



Course Contents

M.Sc. (Forestry) in Silviculture and Agroforestry

I. Course Title : Silviculture

II. Course Code : SAF 501

III. Credit Hours : 2 + 1

IV. Aim of the course

To understand stand growth, development and provide knowledge regarding the application of silvicultural principles for the production and protection benefits from the forests.

V. Theory

Unit I

Forest ecosystems- Introduction to tropical/ temperate silviculture. Role of silviculture in forest and wild land management, major forest formations- classification, distribution, composition and structure. Vegetation dynamics- species richness-diversity indices. Vegetation forms of India and their productivity.

Forest ecosystem- structure and functioning, community development, competitive interactions in forest communities, forest succession, concepts and models of succession-Connell-Slatyer models, climax theories, tolerance.

Unit II

Ecophysiology of tree growth- effect of radiation and water relationship, mineral nutrients and temperature. Forest stand development – stand development, even-aged and uneven-aged stands, age and site quality. Tree architecture and its role in stand management.

Unit III

Stand density determination-stand density indices-stand density management- density management diagram, silvicultural treatments involved- thinning as a stand management tool, objectives of thinning, effects on growth and yield, thinning effect on economic yield of stands.

Forest site quality evaluation-direct and indirect methods.

Unit IV

Treatment analysis-silvicultural regimes- factors influencing choice of regimes, use of system analysis to determine regimes, models for evaluating silvicultural alternatives, development of silvicultural regimes to suit management objectives, optimum management strategies, silvicultural prescriptions for maximum production regime.

VI. 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;



Sr. No.	Topic	No. of Practical(s)
4.	To study the stand form, growth and stand density in major forest of the locality	2
5.	To carry out the productivity studies in different forests	2
6.	To study the impact of thinning in different periodic blocks/ selection forest	2
Total		16

I. Course Title : Forest Biometry

II. Course Code : SAF 502

III. Credit Hours : 1+1

IV. Aim of the course

To develop understanding of students about tree and stand measurements, forest inventory and yield concepts.

V. Theory

Unit I

Measurement of tree parameters. Determination of tree age and dendrochronology for growth history and climate change studies.

Unit II

Estimation of volume, growth and yield of individual tree and forest stands. Preparation of volume tables. Application of yield and stand tables.

Unit III

Forest inventory, sampling methods adopted in forestry, Use of GIS in forest inventory. Quantification of regeneration and stand establishment. Measurement of crown density and crown ratios. Simulation techniques. Growth and yield prediction models – their preparation and applications.

VI. Practical

- Calculations of volume of felled as well as standing trees;
- Volume table preparation;
- Application of different sampling methods;
- Preparation of yield and stand table;
- Quantification of regeneration and stand establishment;
- Measurement of crown density and crown ratios;
- Crown profiling of trees and stand;
- Dendrochronological studies.

VII. Suggested Reading

- Chaturvedi AN and Khanna LS. 1994. *Forest Mensuration*. International Book Distributor.
- Ram Parkash 1983. *Forest Surveying*. International Book Distributor.
- Sharpe GW, Hendee CW and Sharpe WE. 1986. *Introduction to Forestry*. McGraw-Hill.
- Simmons CE. 1980. *A Manual of Forest Mensuration*. Bishen Singh Mahender Pal Singh, Dehradun.

- I. Course Title : Silvicultural Practices
II. Course Code : SAF 503
III. Credit Hours : 1+1

IV. Aim of the course

To acquaint the students with the advanced silvicultural practices in forestry with particular reference to commercial and short rotation forestry.

V. Theory

Unit I

Silviculture under changing context of forestry- silviculture and ecosystem management, stand dynamics, silvicultural practices for pure and mixed stand, even aged and uneven aged stand – silvicultural practices for changing climatic conditions.

Unit II

Silvicultural practices for natural and artificial regeneration – Ecology of regeneration, forest site management- enrichment of site – quality classes and site index models – stand density – spacing and tree growth – forest vegetation management – techniques for early stand growth- tending operations. Biomass allocation: belowground and aboveground. Changing trends in adoption of silvicultural systems.

Unit III

Stand development – stages- crown dynamics, Crown Competition factor, Maximum crown area, thinning – pruning – response of trees and impact on wood quality, salvage cutting – improvement felling and enrichment planting – management of weeds, Invasive weeds in forests, Silvicultural practices for short rotation forestry- coppice forestry, Continuous cover forestry.

Unit IV

Site specific selection of tree species. Precision silviculture –silvicultural practices for important fast growing trees and bamboos of India- *Populus species*, *Neolamarkia cadamba*, *Eucalyptus sp.*, *Casuarina sp.*, *Tectona grandis*, *Melia dubia*, *Dalbergia sissoo*, *Gmelina arborea*, *Leucaena leucocephala*, *Ailanthus excelsa*, *Azadirachta indica*, *Swietenia macrophylla*, *Dendrocalamus sp.*, *Bambusa sp.*, – Mechanization of silvicultural practices.

VI. Practical

- Visit to different forest sites to study the influence of site factors on composition;
- Determination of site quality;
- Studies on stand structure and composition of different forest types;
- Practicing pruning and its impact on wood quality;
- Characterizing methods of thinning;
- Working out intensity of thinning;
- Study of stand densities in natural forest stand and plantation stand;
- Afforestation techniques, Wood management techniques for forest tree crops;
- Planning and designing a tree planting programme;
- Exercise on precision silviculture practices;
- Exercise on mechanized silvicultural practices.

VII. Suggested Reading

- ✓ Daniel TW, Helms JA and Baker FS. 1979. *Principles of Silviculture*. McGraw-Hill Book Company.
- ✓ Julius E. 1992. *Plantation Forestry in the Tropics*. Oxford University Press.
- Khanna LS. 1996. *Principle and Practice of Silviculture*. International Book Distributors.
- Khanna LS. 2015. *Theory and Practice of Indian Silviculture Systems*. Bio-Green Publisher.
- Lamprecht. 1986. *Silviculture in the Tropics*. Verlag Paul Parey, Hamburg und Berlin.
- Nyland RD, Laura S, Kenefic, Kimberly K, Bohn and Susan LS. 2016 *Silviculture: Concepts and Applications* (III edition), Kindle Edition, USA.
- Shepherd KR. 1986. *Plantation Silviculture*. Springer.
- Smith DM, Larson BC, Ketty MJ and Ashton PMS. 1997. *The Practices of Silviculture- Applied Forest Ecology*. John Wiley & Sons.



I. Course Title : Agroforestry Systems

II. Course Code : SAF 504

III. Credit Hours : 2+1

IV. Aim of the course

To impart knowledge on the concept of agroforestry as a sustainable land use including diagnosis and design methodologies; overview of agroforestry and case studies.

V. Theory

Unit I

Agroforestry: objectives, importance, potentials and limitations for implementations. Land capability classification and land evaluation. Basis of classification of agroforestry systems and principles, indigenous vs. exotic, intraspecific variations, crown architecture of tropical/ temperate trees. Ideotype concept for selection of multipurpose trees. Nitrogen fixing trees. Overview and case studies of different agroforestry systems.

Unit II

Structural and functional attributes of agroforestry systems, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, silvopastoral systems, shelter-belts and windbreaks, energy plantations and home gardens.

Unit III

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

Unit IV

Community forestry and social forestry, linear strip plantations.

Unit V

Trends in agroforestry systems research and development, Diagnosis and Design -PRA-RRA tools in agroforestry problem diagnosis.

Unit VI

Climate Change mitigation and adaptation through agroforestry- climate negotiations- LULUCF- agroforestry options.

VI. Practical

- Survey and analysis of land use systems in the adjoining areas;
- Study of tree crown architecture;
- Design and plan of suitable models for improvement;
- PRA-RRA tools in agroforestry problem diagnosis.

VII. Suggested Reading

- Buck LE, Lassoie, Fernandes ECM 1999. *Agroforestry in Sustainable Agri. Systems*. CRC Press.
- Kumar BM and Nair PKR. 2006. *Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry*. Springer publication.
- Kumar BM and Nair PKR. 2013. *Carbon Sequestration Potential of Agroforestry Systems: Opportunities and Challenges (Advances in Agroforestry)*. Springer publication.
- Nair PKR and Latt 1998. *Directions in Tropical Agroforestry Research*. Kluwer.
- Nair PKR, Rai MR and Buck LE. 2004. *New Vistas in Agroforestry*. Kluwer

I Course Title : Interactions In Agroforestry Systems

II Course Code : SAF 505

III Credit Hours : 1+1

IV. Aim of the course

To impart knowledge to the students regarding tree-crop interaction, their quantification and techniques to neutralize the negative tree- crop interactions.



V. Theory

Unit I

Tree-crop interphase- biological factors affecting form and function in woody and non-woody plant mixtures. Nature and types of interactions- positive and negative, aboveground and belowground interactions- competition, complementarity in resource sharing.

Unit II

Method for quantifying interactions, principles of resource capture and utilization of light and water, nutrition and space. Tree-soil-crop interactions- nitrogen fixing trees interactions in agroforestry. Allelopathy. Use of radioisotopes in tree-crop interaction studies. Root distribution of trees and crops-competition and/or complementarity. Animal-tree-crop interaction.

Unit III

Management options to neutralize negative (competitive) interactions, tree husbandry practices for alleviating competition- tree density manipulation, pruning, mixture of trees and herbaceous crops.

VI. Practical

- Different methods for quantifying interactions;
- Studies on allelopathy;
- Effect, microclimate modifications, different plant mixtures, tree-soil-crop interactions;
- Estimation of Land Equivalent Ratio, Estimation of competition indices;
- Measurement and interpretation of light interception in agroforestry systems;
- Interpretation of yield responses to shelter, soil water and drainage measurement, transpiration measurement, quantifying root distribution.

VII. Suggested Reading

- Avery MA, Cannel MGR and Ong CK. 2005. *Biophysical Research for Asian Agroforestry*. Oxford and IBH Publishing Co. Pvt. Ltd.
- Mac Dicken, KG and Vergara NT. 1989. *Agroforestry-classification and Management*.
- Nair PKR. 1993. *An Introduction to Agroforestry*. Kluwer Academic Pub.
- Ong CK and P Huxley. 2002. *Tree-Crop Interactions- A Physiological approach*, CAB International.
- Patra AK. 2013. *Agroforestry-Principles and Practices*. New India Publishing AGENCY, New Delhi (India).



Sr. No	Topic	No. of Lecture(s)
12.	Analog forestry for site productivity and carbon value	01
13.	Expanding forest and tree cover area- TOF sector in India	02
14.	Role of canopy in regulating functional inputs to stand; canopy and forest continuum, Continuous Cover Forestry	02
15.	Silviculture of old growth stands and sacred grooves- their ecological significance and biodiversity values	02
16.	Carbon sequestration potential of Trees Outside forests (TOFs), homegardens and urban forests	02
Total		32

I. Course Title : Trees and Shrubs for Agroforestry

II. Course Code : SAF 510

III. Credit Hours : 1+1

IV. Aim of the course

To make students familiar with trees and shrubs (fruit, fodder and small timber) suitable for agroforestry.

V. Theory

Unit I

Introduction, importance of woody elements in agroforestry systems, their role in biomass production. Suitability of species for different purposes. Multipurpose trees in agroforestry systems. Fodder from trees/ shrubs and their nutritive value, propagation techniques.

Unit II

Role of nitrogen fixing trees/ shrubs. Choice of species for various agro-climatic zones for the production of timber, fodder, fuel wood, fibre, fruits, medicinal and aromatic plants. Generic and specific characters of trees and shrubs for agroforestry.

Unit III

Fruit crop and small timber trees and their need and relevance in agroforestry, trees suitable for various assemblage and their planting plan in different agroclimatic zones and agroforestry system. Intercropping in fruit orchards like Apple, Walnut, Jack fruit, Mango, Sapota, Pomegranate, Orange, Citrus, Guava, etc. Modification in tending and pruning operations and canopy management. Fertility management, yield and quality improvement.

VI. Practical

- Field survey and acquaintance with specialized features of trees, shrubs and fruit species and varieties for Agroforestry;
- Planting plans including wind breaks;
- Training and pruning of forest trees, shrubs and fruit trees for enhancing production in agroforestry system.

VII. Suggested Reading

- Dwivedi AP. 1992. *Agroforestry: Principles and Practices*. Oxford & IBH.
 Nair PKR, Rai MR and Buck LE. 2004. *New Vistas in Agroforestry*. Kluwer.
 Nair PKR. 1993. *An Introduction to Agroforestry*. Kluwer.

-
- I. Course Title : Economics of Agroforestry Systems
II. Course Code : SAF 511
III. Credit Hours : 2+1

IV. Aim of the course

To acquaint the students with principles of economics and use of economic tools in appraisal of the agroforestry systems. Evaluation of ecosystem services from agroforestry- economic and ecological aspects of agroforestry.

V. Theory

Unit I

Basic principles of economics applied to agroforestry. Financial measures.



Quantification and valuation of inputs and outputs- direct and indirect methods.

Unit II

Optimization techniques-Planning, budgeting and functional analysis. Role of time, risk and uncertainty in decision making. Agroforestry budgeting. Risk analysis, re-assessment.

Unit III

Financial and socio-economic analysis of agroforestry projects. Principles of financial management and harvesting, post harvest handling, value addition, marketing of agroforestry products including benefit sharing.

Unit IV

Valuation of ecosystem services in agroforestry and payment for ecosystem systems. Bankable agroforestry projects, incentives, tree insurance, etc. Certification process in agroforestry based carbon projects, carbon finance, etc.

VI. Practical

- Exercises on agroforestry production relationships;
- Preparation of agroforestry based enterprise, partial and complete budgets;
- Application of various methods in formulation and appraisal of agro-forestry projects;
- Case studies on harvesting, post harvest management and marketing of agro-forestry products;
- Valuation of ecosystem services in agroforestry and payment for ecosystem services.

VII. Suggested Reading

- Alavalapati JRR and Mercer D Evan. 2004 *Valuing Agroforestry Systems: Methods and Applications*. Kluwer Academic Publishers.
- Kant S and Janaki A. 2014. *Handbook of Forest Resource Economics*. Publisher: Routledge
- Nair PKR, Rai MR and Buck LE. 2004. *New Vistas in Agroforestry*. Kluwer Academic Publishers.
- Nair PKR. 1993. *An Introduction to Agroforestry*. Kluwer Academic Publishers.
- Ong CK and Huxley PK. 1996. *Tree Crop Interactions – A Physiological Approach*. ICRAF.
- Sullivan Gregory M, Susan Hoke M and Jefferson M. Fox (editors). 1992. *Financial and Economic Analyses of Agroforestry Systems. Proceedings of a workshop held in Honolulu, Hawaii. USA. July 1991*. Paia, Ill: Nitrogen Fixing Tree Association.
- Thampan PK. 1993. *Trees and Tree Farming*. Peekay Tree Crops Development Foundation.

- I. Course Title** : Tree Seed Technology
II. Course Code : SAF 512
III. Credit Hours : 2+1

IV. Aim of the course

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

V. 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 of 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

Determining 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. Storage of orthodox, recalcitrant and intermediate seeds, Fumigation and seed treatment.

VI. 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-causing organisms such as fungi, bacteria, virus and animal pests, recording, calculation and use of results of seed treatment.

VII. Suggested Reading

- Baldwin HI. 1942. *Forest Tree Seed of the North Temperate Regions*. Periodical Experts Book Agency, Delhi.
- Bedell PE. 1998. *Seed Science and Technology: Indian Forestry Species*. Allied Publisher Limited.
- Chin HF and Roberts EH. 1980. *Recalcitrant crop seeds*. Tropical Press Sdn. Bhd. Malaysia.
- Dutta M and Saini GC. 2010. *Forest Tree Improvement and Seed Technology*.
- Hong TD and Ellis RH. 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.
- ISTA. 1993. *International Rules for Seed Testing*. International Seed Testing Association, Zurich, Switzerland.
- Khullar P. et al. 1992. *Forest Seed*. ICFRE, New Forest, Dehra Dun.
- Leadem CL. 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.
- Umarani R and Vanangamudi K. 2004. *An Introduction to Tree Seed Technology*. IBD, Dehradun.
- Vanangamudi K. 2007. *Advances in Seed Science and Technology*: (Vol. 1. to 5).
- Willan RL. 1985. *A guide to forest seed handling*. FAO Forestry Paper 20/2, DANIDA Forest Seed Centre, Denmark and FAO, Rome.

Lecture Schedule

Sr. No.	Topic	No. of Lecture(s)
Theory		
1.	Introduction, trends and development in tropical, sub-tropical and temperate forestry and their influence on seed demand	03
2.	Seed problems, limiting factors in tree propagation and afforestation	01
3.	Reproductive biology of seed plants - development and maturation of seed bearing organs and seeds	03
4.	Morphology of fruit and seed - seed dispersal - ecological fruit and seed types	02

- I. Course Title** : Crops and Live Stock Management in Agroforestry
II. Course Code : SAF 514
III. Credit Hours : 2+0

IV. Aim of the course

To impart knowledge on interactions between tree and live stock including their management, principles of crops and fodder production in agroforestry.

V. Theory

Unit I

Choice of inter-crops for different tree species, sowing and planting techniques. Planting patterns, crop geometry, nutrient requirements, and weed management. Management of fodder tree species, thinning, lopping, pruning. Ecological and socio-economic interactions.

Unit II

Role of tree architecture and its management on system's productivity. Production potentials of fodder based agroforestry systems in different agro-climatic conditions and crop combinations. Importance of cattle, sheep and goat vis-à-vis agro-forestry systems. Feed and fodder resources in agro-forestry systems and live stock management.

Unit III

Nutrient analysis of forages derived from fodder trees/ shrubs. Nutrient requirement for various livestock and their ration computation with agroforestry forages and tree leaves. Forage and tree leaves preservation.



Unit IV

Calendars for forage crop production in agro-forestry systems including lopping schedules. Optimization of animal production. Animal products technology and marketing.

Unit V

Integrated Agroforestry Farming System.

VI. Suggested Reading

- Bran Powell. 2017. *Livestock Production and Management*. L & K Education.
- ✓ Kundu SS, Dagar JC, Prakash O, Chaturvedi and Sirohi SK. 2008. *Environment, Agroforestry and Livestock Management*.

1. Prof. (Dr.) Nagendra Prasad Todaria
Professor, Forestry and
Retd. Dean, School of Agricultural and Allied Sciences
HNB Garhwal University
Srinagar (Garhwal) – 246174
Mobile No: 9412079688
E-mail: nptfd@yahoo.com/ nagendratodaria@gmail.com

OR

House No. – 47, lane No. – 4
Vivekanandagram, Phase – 1, Jogiwala,
Dehradun - 248005

2. Prof. (Dr.) Sushil Kumar Gupta
Professor, Division of Agroforestry
SKUAST – J, Jammu
Chatha, Jammu – 18009
Jammu and Kashmir
Mobile No: 9419109684/ 6006144431
E-mail: sushilgupta67@rediffmail.com/ sushilgupta67g@gmail.com

3. Dr. Kunhamu T. K.
Professor and Head
Department of Silviculture and Agroforestry
College of Forestry, KAU,
Vellanikara – 680656
Thrissur, Kerala
Mobile No: 9495331771
E-mail: kunhamutk@gmail.com