

**Dr. B.R. Ambedkar University,
Agra**



**Revised M.Sc. Forestry Syllabus
(Choice Based Credit System Based)**

**Department of Forestry
School of Life Sciences,
Khandari Campus,
Agra**

(Session 2021-22)

**Department of Forestry, School of Life Sciences,
Dr. B.R. Ambedkar University, Khandari Campus, Agra**

M.Sc. Forestry Syllabus (Choice Based Credit System Based)

I Semester

Core courses

- FOR 629101: **SILVICULTURE & PLANTATION TECHNOLOGY**
FOR 629102: **FOREST ECOLOGY , BIODIVERSITY CONSERVATION & ENVIRONMENT
MANAGEMENT**
FOR 629103: **WILD LIFE CONSERVATION & MANAGEMENT**
FOR629104 : **TUTORIALS/ SEMINAR/ ASSIGNMENTS/FIELD VISIT**
FOR629105: **PRACTICALS BASED ON CORE COURSES**
FOR629106: **Soft core: ECO-TOURISM**

II Semester

Core courses

- FOR 629201: **FOREST PROTECTION, PEOPLE AND FORESTS, POLICY ,LAWS &
INTERNATIONAL CONVENTIONS,**
FOR 629202: **FOREST RESOURCE MANAGEMENT AND ECONOMICS**
FOR 629203: **FOREST BIOMETRY , REMOTE SENSING AND GEOGRAPHIC INFORMATION
SYSTEM**
FOR629204 : **TUTORIALS/ SEMINAR/ ASSIGNMENTS/FIELD VISIT**
FOR629205: **PRACTICALS BASED ON CORE COURSES**
FOR629206: **Open elective: REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM**

III Semester

Core courses

- FOR 629301: **WOOD SCIENCE AND TECHNOLOGY, FOREST PRODUCTS – CHEMISTRY AND
INDUSTRIES**
FOR 629302: **FOREST BIOTECHNOLOGY , GENETIC RESOURCES & TREE IMPROVEMENT**
FOR 629303: **FOREST MANAGEMENT & SUSTAINABLE DEVELOPMENT**

FOR629304 : **TUTORIALS/ SEMINAR/ ASSIGNMENTS/FIELD VISIT**
FOR629305: **PRACTICALS BASED ON CORE COURSES**
FOR629306: **Soft core: MEDICINAL AND AROMATIC PLANTS**

IV Semester

Core courses

- FOR 629401: **AGRO-FORESTRY , CROPPING SYSTEM, PASTURE & FODDER DEVELOPMENT**

FOR 629402: **GENERAL SOIL SCIENCE, SOIL & WATER CONSERVATION, WATERSHED
MANAGEMENT & HYDROLOGY**
FOR 629403: **GENERAL STATISTICAL METHODS ,RESEARCH METHODOLOGY &
COMPUTER APPLICATIONS**
FOR629404 : **TUTORIALS/ SEMINAR/ ASSIGNMENTS/FIELD VISIT**
FOR629405: **PRACTICALS BASED ON CORE COURSES**
FOR629406: **Open elective: NGO MANAGEMENT**

Note:

1. Total number of credits in M.Sc. (Forestry) is 80 and 4 extra credits for each soft core / open elective.
2. Open elective course (interfaculty) and soft core (within faculty).
3. There shall be three periodical tests from each course of which marks of two best tests will be taken in consideration as C_1 and C_2 in each semester.

FIRST SEMESTER

Core course-FOR 629101

SILVICULTURE& PLANTATION TECHNOLOGY

UNIT: I

Silviculture: Definition, history, objectives and scope, status of forest cover in India. Major forest types of India –forest composition and structure. Locality factors influencing forest growth and distribution in India. Need for forest conservation.

UNIT: II

Regeneration: Natural regeneration: definition. Advantages and disadvantages of natural regeneration. Techniques of obtaining natural regeneration. Artificial regeneration: definition and objectives, steps involved in artificial regeneration. General nursery techniques Silvicultural Practice: Thinning- ground thinning, silvicultural thinning, cleaning, pruning, girdling etc.

Silvicultural systems: Definition and types of silvicultural systems - clear-felling systems, shelter wood systems, selection systems, Indian Irregular shelter wood system, Accessory systems and Coppice systems. Conversion: objectives, scope and methods.

UNIT: III

Silvics of important tree species. Distribution, morphology, phenology, growth behavior, silviculture characters, nursery techniques, silvicultural system of management, protection and utilization of the following tree species:

Cedrus deodara, *Pinus kesiya*, *Gmelina arborea*, *Shorea robusta*, *Tectona grandis*, *Artocarpus heterophyllus*, *Emblica officinalis*, *Dalbergia sissoo*, *Acacia spp.*, *Albizia spp.*, *Lagerstroemia spp.*, Bamboo species.

UNIT: IV

Role of plantation forestry in meeting the wood demand – Plantation forestry in India and abroad, Purpose of plantation, Factors determining scale and rate of plantation, Land suitability and choice of plantation species.

Production technology for quality planting stock, preliminary site preparation for establishing plantation, Planting programme, time of planting, planting pattern, spacing, planting method. 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, Protective Afforestation, afforestation of inhospitable sites, Ecological factors and long term productivity, Sustainable yield from plantation. Case studies -Wasteland plantation, Industrial Plantation.

Practicals:

1. Identification of some important tree species and their utility Index.
2. Phenological study of some important tree species.
3. Regeneration survey of mixed and pure forests
4. Identification on different types of coppices in the forest.
5. Visit to different sites to study silvicultural operations undertaken as part of forest management.
6. Analysis of plantation problems in Asia and India
7. Preparation of plantation calendar
8. Preliminary arrangement for a plantation programme.
9. Planting geometry and calculation of planting stock
10. Study of different cultural operations and site preparation for plantation
11. Studies on wood based industries Problems and prospects
12. Management of Eucalyptus, Casuarina, Teak, Sal, Poplar, Acacias and Bamboo plantations

13. Production technology for energy plantations
14. Economics of pulpwood, timber and energy plantations

Suggested reading:

1. Champion, H.G. and Seth, S.K. 1968. *The revised survey of the forest types of India*. Manager of Publication, Govt. of India, Delhi.
2. Dwivedi, A.P. *A text book of Silviculture*. International Book Distributor, Dehra Dun.
3. Khanna, L. 1985. *Principal and practice of Silviculture*. International Book Distributor, Dehra Dun.
4. Negi, S.S. 1985. *General Silviculture*, Natraj Publication, Dehra Dun
5. Prakesh, R. and Khanna, L. S. 1979. *Theory and Practice of Silvicultural Systems*. International Book Distributor, Dehra Dun.
6. Evans J. 1982. *Plantation Forestry in the Tropics*. Clarendon Press, Oxford. 39
7. Kumar V. 1999. *Nursery and Plantation Practices in Forestry*. Scientific Publ.
8. Luna RK. 1989. *Plantation Forestry in India*. International Book Distributors.
9. Ram Prakash, Chaudhari DC & Negi SS. 1998. *Plantation and Nursery*
10. *Techniques of Forest Trees*. International Book Distributors.

FIRST SEMESTER
Core course-FOR629102
FOREST ECOLOGY , BIODIVERSITY CONSERVATION & ENVIRONMENT
MANAGEMENT

UNIT I

Forest ecosystem concept, history and progress of forest ecosystem research in India, Genetic Diversity; Gene pools and implication of genetic variability, Basics of diversity; phenotypic and genotypic variations, ecological niche, Forest community composition; Species number, abundances, species associations, species distribution, Methods used for measuring forest composition

UNIT II

General appearance; Vertical and spatial heterogeneity, Forest structure: Stratification (vertical distribution of species), spatial heterogeneity (horizontal distribution of species, density, edge effect), community structure (biotic interactions, competition, predation, herbivory, symbiosis), mosaic formation and micro-environments, gap formation, dead trees, Source of energy, Trophic structure, Food chain, Food web, Ecological pyramids, Populations: reproduction, growth, natality, mortality and survivorship, Community characteristics: stability, species interactions, species diversity

UNIT III

Forest productivity, energy capture and trophic structure, Forest biogeochemistry with emphasis on carbon and nitrogen cycling in tropical forest, Water movement in forest (hydrological cycle), water availability to plant, Global cycles of carbon and nitrogen

UNIT VI

Definition of pollution, Causes of Pollution of the biosphere, classification of pollutants, National and International Environmental Standards of important Pollutants. Air Pollution, Water Pollution, Soil Pollution, Noise Pollution. Conservation of natural resources (hotspot areas, wildlife sanctuaries, national parks, biosphere reserve). Global warming and forests. Green House Effect and its consequences. Ozone depletion. Conservations laws and acts. Biological diversity and its significance to sustainable use. Agenda 21, Biological Diversity act.

Practicals

1. Study of forest community structure and its successional status,
2. Estimation of productivity of forest ecosystem,
3. Trip to different regions of the state to study forest vegetation,
4. Collection and preservation of specimen,
5. Methods of vegetation analysis, Measurement of biomass and productivity,
6. Quantification of litter production and decomposition
7. Visit to national parks, wldlife sanctuaries, botanical gardens and arboreta.

Suggested Readings

1. Anonymous 2006. *Report of the National Forest Commission*. Govt. of India.
2. Dhyani SN. 1994. *Wildlife Management*. Rawat Publ.
3. Huxley P. 1999. *Tropical Agroforestry*. Blackwell.
4. Khan TI & Al-Azmi DN. 1999. *Global Biodiversity Conservation Measures*. Pointer Publ.
5. Kimmins JP. 1976. *Forest Ecology*. MacMillan.
6. Nautiyal S & Koul AK. 1999. *Forest Biodiversity and its Conservation Practices in India*. Oriental Enterprise.
7. Ramakrishnan PS. 1992. *Shifting Agriculture and Sustainable Development*. Man and Biosphere Series. The Parthenon Publ. Group.

FIRST SEMESTER
Core course-FOR629103
WILD LIFE CONSERVATION & MANAGEMENT

UNIT – I

Wild-life management- Definition, importance and concepts. Wild life management in relation to allied subjects, study of rare and threatened species, steps taken for their preservation. Wild-life values and conflicts positive values Aesthetic, cultural, social etc.

UNIT – II

Introduction to biological and ecological base of management. Distribution and behaviour including various environmental factors. Factor affecting animal population, concept of age and sex structure (Mortality and natality). Ecology of wild life. Field observations and investigations. Census, Management Techniques.

UNIT – III

History of wild life conservation in india. National conservation strategy with special reference to forestry & wild life conservation. National wild-life Action Plan.

UNIT – IV

Agencies for conservation of wild life, zoo management, Management of wetland habitat for ecological process and wildlife, Wildlife Conservation Projects.

Practicals:

1. Plant/Tree/Wild Life enumeration in protected area/ National Parks/ Wild life sanctuaries.
2. Ecological census techniques- wild animal census.
3. Socio-economic impact study/assessment.
4. Identification of causes of man-animal conflict and measures for restoration.
5. Environment and Social impact assessment.

Suggested Readings:

1. Gaston, K.J and Spicer, J.I. 2004. *Biodiversity: An Introduction*. Blackwell Publishing Company, USA.
2. Richard. B. Primack. 1998. *Essentials of conservation biology*. Sinauer Associates, Inc. USA.
3. Agarwal, S.K. 2002. *Biodiversity conservation*. Rohini Publishers, Jaipur.
4. Nautiyal, S and Kaul, A.K. 1999. *Forest Biodiversity and its conservation Practices in India*. Oriental Enterprises, Dehradun.
5. R. Umashaanker *et.al.* 2001. *Forest Genetic Resources*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
6. Ian. F. Spellberg. 1992. *Evaluation and Assessment for Conservation*. Chapman Hall, London, UK.
7. David, E.B. and Joel, T.C., 2003. *Monitoring Ecosystems*. Island Press, Washington, DC
8. Stanley, A.H., 2002. *Managing our wildlife resource*. Printice-Hall, USA.
9. Benson, E.E., 1999. *Plant conservation Biotechnology*. Taylor and Francis Ltd. London.
10. Agrawal, K.C., 2000. *Wildlife of India: Conservation and Management*. Nidhi Publishers, India
11. Dunbar, A.A., (Eds: Reprinted from BNHS). *The preservation of wildlife in India*. Daya Publishing House, New Delhi.
12. Sinha, P.C., 1998. *Wildlife and forest conservation*. Anmol Publication Pvt. Ltd, New Delhi.
13. Edward, O.G., 2004. *Ex situ plant conservation*. Island Press, Washington, DC

SECOND SEMESTER

Core course-FOR629201

FOREST PROTECTION, PEOPLE AND FORESTS, POLICY , LAWS & INTERNATIONAL CONVENTIONS

UNIT: I

General Concept and Forest Fire; Factors affecting forest health; Outbreak of diseases, insect pests attack, grazing & browsing, adverse climatic factors, acids rains & air pollution, bamboo flowering & weeds (invasive species & its mitigation). Forest fire (History, types, main causes, prevention and control), Evaluation of losses due to forest fire.

UNIT: II

Forest Pathology; Concept of disease, sign & symptoms & Koch's postulates. Bacteria as an agent of tree disease. Fungi as an agent of tree disease (wood decay, root rot, wilt, rust and canker). Important diseases of seedlings in nursery. Role of mycorrhiza in tree health.

Forest Entomology; Insect-plant relationship, population dynamics of forest insects, Insect feeding groups (defoliating insects, sap feeding, bark & wood feeding, bark boring, shoot boring, fruit & seed boring, root feeding, gall forming, stem & branch cutters), Insect pests of important tree species (Teak, Pine, Gamhari & Sal).

Principal Methods of Pest Management; Chemical control (Pesticides, attractants, repellants & chemosterilants). Silvicultural measures & biological control agents. Use of different fungicides in nurseries and forest plantations. Plant quarantine. Integrated Pest Management.

UNIT: III

Forest Policy : Foundation, need and scope, national forest policies of 1894, 1952 and 1988 : salient features and drawbacks. Forest laws - Legal definitions, objectives of special forest law, Indian forest Act, 1927. Forest conservation Act 1980. Wildlife Protection Act 1972

UNIT: IV

Forests and its importance, interactions between forests and people, importance of forests in traditional farming systems. People's movement in forest conservation; Gender dimension of forest management, tribal's and forests.

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, JFM.

Practicals:

1. Identification of diseases of nursery seedlings
2. Collection, identification and preservation of disease specimens of forest plants.
 - a. Collection and preservation of forest insects.
 - b. Spraying equipment and demonstration of spraying pesticide application technology in forest ecosystem
3. Familiarization with the meteorological and plant protection equipment.
4. Preparation of herbarium of forest weeds.
5. Fire control methods and devices.

Suggested Readings:

1. Khanna, L.S., 1982. *Forest Protection*. Khanna Bhandu, Dehradun.
2. Negi, S.S., 1999. *Handbook of Forest Protection*. International Book Distributors, Dehradun.
3. Brown, A.A. and Davis, K. P., 1973. *Forest Fire: Control and Use*. McGraw-Hill, Inc. USA
4. Rawat, G.S and Nautiyal, S., 1999. *Forest Fire and its Control Measures*. Oriental Enterprises, Dehra Dun.
5. Agrios, G.N., 2005. *Plant Pathology*. Elsevier Academic Press, USA.

6. Negi, S.S., 2002. *An Introduction to Forest Pathology*. International Book Distributors, Dehradun.
7. Tery, A., 1984. *Diseases of Shade Trees*. Academic Press, Inc, London
8. Boyce, J.S., 1961. *Forest Pathology*. McGraw-Hill Book Co Inc, New York.
9. Speight, M.R and Wylie, F.R., 2001. *Insects Pests in Tropical Forestry*. CABI International, UK.
10. Bihari, B., 1992. *Forest Entomology*. Bishen Singh Mahendra Pal Singh, Dehradun.
11. Pedigo, L.P., 2002. *Entomology and Pest Management*, Prentice-Hall of India, New Delhi.
12. Dhaliwal, G.S and Arora, R., *Principles of Insect Pest Management*, Kalyani Publishers, Ludhiana.
13. *Indian Forest Acts (with short notes)*1975. Allahabad Law Agency.
14. Jha LK. 1994. *Analysis and Appraisal of India's Forest Policy*. Ashish Publ. House.
15. National Forest Policy 1952. Ministry of Food and Agriculture, New Delhi.
16. National Forest Policy 1988. Ministry of Environment and Forests, New Delhi.
17. Negi SS. 1985. *Forest Law*. Natraj Publ.
18. Saharia VB. 1989. *Wildlife Law in India*. Natraj Publ.
19. Annamalai R. 1999. Participatory Learning Action and Micro planning for JFM. Dean SFRC, Coimbatore.
20. FAO. 1978. Forestry for Local Community Development. FAO Publication.
21. Shah SA. 1988. Forestry for People. ICAR.
22. Tiwari KM. 1988. Social Forestry and Rural Development. International Book
23. Vyas GPD. 1999. Community Forestry. Agrobios.

SECOND SEMESTER

Core course-FOR629202 FOREST RESOURCE MANAGEMENT AND ECONOMICS

UNIT I

Forest Economics : Nature and scope, Theory of consumption with reference to marshallian, and Hicks Allen approach, concept of demand and supply. Financial and economic analysis, Measurement of National income, GNP & GDP, National income,

UNIT II

Project- Concept, Components, preparation and analysis of IRR, NPW & B/C ratio . Financial economic aspects of project analysis. Preparation of project reports, Guidelines for project preparation, Introduction, background, project rationale summary & conclusion, the project area the organisation and management.

UNIT III

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

UNIT VI

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

Practicals

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

Suggested Readings

1. FAO 1986. *Guidelines to Practical Project Appraisal*. Natraj Publ. Kerr JM, Marothia DK, Singh K, and *Applications in India*. Oxford & IBH.
2. Nautiyal JC. 1988. *Forest Economics*
3. Ramaswamy C & Beritley WR. 1997. *Natural Resource Economics : Theory Principles and Applications*. Natraj Publications, Dehradun. Sharma LC. 1980. *Forest Economics, Planning and Management*. International Book Distributors, Dehradun.

SECOND SEMESTER
Core course-FOR629203
FOREST BIOMETRY , REMOTE SENSING AND GEOGRAPHIC
INFORMATION SYSTEM

UNIT: I

Role and principle of forest measurement, variable, precision, accuracy and bias, data summary and presentation, measures of central tendency and dispersion, sampling error, sample size determination, correlation and regression, measurement of tree diameter and girth-standard rule, diameter distribution of trees, bark thickness. Forest inventory, Sampling methods adopted in forestry, Use of GPS in forest inventory.

UNIT: II

Individual tree height measurement- methods, principles and instruments used, height measurement under different terrain situation. Form- Metzger's theory or Girder theory, methods of studying form. Crown parameters. Determination of age of trees. Estimation of tree volume and growing stock.

UNIT : III

Forest biomass and its measurement, carbon content of biomass, forest carbon sequestration, emission trading, stand growth and yield, methods of estimating growth and yield, CAI & MAI, increment percent, growth and Preparation of volume & its application, yield and stand tables.

UNIT: IV

Introduction to Remote Sensing, electromagnetic energy, sensors, scanners, aerial cameras, microwave remote sensing, aerial photography and photogrammetry, visual image interpretation, digital image classification, Future prospects of remote sensing in India; softwares used in remote sensing ; GIS versus remote sensing; remote sensing software's and GIS Software used in forestry and environments; Analysis of data; Application of remote sensing and GIS in forestry.

Practical

1. Diameter and height measurement of individual tree.
2. Determination of crown height & diameter and age of tree.
3. Determination of tree volume and growing stock of the populations.
4. Measurement of tree biomass and carbon stock.
5. Identification of Spatial Features on Aerial Photographs.
6. Visual and Digital Image Interpretation.
7. Image Classification.
8. Calculations of volume of felled as well as standing trees.

Suggested readings:

1. Aronoff, S. 1989. *Geographic Information Systems: A Management Perspectives*. WDL Publications, Ottawa, Canada.
2. Avery, T. E. and Burkhart, H. E. 2002. *Forest Measurements*. 5th Edition. McGraw Hill, New York.
3. Beers, T. W. and Miller, C. I. 1973. *Manual of Forest Mensuration*. T & C Enterprises, West Lafayette, IN
4. Chapman, H. H. and Meyer, W. H. 1949. *Forest Mensuration*. McGraw-Hill, New York.
5. Chaturvedi, A. N. and Khanna, L. S. 1982. *Forest Mensuration*. International Book Distributors, Dehra Dun.
6. Hamilton, G. D. 1975. *Forest Mensuration Hand Book*. Her Majesty's Stationary office, London.
7. Husch, B.; Beers, T. W. and Kershaw, J. A. 2003. *Forest Mensuration*. 4th edition. John Wiley and Sons, INC, Hobokon, New Jersey.
8. Paine, D. P. 1981. *Aerial Photography and Image Interpretation for Resource Management*. Wiley, New York
9. Chaturvedi AN & Khanna LS. 1994. *Forest Mensuration*. International Book Distributor.
10. Ram Parkash 1983. *Forest Surveying*. International Book Distr.
11. Sharpe GW, Hendee CW & Sharpe WE. 1986. *Introduction to Forestry*. McGraw-Hill.
12. Simmons CE. 1980. *A Manual of Forest Mensuration*. Bishen Singh Mahender Pal Singh, Dehradun.

THIRD SEMESTER

Core course-FOR629301

WOOD SCIENCE AND TECHNOLOGY, FOREST PRODUCTS – CHEMISTRY AND INDUSTRIES

UNIT I

Non wood forest produce, Non-timber forest products of India and their importance in rural and industrial economy. Fibres and flosses, grasses, bamboos and canes, their distribution, cultivation, harvesting processes and uses. Essential oils commercial importance and the methods of cultivation of oil bearing plants. Oil seeds : Important oil seed obtained from forests. Gum, Resin and oleoresin, Tans and dyes, Drugs, Poison and Insecticides, Rubber, char-coal. Miscellaneous products - Bidi Leaves, products of destructive distillation of wood, Leaf Fodder Lac and shallac, silk and tassar, mineral products.

UNIT II

Description of different forest based industries - paper and pulp, furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes. Main uses of some important woods of Uttar Pradesh. Chemical nature and uses of volatile oils, tannins, katha and cutch, oleoresin from major pine species. Chemical nature and uses of important forest based dyes and pigments

UNIT III

Wood properties - gross anatomical features of wood, physical properties of wood, mechanical properties of wood, Defects of timber- natural and seasoning defects, wood preservation- properties and types of preservatives,

UNIT IV

Wood seasoning and preservation - Introduction, object need importance of seasoning and preservation, general principles of seasoning, air and kiln seasoning solar dehumidification, steam heated and electrical Kiln. Composite wood products and improved woods. logging - Definition of logging, Log making, purpose of log, making, felling & conversion, methods and procedure of felling, implement and tools. Storage of timber and management of depots. grading of Indian timber.

Practicals

1. Extraction of essential oils, resins, tannins, Acetylation of wood,
2. Visit to nearby forest based industries.
3. Determination of specific gravity and bending properties of various wood species.
4. Collection wood samples of various species and identification of their anatomical features and physical features.
5. Identification of Non-timber forest products of the State.
6. Survey of NTFP species in the nearby forest.
7. Visit to nearby wood based industries and observe the tools, equipment and processes used

Suggested Readings

1. Anonymous. 1981. *Wealth of India*. CSIR.
2. Anonymous. 2007. *Year Book of Forest Products*. FAO.
3. Dwivedi AP. 1993. *Forestry in India*. Surya Publ.Mehta T. 1981. *A Handbook of Forest Utilization*. Periodical Expert Book Agency.
4. Krishnamurthy T. *Minor Forest Products of India*. Oxford & IBH.
5. Naik, V. N.2004. *Identification of Indian Medicinal Plants*.

6. Negi, S.S. and Vaithani, H.B. 1994. *Handbook of Indian Bamboos*. Oriental Enterprises, Dehra Dun (India)
7. Patrick, B. Dust, Ward Verizh, Kasluo, M. 1993. *Non-Wood Forest Products in Asia*, Oxford and IBH, Publishing Co.Pvt.Ltd. New Delhi
8. Purohit, 2004. *Medicinal Plant Cultivation: A Scientific Approach*.
9. Ram Prasad and Manish Mishra 2001. *Non-Timber Forest Products (1989-2000)*. IIFM, Bhopal
10. Tewari, D.N. 1995. *A Monograph on Bamboo*. International Book Distributors, Dehra Dun, India.
11. Tiwari, D.D & Campbell, J.Y.(1997). *Natural Resources Economics: Theory and Applications*, Oxford and IBH Publ. Co. New Delhi
12. Trivedi, P.C. 2004, *Medicinal Plants: Utilization & Conservation*. Avishkar Publisher 807, Jaipur.
13. Trivedi, P.C. 2004. *Ethnomedicinal Plants*. Avishkar Publisher 807, Jaipur.
14. Trotter, H.1982. *Indian Forest Utilization*, FRI & College, Dehradun
15. Anon, 1972. *Indian Forest Utilization Vol 1&2*, FRI, Dehra Dun.
16. Anon, 1996. *Wood Preservation Manual*. FAO, Rome
17. Conway, Steve, 1978. *Logging Practices: Principles of Timber harvesting systems*. Miller Freeman Publications, USA.
18. Fisher, W.R., 1908. *Manual of Forestry; Forest utilization*, Vol. V (Second Edition). Periodical Experts Book Agency, Delhi.
19. Mehta, Tribhawan., 1981. *A handbook of Forest Utilization*. International Book Distributors, Dehra Dun.
20. Negi, S.S., 1992. *Textbook of forest Utilization: Wood and Non-Wood forest products*. Bishen Sing Mehandra Pal Singh, Dehra Dun.
21. Rao, K.Ramesh and Juneja, K.B.S, 1992. *Field Identification of fifty important timbers of India*. ICFRE, Dehra Dun. 123p.
22. Simpson, W.T. 1989. *Drying wood: a review*. *Drying Technology*. An International Journal, Pt. 1, 2(2): 235–265, Pt. 2, 2(3): 353–368.
23. Eaton, R.A.; Hale, M.D.C. 1993. *Wood: decay, pests and protection*. New York, NY: Chapman & Hall.
24. Hunt, G.M.; Garratt, G.A. 1967. *Wood preservation*. 3rd Edition. The American Forestry Series. New York, NY: McGraw–Hill.

THIRD SEMESTER
Core course- FOR 629302
FOREST BIOTECHNOLOGY , GENETIC RESOURCES & TREE IMPROVEMENT

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

UNIT: III

Basic genetics principles - genomes and genes, genome structure, genetic code and gene expression, sources of genetic variation, Population genetics – Hardy-Weinberg equilibrium, gene frequencies, factors affecting allele frequencies, inbreeding and forces of evolution.

Mating system of forest trees – Reproductive phenology, flowering, pollination vectors, threats to pollination, dynamics of mating system in forest trees, incompatibility mechanism, out crossing, estimation of selfing rate, breeding system estimation, sex expression.

Concepts and importance of tree improvement, genetic variation in natural populations – variation within population, geographic variation: races, clines, ecotypes, land races, Selecting superior trees, Quantitative aspects of tree improvement - genetic value, genetic gain and heritability.

UNIT: IV

Seed orchard – types, establishment, management and records, Methods of vegetative propagation, clonal forestry and its advantages, the need for resistant trees, breeding for resistant to disease, insects and adverse environment, mechanisms of speciation, hybridization.

Practicals

1. Exercise for – Complete elimination of homozygous recessive (aa) trees, selection for genes with additive effects, partial selection against recessive (aa) trees.
2. Selection of superior phenotypes, marking of candidate trees, plus trees and elite trees.
3. Study of pollination system of some tree species.
4. Pollen viability estimation, pollen germination following growth hormones, methods of judging stigma receptivity.
5. Visitation rate and foraging behavior of Pollinators. Practice of cutting, grafting and air layering.
6. Micro propagation technique, Preparation of MS media, collection of explants, acquaintance of different instruments use in biotechnology, visit to the laboratories

Suggested Readings

1. Becker, W. A. 1975. *Manual of Quantitative Genetica*. Student Book Corporation, Washington State University, Pullman, Wash.
2. Boulter, S. L., Kitching, R. L., Zalucki, J. M. and Goodall, K. L. 2006. *Reproductive Biology and Pollination in Rainforest Trees: Techniques for a Community-level Approach*. Practical Manual. Cooperative Research Centre for Tropical Rainforest Ecology and Management. Rainforest CRC, Cairns, Australia
3. Callaham, R. Z. 1966. *Breeding for pest resistance*. Sex to Congresso Forestal Mundial, Madrid.
4. Mandal, A. K. and Gibson, G. L. (eds.) 1998. *Forest Genetics and Tree Breeding*. CBS Publishers and Distributors, New Delhi.

5. White, T.L., Adams, WT. and Neale, DB. 2007. *Forest Genetics* (Winner of a 2009 Outstanding Academic Title (OAT) award) CABI Publishing , Oxfordshire, UK.
6. Wright, J. W. 1976. *Introduction to Forest Genetics*. Academic press, New York.
7. Young, A., Boshier, D. and Boyle, T. (eds.). 2000. *Forest Conservation Genetics: Principles and Practices*. CABI Publishing, Oxfordshire, UK.
8. Zobel, B. and Talbert, J. 1984. *Applied Forest Tree Improvement*. John Wiley and Sons, New York.
9. Bajaj YPS. (Ed.). 1988. *Biotechnology in Agriculture and Forestry*. Springer Verlag.
10. Gupta PK. 2000. *Elements of Biotechnology*. Rastogi Publ.
11. Kumar S & Singh MP. 2008. *Plant Tissue Culture*. APH Publ.
12. Mandal AK & Gibson GL. (Ed.). 1997. *Forest Genetics and Tree Breeding*. CBS.
13. Punia MS. 1998. *Plant Biotechnology and Molecular Biology*. Scientific Publ.
14. Singh BS & Singh MP. 2007. *Fundamental of Plant Biotechnology*. SodeshSerial Publ.
15. Srivastava PS, Narula A & Srivastava S. (Ed.). 2004. *Plant Biotechnology and Molecular Markers*. Anamaya Publ.

THIRD SEMESTER

Core course- FOR 629303

FOREST MANAGEMENT & SUSTAINABLE DEVELOPMENT

UNIT: I

Introduction to forest management : Development and status. Elements of forest management. Forest organisation, sustained yield relation, normal forest, growing stock. Yield and its regulation, in regular and Irregular forest. Working plans General consideration and preparation of working plans.

UNIT: II

Sustainable development; Meaning, Need & Importance of sustainable Forest Management (SFM), Evolution of SFM, Global Scenario, Concept of sustainability – Pillars of sustainable development (Ecological, Economical, Social), Introduction to criteria and indicators for sustainable Management.

UNIT: III

International processes of SFMs, Bhopal-India process of SFM, National Forest Policy - participation of stake holders, particularly communities, Joint Forest Management (JFM) as operational strategy for sustainable Forest Management, SFM and livelihood – Ensuring production of Forestry goods and services.

UNIT: IV

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

Practicals:

1. Observation and collection of data on the identified indicators in the nearby forests.
2. Arranging the field data into appropriate reporting formats.
3. Working out minimum Acceptable standards for the indicators.
4. Analysis and interpretation of data for sustainability index at FMU level.
5. Estimations of trees outside (TOF) in the town/University/Institutions having large campus.
6. The students shall be assigned to prepare a report based on their field visit/community participation and submit for evaluation. The report will be evaluated through seminar presentation by the course in charge.

Suggested Readings:

1. IFFM, 1999. *Bhopal-India Process for sustainable Management of India Forest*.
2. IFFM, 2000. *Report of the National Task Force on SFM*, Govt. of India.
3. IFFM, 2001. SFM Series. *Tree resources outside Forests (TOF) in India*.
4. IFFM, 2002. *Annotated Bibliography on sustainable forest management*.
5. IFFM, 2002. *Illustrated Manual on Criteria & Indicators for sustainable Forest Management*.
6. IFFM, 2002. *Manual for operationalizing criteria & Indicators for sustainable forest management at FMU level*.
7. IFFM, 2003. *Prashikshan Niyamavati: Sattatposhniya/Tikau Van Prabandhan* (In Hindi)
8. IFFM, 2003. *Strategy for operationalizations of SFM in India*.
9. Dwivedi AP. 1992. *Agroforestry: Principles and Practices*. Oxford and IBH.
10. Dwivedi AP. 1993. *A Text Book of Silviculture*. International Book Distributors, Dehradun.
11. Khanna LS. 1996. *Principle and Practice of Silviculture*. International Book Distributors.
12. Smith DM, Larson BC, Ketty MJ & Ashton PMS. 1997. *The Practices of Silviculture-Applied Forest Ecology*. John Wiley & Sons.

FOURTH SEMESTER

Core course-FOR 629401

AGRO-FORESTRY , CROPPING SYSTEM, PASTURE & FODDER DEVELOPMENT

UNIT : I

Definitions, Historical perspective, objectives, importance and scope of Agroforestry. Agroforestry as a land use system. Role and characteristics of trees, experimental evidence of tree-crop mixtures, choice of agricultural crops, trees and crops management in agroforestry system. Characteristics of Multipurpose tree species (MPTs).

Agroforestry systems: Definitions, Classification of Agroforestry systems, Tree domestication, local agroforestry systems and practices (common agroforestry systems including home gardens in the local setting, their strength, limitations, opportunities, financial issues, production, sustainability and adoptability issues), Cost-benefit analysis. . Land capability classification and land evaluation. Financial and socio-economic analysis of agro-forestry projects.

UNIT: II

Overview of global agro-forestry systems, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, shelter-belts and windbreaks, energy plantations and homestead gardens. Production potential of different silvi-pasture system

Role of Agroforestry in rural livelihood, subsistence products and cash income, Environmental services in Agroforestry system (cause & effects of land use change at farm level and carbon stock, emission of greenhouse & uses).

Advancing Agroforestry Systems: Participatory Planning, Various Participatory Tools (Farming system Research (FSR), Agro ecosystem Analysis (AEA), Rapid Rural Appraisal (RRA), Diagnosis and Design (D&D), SWOT analysis, Geographical Information System (GIS), Institutions and Policies related to Agroforestry, Role of different stakeholders in agroforestry development, role of training and educational institutions in capacity building, Field experiments in agroforestry Options for agroforestry technology generations and dissemination,

UNIT: III

Agroforestry systems classification based on various approaches i.e. structure, dominance of components, temporal arrangement of components and allied components. Types of Agro-forestry systems A brief study of Homestead Agro-forestry, Agroforestry models (3-tier ICAR system, Slopping Agricultural Land Technology(SALT)/Slopping Watershed Engineering Technology (SWEET) system, their merits and demerits.

Cropping system – An overview, types of cropping systems-mono cropping, multiple cropping, inter cropping, mixed cropping, relay cropping, sequence cropping and their efficiency. Interactions between different components in Inter cropping and Sequence Cropping.

UNIT: IV

Importance and role of fodder and pasture development -in the National scenario. Classification and types of fodder -Green fodder, dry fodder, concentrates, commercial feed, systems of fodder production, intensive dairy farming.

Fodder requirements and resources; Forest as a source of fodder-grazing and browsing, Lopped tree fodder and species suitable of logging, grasses, herbs and shrubs. Carrying capacity and silos, damages to forest due to excessive grazing and browsing. Augmenting fodder resources of the forests. Nutritive value of important fodder. Fodder conservation; Silos, Hay and Silage making. New avenues for fodder promotion, fodder research and development.

Practicals:

1. Survey and analysis of land use systems in the adjoining areas
2. Design and plan of suitable models for improvement.
3. Mineral and nutrient analysis of soil plants
4. Qualitative evaluation of multiple and intercropping systems.

5. Case studies on harvesting, post harvest management and marketing of agro- forestry products.
6. Identification and characterization of important fodder, grasses and legume species.
7. Preparation of herbarium of above species.
8. Conservation of fodder (Hay and Silage Making)
9. Survey and analysis of land use systems in the adjoining areas. Design and plan of suitable models for improvement.

Suggested Readings:

1. Chudawat, B.S. & Goutam, S.K. 1993. *A text book of Agroforestry*.
2. Forestry Sciences, Agroforestry Education and Training: Present and Future. Eds.-PKR Nair; H.L Gholz, M.L.Duryea. Proceedings of International Workshop on Professional Education and Training in Agroforestry, 1988. Kluwer Academic Publishers, Dordrech, The Netherlands.
3. Mac Dicken, K.G., Wolf, G.V, & Briscoe, C.B. 1991, *Standard Research Methods for Multipurpose Trees and Shrubs*. Winrock International, USA.
4. Martha, E. Avery, Cannell, M.G.R., & Chin K. Ong., 1991. *Biophysical Research for Asian Agroforestry*, Winrock International, USA
5. Nair, P.K.R., 1995. *An Introduction to Agroforestry*. Klumer Academic Publishers and ICRAF.
6. Budd, W.W. & Duchhart, I. *Planning for Agroforestry*. Elsevier Science, Amsterdam.
7. Burch, W. R. & Parker, J. K. 1991. *Social Science Applications in Asian Agroforestry*. Winrock International, USA, South Asia Books.
8. Breymeyer, A.I. 1980. *Grassland Systems Analysis and Man*. Suman Book House, Delhi.
9. Chatterjee, B.N. 1989. *Forage Crop Production*. Suman Book House, Delhi.
10. Shankar Narayan and Kumar, V. 1984. *Grasses and Legumes for Forage and Soil Conservation*. ICAR Publication, New Delhi.
11. Singh et al , 1998. *Forage Grasses and Legumes*. Scientific Publishers (INDIA)
12. Skerman, P.J. and Riveros, F. 1992. *Tropical Grasses*. Scientific Publishers, Jodhpur, India.
13. Nair, P.K.R., 1995. *An Introduction to Agroforestry*. Klumer Academic Publishers and ICRAF.
14. Avery E., Martha & Cannel, Melvin G.R., Ong K, Chin, 1991. *Biophysical Research for Asian Agroforestry*. Winrock International, USA
15. Chatterjee, B.N.Maiti,S and Mandal, B.K. 1989. *Cropping Systems: Theory and Practice*, Oxford and IBH Publishers, Delhi
16. Chudawat & Goutam, S.K. 1993. *A text book of Agroforestry*. Oxford & IBH Publication
17. De G.C. 1989. *Fundamentals of Agronomy*. Oxford and IBH Publishers (Delhi)
18. 'Forestry Sciences, Agroforestry Education and Training : Present and Future'. Eds.-PKR Nair; H.L Gholz, M.L.Duryea. Proceedings of International Workshop on Professional Education and Training in Agroforestry, 1988. Kluwer Academic Publishers, Dordrech, The Netherlands.
19. Khurana, D.K. and Khosla, P.K. 1989. *Agroforestry for Rural Need*, I.S.T.S Solan.
20. Mac Dicken, K.G., Wolf, G.V, & Briscoe, C.B. 1991. *Standard Research Methods for Multipurpose Trees and Shrubs*. Winrock International, USA.

FOURTH SEMESTER

Core course-FOR 629402

GENERAL SOIL SCIENCE, SOIL & WATER CONSERVATION, WATERSHED MANAGEMENT & HYDROLOGY

UNIT: I

Introduction to Soil, Factors of Soil Formation, Soil Forming Processes, Soil Structure, Soil Properties, Soil Profile, Soil Classification, Carbon and Nitrogen transformations, Soil Pollution/Degradation and Remediation/Reclamation

Soil Organic Matter: Source, Composition, Properties and Functions and Steps in Decomposition, Impact on Soil Fertility, C/N Ratio, Soil Colloids, Improvement of Problem Soil, Soil Amendment, Ecological Significance of Soil, Mycorrhizae and Its Role in Plant Nutrition, Vermiculture & vermicomposting, Biological Nitrogen Fixation, Deficiency Symptoms of Nutrient in Soil and Methods Soil Fertility Evaluation

UNIT: II

Soil Erosion, Types of Soil Erosion, Effects of Soil Erosion, Factors Effecting Soil Erosion, Agronomic/Biological Measures of Soil and Water Conservation, Engineering and bioengineering measures of soil and water conservation,

UNIT: III

Watershed; Definition, Concept, Types, Characteristics, Priority Watershed Concept and their Identification, Watershed types, Watershed Management; Concept, Objectives and Principles of Watershed Management,

Watershed Problem; Preparation of Watershed Management Plans- Need, levels and Approaches of Watershed Planning, Data Collection, Watershed maps. Watershed plan Formulation. Log Frame Approach for Watershed Project Development, 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: IV

Hydrological cycle and characteristics of small and medium watersheds precipitation, infiltration, run-off (run-off hydrographs) total and peak, soil moisture, hydrograph, ground water and evapo-transpiration. Water harvesting – principles and important techniques.

Practicals:

1. Study of Forest Soil Profile
2. Determination of pH, Moisture, Texture, Porosity, Water Holding Capacity
3. Determination of Soil Organic Carbon, Nitrogen, Phosphorous, Potassium in Soil and Manure
4. Identification of Common Soil Micro-Flora
5. Field Study to acquaint with various land degradation problems.
6. Field visit to study various engineering measures for soil and water conservation
7. Preparation of an integrated watershed development project for a micro/macro watershed in co-ordination with concerned department for identified area
8. Measurement of slope and identification of contour points in a field with simple and low cost methods
9. Design of terraces, contour bunds, contour trenches, waterways
10. Laboratory exercise for the estimation of peak rate of runoff, sediment yield and identification of priority watershed
11. Socio-economic and resource survey for a small watershed
12. Survey of watershed, Preparation of micro-plan and planning of watershed for effective implementation.
13. Exercises on economic profitability of various land-based enterprises bases in cost and revenue concepts.

Suggested Readings:

1. Buckman & Brady. 1984. *The Nature and Properties of Soil*. Nataraj Publication, Dehra Dun
2. Negi, S.S. 1985. *Soil Conservation*, Nataraj Publication, Dehra Dun
3. FAO. 1984. *Physical and Chemical Methods of Soil and Water Analysis*. FAO, Publication, Rome, Italy
4. Somani, L.L. 1986. *Biofertilizer*. Scientific Book Suppliers. Delhi
5. Summer, M.E. 2000. *Handbook of Soil Sciences*. CRC Press LLC, Florida, USA
6. Biswas, T.D. 1995. *Text Book of Soil Science*, McGraw Hill Higher Education, USA
7. USA
8. Arkar, H.R. 1984. *Principles of Soil Conservation and Water Management*. Summan Book House, Delhi
9. FAO. 1988. *Watershed Management Field Manual: Slope Treatment Measure and Practices*. Conservation Guide 13/3, Rome
10. ICIMOD and FAO. 1999. *Recent concepts, knowledge, practices and new skills in Participatory Integrated Watershed Management: trainer's resource book*. PWMTA field document no.17
11. MANAGE. 1984. *Technical manual on Watershed Management*. Vol.I to VI, Hyderabad
12. MYRADA. 1984. PRA PALM Series 1-10 Bangalore
13. Singh, *et al.* 1990. *Manual of Soil and Water Conservation Practices*. CSWCRTI, Dehra Dun
14. Singh, Rajvir. 1984. *Watershed Planning and Management* (Second Edition). Yash Publishing House, Bikaner, Rajasthan
15. Tideman, E.M. 1996. *Watershed Management: Guidelines for Indian Conditions*. Omega Scientific Publishers, New Delhi
16. Young, A. 1989. *Agroforestry for Soil Conservation*. ICRAF, Kenya
17. Datta SK. 1986. *Soil Conservation and Land Management*. International Book Distributors, Dehra Dun.
18. Hamilton IS. 1987. *Forest and Watershed Development and Conservation in Asia and the Pacific*. International Book Distributors, Dehra Dun.
19. Hamilton IS. 1988. *Tropical Forest Watersheds. Hydrologic and Soil Response to Major Uses of Conservation*. International Book Distributors Moorthy VVN. 1990. *Land and Water Management*. Kalyani.
20. Oswal MC. 1999. *Watershed Management (For Dryland Agriculture)*, Associated Publishing Co., New Delhi.
21. Rajora R. 1998. *Integrated Watershed Management*. Ravat Publ., New Delhi.
22. Rama Rao. 1980. *Soil Conservation*. Standard Book Depot, Bangalore.

FOURTH SEMESTER

Core course- FOR 629403

GENERAL STATISTICAL METHODS , RESEARCH METHODOLOGY & COMPUTER APPLICATIONS

UNIT: I

Need for statistics in forestry research. Research planning and methods of data collection, Principal steps in sample surveys. Sampling variation and estimation of sampling errors. Determinations of sample size. Classified sampling design used in forest surveys (Simple random sampling, stratified random sampling, systematic sampling), Point sampling and use of wedge prism.

UNIT: II

Frequency distribution, measure of central tendency (arithmetic mean, median, mode), measure of dispersion (standard deviation, variance and coefficient of variation). Correlation and regressions, correlation coefficient, simple regression analysis, examples of multiple regression. Test of significance (t-test, ANOVA) and its applications in forestry research.

UNIT: III

Principles of Experimental Design, layout and analysis of data of Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Split Plot and Strip Plot Designs. Use of statistical software packages in forestry research (SPSS, Statistical 22).

UNIT: IV

Selection of research problem, Proposing and testing of hypothesis, Literature survey, Statistical Analysis, presentations of data, tabulation. Interpretation and deriving inference and conclusions. Brief account on writing project proposal, project report / dissertations.

Practicals:

1. Enumerations exercises in the field and recording of the data
2. Study of experimental design , layout and analysis of data in the field.
3. Sampling size determination in the field
4. Use of Computer Software for data analysis.

Suggested Readings:

1. Chaddha, 1989. *Agricultural statistics in India*. Suman Book House, Delhi.
2. Dear, K.B.G., Mead, R.& Rilay, J. 1987. *Statistical tools for Agro Forestry Research Bivariate Analysis for Intercropping Experiments*. ICRAF, Kenya.
3. Dos Pe Khar,C.A. 1984. *Field Experimentation statistical Procedures*. M.T.R. Publishers, Moscow.
4. Mahin, J., 1976. *Principles of Data base management*. Practice Hall New York.
5. Sokal,R.R.and Rohlf, F.J. 1995. *Biometry: The principles and practice of statistics in biological research*. 3rd Edition. W.H.Freeman Company, New York.
6. Zar, J.H.(1999). *Biostatistical Analysis*. Fourth Edition. Prentice Hall, New York.

M.Sc. Forestry I Sem
Soft core -FOR 629106
ECO-TOURISM

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. Influence of anthropogenic factors on the adaptation of different ecosystems. Studies on localized niches of potential tourist spots. Organized tours and Free Independent Travelers. World Tourism. Organization. Problems with definition of ecotourism and criticisms.

Ecotourism as a way for sustainable management of natural resources. Local livelihoods and ecotourism like nomadic grazing, agropastoralism

UNIT III

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

Importance of arboriculture in ecotourism. Landscaping- Management of trees - planning of roads, bridges, parking area. The genders dimensions of designing and management of eco-tourism and management of eco-tourism.

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.

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).

Practicals

1. 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.
2. Exercises on the blending of local cultural and sociological heritage with the various forms of ecotourism.
3. Debate on the concept to reach the most viable.
4. Problems on common property resources and facilitate group discussion for commendations. Discuss the merits and demerits of the recommendations.
5. 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, the backwater cruise.
6. Identify an area where ecotourism in vogue- Identify the various ecosystem activities in the selected area, evaluate in terms of economic feasibility, ecological adaptability and social acceptance.
7. Climate change and its influence on carbon economy.

8. Study the carrying capacity and impact of ecotourism activity on the ecosystem, suggest recommendation to overcome the ill effects of ecotourism.
9. 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.
10. Economic analysis of tourism components- case study of some important ecotourism destinations- analysis of primary and secondary beneficiaries report preparation.
11. Exercises on feasibility studies, environmental impact assessment and economic valuation of natural.

Suggested Readings

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

M.Sc.Forestry II Sem
Open elective-FOR 629206
REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM

UNIT I

Introduction to Remote Sensing, electromagnetic energy, sensors, scanners, aerial cameras, microwave remote sensing, aerial photography and photogrammetry, visual image interpretation, digital image classification.

UNIT II

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

UNIT III

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: IV

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

Suggested Readings

1. Burrough PA. 1990. *Principles of GIS for Land Resources Assessment*.Oxford & IBH.
2. Lillsand TM. 1989. *Remote Sensing and Image Interpretation*. John Wiley.
3. Narayanan LRA. 1999. *Remote Sensing and its Application*. Universities Press (India) Orient Longman.
4. Sharma NK. 1986. *Remote Sensing and Forest Survey*. International Book

M.Sc. Forestry III Sem

Soft core-FOR 629306

MEDICINAL AND AROMATIC PLANTS

UNIT I

Mode of plant propagation technique. Factors influencing growth; role of macro and micro nutrients. Nursery techniques, plant protection measures, methods of harvesting and post harvesting handling. Role of genetics and related sciences in breeding of Medicinal herbs. Breeding methods, self and cross pollinating. Heterosis, sterility and self incompatibility in herbs; mutation and polyploidy breeding, wide hybridization; production and maintenance of pure seeds. Systems followed in the release of plant varieties

UNIT II

Organic compounds and their classification such as aliphatic, aromatic, alkaloids, steroids, terpenoids, glycosides, phenolic compounds, heterocyclic compounds and carbohydrates. Primary and Secondary plant metabolites and their therapeutic uses of phytoconstituents such as gums, anthraquinones, steroidal and triterpenoidal glycosides, phenolic compounds, lipids, alkaloids and terpenoids. Basic principles of extracting different phytoconstituents. Post harvest processing- drying, grading and storage. Extraction of essential oils and their storage

UNIT III

Scope of Biotechnology in MAP's, Tissue culture technique and in-vitro propagation of *Rauvolfia serpentina*, *Santalum album*, *Stevia rebaudiana*, *Andrographis paniculata*, *Hyocyamus niger*, *Carum carvi*, *Catharanthus roseus*, *Glycyrrhiza glabra*, *Atropa belladonna*.

Importance & need of cultivation of MAP's species. origin, distribution, morphological features, climate, soil requirement, nursery technique, transplantation, harvesting and post harvest handling of Important MAP's like *Picrorrhiza kurroo*, *Saussurea costus*, *Aconitum heterophyllum*, *Swertia chirayita*, *Valeriana jatamansi*, *Chlorophytum borivilianum*, *Stevia rebaudiana*, *Andrographis paniculata*, *Pelargonium graveolens*, *Rosa damascena* and other important species specific to the region.

UNIT IV

Conservation of medicinal and aromatic plants; its techniques- in-situ, ex-situ & biotechnological. Evaluation and breeding techniques of important medicinal and aromatic plants- *Picrorrhiza kurroo*, *Swertia chirayita*, *Valeriana jatamansi*, *Viola spp.*, *Gloriosa superba*, *Rauvolfia serpentina*, *Plantago ovata*, *Cassia angustifolia*, *Ocimum sanctum*, *Withania somnifera*. Concept of Health Care systems Brief introduction to Ayurveda, Unani, Sidha, Homeopathy, allopathy, naturopathy, electrohomeopathy, etc. Important medicinal plants used in treating various diseases in modern and complementary systems. Biological activity of selected medicinal plants. Methods of preparing poultices, decoctions, powders, tinctures, active content rich extracts.

Pharmacognostic features of Sarpagandha, Jatamansi, Ashwagandha, Turmeric, Punarnava, Ephedra, Gymnema, Senna, Amla, Gokhru, Issabgol, Black pepper, Banafsha, Arjun or any other commercially species specific to the region.

Practicals

1. Asexual vegetative reproduction techniques- cutting, budding, layering.
2. Methods of seed collection and storage technique.
3. Use of thin layer and column chromatography during extraction and purification of phytopharmaceuticals.

4. Preparation of active constituent enriched extracts. Extraction of Essential oils and their quality evaluation, preparation of concretes and absolutes
5. Preparation and layout of nursery and field beds/ plots methods of seed sowing, preparation of shoot and root cuttings.
6. Visit to government and private Pharmaceutical UNITS/ Institutes in adjoining areas.
7. Visit to large scale herb growing and processing UNITS engaged in commercial cultivation and preparation of purified photochemical/standardized extracts.
8. Visit to nearby marketing/trade centers.
9. Visit to Pharmaceutical and Processing Units

Suggested Readings

1. Alikhan I & Khanum A. 2008. *Role of Biotechnology in Medicinal and Aromatic Plants*. UKAZ Publ.
2. Chadha KL & Gupta R.. 2006. *Advances in Horticulture*. Vol. XI. *Medicinal and Aromatic Plants*. Malhotra Publ. House.
3. Gupta AK & Sharma M. 2008. *Reviews on Indian Medicinal Plants*. ICMR. Gupta AK, Tandon N & Sharma M. 2008. *Quality Standards of Indian Medicinal Plants*. ICMR.
4. Johnson CB & Franz C. 2005. *Breeding Research on Aromatic and Medicinal Plants*. International Book Distr.
5. Sharma R. 2004. *Agrotechniques of Medicinal Plants*. Daya Pub.

M.Sc. Forestry IV Sem
Open Elective -FOR 629406
NGO Management

UNIT - I

NGO's : Definition, Concept, Objectives & Types Genesis and Present Status of NGO's Role of NGO's History of NGO's in India NGO's Movements in Other Countries , Concept of Civil Society Role of Civil Society in Social Change Social Movement in India: Women's Movement, Dalit's Movement, Peasant Movement and etc.

UNIT - II

Human Rights: Definition, Concept & Scope National Human Rights Commission Right to Information Gender Equality: Status & Issues , Definition, Concept & Scope Media Management Role of Electronic Media in Social Change Role of Print Media in Social .

UNIT - III

Management: Definition, Nature, Scope & Significance Levels of Management Functions & Principles of Management Role of a Manager Managerial Skills . Organization : Definition, Nature, Types & Structure Leadership: Definition, Objectives, Types & Function Traits of People Centered Leadership Motivation: Definition, Types & Significance. Planning: Concept, Objectives, Scope & Significance Limitations of Planning Steps in Planning Meaning of Authority, Responsibility & Accountability Centralization & Decentralization: With Special Reference to NGO's Team Building: Concept & Significance Role of Effective Team Building in Management of NGO's People's Participation: Concept, Meaning and Objectives Role of People's Participation in Community Development Understanding Self: Formulation of Self Concept, Dimension, Component, Self Assessment Analysis & Action Plan NGO's: Legislation, Agencies & Programmes.

UNIT - IV

Societies Registration Act,1860 Charitable Endowments Act, 1890 (with Charitable Endowments (Central) rules 1942 Cooperative Societies Act, 1912 Company Act,1956 (Some Relevant Part) Indian Trust Act, 1882 FCRA : Foreign Contribution Regulatory Act Income tax Act 1961: Nature and scope of Section 10 Income Tax Exemption: Under Sections 11 and 12. Rebate under Sections 80G and 35AC of Income Tax Act. UN Agencies Donor Agencies Other International Agencies World Bank, IMF and Asian Development Bank ,Major Schemes of the Government of India in Various Sectors Role of NGO's and Criteria for NGO's Support Minor modification in PG Diploma in management of NGO's NGO's: Financial & Project Management.