non-Timber forest products of India, Prashant Gahlot at Valley*. Offset Printers and Publishers, Dehra Dun.

Nair K.K.N. 2000. *Manual of Non-wood Forest produce plants of Kerala*. Kerala Forest Department Government of Kerala, Thiruvananthapuram.

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

Tribhawan Mehta. 1981. *A handbook of Forest Utilization*. Periodical expert book agency.

9. FEM 509 MEASUREMENT AND ASSESSMENT OF VEGETATION 1+1

Objective

To recognize the forest vegetation attributes that can be measured and quantified. This course will also help the student to familiarize with the major field protocols for measuring vegetation characteristics and to select the most relevant protocol.

Theory

UNIT I

History and trends in vegetation analysis, Importance of floristic surveys, past and present distribution of different forest vegetation on the earth, forest vegetation environment relationships, factors affecting current distribution.

UNIT II

Basic principles of sampling- Populations and Samples-Accuracy vs. Precision - Sampling vs. Non-sampling errors -Sampling Distributions-Considerations-sampling objectives-Sampling design-Appropriate Sampling Unit Size and Shape for vegetation analysis.

UNIT III

Field Techniques for measuring vegetation-Diversity indices, Photoplots and Photopoints, Video Photography, Remote Sensing and GIS Techniques-Complete Population Counts -Density -Cover-Production and Other Vigor Indicators-Choosing an Attribute and Technique- Locating Sampling Units in the Field -Relocating Study Areas - Monumentation -Field Equipment - New Tools in collecting and pressing plants, drafting plant manuals.

UNIT IV

Different ways of recording data in the field, biodiversity software for data analysis, display the results of analysis, and the interpretation of data following analysis.

Practical:

Choosing sample sites and description of vegetation in the field, sampling design - hands-on-training in biodiversity software - Use of open source GIS software to represent plant diversity-tree and plant identification -drafting plant manuals.

Suggested readings

Bonham, C.D. 1989. *Measurements for terrestrial vegetation*. John Wiley & Sons, New York, NY.
Coulloudon, B. et al. 1999. *Sampling Vegetation Attributes*. Technical Reference 1734-4, Bureau of Land Management. Denver, Colorado.
Elzinga, C.L., Salzer D.W. and Willoughby J.W. 1998. *Measuring and Monitoring Plant Populations*. Technical Reference 1730-1. Bureau of Land Management. Denver, Colorado. USDI, BLM
Elzinga C.L., Salzer, D.W. Willoughby J.W. and Gibbs J.P. 2001. *Monitoring Plant and Animal Populations*. Blackwell Science.
Magurran, A.E. 1988. *Ecological Diversity and Its Measurement*. Chapman and Hall, London.
E-resources
http://www.cnr.uidaho.edu/veg_measure/

10. FEM 510 PRINCIPLES AND PRACTICES OF ARBORICULTURE 1+1

Objective
To understand various techniques adopted for cultivation of trees and their utilization in landscaping and avenue planting.

Unit 1
Scope of arboriculture- Tree forms, shapes and architecture-arboriculture for soil improvement and soil conservation, for domestic and industrial produces, trees and environmental pollution control abatement- arboriculture for employment generation.

Unit II
Avenue planting of trees species selection and planting methods, shade, water and nutrient management sprayers and dusters low volume and high volume sprayers, vapourizers, aerosols.

Unit III
Planting and management of timber, ornamental flowering and foliage trees, multipurpose, medicinal and fruit trees, Designing and landscaping of parks and other public areas-landscaping with trees-principles and practices Social awareness and social concern of tree planting

Practical:
Visit to arboretums and botanical gardens maintained by various institutes-Study the different forms and shapes of trees, explain tree architecture-make diagrams and sketch, study the role of trees in environmental amelioration.

Suggested reading
Ahuja, M.R and Libbey, W.J 1993. *Clonal Forestry*. Springer-Verlag, London
Doormbos, M., Saith, A and White, B. 2000. *Forest – Nature, People, Power*. Blackwell Publishers, Massachisetts, USA.
James, N.D.G. 1989. *The Aboriculturists Companion*. Basel Blackwell Ltd. Oxford.
Sagwal, S.S. 1994. *Trees on Marginal Hands*. Scientific Publishing Company, Jodhpur.

FEM 591	**MASTER'S SEMINAR**	**0+1**
FEM 599	**MASTER'S RESEARCH**	**0+20**

DEPARTMENT OF TREE PHYSIOLOGY AND BREEDING

Code	Course Title	Credits
TPB 501*	Tree Breeding	2+1
TPB 502*	Forest Ecophysiology	1+1
TPB 503	Tissue Culture in Forest Trees	1+2
TPB 504	Quantitative Genetics in Forest Tree Breeding	1+1
TPB 505	Forest Genetic Diversity and Conservation	2+0
TPB 506*	Biotechnology Approaches in Forestry	1+1
TPB 507	Molecular Biology	2+1
TPB 508	Principles and Techniques of Genetic Engineering	2+1
TPB 509*	Tree Physiology	2+1
TPB 591	Master's Seminar	0+1
TPB 599	Master's Research	0+20

*Compulsory courses for Master's programme

The advisory committee at its discretion may decide on additional courses from other departments of the college as "major courses" depending on the research needs of the student concerned and the availability of such courses.

1. TPB 501 TREE BREEDING 2+1

Objective

To acquaint the students about general principles of tree breeding with examples of important trees.

Theory

UNIT I

Tree breeding , introduction , objectives of tree breeding , history. Tree breeding, forest genetics, tree improvement – Definitions. Special problems of tree breeding , prospects of tree breeding , advantages and disadvantages of tree breeding

UNIT II

Some basic genetic concepts , genes and gene action , additive and dominant gene action Partitioning of phenotypic variance , additive and non additive , estimation of heritability , significance of heritability in tree breeding.

UNIT III

Importance of natural variation , natural variation as a basic tool for breeding , partitioning of natural variation between provenance, between sites, between stand and between tree variations , relative significance of these in tree breeding . Seed source, Forces that affect variation – ecotypes and clines – their relative importance in breeding

UNIT IV

Provenance testing objectives, delineation of provenances. Range-wide and limited range tests. Seed collection and layout of the experiments – data collection, statistical analysis and interpretation , Land race concept – stress theory

UNIT V

Selection as a method of tree breeding , significance of selection , mass selection and pedigree selection . Selection from even aged stand - mass selection – procedure of comparison tree method - candidate tree – plus tree – elite tree . Selection and genetic gain, selection differential, intensity of selection , prediction and manipulation of genetic gain. Selection from uneven aged and mixed stand – problems, regression method of selection, mother tree selection.

UNIT VI

Meeting immediate seed requirement, seed production area – its production and management. Meeting long term seed requirement – seed orchards – production and management , different types of seed orchards – SSO and CSO – merits and demerits , improved seed orchard , 1.5 generation seed orchard , seed orchard generations

UNIT VII

Genetic testing programmes , objectives and methodologies , applications. Progeny testing , General and specific combining ability estimation , genetics of combining abilities. .Mating designs – importance and need. Choice of design. Complete and incomplete mating designs, designs like: open pollinated, polycross, nested, factorial, diallel etc. and their modifications. Experimental designs of progeny testing , choice of design , their importance , statistical handling of data. Selection from progeny test plot , pedigree selection: family, within family and combined selections. General scheme of selection as a method of breeding: a schematic representation. Base population, production population, breeding population, infusion population etc. Recurrent selection , multiple population system of selection , sib selection. Selection for several traits, multi-trait selection: tandem selection, independent culling and index selection merits and demerits of these. Indirect selection – marker aided selection –

morphological, anatomical, biochemical and molecular markers. Significance of juvenile–adult correlation.

UNIT VIII

Hybridization as a method of tree breeding , methods , combining characters incorporation of a single character , backcross method, exploitation of heterosis – merits and difficulties of hybridization.

UNIT IX

Vegetative propagation in tree breeding , methods , applications , clonal forestry, its pros and cons. Tissue culture – its application in tree breeding – clonal propagation – secondary metabolite production – somaclonal variation – distant hybrids

UNIT X

Genetic engineering as a tool in tree improvement, general methods, applications, prospects and difficulties

UNIT XI

Intellectual Property rights (IPR), Geographical indications (GI). Farmers' rights – researchers' rights. IPR on biological diversity – Convention on Biological Diversity (CBD), Regulation of biodiversity – National Biodiversity Authority (NBA), State Biodiversity Board (SBB). ICAR guidelines for IPR management. Biodiversity Act.

Practical:

Visits and study of seed orchard designs. Estimation of overlap in flowering among genotypes. Study of inter and intra-clonal variation in floral, seed characters. Effect of girdling on flowering. Plant growth regulator application for flower induction. Pollen viability/fertility. Assessment of pollen dispersal. Supplemental mass-pollination. Effects of foliar application of fertilizers on seed set. Estimation of genetic parameters for a few traits. Estimation of parental balance. Identification of ecotypes, races, and land-races in natural forest. Visit to species, provenance and progeny trials. Selection of superior phenotypes. Marking of candidate trees, plus trees and elite trees. Visit to seed orchards. Comparison of parents and their putative hybrids. Induction of polyploidy through colchicine treatment.

Suggested Readings

FAO. 1985. *Forest Tree Improvement*, FAO Pub.

Faulkner R. 1975. *Seed Orchard.* Forestry Commission Bull. No.34.

Fins L, Friedman ST and Brotschol JV. 1992. *Handbook of Quantitative Forest Genetics*. Kluwer.

Khosla PK. 1981. *Advances in Forest Genetics*. Ambika Publ., New Delhi.

Mandal AK and Gibson GL. (eds). 1997. *Forest Genetics and Tree Breeding*. CBS.

Surendran C, Sehgal RN and Parmathama M. (eds). 2003. *A Text Book of Forest Tree Breeding*. ICAR.

Sehgal RN and Paramathma M. 2003. *Text Book of Forest Tree Breeding*. ICAR Publ.

Wright JW. 1976. *Introduction to Forest Genetics*. Academic Press.

Zobel BJ and Talbert J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.

Zobel BJ, Wyk GV and Stahl P. 1987. *Growing Exotic Forests*. John Wiley & Sons.

2. TPB 502 FOREST ECOPHYSIOLOGY 1+1

Objective

To acquaint the students about general principles of ecophysiology for application in

improving forest productivity.

Theory

UNIT I

Forest environment interactions – Forest ecosystems – Geographic and climatic factors. Environmental factors influencing forest growth and productivity. Sun and shade plants.

UNIT II:

Influence of temperature, water stress and nutrient availability and disturbance in the forest on tree growth and forest productivity.

UNIT III:

Dynamics of forest ecosystems – energy, productivity and biomass. Decomposition and nutrient cycling.

UNIT IV:

Stand structure and micro-climate – energy relationships – Canopy energy balance. Partitioning absorbed energy. Radiation penetration into and absorption by canopies. Air temperature and humidity in forests. Turbulent transfer process above forests.

UNIT V:

Transpiration and Evapotranspiration from forest canopies. Estimation of ET.

UNIT VI:

Stress - Avoidance and tolerance mechanisms - temperature stress – low temperature stress - physiology of resistance to frost - Heat stress – Heat injury - Heat avoidance and tolerance mechanism - Radiation stress - mechanism of shade tolerance –water logging - physiology of resistance to water logging – Drought stress - Salt and ion stress.

Practical:

Morphological, anatomical and physiological variations between sun and shade plants. Estimation of biomass production of trees of different species. Estimation of micro-climatic elements as influenced by stand structure. Estimation of evapotranspiration. Measurement of radiation in different types of forest and agroforestry systems.

Suggested Reading:

Kozlowski, T.T., Kramer, P.J. and Pallardy, G.S. 1991. *The Physiological Ecology of Woody Plants*. Academic Press, New York.

Kramer, P.J. 1972. *Plant and Soil Water Relationships*. TMH Edition, Tata McGraw Hill Publ. Co., New Delhi.

Ksenzhek, O.S. and Volkov, A.G. 1998. *Plant Energetics*. Academic Press, New York.

Lack, A.J. and Evans, D.E. 2001. *Plant Biology- Instant Notes*. Vina Books Pvt. Ltd., New Delhi.

Larcher, W. 2003. *Physiological Plant Ecology*. 4th edn, Springer-Verlag, Germany

Luttge, U. 2008. *Physiological ecology of tropical plants*. Springer-Verlag, Germany

Moore, T.C. 1989. *Biochemistry and Physiology of Plant Hormones*, 2nd ed. Springer-Verlag, Berlin.

Taiz, L. and Zeiger, E. 2007. *Plant Physiology*, 4th ed. Sinauer Associates Inc. Publishers, Sunderland.

Wilkins, B.M. 1984. *Advanced Plant Physiology*. ELBS/ Longman Pub. Co.

3. TPB 503 TISSUE CULTURE IN FOREST TREES 1+2

Objective

To develop faculties of students to explore and analyze the propagation techniques *in vitro* and to provide knowledge in the field with principles, techniques and progress achieved in the discipline.

Theory

UNIT I

Tissue culture-principles as applied to forest tree species, history, development, fields of application, progress and prospects with special reference to tree crops. Culture conditions. Stages of micro propagation.

UNIT II

In vitro propagation via enhanced release of auxiliary buds. Somatic organogenesis and somatic embryo genesis, leaf diseases, embryoid and synthetic seed production.

UNIT III

Problems and Progress in *in vitro* propagation of tree crops. *In vitro* pollination and fertilization for distant hybridization. Somaclonal variation – factors influencing – exploitation for crop improvement.

UNIT IV

Haploid culture and production of homodiploids, Protoplast isolation, culture and regeneration; Protoplast fusion for somatic hybridization and its application.

UNIT V

Techniques for direct gene transfer to protoplasts.

UNIT VI

Need of in vitro conservation. Short and medium term conservation. Long term storage, cryo-preservation, freeze preservation, significance of liquid nitrogen, prefreezing treatments – use of cryo-protectants, dry freezing, incubation.

UNIT VII

Alteration/modifications in cell components during cryo-preservation. Recalcitrant species. Thawing and reculture. Survival of freeze preserved cells/tissues.

UNIT VIII

Clonal fidelity and karyotype stability of cryopreserved cultures and regenerates. Use of biochemical and molecular markers for testing the stability, Protocol development.

Practical:

Preparation and storage of stock solutions, preparation of culture media. Collection, handling and pre-treatment of explants. Micro-propagation of tree species via different routes. *Ex vitro* establishment of plantlets. Production of somatic embryos. *In vitro* pollination and fertilization. Protoplast isolation and culture. Haploid culture. Components and preparation of culture medium. Collection, handling and surface sterilization of explants. Inoculation and incubation. Preparation of in vitro cultures for short, medium and long term preservation. Practicing different protocols for conservation. Thawing and reculture. Assessing the stability of regenerates. Manipulation of culture media and conditions for prolonging the culture period. Essential features of tissue culture laboratories.

Suggested Readings

Bajaj YPS. (ed.). 1988. *Biotechnology in Agriculture and Forestry*. Springer Verlag.
Gupta PK. 2000. *Elements of Biotechnology*. Rastogi Pub.
Kumar S and Singh MP. 2008. *Plant Tessue Culture*. APH Pub.
Mandal AK and Gibson GL. (ed.). 1997. *Forest Genetics and Tree Breeding*. CBS.
Punia MS. 1998. *Plant Biotechnology and Molecular Biology*. Scientific Publ.
Singh BS and Singh MP. 2007. *Fundamental of Plant Biotechnology*. Sodesh Serial Publ.
Srivastava PS, Narula A and Srivastava S. (ed.). 2004. *Plant Biotechnology and Molecular Markers*. Anamaya Pub.

4. TPB 504 QUANTITATIVE GENETICS IN FOREST TREE BREEDING 1+1

Objective

To impart knowledge in the field of biometry as applied to breeding, population, provinces and making experiment in forest genetics and tree breeding.

Theory

UNIT I

Historical aspects of quantitative genetics; multiple-factor-hypothesis. Population structure, mating systems.

UNIT II

Hardy-Weinberg equilibrium: properties and implications of equilibrium , influence of mutation, migration and selection. Random mating consequences in small populations. Random drift, inbreeding coefficient, rate of inbreeding.

UNIT III

In breeding in pedigreed population, inbreeding coefficient under regular systems of inbreeding. Statistical parameters used in studying polygenic traits.

UNIT IV

Testing and estimating: population mean and components of phenotypic value, breeding value, dominance, interaction and environment deviation. Models of gene action, significance of different genetic components, G x E component of variance.

UNIT V

Estimation of genetic components of variance through resemblance of relatives. Fisher's fundamental theorem on natural selection and its implications. Heritability-its estimation and significance.

UNIT VI

Selection theory for a quantitative character. Prediction of selection response: patterns, asymmetry, and causes. Selection criteria and use of information from relatives. Correlation among characters, correlation response and indirect selection.

UNIT VII

Effect of inbreeding on mean and variance. Heterosis and causes for heterosis in F1 and later generations. Combining ability effects, variances and selection for combining ability. Threshold characters.

Practical:

Problems on multiple factors inheritance - Partitioning of variance - Estimation of heritability and genetic advance - Covariance analysis - Correlation analysis - Path analysis - Parent-progeny regression analysis - Estimation of heterosis: standard, mid-parental and better-parental heterosis - Estimation of inbreeding depression - Generation mean analysis: Analytical part and Interpretation – Estimation of different types of gene actions. Partitioning of phenotypic variance and co-variance into components due to genotypes, environment and genotype x environment interactions - Working out efficiency of selection methods in different populations and interpretation, Biparental mating, Triallel analysis, Quadriallel analysis and Triple Test Cross (TTC) – use of softwares in analysis and result interpretation, .

Suggested Readings

Brotschol JV. 1992. *Handbook of Quantitative Forest Genetics*. Kluwer.

Falconer, D.S. 1989. Introduction to quantitative genetics, 4th ed. Pearson Education Ltd. Essex

FAO. 1985. *Forest Tree Improvement*, FAO Pub.

Khosla PK. 1981. *Advances in Forest Genetics*. Ambika Pub., New Delhi.

Mandal AK and Gibson GL. (eds). 1997. *Forest Genetics and Tree Breeding*. CBS.

Surendran C, Sehgal RN and Parmathama M. (eds). 2003. *A Text Book of Forest Tree Breeding*. ICAR.

Wright JW. 1976. *Introduction to Forest Genetics*. Academic Press.
Zobel BJ and Talbert J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.
Zobel BJ, Wyk GV and Stahl P. 1987. *Growing Exotic Forests*. John Wiley & Sons.

5. TPB 505 FOREST GENETIC DIVERSITY AND CONSERVATION 2+0

Objective

To provide the students knowledge about the genetic diversity in forest tree species, their distribution, and analyze laws and methodologies of *in-situ* and *ex-situ* conservation.

Theory

UNIT I

Biological diversity-concept, levels ecosystem. Genetic diversity and differentiation-definition, characteristics and importance for tree breeding. Genetic erosion. Techniques to assess genetic diversity. Analysis of karyotypic variation.

UNIT II

Molecular approaches for assessing genetic diversity. Inventory and monitoring biodiversity: sampling strategies for genetic diversity assessments sufficiency of sampling procedures, neutral allele model and optimal allocation of sampling efforts.

UNIT III

Effects of sampling on genetic diversity. Factors influencing levels of genetic diversity in woody plant species. Conservation of genetic diversity. Global and local initiations for bio chemistry conservation.

UNIT IV

Laws and policies. Methods for maintenance of conservation: Gene banks, arboreta, gardens, breeding populations as repositories of gene conservation. Rare, endangered and endemise plants (IUCN).

UNIT V

Techniques for survey and assessment of endangered plants. Rarity patterns and endemism. Concept of island biogeography. Managing corridors and natural habitat fragments.

UNIT VI

Monitoring and recovery plans for endangered plants. Plant community reserves. Managing wild flora tourism impacts and urbanization of rare plants. Implications of rarity.

UNIT VII

Intellectual Property rights – (IPR) issues involved – Nature of IPR. Geographical indications (GI) – benefits – protection of GI – national & international level – goods that can be protected under GI – procedure, violation of GI protection – examples. IPR on plant varieties – Plant Breeders' Rights - history – PPV & FR Act, 2001 – Registration of varieties under the Act- Novelty, Distintiveness, unifiormity and stability – Extant variety, Farmers' variety. Farmers' rights – researchers' rights. IPR on biological diversity – Convention on Biological Diversity (CBD), Regulation of biodiversity – National Biodiversity Authority (NBA), State Biodiversity Board (SBB). ICAR guidelines for IPR management. Biodiversity Act. Seed Bill – its impact. Various treaties – their comparisons.

Suggested Readings

FAO. 1985. *Forest Tree Improvement*, FAO Pub.
Faulkner R. 1975. *Seed Orchard* Forestry. Commission Bull. No.34.
Fins L, Friedman ST and Brotschol JV. 1992. *Handbook of Quantitative Forest Genetics*. Kluwer.

Khosla PK. 1981. *Advances in Forest Genetics*. Ambika Publ., New Delhi.
Mandal AK and Gibson GL. (eds). 1997. *Forest Genetics and Tree Breeding*. CBS.
Surendran C, Sehgal RN and Parmathama M. (eds). 2003. *A Text Book of Forest Tree Breeding*. ICAR.
Wright JW. 1976. *Introduction to Forest Genetics*. Academic Press.
Zobel BJ and Talbert J. 1984. *Applied Forest Tree Improvement*. John Wiley & Sons.
Zobel BJ, Wyk GV and Stahl P. 1987. *Growing Exotic Forests*. John Wiley & Sons.

6. TPB 506 BIOTECHNOLOGY APPROACHES IN FORESTRY 1+1

Objective

To imbibe an understanding of scope, potential and techniques in forest biotechnology and to prepare them for experimentation in the discipline.

Theory

UNIT I

Historical development of biotechnology; scope of biotechnology in forestry; different methods of biotechnology related to forestry

UNIT II

Plant tissue culture and response pattern; application of plant tissue culture in tree improvement.

UNIT III

In vitro selection and micro propagation in forestry for conservation; gene regulation, genetic engineering techniques; basis of operation in DNA manipulation;

UNIT IV

Transgenic plants; molecular markers and its application in forestry; modification of plant species to practically desired products; biodegradation of forestry wastes through genetically engineered microbes.

Practical:

Biochemical techniques: Preparation of buffers and reagents, Principle of centrifugation, Chromatographic techniques Gel electrophoresis- agarose and PAGE (nucleic acids and proteins); PCR and optimization of factors affecting PCR. Dot blot analysis; Southern hybridization; Northern hybridization; Western blotting and ELISA; Radiation safety and non-radio isotopic procedure.

Suggested Readings

Bajaj YPS. (ed). 1988. *Biotechnology in Agriculture and Forestry*. Springer-Verlag.
Gupta PK. 2000. *Elements of Biotechnology*. Rastogi Pub.
Kumar S and Singh MP. 2008. *Plant Tissue Culture*. APH Pub.
Mandal AK and Gibson GL. (ed.). 1997. *Forest Genetics and Tree Breeding*. CBS.
Punia MS. 1998. *Plant Biotechnology and Molecular Biology*. Scientific Pub.
Singh BS and Singh MP. 2007. *Fundamental of Plant Biotechnology*. Sodesh Serial Pub.
Srivastava PS, Narula A and Srivastava S. (ed.). 2004. *Plant Biotechnology and Molecular Markers*. Anamaya Pub.

7. TPB 507 MOLECULAR BIOLOGY 2+1

Objective

To develop understanding of students in field of molecular biology through imparting knowledge about the structure and function of RNA and DNA, its organization, isolation, extraction, assay and application.

Theory

UNIT I

History and development of Molecular Biology. Nucleic acids – DNA and RNA as genetic materials. Nucleosides and nucleotides, DNA double helix –properties of DNA – absorbance, ionic interaction, denaturation and renaturation, sedimentation.

UNIT II

Secondary structure of single stranded DNA – inverted repeat sequences, alternative structures of duplex DNA C value and concept of selfish DNA, cell organelle DNA Chloroplast and genes and mitochondrial DNA and genes. DNA replication – semi-conservative replication.

UNIT III

Organization in prokaryotes and eukaryotes. DNA polymerases, replicon, eyes, rolling circle and D-loops, nick translation, okazaki viruses. Reverse transcriptase, primase, helicase, topoisomerases, gyrases, methoylases and nucleases. DNA sequencing.

UNIT IV

Molecular breeding of Forest trees, Constructing molecular maps, Molecular tagging of genes/traits, Market-assisted selection of qualitative and quantitative traits, Physical maps of chromosomes, The concept of gene synteny, The concept of mapbased cloning.

UNIT V

Basic structure of DNA, overview of genomics technology, concept of maps: Genetic maps, properties of marker used for creating genetic maps, Physical maps: STSs, ESTs Chromosome separation method, high resolution physical mapping approach, Automated sequencing, sequence annotation. Recent advances in molecular marker technique and genomics with special reference to tree.

UNIT VI

Micro arrays Application: gene expression, SNP detection, detection of environmental agents.

UNIT VII

Micro array design: cDNA micro array, oligonucleotide arrays. Micro array fabrication. Detectin technology. Computational analysis of micro array data.

Practical:

Estimation of DNA and RNA. Isolation of total nucleic acids from bacteria. Large-scale preparation of total plant DNA. Isolation of total RNA. Agarose gel electrophoresis. Denaturation of DNA. Ethidium fluorescent assay of nucleic acids. Estimation of C value. Binding of polyamines to DNA. Assay of DNA ploymerase. DNA sequencing. Isolation and quantification of plant DNA, PCR operation and gel electrophoresis, RAPD and ISSR, gene sequencing, sequence annotation.

Suggested Readings

Bajaj YPS. (ed.). 1988. *Biotechnology in Agriculture and Forestry*. Springer-Verlag.

Lewin B. 2008. *Gene IX*. Peterson Publications/ Panama.

Kumar S and Singh MP. 2008. *Plant Tissue Culture*. APH Pub.

Malacinski GM and Freifelder D. 1998. *Essentials of Molecular Biology*. 3rd ed. Jones & Bartlett Publishers.

Nelson DL and Cox MM. 2007. *Lehninger's Principles of Biochemistry*. W.H. Freeman & Co.

Primrose SB. 2001. *Molecular Biotechnology*. Panama.

Punia MS. 1998. *Plant Biotechnology and Molecular Biology*. Scientific Pub.

Singh BS and Singh MP. 2007. *Fundamental of Plant Biotechnology*. Sodesh Serial Publ.

Srivastava PS, Narula A and Srivastava S. (ed). 2004. *Plant Biotechnology and Molecular Markers*. Anamaya Pub.

Watson JD, Bakee TA, Bell SP, Gann A, Levine M and Losick R. 2008. *Molecular Biology of the Gene*.

8. TPB 508 PRINCIPLES &TECHNIQUESOF GENETIC ENGINEERING 2+1

Objective

To acquaint students about the concepts of enzymes, vectors and techniques involved in DNA transferred technology.

Theory

UNIT I

Recombinant DNA Technology: Major events, Genomic and DNA clones, Different methodologies and rationale of cloning gene.

UNIT II

The Tools of Genetic Engineering: Concept of restriction and modification, Restriction endo-nucleases, Modifying enzymes, Ligases, Host-vector system, – *E. coli* as a host.Different Kinds of vectors: Plasmids, phage vectors, M 13, cosmids, phagemids, YACS, BACS, PACS and expression vectors.

UNIT III

The Means of Genetic Engineering: Different strategies of cloning, Ligationstrategies, Genomic libraries, cDNA libraries, Gene tagging, Introduction to molecular market technology.

UNIT IV The product: Sub cloning, Nested deletions, Sequencing and sequence analysis, Site directed mutagenesis, Expression of cloned genes, Isolation and purification of the expressed product.

UNIT V

PCR Technology: Different types of PCR, Applications of PCR in cloning genes, promoters and flanking sequences. Utilizing PCR in the lab for preparation of probes, PCR on molecular marker technology.

UNIT VI

Cloning and Transformation in Prokaryotes, Vector preparations, Insert preparations, Legation.

UNIT VII

Transformation: Methods of direct transformation: PEG mediated, microinjection, particle bombardment, edlectoportation.

UNIT VIII

Method of indirect transformation: *Agrobacterium tumefaciens* and *A. rhizogenes*, Screening for recombinant clones, analysis of the recombinant DNA, Isolation of the recombinant plasmid, Restriction analysis, Excision of the insert, Restriction analysis of the excised insert, Sequence analysis of the insert, construction of Genomic and cDNA library, Gene isolation, Promoter analysis, Gene expression. Genetic engineering for insect/disease resistance, Genetic engineering for wood quality improvement, high biomass, adoption to harsh sites and for incorporating male sterility and rooting of tree cutting.

Practical:

Isolation of nucleic acids and their sequencing, Experiment with cloning vectors: pUC 18, pUC 19, pBR 322, phase etc. Extraction and purification of plasmid DNA restriction methylation and ligation reactions, preparation and transformation of competent E. coli. Agro-bacterium mediated genetic transformation, Antibiotic resistance, insertional inactivation. Estimation of proteins and enzymes involved in the defense mechanism-glucanase and chitinase activity, mRNA isolation after exposing the plant to stress

conditions. Evaluation of gene expression. Identification of recombinants.

Suggested Readings

Bajaj YPS. (ed.). 1988. *Biotechnology in Agriculture and Forestry*. Springer Verlag.
Becker JM, Coldwell GA and Zachgo EA. 2007. *Biotechnology – a Laboratory Course*. Academic Press.
Brown CM, Campbell I and Priest FG. 2005. *Introduction to Biotechnology* Panima Pub.
Dale JW and von Schantz M. 2002. *From Genes to Genomes: Concepts and Applications of DNA Technology*. John Wiley & Sons.
Gupta PK. 2004. *Biotechnology and Genomics*. Rastogi Publications.
Sambrook J, Fritsch T and Kumar S and Singh MP. 2008. *Plant Tissue Culture*. APH Pub.
Mandal AK and Gibson GL. (ed.). 1997. *Forest Genetics and Tree Breeding*. CBS.
Maniatis T. 2001. *Molecular Cloning – A Laboratory Manual*. 2nd ed. Cold Spring Harbour Laboratory Press.
Singh BD. 2007. *Biotechnology Expanding Horizons*. Kalyani Publishers.
Singh BS and Singh MP. 2007. *Fundamental of Plant Biotechnology*. Sodesh Serial Pub.
Srivastava PS, Narula A and Srivastava S. (ed.). 2004. *Plant Biotechnology and Molecular Markers*. Anamaya Pub.

9. TPB 509 TREE PHYSIOLOGY 2+1

Objective

To acquaint students about the concepts of physiology for understanding its use in increasing productivity of forest stands

Theory

UNIT I:

Introduction – Tree physiology – Growth – phases of growth – growth curve – factors affecting growth.

UNIT II

Plant cell as a structural and functional unit. Organization of cells and tissues – morphogenesis.

UNIT III

Structure of leaves, stem wood , bark and roots in trees. Functions and process in plant growth and development.

UNIT IV

Photosynthesis – structure of photosynthetic tissues and organs – enzyme, energetics and factors influencing photosynthesis. Photorespiration – its mechanisms and significance – factors affecting photorespiration.

UNIT V

Respiration – mechanisms – enzymes, energetics and factors influencing respiration. Respiratory quotient.

UNIT VI:

Water relations in plants – absorption – ascent of sap. Translocation of solutes – Phloem loading and phloem transport. Transpiration – Mechanisms and factors influencing – regulating transpiration – antitranspirants.

UNIT VII:

Mineral nutrition – Mineral salt absorption and translocation – deficiency and toxicity of mineral nutrients. Diagnosis of mineral deficiency.

UNIT VIII:

The enzymes – nomenclature and classification – structure and composition – Mode of action. Phytohormones – Auxins, GA, Cytokinins, ABA, Ethlynene. Biosynthesis and biochemical activity of . Plant hormones. Synthetic plant growth regulators. Growth retardants.

UNIT IX

Nitrogen metabolism. N_2 fixation – physical and biological . Nitrogen assimilation – Amino acid and protein synthesis.

UNIT X:

Fat metabolism. Carbohydrate metabolism.

Practical:

Preparation of growth curves of different tree seedlings Study of structure of leaves in leaves and stem wood. . Observing structure of plant cells and leaves in C3 and C4 species. Studying stomates in different tree species and working out stomatal frequency. Measurement of stomatal size in different tree species. Estimation of transpiration rates in different trees. Isolation and estimation of chlorophyll. Observing xylem vessel size variation in tree species. Estimation of plant water status by different methods. Nutrient deficiency symptoms in tree seedlings.

Suggested Reading:

Kramer, P.J. 1972. *Plant and Soil Water Relationships*. TMH Edition, Tata McGraw Hill Publ. Co., New Delhi.

Ksenzhek, O.S. and Volkov, A.G. 1998. *Plant Energetics*. Academic Press, New York.

Lack, A.J. and Evans, D.E. 2001. *Plant Biology- Instant Notes*. Vina Books Pvt. Ltd., New Delhi.

Larcher, W. 2003. *Physiological Plant Ecology*. 4th edn, Springer-Verlag, Germany

Luttge, U. 2008. *Physiological Ecology of Tropical Plants*. Springer-Verlag, Germany

Moore, T.C. 1989. *Biochemistry and Physiology of Plant Hormones. 2nd ed. Springer-Verlan, Berlin.*

Taiz, L. and Zeiger, E. 2007. *Plant Physiology* 4th ed. Sinauer Associates Inc. Publishers, Sunderland.

Wilkins, B.M. 1984. *Advanced Plant Physiology*. ELBS/ Longman Pub. Co.

TPB 591 MASTER'S SEMINAR **0+1**

TPB 599 MASTER'S RESEARCH **0+20**

DEPARTMENT OF WILDLIFE SCIENCES

Code	Course Title	Credits
WLS 501*	Fundamentals of Conservation Biology	2+1
WLS 502*	Advanced Wildlife Management	2+1
WLS 503*	Ecotourism - Concepts and Modern Approaches	2+1
WLS 504*	Economics of Ecotourism	2+1
WLS 505	Mammalogy and Indian Mammals	2+1
WLS 506	Ornithology and Indian Birds	2+1
WLS 507	Herpetology and Ichthyology	1+1
WLS 508	Wildlife Ecology	1+1
WLS 509	Quantitative Methods in Wildlife Management	2+1
WLS 510	Invertebrate Biodiversity	2+1
WLS 511	Wetland Ecology and Management	1+1
WLS 512	Principles and Practice of *Ex Situ* Conservation	1+1
WLS 513	Ethno Biology and Tribal Welfare	1+1
WLS 514	Ecosystems of the World	2+0
WLS 515	Ecotourism in Protected Areas	2+0
WLS 516	Ecotourism and Landscaping	2+1
WLS 517	Design and Management of Ecotourism	2+1
WLS 518	Environmental Impact Assessment of Protected Areas	2+1
WLS 519**	Remote Sensing and Geographic Information System	1+1
WLS 591	Master's Seminar	0+1
WLS 599	Master's Research	0+20

*Compulsory courses; ** Supporting course for MSc (Forestry) programmes in all disciplines.

The advisory committee at its discretion may decide on additional courses from other departments of the college as "major courses" depending on the research needs of the student concerned and the availability of such courses.

1. WLS 501 FUNDAMENTALS OF CONSERVATION BIOLOGY 2+1

Objective:
To provide knowledge about the various aspects of Conservation Biology such as biological diversity, design of protected areas network etc

Theory

UNIT I

Introduction to Conservation Biology, Conservation of biodiversity, Patterns and processes; concepts of biodiversity, levels of biodiversity, patterns of losses.

UNIT II

Conservation Genetics, Management and conservation of genetic variation in natural populations. Ex-situ conservation. Demographic issues, Population viability analysis, ecological restoration,

UNIT III

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:
Seminar based discussion and paper analysis. Calculations of degree of inbreeding, MVP sizes, PHVA, etc. Evaluation of existing protected areas from the point of view of principles of conservation biology.

Suggested reading

Primack, R.B. 1993. *Essentials of Conservation Biology*. Soiner, MA.
Piank, E.R. 1981. Competition and niche theory. In *Theoretical Ecology*. May (ed).
Pielou, E.C. 1975. *Ecological Diversity*. Wiley Interscience Pub.
Hunterer, M.L. 1996. *Fundamentals of Conservation Biology*. Blackwell

2. WLS 502 ADVANCED WILDLIFE MANAGEMENT 2+1

Objective:
To acquaint about the wildlife management aspects

Theory

UNIT I

History of wildlife management and conservation in India, Zoogeographic regions of the world, major biomes of the world, biogeographic zones of India.

UNIT II

IUCN revised red list categories, Red Data Book and red listing, Wildlife census, radio telemetry in wildlife studies. Captive wildlife: Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife (Protection) Act, 1972.

UNIT III

Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Captive breeding and reintroduction of threatened species. MAB, CITES, TRAFFIC. Protected area network of India, wildlife sanctuaries, national parks, biosphere reserves, world heritage sites, ramsar sites etc

Practical:
Exercise on the census methods, use of soft ware for analysis of census data. Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife.

Suggested readings

Berwick, S.H. and Saharia, V.B. 1995. *Wildlife Research and Management*. OUP, New Delhi.481pp.

Dasmann, R.F. 1982. *Wildlife Biology*.
Rajesh, G. *Fundamentals of Wildlife Management*, Justice Home, Allahabad.
Reena Mathur. 1985. *Animal Behaviour*. OUP
Sawarkar B. *Wildlife Management*. WII.
Sukumar, R. *Asian Elephant. Ecology and Management*. OUP Cambridge.
Wildlife Institute of India 2004. *Compendium on the notes on the course Captive management of Endangered Species*. WII. 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

3. WLS 503 ECOTOURISM - CONCEPT AND MODERN APPROACHES 2+1

Objective

To acquaint about the impact of tourism on ecology.

Theory

UNIT I

Eco tourism - study history of tourism, identify various forms of tourism and evolution of ecotourism. Dimensions of tourism and essential conditions for tourism to occur. Differences between tourism components. Mass tourism versus ecotourism.

UNIT II

Understand dimensions of ecotourism and the criteria to qualify for ecotourism. Quebec declaration. Different forms of ecotourism like hard and soft ecotourism. Ecotourism indicators and conceptual differences between developing and developed countries.

UNIT III

Organized tours and Free Independent Travelers. World Tourism Organization. Problems with definition of ecotourism and criticisms.

UNIT IV

International organizations and NGOs promoting ecotourism. Sociological implications of eco-tourism.

Practical:

Students should make detailed reference on the various forms of Ecotourism in the World. Visit to various ecotourism areas and identify the tourism components- suggest modifications. Exercises on the blending of local cultural and sociological heritage with the various forms of ecotourism. Debate on the concept to reach the most viable. Once they agree on a concept, then the debate. Problems on common property resources and facilitate group discussion for recommendations. Discuss the merits and demerits of the recommendations. Evaluation and monitoring of the various ecotourism activities of the region such as Nature Walk - The guided day trek, The Tiger Trail, Border Hiking, Bamboo Rafting, Jungle Patrol, Tribal Heritage, Jungle Inn, The Soared groves, Bamboo Grove, Green Mansions, 45 the backwater cruise. Identify an area where ecotourism in vogue- Identity the various ecosystem activities in the selected area, evaluate in terms of economic feasibility, ecological adaptability and social acceptance. Climate change and its influence on carbon economy. Study the carrying capacity and impact of ecotourism activity on the ecosystem, suggest recommendation to overcome the ill effects of ecotourism.

Suggested Readings

Baker CP. 1996. *World Travel: A Guide to International Eco Journeys*. Warner Books.
Honey M. 1998. *Ecotourism and Sustainable Development*. Iceland Press.

Luck M and Kirstges T. 2002. *Global Ecotourism Policies and Case Studies*. Channel View Publ.
Neale G. 1999. *Green Travel Guide*. Earthscan.

4. WLS 504 ECONOMICS OF ECOTOURISM 2+1

Objective
To develop understanding about impact of ecotourism on local economics.
Theory
UNIT I
Ecotourism as a business opportunity- market demand for ecotourism - analysis of ecosystem market demand in India- marketing issues- Investment of international agencies like World Bank in ecotourism projects.
UNIT II
Ecotourism economics at macro and micro economic level in developing countries. Ecotourism as a green business and role of green consumerism. Business plans. Identifying unique selling points for marketing. Potential of internet in marketing ecotourism. Economic valuation of ecotourism sites (based on methods like travel cost method).
UNIT III
Environmental Impact Assessment. Payments for Environmental services and role of ecotourism. Multiplier effects, opportunity costs and leakage in ecotourism industry. Sharing ecotourism revenues among stakeholders
UNIT IV
Training in ecotourism to deliver quality service- Practical exercise on the economic inflow-out flow in the selection ecotourism area- impact on the economic well being of the local population.
UNIT V
Potential of eco-tourism in the sustainable management of local livelihood. Impact of eco-tourism on the income of local inhabitants. Feasibility plans for effective eco-tourism. Eco-tourism based capacity building.
Practical:
Economic analysis of tourism components- case study of some important ecotourism destinations- analysis of primary and secondary beneficiaries report preparation. Exercises on feasibility studies, environmental impact assessment and economic valuation of natural resources need to be included
Suggested Readings
Baker CP. 1996. *World Travel: A Guide to International Eco Journeys*. Warner Books.
Honey M. 1998. *Ecotourism and Sustainable Development*. Iceland Press. 48
Luck M and Kirstges T. 2002. *Global Ecotourism Policies and Case Studies*. Channel View Pub.
Neale G. 1999. *Green Travel Guide*. Earthscan.

5. WLS 505 MAMMALOGY AND INDIAN MAMMALS 2+1

Objective:
To acquaint about the Indian mammals, their biology, ecology, behaviour and conservation issues
Theory
UNIT I

Evolution of mammals, early radiation and classifications up to orders. Classification of Mammals of the world, with particular emphasis on the Indian mammals.

UNIT II

Biology, ecology and behaviour of Indian mammals, Proboscidean, Sirennias, Insectivora Scandentia, Chiroptera, Primates, Carnivora, Cetaceae, Sirenia, Proboscidea, Perissodactyla, Artiodactyla, Pholidota, Rodentia and Lagomorpha

Practical:

Comparative studies of dentition; comparative studies of skull; zoogeography of mammals of Indian sub-continent; Distribution of primates, carnivores, elephants, ungulates and small mammals.

Suggested readings

Gee, E.P. 2000. *The wildlife of India*. Harper Collins Publication.

Johnsingh, A.J.T. (ed.). 2009. *The Mammals of South Asia: Ecology, Behaviour and Conservation*. Permanent Black.

Kapoor ,V.C. 1983. *Theory and Practice of Animal Taxonomy*. Oxford University Press.

Nameer, P.O. 2000. *Checklist of Indian mammals*. Kerala Forest Department. 90p.

Prater, S.H. 1971. *The Book of Indian Animals*. Oxford University press, Bombay.

Vivek Menon. 2003. *Field Guide to Indian Mammals*. Penguin Books, India.

6. WLS 506 ORNITHOLOGY AND INDIAN BIRDS 2+1

Objective:

To acquaint about the Indian birds, their biology, ecology, behaviour and conservation issues

Theory

UNIT I

Origin and radiation of birds, taxonomy, classification of birds - Indian birds with special reference to the birds of Western Ghats – 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. Birds and man. Bird watching, general natural history, biogeographic patterns in Indian avifauna and their affinities, bird migration, avian community ecology and habitat selection

UNIT II

Birds census techniques, conservation of birds habitats, avian extinctions past and present. Bird conservation and management in India. Important Bird areas of India and Kerala, Red Data Book birds of India with particular reference to Western Ghats, Wetland conservation, Ramsar sites of India and Kerala.

Practicals:

Examination and drawing of museum materials: skins, skulls, feet, eggs and nests of characteristic species. Birds skin preparation. Field identification of major birds of Kerala. 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 readings

Ali, S. and Ripley, D.S. 1987. *A compact Handbook of Birds of Indian subcontinent*. OUP, Bombay.

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

Wallace, J.G.1975. *An Introduction to Ornithology*. Macmillan Publishing Co. New York.
Grimmet R, Inskipp C and Inskipp T. 1999. *Handbook of birds of Indian subcontinent*.
Grimmet R, Inskipp C and Nameer PO. 2006. *Birds of Southern India*. BNHS publication.
Krys Kazmierczak. 2000. A *field guide to the Birds of India, Sri Lanka, Nepal, Pakistan, Bhutan, Bangladesh and Maldives*.

7. WLS 507 HERPETOLOGY AND ICHTHYOLOGY 1+1

Objective:
To acquaint about the Indian herpetofauna and ithiofauna, their biology, ecology, behaviour and conservation issues

Theory

UNIT I

Systematics and zoogeography of amphibians and reptiles: 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 eco-physiological adaptations. Role of temperature in sex determination in reptiles. An overview of conservation problems and issues of herpetofauna of Indian sub-continent. Methods for herpetofaunal ecological studies.

UNIT II

Systematics and Ichthyogeography of India. Ecology of fish: fresh, brackish and marine water fish and their adaptations. Threats to fish biodiversity: global as well as in India. Threatened fishes of India. Conservation status of fish fauna in India. Methods for fish ecological studies.

Practical:
Collection methods and equipment. Preservation and storage. Study and identification. Exercises on ecological field techniques, pitfall traps,

Suggested readings

Daniel JC. 1980. *Book of Indian reptiles*. OUP
Indraneil Das. 1987. *Turtles and Tortoises of India*, OUP
Ranjit Daniels. *Freshwater Fishes of Peninsular India*. Indian Academy of Sciences
Whitaker R and Ashok Captain. 2004. *Snakes of India: The Field Guide*. Draco Books, Chennai.

8. WLS 508 WILDLIFE ECOLOGY 1+1

Objective
To provide knowledge about the ecological aspects of wild animals, which in turn help the conservation of wild animals

Theory

UNIT I

Demographic and life history parameters, evolution of life history parameters: r & K selection, allometry, aging and sexing, life tables, methods of estimation of life history parameters, population dynamics: exponential, logistic and other forms of growth of population, density dependent and independent growth, population ecology of plants, population simulation, predator-prey systems, carrying capacity, population estimation

methods: relative, absolute measures and age/sex composition. Preparation of sampling designs for population estimation.

UNIT II

Community Ecology - Definitions and nature of communities - Energy & materials flux through communities; Productivity; Intra and inter-specific competition and mutualism; Community structure, organization and stability (guilds, resource partitioning, niche, competitive exclusion); measures of diversity and richness.

Practicals:

Seminars and discussion of relevant published literature; Simulation (stochastic and deterministic) modeling of populations. Calculations of energy and productivity. Analysis of species diversity.

Suggested reading

Berry RJ and Hallen A. 1989. *Animal Evolution*, William Colliasn & Soni.

Grover SP and Gupta. SK.1998, *An introduction to Animal Behaviour*. Bishansingh Mandra Pal Singh

John A Cock. 1985. *Animal Behavior an Evolutionary Approach.* Sinavier Associates. Massachusetts.

Reena Mathur 2000. *Animal Behavior*. Rastogi Publication

Slater. RJB.1984. *An introduction to Ethology*. Cambridge University press.

Stanley H. Anderson. 1990. *Managing our Wildlife resource*. Prentice Hall. New Jersey.

Elton C.S.1927. *Animal ecology,* Sidgwick and Jackson, London.

9. WLS 509 QUANTITATIVE METHODS IN WILDLIFE MANAGEMENT 2+1

Objective

To provide knowledge about the quantitative methods in wildlife studies

Theory

UNIT I

Introduction to wildlife population estimation - direct methods - total count, block count, registration count, drive count, road-side count, water hole count, fixed-point count, capture - recapture method, aerial count and line transect method. Wildlife population estimation - indirect methods, dung count for elephants and gaur, pugmark method for larger cats and pellet count for other animals. Conservation assessment Management Plans, Concepts of Minimum Viable Population, Population Habitat Viability analysis, Habitat Suitability Index, Vortex etc. Population and habitat modeling prediction as a tool in wildlife management.

UNIT II

Hypothesis testing analysis of variance. Regression and correlation. Non parametric procedures. Measuring wildlife habitats: Availability, quality, palatability of graze and browse. Utilization of habitats by wild animals. Cover classification and mapping, Inventory of unique habitats and their distribution, e.g. coasts, mangroves and coral reef ecosystems, estuaries, mud, sand and rocky shores. Animals signs as indicators of use patterns: Use of map overlay approach in evaluation. Monitoring changes in vegetation and the relative abundance of animals. Use of photographic records for habitat monitoring. Use and availability of habitat resources. Development of predictive models. Introduction to multivariate assessment of wildlife habitat.

Practical:

Exercise on the census methods - direct method - total count, block count, water hole count, capture - recapture method, point transect, and line transect method, indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for

other ungulates, – use of different software for analysis - pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife. Comparison of several techniques for quantitative habitat survey and mapping. Evaluating habitat availability and utilization.

Suggested reading

Berwick, S.H. and Saharia, V.B. 1995. *Wildlife Research and Management*. OUP, New Delhi. 481p.

Rajesh, G. 1989. *Fundamentals of Wildlife Management*. Justice Home, Allahabad.

Karanth U and Nichols J. 2002. *Monitoring Tigers and their Prey: A Manual for Researchers, Managers and Conservationists in Tropical Asia*. WCS

10. WLS 510 INVERTEBRATE BIODIVERSITY 2+1

Objective

To provide knowledge about the invertebrate biodiversity and their conservation

Theory

UNIT I

Introduction - Definition and importance of biodiversity, biosafety and bioethics, Intellectual Property Rights. Systematics and detailed study of invertebrate groups relevant to forestry (annelida, acarina, araneae, arthropoda) - importance of tropics and invertebrate diversity - values of invertebrate diversity - scientific, recreational, ecological. diversity of invertebrates in the forest floor - predator dynamics in the litter ecosystem- attitudinal diversity of invertebrates- species diversity and population sizes of important forest insect groups- insect seasonality in different habitats- influence of ecological factors in distribution of insects - threats to invertebrate diversity - effect of shifting cultivation, deforestation, fire, land use patterns- use of pesticides and toxins, protected areas and conservation of insects.

UNIT II

Ecosystem functioning - insects as pollinators, biological indicators - insect bird relationship - insect diversity and vegetation inter-links. Role of soil invertebrates in nutrient cycling, soil processes etc. Ecological importance of butterflies in forests, invertebrate conservation.

Practical:

Survey and identification of invertebrate fauna from forest areas. Rearing of invertebrate. Methods of isolating soil invertebrate macro and micro fauna.

Suggested reading

Lee KE. 1985. *Earthworm ecology and relationship with land use*. Academic press.

Veeresh UK, et al. 1991. *Advances in Management and Conservation of Soil fauna*. OUP

Veeresh UK and Raj Gopal. 1992. *Applied Soil biology and ecology*. OUP

Magurran AE. 1991. *Ecological diversity and its measurements*. Croom-Helm Ltd.

11. WLS 511 WETLAND ECOLOGY AND MANAGEMENT 1+1

Objective:

To acquaint with the importance of wetlands, its conservation and management

Theory

UNIT I:

Definition and classification - Wetland functions and values - Physical - aesthetic and biological values of fish, herpetofauna and waterfowl - Natural process and anthropogenic values - The classification and distribution of wetlands of India – a review

of physical and biological components of India's coastline. Mangroves, estuaries, mud, sand and rocky shores - coral and offshore waters - Coastal resources and conservation - Coastal erosion, pollution, mangrove exploitation and over-fishing.

UNIT II

Introduction to key issues of freshwater ecology and limnology - Conservation issues of Indian wetlands including detailed studies. Wetland Management Plan Preparation - Methods in wetland management - General principles - Management of migratory and resident waterfowl - Management of fishery resource. Management of other wetland dependent vertebrates such as amphibians, reptiles and mammals - management of ecotourism - Siltation and its control in wetlands. Pollution and its control - management of aquatic weeds - law and policy for wetland management.

Practical:

Visit to different types of wetlands such as estuaries, mangroves, inland water bodies, freshwater and brackish water lake, studies on wetland fauna. Study techniques on wetland ecology

Suggested readings

WWF. 1995. *Handbook of Wetland Management*. WWF, India

Whigham PF. 1989. *Wetland Ecology and Management*. Kan.

Raff W T. 1991. *Wetland indicators: A Guide to Wetland Identification and Mapping*

12. WLS 512 PRINCIPLES AND PRACTICES OF *ex situ* CONSERVATION 1+1

Objective

To provide knowledge on the significance of ex situ conservation, its principles and practices

Theory

UNIT I

Evolution of zoological gardens, purpose of zoo, types of zoos, administrative structure, collection plan, different types of animal exhibits/enclosures – moated enclosures, exhibit design process, behavioural and environmental enrichment, mixed species exhibits.

UNIT II:

Animal capture and management, animal transportation, genetic management, zoo animal nutrition, invertebrates in captivity, animal record keeping, stud book, quarantine measures to be taken during the procurement of new animals to zoos, National Zoo policy, Central Zoo Authority; rules and regulations, Captive breeding and reintroduction protocols and procedures of animals; Management of zoological gardens.

Practical:

Visit to zoological gardens, exercise on enclosure design, schedule of feeding; cleaning and other management practices; documentation; identification of individual animals and different types of marking.

Suggested readings

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

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

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

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

13. WLS 513 ETHNOBIOLOGY AND TRIBAL WELFARE 1+1

Objective

To acquaint with tribals of Indian with particular emphasis on the tribals of Western Ghats, their problems and welfare issues

Theory

UNIT I:

Ethnobiology - definition, Ethno botany, Ethno zoology, definition of tribe, main features. General economic, political and social structure, Racial classification, concepts of race, family, class, heirship, Principles of social grouping and social control. Cultural traditions, customs, ethos, beliefs and practices. Important tribes of India. Important tribes of Kerala. Tribal economy, features, occupational characteristics, interdependence with forests, role of NWFP in the life of tribes. Tribes and Forest policies - Rights and concessions and fall out. Constitutional safeguards for the welfare of tribes. Problems faced by tribes of India - Indebtedness and land alienation. Role of tribes in Forest and PA management. Tribal development schemes and problems in implementation. Legal provisions to safeguard tribal interests. Ethnic conflicts between tribes and non tribes. Voluntary organizations and tribal development.

UNIT II

Tribal research - priorities and back drop. The continuity and changes in culture of tribe future of tribal society. Tribals and JFM, Indigenous knowledge and tribal development, Ethno medicinal practices and traditional wisdom, Bio piracy of medicinal plants, Bio imperialism and bio prospecting. Tribal development and five year plans. Commercial forestry and indigenous people. Shifting cultivation and tribes. Tribes and forest development works, Eco development through tribal development - Case study of Periyar Tiger Reserve. Human rights and tribes.

Practical:

Visit to different tribal colonies to understand problems faced by them, Conduct surveys to evaluate the life standards. Visit to different development organizations and NGO's implementing tribal welfare schemes and study about research aspects of Indian tribes. Visit Vana Samrakshana Samiti (VSS) of tribes and understand their role in forest management.

Suggested readings

Maheshwari K. 1998. *Ethnobotany in S Asia*. Scientific publishers

Pushpangathan et al. 1997. *Conservation and Ecological Economics of biodiversity*. Longman.

Ramprasad Sangupta. 2001. *Ecology and Economics*. OUP

14. WLS 514 ECOSYSTEMS OF THE WORLD 2+0

Objective

To impart knowledge about ecosystem dynamics especially of tourist spots.

Theory

UNIT I

Major ecosystems of the world - definitions of a typical ecosystems concepts and approaches of Odum -Arctic tundra eco system, northern and southern hemisphere ecosystems, coniferous forests, temperate ecosystems, savanna –grass land, tropical rain forests, deciduous forest ecosystems, coastal systems mangroves etc, important features, faunal and floral populations.

UNIT II

Adaptations and modifications threat to ecosystems-conservation and preservation-new approaches.

UNIT III

Influence of anthropogenic factors on the adaptation of different ecosystems.

UNIT IV

Studies on localized niches of potential tourist spots.

Suggested Readings

Baker CP. 1996. *World Travel: A Guide to International Eco Journeys*. Warner Books.
Honey M. 1998. *Ecotourism and Sustainable Development*. Iceland Press.
Luck M & Kirstges T. 2002. *Global Ecotourism Policies and Case Studies*. Channel View Publ.
Neale G. 1999. *Green Travel Guide*. Earthscan.

15. WLS 515 ECOTOURISM IN PROTECTED AREAS 2+0

Objective

To develop understanding of students about ecology of tourist spots in protected area.

Theory

UNIT I

Protected areas in India - Ecotourism- a worldwide view. Ecotourism in Indian context. 46

UNIT II

Planning ecotourism in protected areas. Visitor management in ecotourism areas – zoning, carrying capacity. Participation of local people in ecotourism. Conflicts in PAs. Ecotourism for sustainable development of PAs.

UNIT III

New directions in ecotourism industry. Ecotourism in practice in important PA's of India – case studies of Periyar Tiger Reserve, Keoladeo National Park, Kanha National Park and Jim Corbet National Park, Project Tiger Research, Betla and Sunderbans Tiger Reserve. Limitations and problems of ecotourism.

UNIT IV

Ecotourism as a way for sustainable management of natural resources. Local livelihoods and eco-tourism like nomadic grazing, agropasturalism.

Practical:

Visits to surrounding ecotourism destinations- prepare ecotourism activity maps- Preparation of route maps to important National parks and sanctuaries of India. Preparation of information procedure about forest tourist spots in India. Exercises on the preparation of location-specific model eco-tourism plans.

Suggested Readings

Baker CP. 1996. *World Travel: A Guide to International Eco Journeys*. Warner Books.
Honey M. 1998. *Ecotourism and Sustainable Development*. Iceland Press.
Luck M & Kirstges T. 2002. *Global Ecotourism Policies and Case Studies*. Channel View Pub.
Neale G. 1999. *Green Travel Guide*. Earthscan.

16. WLS 516 ECOTOURISM AND LANDSCAPING 2+1

Objective

To impart understanding about developing and protecting landscapes of ecotourist spots.

Theory

UNIT I

Introduction - definition and historical background - Components and elements in landscaping - Principles of landscaping - landscape architecture for ecotourism- Landscape ecology with special reference to ecotourism.

UNIT II

Walkways ropeways- turfs, topiaries, live hedges-pergolas, carpets, lawn etc. Urban ecotourism -importance -history of urban planting in India - Planning and planting programmes for institution and industrial complexes

UNIT III

Importance of arboriculture in ecotourism. Landscaping- Management of trees - planning of roads, bridges, parking area.

UNIT IV

Planting methods - balanced lines - unbalanced line and sporadic system – formal and informal planting methods. 47

Practical:

Preparation, planning and designing of recreation parks, thematic parks, practice on topiary, arboriculture, preparation of planting pattern for avenue planting, national highways and village roads.

Suggested Readings

Baker CP. 1996. *World Travel: A Guide to International Eco-Journeys*. Warner Books.

Honey M. 1998. *Ecotourism and Sustainable Development*. Iceland Press.

Luck M and Kirstges T. 2002. *Global Ecotourism Policies and Case Studies*. Channel View Pub.

Neale G. 1999. *Green Travel Guide*. Earthscan.

17. WLS 517 DESIGN AND MANAGEMENT OF ECOTOURISM 2+1

Objective

To impart knowledge regarding regulating ecotourism within sustainable limits.

Theory

UNIT I

Ecotourism plans and management of visitors and other resources including human and natural resources. Types of eco-tourists - commercial ecotourist – nature tour operators - Quality control, codes of conduct etc. Use of GIS and ICT for effectively managing and planning ecotourism.

UNIT II

Criteria and indicators for sustainable management and monitoring. Charter for Sustainable Tourism. Sustainability issues in ecotourism management and ecotourism certification

UNIT III

Role of socioeconomic factors in decision making. Designing ecotourism products using local technologies. Carrying capacity considerations. Use of GIS in ecotourism design- Existing ecotourism markets and ecotourism market segmentation.

UNIT IV

Paradigm shifts possible due to climate change and its potential influence of carbon economy on existing ecotourism markets. Role of local institutes and other grass-root agencies in the design and managerial of specific ecotourism plans.

UNIT V

The genders dimensions of designing and management of eco-tourism and management of eco-tourism.

Practical:
Mapping of major ecotourism destinations with GIS intervention- Identify one area of ecotourism potential – assess the carrying capacity- design suitable ecotourism activities

Suggested Readings

Baker CP. 1996. *World Travel: A Guide to International Eco Journeys*. Warner Books.
Honey M. 1998. *Ecotourism and Sustainable Development*. Iceland Press.
Luck M & Kirstges T. 2002. *Global Ecotourism Policies and Case Studies*. Channel View Publ.
Neale G. 1999. *Green Travel Guide*. Earthscan.

18. WLS 518 ENVIRONMENTAL IMPACT ASSESSMENT OF PROTECTED AREAS 2+1

Objective
To train the students in planning and evaluation projects.

Theory
UNIT I
Introduction; Principles and purposes of IEE and EIA and its significance for the society, Cost and benefits of EIA; EIA involvement during project life cycle.
UNIT II
EIA management; principles & management of EIA, main stages in EIA processes; screening, scooping, prediction, mitigation and alternatives auditing.
UNIT III
EIA techniques, checklists, matrices, network method, remote sensing and GIS. Public consultation and participation in EIA process. EIA guidelines and review process. EIS formulation. New approaches to EIA and SEA (strategic environmental assessment).

Practical
Preparation of EIA & SEA reports.

Suggested Readings

Anonymous 2006. *Report of the National Forest Commission*. Govt. of India, New Delhi.
Claussen E, Cochran VA and Davis DP. 2001. *Climate Change: Science, Strategies and Solutions*. Pew Centre on Global Climate Change, USA.
Committee on Abrupt Climate Change. 2002. *Abrupt Climate Change: Inevitable Surprises*. National Research Council, Ocean Studies Board, National Academics Press, Washington.
Huxley P. 1999. *Tropical Agroforestry*. Blackwell Science.
Koskela J, Buck A and Teissier du Cros E. 2007. *Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe*. Biodiversity International, Rome, Italy.

19. WLS 519 REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM 1+1

Objective
To acquaint with the use of imageries, GIS and simulation in forest survey and management.

Theory
UNIT I

The use of aerial photography, satellite imagery and geographic information system for the collection, storage and spatial analysis for georeferenced forest resources data and information.

UNIT II

The integration of spatial data analysis systems with knowledge-based systems and/or simulation systems for the development of information/decision support systems for forest management; satellite systems; satellite imageries – techniques, uses and limitation;

UNIT III

Future prospects of remote sensing in India; software used in remote sensing; GIS versus remote sensing; GIS Software used in forestry and environments; Analysis of data; Application of GIS in forestry.

Practical

Uses of various photogrammetry instruments, recognition and identification of objects on photography, compilation of maps and their interpretation, Hands on practice on remote sensing and GIS, software.

Suggested Readings

Burrough PA. 1990. *Principles of GIS for Land Resources Assessment*. Oxford & IBH.

Lillsand TM. 1989. *Remote Sensing and Image Interpretation*. John Wiley.

Narayanan LRA. 1999. *Remote Sensing and its Application*. Universities Press (India) /Orient Longman.

Sharma NK. 1986. *Remote Sensing and Forest Survey*. International Book Distributors.

WLS 591 MASTER'S SEMINAR **0+1**

WLS 599 MASTERS RESEARCH **0+20**

SUPPORTING COURSES FOR MSc (FORESTRY) PROGRAMME

Code	Course Title	Credits
STAT 512*	Experimental Designs	2+1
WLS 519	Remote Sensing and Geographic Information Systems	1+1

*Offered by Department of Agricultural Statistics

NON-CREDIT COMPULSORY COURSES

Five courses (PGS 501-PGS 505) are of general nature and are compulsory for Master's programme. PhD students may be exempted from these courses if already studied during Master's degree. For course catalogue please refer the course curricula and syllabi for postgraduate programmes in agricultural sciences.

Code	Course Title	Credits
PGS 501	Research Methodology	1+1
PGS 502 (e-Course)	Intellectual Property Rights and its Management in Agriculture	1+0
PGS 503	Basic Concepts in Laboratory Techniques	0+1
PGS 504 (e-Course)	Agricultural Research, Ethics and Rural Development Programmes	1+0
PGS 505 (e-Course)	Disaster Management	1+0