

6. Prakash R., and Khanna, L.S. 2013. Theory and Practice of Indian Silvicultural system. International Book Distributors, Dehradun, India.
7. Shrestha T .B. Vegetation map of Nepal. NARMSAP, Kathmandu.

Second Year (1st Semester)/Semester III

FMS 301 Forest Genetics and Breeding

Course Number	Course Title	Credit (Th + Pr)
FMS 301	Forest Genetics and Breeding	3 (2 + 1)

SCOPE

This subject deals with the genetic diversity, and its factors and process, of the forest trees and overall forestry ecosystems which is the basis for the survival and vitality of the species and forests and their adaptation and evolution. The pedagogy of this course will include a combination of classroom learning, practical laboratory exercise, use of the Genetic Analyzing Software such as an integrated software for population genetic data analysis (Arlequin), and field excursions.

OBJECTIVES

- Learn about the importance of the genetic diversity, methods and techniques of its estimation and factors affecting the gain or loss of genetic diversity,
- Use appropriate sampling techniques for collecting genetic materials and handling of collected samples
- Understand the concepts of conservation and advanced genetics in tree breeding
- Demonstrate DNA extraction, electrophoresis, and Genetic Data analysis technique
- Develop skills in conducting genetic research with the limited supervision

EXPECTED OUTCOMES

Upon the completion of the course, students will be able to understand the concepts and principles of forest genetics and tree breeding and learn the importance of genetic conservation in plant species.

COURSE DESCRIPTION

UNIT 1. CONCEPT AND INTRODUCTION (4)

- 1.1 Cell structures, cytology, cell types
- 1.2 Chromosomes DNA, genes, locus, alleles, heterozygosity, homeozygosity
- 1.3 Cell division, mitosis, meiosis
- 1.4 Mutations, polymorphism
- 1.5 Gene flow and migration

UNIT 2. INTRODUCTION AND BASIC PRINCIPLES (8)

- 2.1. Forest Genetics: concepts, scope, history, importance and future
- 2.2 Basic principles
- 2.3. Molecular basis of inheritance- genome organization, gene structure and regulation
- 2.4. Transmission genetics-chromosomes, recombination and linkage
- 2.5. Genetic markers- morphological, biochemical and molecular markers
- 2.6. Population genetics- gene frequencies, inbreeding and factors of Evolution

UNIT 3. GENETIC VARIATION IN NATURAL POPULATION (4)

- 3.1. Within-population variation: genetic diversity, mating systems and stand structure
- 3.2 Geographic variation: races, clines and ecotypes
- 3.3 Evolutionary genetics: divergence, speciation and hybridization
- 3.4. Gene conservation: in-situ, ex-situ and sampling strategies

UNIT 4. DOMESTICATION, TREE BREEDING AND IMPROVEMENT (8)

- 4.1. Domestication, Tree improvement programs-structure, concepts and importance
- 4.2. Base populations-species, hybrids, seed sources and breeding zones
- 4.3 Phenotypic mass selection-genetic gain, choice of traits and indirect response
- 4.4. Genetic testing: mating designs, field designs and test implementation-Plus tree selection, progeny testing, provenance trial, Seed Production Area (SPA), BSO (Breeding Seed Orchard).
- 4.5. Advanced-generation breeding strategies-breeding population size, structure and management

UNIT 5. DEMESTICATION AND BREEDING OF FOREST TREES (8)

- 5.1 in situ genetic conservation
 - 5.1.1 Conservation of forest genetic resources within protected areas
 - 5.1.2 In situ conservation outside protected areas
 - 5.1.3 Potential and strategies for in situ conservation
- 5.2 Ex situ genetic conservation
 - 5.2.1 Ex situ genetic conservation
 - 5.2.2 Tissue culture
 - 5.2.3 Breeding seedling orchards
 - 5.2.4 Botanical gardens
 - 5.2.5 Potential and strategies for ex situ conservation

PRACTICAL

- Sample collection of genetic materials and handling of collected samples
- Morphological analysis
- Plant DNA extraction
- Gel electrophoresis
- Use of genetic software for the analysis of genetic data such as Arlequin

REFERNCES

- 1 Clark, A.G., Hartl, D.L. (1997). Principles of Population Genetics, Third Edition
- 2 Eriksson, G., Ekberg, I., Clapham, D. (2006). An introduction to Forest Genetics. Second Edition. ISBN 91-576-7190-7
- 3 Finkeldey, R. Hattemer, HH (2007). Tropical Forest Genetics. The Springers Publishers
- 4 Frankham, R., Ballou, J., Briscoe, D., & McInnes, K. (2004). A Primer of Conservation Genetics. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511817359
- 5 Freeland, J.R.(2005), Molecular Ecology, John Willey and Sons Publishers
- 6 Ide, Y. Ed. (2021).Genetics and Improvement of Forest Trees
- 7 Lörz, H. and Wenzel, G. (2005). Molecular Marker Systemsin Plant Breeding and Crop Improvement. Springer Publisher
- 8 MFSC, 2013. Country Report on the State of Forest Genetic Resources Nepal
- 9 Sandeep, K., and Fladung, M. (2004). Molecular Genetics and Breeding of Forest Trees.
- 10 Thomas B. Smith, Robert K.Wayne edited (1996): Molecular genetic approaches in conservation

- 11 Watson, James D., 1928. The Double Helix: a Personal Account of the Discovery of the Structure of DNA. London :Weidenfeld and Nicolson, 1981.
- 12 Weising, K., Nybom, H., Pfenninger, M., Wolff, K. and Kahl, G. (2005). DNA Fingerprinting in Plants Principles, Methods, and Applications, Second Edition

FPU 302: Forest/NTFPs Nursery Management

Course Number	Course Title	Credit (Th + Pr.)
FPU 302	Forest/NTFPs Nursery Management	3 (2 + 1)

SCOPE

This course deals with the Forest and Non-timber Forest Products (NTFPs) Nursery Management. It provides basic knowledge and skills in raising the seedlings of forest tree species and non-timber forest products including medicinal and aromatic plants. The course covers nursery concept and its construction, operation and management. The teaching style of the course will include combination of classroom leaning and field.

OBJECTIVES

- Understand the concept and objective of forest and NTFPs nursery establishment
- Design, layout and construction of nursery as per requirements
- Explain the economic important of trees and NTFPs to raise the seedlings in nursery for plantations
- Seed collection, extraction, storage and sowing in the nursery for seedling production
- Learn the method and technique of seed treatment before sowing for successful germination
- Explain plantation, cultivation and harvesting of trees and NTFPs

EXPECTED OUTCOMES

After the completion of the course, students will be able to understand how to operate, manage, and produce seedling of desired species and trees and NTFPS. Moreover, they will be able to make judgement for quality seedling and its economic vale and able to cultivate seedling of economically important species of trees and NTFPs.

COURSE DESCRIPTION

UNIT 1: INTRODUCTION (2)

- 1.1 Definition, concept and objectives of nursery
- 1.2 Importance of Forest / NTFPs nursery
- 1.3 General information of forest / NTFPs species for economic value
- 1.4 Introduction of economically important trees and NTFPs for cultivation

UNIT 2: NURSERY SITE SELECTION AND CONSTRUCTION (3)

- 2.1 Appropriate site selection, aspect and water availability
- 2.2 Area of nursery and capacity of seedling production
- 2.3 Compound wall, fencing, water tank and warehouse construction
- 2.4 Objective of seedling production and nursery bed construction (Bed size, number of polypot beds, germination beds and stump beds)
- 2.5 Nursery design and layout (Inspection road alignment)
- 2.6 Compost and garbage pit construction

UNIT 3: SOURCES OF SEEDS and SEED COLLECTION (10)

- 3.1 Identification / selection of mother trees
- 3.2 Marking of seed trees
- 3.3 Delineation, protection and management of seed collection area
- 3.4 Procurement of seeds of tree / NTFPs species
- 3.5 Phytosanitary certificate of seeds procured
- 3.6 Seed grading
- 3.7 Seed collection time of different tree/plant species
- 3.8 Maturity of tree/plant seeds
- 3.9 Seed drying, seed extraction, seed storage, seed viability and germination test
- 3.10 Seed treatment techniques
 - 3.10.1 Tree species (*Dalgergia sissoo*, *Acacia catechu*, *Anthacephalas chinensis*, *Melia azadiracta*, *Azadirachta indica*, *Pinus roxburghii*, *Cedrella toona*, *Alnus nepalensis*, *Artocarpus lakoocha*, *Juglans regia*)
 - 3.10.2 Medicinal and aromatic plant species (*Swertia chirayita*, *Phyllanthus emblica*, *Tinospora sinensis*, *Zanthoxylum armatum*, *Gultheria fragrantissima*, *Piper longum*, *Acorus calamus*, *Taxus wallichiana*, *Asparagus racemosus*, *Rauvolfia serpentina*)

UNIT 4: NURSERY OPERATION (7)

- 4.1 Types of nursery (temporary and permanent)
- 4.2 Preparation of different types of nursery beds
(Sunken and raised bed; polypot, germination, stump and bare-root)
- 4.3 Seed treatment methods
- 4.4 Seed testing and certificate
- 4.5 Treatment and soil sterilization
- 4.6 Arrangement of seeds, polybpot, soil, sand and fertilizer and mixing soil, sand and fertilizer in appropriate ratio
- 4.7 Filling of polypots with soil
- 4.8 Plan for seedling production of desired species (polypot, stump or bare root)
- 4.9 Choice of species for seedling production
- 4.10 Seed sowing
- 4.11 Nursery equipment / tools and maintenance (spade, pick, sickle, water spray, trays, shovel, scissor, tray, hosepipe)

UNIT 5: NURSERY MANAGEMENT (5)

- 5.1 Weeding, pruning and watering
- 5.2 Prick out seedlings into polypots
- 5.3 Nursery shade preparation
- 5.4 Shifting of polypots and root pruning
- 5.5 Hardening off seedlings
- 5.6 Preparation of polythene tunnel (Green house effect)
- 5.7 Mulching
- 5.8 Stump preparation/ root-shoot cutting
- 5.9 Role of 'Nursery Naik'

UNIT 6: PLANTATION / CULTIVATION AND HARVESTING (3)

- 6.1 Field preparation and transplanting
 - 6.1.1 Field preparation (site preparation, cleaning and pitting)
 - 6.1.2 Transplanting (Handling of seedling, transportation, and distribution of seedlings in pits)
- 6.2 Harvesting, Processing and Marketing

- 6.2.1 Harvesting
- 6.2.2 Processing (drying, seasoning/treatment, storage and packing)
- 6.3 Marketing
 - 6.3.1 Tender
 - 6.3.2 Auction

PRACTICAL

1. Nursery construction (3)

- 1.1 Site selection
- 1.2 Design and layout
- 1.3 Bed construction
- 1.4 Fencing / compound wall

2. Seed collection and Extraction (4)

- 2.1 Mother tree identification
- 2.2 Seed collection and extraction
- 2.3 Seed cleaning and storage

3. Nursery Operation and Management (8)

- 3.1 Nursery bed preparation
- 3.2 Soil preparation
- 3.3 Polypot filling
- 3.4 Shade preparation
- 3.5 Polythene tunnel preparation (Green house for seed germination)
- 3.6 Seed treatment
- 3.7 Seed sowing
- 3.8 Watering
- 3.9 Mulching

REFERENCES

1. Chowdhury, S. 2003. Manual of Forest Utilization, Institute of Forestry, Tribhuvan University
2. Dwivedi, A.P. 1993. Non-Wood Forest Product. International Book Distributors, Dehradun.
3. Evans, J. and Turnbull, John W. 2004. Plantation Forestry in the Tropics, Third Edition, Oxford University Press. Oxford.
4. Ghosh, R.C. 1977. Handbook on Reforestation Techniques. Controller of Publication, Gov. of India, New Delhi.
5. GON, 2061B.S. Community Forestry NTFP Inventory Guideline 2061. Government of Nepal.
6. Hussein, A. 1993. Important Medicinal Plants and their Cultivation. Central Institute of Medicinal and Aromatic Plants, Council of Scientific and Industrial Research. Lucknow.
7. Jackson, J.K. 1994. Manual of Afforestation, Second ed. Vol. I & II. Forest Research and Survey Division, Kathmandu.
8. Kayastha, Baban Prasad. 1985. Silvics of Trees of Nepal. Community Forestry Development Project, Kathmandu. Nepal.
9. Kumar, N., Khade, J.B.M. Md. A., Rangaswami, P., Irulappan, I. 2004. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants. Oxford and IBH Publishing Co., New Delhi, India.
10. Majpuria, T.C. 1989. Religious and Useful Plants of India and Nepal. White Lotus Co. Ltd., Thailand.
11. Murty, T. Krishna. 2010. Minor Forest Products in India (Non-Timber Forest Products of India) BSP Books, Hyderabad.
12. Parajuli, D.P., Gyawali, A.R., and Shrestha, B.M. 1998. Manual of Important NTFPs of Nepal. Institute of Forestry, Tribhuvan University.

13. Royal Government of Bhutan, 2012. A Field Manual on Nursery Management and Cultivation of Chiraita (*Swertia Chirayita*). Department of Forests and Park Services, Royal Government of Bhutan.



FPU 303: Forest Resource Economics and Valuation

Course Number	Course Title	Credit (Th + Pr.)
FPU 303	Forest Resource Economics and Valuation	3 (3+ 0)

SCOPE

The course will start from orientation on basic micro-economic concepts to enable students to understand basic concept of forest economics and its distinguishing features. Bulky part is dedicated to economic tools to understand theoretical and practical approach to solve issues related to forest valuation, investment analysis, forest charges/taxes and project evaluation. Students will also get opportunity to learn about the economics of climate change with respect to forest adaptation and mitigation; and also get opportunity to learn about the emerging policy issues in Nepalese context with respect to global initiatives.

OBJECTIVES

- Facilitate students to expand their knowledge on theoretical concepts of forest economics
- Learn new skills to apply applied research in investigating effectiveness of basic economic tools in solving simple forestry problem
- Apply economic instruments in decision making process related to investment in forest management, and trade of ecosystem goods and services
- Familiarize with different valuation tools/ techniques used in the valuation of forests, provide technical input on optimal forest rotations based on the objectives of forest management plans
- Understand importance of forest accounting to appreciate the true value of forests beyond the GDP contribution

EXPECTED OUTCOMES

Students will understand to apply basic forest economic theory/tools to analyze problems and solve operational level issues related to forest management, investment decisions, and utilization of forest resources. They will be able to carry out simple financial analysis to compare returns from forest investments considering risk and uncertainty and acquainted on economics of forest carbon sequestration, pricing and trade; understand economic relationships of forests with other sectors and identify potential policy and operational level shifts in forestry in response to changes in other sectors.

COURSE DESCRIPTION

UNIT 1 INTRODUCTION (9)

1. Basic Elements of Supply and Demand
2. Supply and Demand: Elasticity and Applications
3. Demand and Consumer behavior
4. Theory of Production and Marginal Products
5. Economic Analysis of Costs
6. Introduction to Forest Economics

UNIT 2 MARKET FAILURE AND GOVERNMENT INTERVENTION (6)

1. Externalities
2. public goods
3. Regulatory and fiscal policies



UNIT 3 ECONOMIC VALUES OF FORESTS & INVESTMENT ANALYSIS (14)

1. Timber supply, Demand and pricing
2. Land allocation and multiple use of forests
3. Forest valuation & investment criteria
4. Unpriced Forest values
5. Compound interest and discounting formulae
6. Financial criteria and investment analysis
7. Forest valuation and cost-benefit analysis

UNIT 4 ECONOMICS OF SILVICULTURE (6)

1. The optimal Forest rotations
2. Timber Stand Improvement
3. Silvicultural & harvesting priorities
4. Economics of mixed land use

UNIT 5 ECONOMICS OF FORESTS, CLIMATE CHANGE AND BIODIVERSITY (5)

1. Resilience of Forests to Climate change
2. Economics of Forest carbon sequestration
3. Forest Carbon trade
4. Forests and Biodiversity

UNIT 6 EMERGING ISSUES IN FOREST ECON (5)

1. Political economy of Forestry
2. Tradeoff in conservation and development planning
3. Twelve unresolved questions in Forest economics
4. Forest accounting

REFERENCES

1. Duerr, W. A. 1960. Fundamentals of Forestry Economics. McGraw Hill, New York.
2. Gregory, R. 1972. Forest Resource Economics. Ronald Press, New York.
3. Randall, A. 1981. Natural Resource Economics., University of Kentucky Press, Lexington
4. Little I.M.D. and J.A. Mirrlees 1974. Project Appraisal and Planning for Developing Countries. Arnold Hunemam Publishers India
5. FAO, 1979. Economic analysis of Forestry Project. Forestry Papers 17-1, 17-2.
6. Price, C. 1989. The Theory and Application of Forest Economics. Basil Blackwell Ltd., 108 Cowley Road, Oxford, UK.
7. Ahmed V. and Michael B. 1990. Monitoring and Evaluating Development Projects. The South Asian Experience, the World Bank, Washington D.C. EDI Seminar Series. 91 pp.
8. Stefano P. and et.al. (Eds); 2002: Selling Forest Environmental Service: Market-based Mechanisms for Conservation and Development. Earthscan, UK and USA
9. Shashi K. and Janaki Alavalapati R.R. (Eds), 2014. Handbook of forest resource economics. Routledge, NY, USA



FPU 304 : Forest Utilization and Wood Technology

Course Number	Course Title	Credit (Th + Pr.)
FPU 304	Forest Utilization and Wood Technology	3 (2 + 1)

SCOPE

The course synthesizes multi-disciplinary knowledge in the biological and physical science of wood and its industrial application with their technology. Improve understanding of the qualitative, quantitative and futuristic aspects of wood science and technology. In addition, build capacity through the interaction of industrial visits, study tour, and excursions.

OBJECTIVES

- Develop basic skill to identify the structure and properties of important timber species.
- Be able to identify and explain the timber species physical properties, strength, and mechanics of timber engineering
- Understand and processing knowledge and techniques in the manufacture of solid and composite wood products.

EXPECTED OUTCOMES

- Identify the different properties and categories of wood as raw material and products
- Develop competency to pursue professional careers in wood technology in the area of forest based industries as a raw material, wood as natural resource and to tackle the problems related to wood as basic material to manufacture various useful products.

COURSE DESCRIPTION

UNIT 1. TIMBER HARVESTING AND LOGGING (6)

- 1.1 Importance, principle, and types of sawmilling and conversion
- 1.2 Existing mechanism and practices of government, community and private timber harvesting and processing (auction, marking, felling, stacking, transport, etc.)
- 1.3 Modern techniques and technology of conversion of lumber and sawn wood
 - 1.3.1 Harvesting planning (Season, rules and appropriate technology)
 - 1.3.2 Methods of harvesting (Clear cutting, Shelter wood and Selection systems).
 - 1.3.3 Tools used in harvesting and logging
 - 1.3.4 Extraction of logs (sliding, skidding, cable yarding etc.)
 - 1.3.5 Grading and storage of logs
 - 1.3.6 Treatment plant: seasoning and preservation of timber
 - 1.3.7 Loading, unloading and transportation of logs (land, water and air)
 - 1.3.8 Sawmill (large, medium and small)
 - 1.3.9 Layout of a lumber and sawn wood manufacturing plant
- 1.4 Import and export scenario of timber/lumber and sawn wood in Nepal

UNIT 2. WOOD ANATOMY, STRUCTURE AND PROPERTIES (6)

- 2.1 Wood anatomy: Importance, characteristics of commercial timber tree species leading to wood identification

2.2 Wood structure: Gross structure of wood (e.g. bark, sapwood/heartwood, growth rings, early and late wood, growth rings, wood grain and texture, pith), Minute structure of wood (e.g. vessels, wood parenchyma, tracheas, fibers, tyloses and other inclusions in pores, rays, pith flecks, ripple marks, intercellular canals)

2.3 Wood properties:

2.3.1 Physical properties of wood (weight, density, hardness, thermal and electrical conductivity and insulation, reaction of heat, sound, light and electricity on wood, thermal expansion, moisture content, porosity, colour, permeability and wood working qualities)

2.3.2 Mechanical properties of wood- influencing factors strength, hardness, compression of wood flexibility, elasticity, fissility and combustibility.

UNIT 3. COMPOSITE WOOD ADHESIVES AND WOOD PRODUCTS (5)

3.1 Animal glue, casein glue, blood albumin, soya bean and starch, silicate of soda glues

3.2 Synthetic glues: Phenolic and substituted Phenolic adhesives. Urea and melamine formaldehyde, epoxy and polyurethane adhesives. Polyvinyl adhesives

3.3 Importance of viscosity and setting time of glues and adhesives.

3.4 Chemical constituents of wood and their determination

3.5 Historical perspective of veneering and the manufacture of Plywood, Particle boards, Fibre boards, Block board, Flush door, Sandwich, impregnated wood, Wood plastic composite:

3.6 Manufacturing process, testing and their application of pulp and paper

UNIT 4. WOOD DEFECTS, TREATMENTS AND DRYING (5)

4.1 Wood defects: natural wood defects during processing, manufacturing, seasoning; wood destroying agents; Defects and their manipulation in logs and sawn form

4.2 Wood treatment: Importance and principles of wood preservation, Preservative properties and treatment of different types; chemicals and wood extractive preservatives, methods of treatment; application of treatment

4.3 Wood seasoning: Importance and principles of wood seasoning; Staking methods; Methods of seasoning: Air, Kiln, Electrical and Solvent seasoning.

UNIT 5. WOOD WORKING TECHNOLOGY (6)

5.1 Layout of wood workshop. Benefits of mechanization as against traditional carpentry tools; Circular saw and range of jobs; Saws for panel products, radial arm saws, cross cut-trim saws.

5.2 General features and designs of wood working machines viz. planner, grinder, sanders mortiser, tenonner, molders, routers, turning lathes and drill-boring machines. Universal testing machines (UTM), copying lathes, four side planners-cum-molder and CNC router.

5.3 Portable power tools and dowel making machines, Brushing, spraying, electrostatic spraying, powder coating, UV curing; Precautions in the use of finishing materials with special reference to polyurethane finishes

UNIT 6. TIMBER GRADING AND ENGINEERING TECHNOLOGY (4)

6.1 Concept and importance of grading (visual stress and machine stress) to non-destructive testing in wood utilization sectors

6.2 Strength, properties and classification of structural timber

6.3 Dimensional optimization for beams columns and associated structural dimensions in a product

6.4 Minimum dimensions of sawn timber essential for timber engineering design

6.5 Technology improvement for utilization of under used timber species

PRACTICAL

1. Identification of timber species based on physical features and anatomical features.
2. Visit Forest Based Industries: Adhesives, Plywood, Particle board, Fibre board, Wood treatment plant, Wood drying, Match, Paper and pulp, Cutch and Katha, Timber Engineering, Furniture workshop.
3. Testing in laboratory: Adhesive viscosity, pH, Solid content, abrasion test, adhesion test, load bearing capacity (shear force and bending moment)
4. Grading of logs, Chhata making and harvest record keeping practice
5. Timber Engineering, strength and structural timber classification

REFERENCES

1. Brown, H. P. 1985. Manual of Indian Wood Technology. International books and periodicals supply service, New Delhi, India.
2. Chauhan, L. and Rao, V. R. 2003. Wood Anatomy of Legumes of India: Their Identification, Properties and Uses, Publisher Bishen Singh Mahendra Pal Singh, New Delhi, India
3. De Zeeuw, A.J. and Panshin, C. 1980. Textbook of Wood Technology, New York: McGraw Hill Book Company.
4. Forest Products Laboratory. 2010. Wood handbook—Wood as an engineering material. General Technical Report FPL-GTR-190. Madison, WI: USDA, Forest Service, Forest Products Laboratory.
5. FRI 1970. Indian Forest Utilization, Volumes I and II, Forest Research Institute (FRI), Publication Dehradun, India.
6. Haygreen, J.G. and Bowyer, J.L. 1982. Forest Products and Wood Science: An Introduction Iowa State University Press/Aims.
7. Negi, S.S. 1997 Wood Science and Technology, International book distributors, India.
8. Panshin, A.J., De Zeeuw, C.D. and Brown, H.P. 1964. Textbook of Wood Technology, Vol I. Structure, identification, uses and properties of commercial woods. McGraw Hill Book Company.
9. Parajuli, D., Chowdhary S.D, Gyawali A.R. and Shrestha, B.M., 1998. Manual of Important Woods of Nepal. Institute of Forestry, ITTO Project, TU.
10. Pearson, R. G. and Wheeler, E. A. 1981. Computer Aided Identification of Hardwood Species. IAWA Bull. n. s., Vol. 2 (1). Pp 37-40.
11. Rao, K. R. and Juneja K. B. S. 1992. Field Identification of 50 Important Timbers of India. ICFRE, Dehradun.
12. Trotter, H. 1982. Manual of Indian Forest Utilization. FRI & College, Dehra Dun.
13. Wadoo, M. S. 1992. Utilization of Forest Resources. IDRIS Publication.



FMS 305: Statistics and Research Methods

Course Number	Course Title	Credit (Th + Pr.)
FMS 305	Statistics and Research Methods	3 (2 + 1)

SCOPE

The course will increase understanding on general concepts, meaning & use of statistics & develop basic skills for computing & interpreting social & bio-physical data and their applications using computer software in applied research. In addition, the course aims to help B.Sc. students in selecting and use of a set of research methods and tools for data collection as well as to carry out the analysis

OBJECTIVES

- Demonstrate the concepts of descriptive statistical measures, probability distribution and their uses in forestry research.
- Demonstrate basic concepts of hypothesis testing, and correlation and regression analysis.
- Understand meaning and types of research and their characteristics
- Use appropriate data collection method, carryout analysis and interpret the result
- Prepare scientific research report

EXPECTED OUTCOMES

Students will demonstrate ability to develop their research proposal, collect data using appropriate method, know the appropriate use of statistics, and develop basic skills for computing & interpreting the data, their applications using computer software in applied forestry research.

COURSE DISCRPTION

UNIT 1. DESCRIPTIVE STATISTICS (4)

- 1.1 Introduction
- 1.2 frequency distribution: discrete, continuous
- 1.3 Bar diagram, Histogram, and Ogive
- 1.4 Measure of central tendency and dispersion
- 1.5 Measure of skewness and kurtosis

UNIT 2. PROBABILITY (8)

- 2.1 Terminology used in probability
- 2.2 Introduction and definition of probability
- 2.3 Addition and multiplicative theorems
- 2.4 Probability mass density functions
- 2.5 Mathematical Expectations
- 2.6 Distribution function
- 2.7 Binomial distribution
- 2.8 Normal distribution

UNIT 3. CORRELATION AND REGRESSION (6)

- 3.1 Simple linear correlation (scatter diagram, Karl Pearson's and Spearman's rank), properties of correlation coefficient
- 3.2 Simple linear regression, properties of regression coefficients

- 3.3 Coefficient of determination

UNIT 4. HYPOTHESIS TESTING (4)

- 4.1 Definition of different terms (statistical hypothesis, types of errors, level of significance, critical region, degrees of freedom),
- 4.2 Procedure of testing of hypothesis,
- 4.3 Z-test, T-test, F test, Chi-square test

UNIT 5. RESEARCH, PROPOSAL RESEARCH & ITS COMPONENTS, RESEARCH DESIGNS (4)

- 5.1 Research purpose concepts and research problem
- 5.2 Scientific research and its characteristics
- 5.3 Research design and sampling designs.

UNIT 6. DATA COLLECTION, ANALYSIS AND REPORT WRITING (6)

- 6.1 Primary and secondary data
- 6.2 Instrument development, pre-testing and revising instruments, test of validity and reliability of instruments
- 6.3 Various data collection methods: Observation, interview, questionnaire participatory methods
- 6.4 Preparation for field work.
- 6.5 Processing and analysis of data, writing research report and scientific paper

PRACTICALS

1. Computations of various measures of central tendency and their interpretations
2. Computations of various measures of dispersion and their interpretations
3. Normal distribution and tests of normality
4. Test of significance of various parametric and non-parametric tests
5. Tests for the co-efficient of ordinary least square regression models
6. Research project (each student picks up an issue and develops a full research proposal).

Software: The practical of the course will be taught using statistical software: SPSS or STATA or R or MS Excel.

REFERENCES

1. Chapin, P.G. (2004). Research Projects and Research Proposals. A Guide for Scientists Seeking Funding. Cambridge University Press, UK.
2. FAO (1999). A Statistical Manual For Forestry Research. Forestry research support program, for Asia and the Pacific, Food and Agricultural Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok.
3. Gupta, S. C. Kapoor, V.K. (1994). Fundamentals of Mathematical Statistics, 4th edition. Sultan Chand & Sons; 23, Daryaganj, Delhi.
4. Kerlinger, F.N. (2004). Foundation of Behavioral Research. Surjeet Publications, New Delhi, India.
5. Kothari, C.R. (2005). Research methodology, Methods and techniques. New Age International (P) Limited, New Delhi.
6. Kumar, R. (2012). Research Methodology, a step-by-step guide for beginners. Sage Publications Private Limited, New Delhi, India.
7. Lannon, J. M. (1988). Technical Writing. Scott, Freshman and Company, Glenview, Illinois.
8. Raj, H. (2005). Theory and Practice in Social Research, Third Edition. Surjeet Publications, New Delhi, India.