

9. Walliman, N. (2006). Social Research Methods. Sage Publications, New Delhi, India.  
 10. Young, P.V. (1996). Scientific Social Surveys and Research. Prentice-Hall, New Jersey, USA.

## Second Year (2<sup>nd</sup> Semester)/Semester IV

### FMS 351: Principle and Practices of Silviculture

Course Number	Course Title	Credit (Th + Pr.)
FMS 351	Principles and Practices of Silviculture	3 (2 + 1)

### SCOPE

Silviculture has its foundations in the biologic and ecological sciences which determine ecologically appropriate alternatives to pursue on particular *stand*, and how different management practices likely affect the growth and regeneration. Further, silviculture also responds to economic (financial, social, and institutional) and administrative/managerial concerns. Overall, understanding the philosophy and principles of silviculture, role of a silviculturist, major reproduction methods, and silvicultural treatments through classroom lectures and field excursions.

### OBJECTIVES

- Understand silviculture and its place in forest resource management, silviculture in the changing context of forestry, and its challenges
- Enable planning a silvicultural treatment or strategy, and their limitations-
- Gain knowledge and application skills of silvicultural methods of forest regeneration;
- Understand the role of silvicultural treatments in sustainable forest management (*even-flow sustained yield*) and assess ecological effects of silvicultural measures.

### EXPECTED OUTCOMES

On completion of this course, Student will familiarized with types of silvicultural (reproduction) methods and treatments variants and their ecological and economic implications, Familiarized with classical and current silvicultural strategies applied in Nepal and evaluate these with regard to forestry objectives, Enabled to design and apply silvicultural systems for CF user groups and forest department on appropriate silvicultural practices.

### COURSE DESCRIPTION

#### UNIT I. SILVICULTURE AND FORESTRY (2)

- 1.1 Philosophy and Principles of Silviculture
  - 1.1.1 Philosophy of Silviculture
  - 1.1.2 Basic principles that inform the practice of Silviculture
- 1.2 Silviculture and the changing context of forestry
  - 1.2.1 Sustained yield management, even-flow yield management
  - 1.2.2 Multiple use, ecosystem management, and ecological forestry
  - 1.2.3 Forest landscape management
- 1.3 Challenges for Silviculture
- 1.4 Role of a Silviculturist
  - 1.4.1 The changing nature of Silviculture
  - 1.4.2 Silviculture as problem solving



**UNIT 2. SILVICULTURAL SYSTEM- OVERVIEW (4)**

- 2.1 Disturbance and Functionality
  - 2.1.1 Ecologic, institutional and social dimensions of the functionality of a forest *stand*
- 2.2 The Silvicultural system as a plan for management
  - 2.2.1 Stage of *stand development*
  - 2.2.2 Character and objectives of silvicultural systems
  - 2.2.3 Importance of Silviculture for sustainable management of forests
- 2.3 Regeneration methods and their implications
  - 2.3.1 Ecologic and economic factors
  - 2.3.2 Regeneration methods and their role in Silviculture
  - 2.3.3 Comparison between even- aged and uneven-aged stands
- 2.4 Deadwood in Forest ecosystem
  - 2.4.1 Definition and deadwood types
  - 2.4.2 Deadwood assessment: parameters, deadwood inventory
  - 2.4.3 Functions and importance of deadwood in forest ecosystem

**UNIT 3. MAJOR SILVICULTURAL SYSTEMS AND THEIR APPLICATIONS (12)**

- 3.1 Clearcutting
  - 3.1.1 Clearcutting as a regeneration method
  - 3.1.2 Effect on environmental conditions
  - 3.1.3 Alternating the configuration
- 3.2 Uneven-aged regeneration methods
  - 3.2.1 The role of a regeneration method in Selection System
  - 3.2.2 Single-Tree Selection method (Concept, Application, Ecologic effects)
  - 3.2.3 Group Selection method (Concept, Application, Ecologic effects)
  - 3.2.4. Integrating Single-Tree and Group Cutting
- 3.3 Shelterwood methods
  - 3.3.1 Uniform Shelterwood
  - 3.3.2 Reserve (irregular) Shelterwood
  - 3.3.3 Strip- and Group Shelterwood
- 3.4. Seed- Tree Method
- 3.5 Coppice Silviculture
  - 3.5.1 Coppice methods based on stump sprouting
  - 3.5.2 Short- and mini-rotation coppice systems
  - 3.5.3 Coppice methods based on root suckers
  - 3.5.4 Setting rotation length in coppice systems
  - 3.5.5 Advantage and disadvantages of Simple Coppice Systems
  - 3.5.6 Alternative coppice systems
    - 3.5.6.1 Coppice-with-Standards and Compound Coppice
    - 3.5.6.2 Conversion from Coppice to High-Forest Systems

**UNIT 4 RELEASE TREATMENT AND TIMBER HARVESTING (5)**

- 4.1 Early release treatment
- 4.2 Weeding
- 4.3 Cleaning
- 4.4 Liberation
- 4.5 Timber harvesting as a tool of Silviculture
  - 4.5.1 Timber harvesting and Silviculture
  - 4.5.2 Timber harvesting Systems
  - 4.5.3 Silvicultural requirements of logging



#### 4.5.4 Reduced Impact Logging

### UNIT 5 THINNING, PRUNING, IMPROVEMENT CUTTING AND SALVAGE/SANITATION CUTTING (6)

#### 5.1 Thinning

##### 5.1.1 Comparing thinning methods and thinning intensity

5.1.1.1 Low thinning

5.1.1.2 Crown thinning

5.1.1.3 Selection thinning

5.1.1.4 Mechanical thinning

5.1.1.5 Free thinning

##### 5.1.2 Effects of thinning

5.1.2.1 Effects of thinning on growth of an Individual tree

5.1.2.2 Effects of thinning on volume production of a forest *stand*

5.1.3 Other considerations: timing of a first thinning, setting a thinning interval

5.2 Pruning: Pruning techniques, effects on growth, timing of a first pruning, tools and equipment

5.3 Improvement Cutting

5.4 Salvage and Sanitation Cutting

### UNIT 6 CHOICES AND FORMULATION OF SILVICULTURAL SYSTEMS (4)

6.1 Factors to be considered while selecting and formulating a silvicultural system

6.1.1 Objective of the forest owner

6.1.2 Silvical characteristics of the constituent species

6.1.3 Natural patterns of community regeneration and development

6.1.4 Ways the physical environment affects tree growth and reproduction

6.1.5 Ecologic outcomes of the treatments at a larger scale

6.1.6 Costs and benefits (amount, kinds) of the implementation of the treatment

6.2 Planning a Silvicultural Treatment

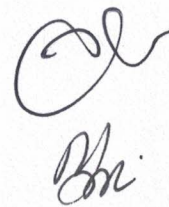
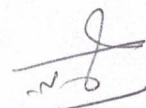
### PRACTICALS

1. Silvicultural systems: Visit Divisional Forest Office or Community-based User Groups implementing both: Selection system and Shelterwood system for understanding planning of the silvicultural system and assess their effectiveness and efficiency.
2. Timber harvesting as a tool of Silviculture: Visit timber harvesting sites and discuss with DFO and users about timber harvesting planning, procedures, and post harvesting operations
3. Coppice system demonstration sites visit
4. Pruning and thinning exercise

### REFERENCES

1. Aryal, U., Neupane, P.R., Rijal, B., Manthey, M., 2022. Timber losses during harvesting in managed *Shorea robusta* Forests of Nepal. Land 11, 67
2. Chadwick, O., Larson, B.A., 1996. Forest Stand Dynamics, Updated Edition. John Wiley and Sons, New York
3. Christensen M., Rayamajhi, S., Meilby, H. 2009. Balancing fuelwood and biodiversity concerns in rural Nepal. Ecological modelling 220:4: 522-532
4. Elias, Applegate, G., Kartawinata, K., Machfudh, Klassen, A., 2001. Reduced Impact Logging Guidelines for Indonesia. Center for International Forestry Research, Jakarta, Indonesia
5. Fundação Floresta Tropical, 2001. Training Manual Reduced Impact Logging. [http://www.itto.int/files/itto\\_project\\_db\\_input/2350/Technical/FTCI%20Training%20Manual%20Reduced%20Impact%20Logging.pdf](http://www.itto.int/files/itto_project_db_input/2350/Technical/FTCI%20Training%20Manual%20Reduced%20Impact%20Logging.pdf)

6. Günter, S., Weber, M., Stimm, B., Mosandl, R., 2011. *Silviculture in the Tropics*. Springer; Chapter 1, 6, 23
7. IntechOpen 2012. *Forest Ecosystems - More than Just Trees* Eds. Juan A. Blanco and Yueh-Hsin Lo. INTECH <http://dx.doi.org/10.5772/1127>, ISBN 978-953-51-0202-1 eBook (PDF) ISBN 978-953-51-5230-9
8. Khanna, L.S., 2004. *Theory and Practices of Silvicultural System*. Khanna Bandhu, India
9. Köhl, M., Magnussen, S.S., Marchetti, M., 2006. *Sampling Methods Remote Sensing and GIS Multiresource Forest Inventory*. Springer-Verlag, Berlin; Chapter 6.1, 6.2
10. Lamprecht, H., 1989. *Silviculture in the Tropics: Tropical Forest Ecosystems and Their Tree Species-Possibilities and Methods for Their Long-Term Utilization*. Deutsche Gesellschaft fuer Technische Zusammenarbeit GmbH, Federal Republic of Germany, Eschborn
11. Nyland, R.D., Kenefic, L.S., Bohn, K.K., Stout, S.L., 2016. *Silviculture: Concepts and Applications*. Third Edition. Waveland Press, Inc.
12. Pearson, T.R.H., Brown, S., Casarim, F.M., 2014. Carbon emissions from tropical forest degradation caused by logging. *Environmental Research Letters* 9, 034017
13. Schlich, W.M., 2008. *Manual of Silviculture: Formation, Preservation and Treatments of Forests Trees*. Asiatic Publishing House, India; Chapter 4, section I
14. Smith, D.M., Larson, B.C., Kelty, M.J., Ashton, P.M.S., 1997. *The Practice of Silviculture: Applied Forest Ecology*. Ninth Edition, Ninth ed. John Wiley & Sons, Inc.
15. Troups, R.S., Jones, E.W., 1955. *Silvicultural Systems* Second Edition. Oxford University Press, p. 232





## FMS 352: Forest Management

Course Number	Course Title	Credit (Th + Pr.)
FMS 352	Forest Management	3 (3 + 0)

### SCOPE

This course covers the regulation, harvest scheduling and planning techniques that are central to modern forest management systems and approaches applied in national to international levels. It focuses on existing forest management practices adopted in Nepal based on the forest condition targeted at revenue generation of productive forest in sustained yield basis by addressing ecological, economic and social issues.

### OBJECTIVES

- Describe principles of forest management and explain effective and sustainable management activities according to forest type and condition.
- Value the forest resources from the social, ecological and economic perspective.
- Fix the rotation or felling cycle of forest based on species composition, economic importance and forest condition.
- Apply tools and techniques to regulate forest for managing the forest in sustainable fashion by applying appropriate decision-making criteria

### EXPECTED OUTCOMES

The students demonstrate knowledge and skill of forest management techniques and in particular enhanced caliber to apply scientific principles (rotation and yield) in the preparation of management plans of different forest types of Nepal.

### COURSE DESCRIPTION

#### UNIT 1. INTRODUCTION (5)

- 1.1 Forest management objectives with historical background
- 1.2 Forest management alternatives and analysis
- 1.3 Decision-making principles and models
- 1.4 Forest management strategies in Nepal.
- 1.5 Contribution of forest management to local, national, and international economy

#### UNIT 2. SUSTAINABLE FOREST MANAGEMENT (8)

- 2.1 Concept and practice of normal forest, growing stock and sustained yield
  - 2.1.1 Concept of forest normality and its implications
  - 2.1.2 Growing stock and its determination
  - 2.1.3 Prerequisites for sustained yield
  - 2.1.4 Limitations in Nepal's conditions
- 2.2 Concept of sustainable forest management
  - 2.2.1 Principle of sustainable forest management
  - 2.2.2 Criteria and indicators of sustainable forest management
  - 2.2.3 Implication of sustainable forest management in Nepal
- 2.3 Forest certification



- 2.3.1 Concept and importance of forest certification
- 2.3.2 Type and process of forest certification
- 2.3.3 Implication of forest certification in Nepal

### **UNIT 3. FOREST VALUATION METHODS (6)**

- 3.1 Common valuation techniques
- 3.2 Time value of money
  - 3.2.1 Interest rate
  - 3.2.2 Discount rate
  - 3.2.1 Inflation adjustment
- 3.3 Decision-making criteria
  - 3.3.1 Present net worth
  - 3.3.2 Benefit cost ratio
  - 3.3.3 Land expectation value
  - 3.3.4 Internal rate of return
    - Economic rate return
    - Financial rate of return
- 3.4 Risk and uncertainty evaluation
  - 3.4.1 Risk management
  - 3.4.2 Decision-making with uncertainty

### **UNIT 4. ROTATION (6)**

- 4.1 Concept and types of rotation
  - 4.1.1 Concepts of rotation in forest management
  - 4.1.2 Types of rotations and their importance
  - 4.1.3 Affecting factors in fixing the rotation
- 4.2 Rotation determination methods
  - 4.2.1 Biological criteria
  - 4.2.2 Financial/economic criteria
  - 4.2.3 Social/environmental criteria
- 4.3 Conversion in forest (species/system) and its importance

### **UNIT 5. FOREST REGULATION (14)**

- 5.1 Growing stock and its determination
- 5.2 Concepts of Normality (Normal Forest), requirements for Normal Forest, and its implication in Nepal
- 5.3 Forest Regulation
  - 5.3.1 Regulating plantation/even-aged forests
  - 5.3.2 Regulating natural / uneven-aged forests
  - 5.3.3 Regulation based on silvicultural system and site quality
- 5.4 Allowable cut methods
  - 5.4.1 Area control
  - 5.4.2 Volume control
  - 5.4.3 Stem control
  - 5.4.4 Combined area/volume/stem control

### **UNIT 6. FOREST RESOURCE MANAGEMENT PLAN (6)**

- 6.1 Forest resource management plan
  - 6.1.1 Concept, definitions, objectives and limitations of forest management plan
  - 6.1.2 Components of forest management plan



- 6.1.3 Forest management unit/institution
- 6.2 Preparation of forest management plan
  - 6.2.1 Data collection and map preparation
    - biophysical
    - socio-economical
    - Maps (resources, social)
  - 6.2.2 General format and their description
  - 6.2.4 Write up of management plan
  - 6.2.5 Updating of management plan

## REFERENCES

8. Clutter, J.C. (1992). Timber Management: A Quantitative Approach. Krieger Pub Co., Malabar, Florida.
9. Davis, L.S., Johnson, K.N. and Davis, K.P. (1987). Forest Management. McGraw Hill Book Company, New York.
10. Davis, L.S., Johnson, K.N., Bettinger, P. and Howard, T.E. (2005). Forest Management: To Sustain Ecological, Economic, and Social Values. Waveland Press Inc., Long Grove, Illinois.
11. FAO. (2015). Global Forest Resources Assessments 2015. How are the world's forest changing? Food and Agriculture Organization of the United Nations (FAO), Rome.
12. GoN various dates. Legal documents; Forest Policy, Regulation, and Act (Historical form). Law Book Distributors, Kathmandu.
13. Leuschner, W. A. 1984. Introduction to Forest Resource Management. John Wiley & Sons.
14. MFSC 2001. Guidelines for Community Forestry Development Program, Department of Forests, Ministry of Forest and Soil Conservation, Government of Nepal.
15. MFSC 2004. Community Forest Resources Inventory Guideline, Ministry of Forest and Soil Conservation, Government of Nepal.
16. MFSC 2017. Scientific Forest Management Guideline 2071, Ministry of Forest and Soil Conservation, Government of Nepal.
17. MFSC 2020. Criteria for Sustainable Forest Management (2078), Ministry of Forest and Soil Conservation, Government of Nepal (under revision).
18. Prakash, R. 1986. Forest Management, International Book Distributors, Deharadun, India.





## FPU 353: Forest Health and Protection

Course Number	Course Title	Credit (Th + Pr.)
FPU 353	Forest Health and Protection	3 (2 + 1)

### SCOPE

The course deals with natural and anthropogenic factors, resulting in the accelerated loss of important forest types, species and genes due to increased environmental pollution caused by forest fire. In addition, it integrates the three areas of Fire, Insects and Diseases into one text within the context of applied forest protection, (ecology, forest health and ecosystem management)

### OBJECTIVES

- Understand forest fire ecology, harmful factors of forest fire, its effect, control measures and fire fighting techniques application.
- Identify the characteristics, life history and control measures (protective and preventive) of important insect pests prevalent in major forest stands, principal tree species and seedlings in the nurseries.
- Identify the characteristics, life history and control measures (protective and preventive) of important disease pathogens prevalent in major forest stands, principal tree species and seedlings in the nurseries.

### EXPECTED OUTCOMES

Upon the completion of the course, students will be able to understand the importance and application of forest protection against the insect pests, disease pathogens and forest fire hazard. Moreover, they can generate ideas and learn the application of modern tools and techniques of forest protection suitable to Nepal.

### COURSE DESCRIPTION

#### UNIT 1. INTRODUCTION TO FOREST HEALTH AND PROTECTION (8)

- 1.1 The concept of forest health and role of forest protection
- 1.2 Ecological Principles
- 1.3 Scope, role and difficulties encountered in forest protection
  - 1.3.1 Protection against atmospheric and climatic agents: temperature, frost, drought, rainfall, wind, smoke/poisonous gas, thunder/lightening
  - 1.3.2 Protection against anthropogenic and infrastructure development: deforestation, encroachment, illegal felling, shifting cultivation, roads, canals, high tension lines, dams
  - 1.3.3 Protection against wild animals, birds and livestock grazing and trampling
- 1.4 Protection against injurious plants (weeds, climbers, parasites, alien and invasive species)

#### UNIT 2. FOREST FIRES AND CONTROL MEASURES (6)

- 2.1 Fire as a Physical Process
- 2.2 Fire Ecology and Fire Regimes (classification, factors influencing the spread and severity, vulnerability, and beneficial effects of fire as management tool)
- 2.3 Organizing for Fire Management (Fire damage assessment and rehabilitation of burnt areas; Prevention and control methods (mechanical, biological,



- social and educational; Modern firefighting and safety tools and techniques)
- 2.4 Fire Strategies for Forest Health (Nepal forest fire management strategy (2067), resilience framework and action plan)
  - 2.5 Wind and Forest Health

### **UNIT 3. INTRODUCTION TO FOREST ENTOMOLOGY (4)**

- 3.1 Basic concept of forest entomology
- 3.2 Development and metamorphosis of important forest insects
  - 3.4.1 Post embryonic development
  - 3.4.2 Metamorphosis
  - 3.4.3 Types of insect larvae-pupae
- 3.3 Harmful characteristics of forest insects and their management
  - 3.2.1 Insect defoliators and leaf-rollers
  - 3.2.2 Bark borer beetles
  - 3.2.3 Stem borer beetles
  - 3.2.4 Wood products insects and termites
  - 3.2.5 Insects of seed orchards, nurseries, and young plantations

### **UNIT 4. PRINCIPLES OF FOREST INSECT PEST MANAGEMENT (6)**

- 4.1 Insect control
  - 4.1.1 Applied control (chemical, mechanical, silvicultural, biological, genetics, pheromones and legal)
  - 4.1.2 Natural control (climate, typography, predators, parasites, insect diseases)
- 4.2 Evaluation, Monitoring and Management of Forest Insect Pests
  - 4.2.1 Forest pest management as unit of forest management
  - 4.2.2 Forest stand dynamics
  - 4.2.3 Pest population monitoring
  - 4.2.4 Prevention, suppression and regulation
  - 4.2.5 Forest Insect Quarantine

### **UNIT 5. PLANT DISEASE SYMPTOM AND CONTROL MEASURES (4)**

- 5.1 Plant diseases: disease causing organisms, symptoms, effects
- 5.2 Host-parasite relationship
- 5.3 Foliage disease and Rusts
- 5.4 Nursery disease and mycorrhizae
- 5.5 Root, stem and branch diseases
- 5.6 Factors affecting epiphytology of a disease

### **UNIT 6. PROTECTION AGAINST DAMAGE BY DISEASES (6)**

- 6.1 Classification of forest tree diseases (root diseases, heart diseases, wilt diseases)
- 6.2 Concept on pythium, polyporous, Fomes, Ganoderma, Poria, Lenzites, Fusarium, Armillaria, and their control
- 6.3 Symptoms, pathogenic organisms, mode of infection, life cycle and control measures for: Sal, Sissoo, Khair, Pine
- 6.4 Management of forest diseases and the deterioration of wood products

### **PRACTICAL**

1. Study of fire triangle and design of the fire line in forests
2. Regions of insect body and external morphology (simple and compound eyes, types of antenna, mouth parts, legs, etc)
3. Visit local nursery and nearby forest to study the insects, pests, mycorrhizae and diseases symptoms and their control.



4. Identification, collection and preservation of important forest insects and fungi.
5. Identification of important diseases of forest trees.
6. Histo-pathological study of diseased plant material.

#### REFERENCES

- 1 Edmonds, R.L., Agee, J.K. and Gara, R.I. 2020. FOREST Health and Protection. McGraw-Hill, Waveland Printers Inc. 630 pp, ISBN: 9780070213388
2. B.K. Bakshi 1976. Forest Pathology: Principles and Practice in Forestry. Forest Research Institute and Colleges, Dehradun, India 400 pp.
3. C.F.C. Beeson, 1941. The Ecology and Control of Forest Insects of India and Neighboring countries. Government Printer, South Africa. 767 pp
4. Peter Savil and Julian Evans 1986. Plantation Silviculture in the Temperate Regions, Oxford University Press; First edition. 250 pp
5. S.A. Graham and F.B. Knight. 1965. Principles of Forest Entomology. McGraw-Hill series in forest resources (USA).
6. Ralph C. Howley and Paul W. Shickel, 1948. Forest Protection. John Wiley and Sons Inc, London 2<sup>nd</sup> Ed. 355 pp
7. B. V. Spurr and S. H. Barnes, 1973. Forest Ecology. The Ronald Press Co., New York. 571 pp.
8. Shrestha, H.L, and Dhonju, H. 2014. Satellite Based Forest Fire Burned Area Assessment in Nepal from 2000 to 2013. Forestry Journal. 98-108.
9. L. S. Khanna 2015. Forest Protection. Khanna Bandhu, Dehradun, India, 232 pp.

172









## FPU 354: Forest Based Industry

Course Number	Course Title	Credit (Th + Pr.)
FPU 354	Forest Based Industry	3 (3 + 0)

### SCOPE

This course builds knowledge and understanding to identify, prioritize and plan for comprehensive industry and enterprise development, operation and management of timber and non-timber forest products. In addition, it will impart knowledge and skills regarding the simple analysis of manufacturing demand-supply value chain of timber and non-timber forest products and byproducts.

### OBJECTIVES

- Understand the concept and values of forest products and the prospects and problems of forest-based industry (FBI) functioning and its products and byproducts.
- Develop technical understanding of the timber and non-timber forest product industries operating in Nepal
- Develop knowledge in establishing and operating a forest based industry or enterprise also by taking into consideration a workable business plan.

### EXPECTED OUTCOMES

- Be able identify and manage the raw material, manufacturing technology, skill, employment, revenue, supply-demand and trade of timber and non-timber forest products in the manufacturing value chain
- Develop competency in the application of sustainable manufacturing (harvesting, processing and marketing) of timber and non-timber forest products (NTFPs)

### COURSE DESCRIPTION

#### UNIT 1. INTRODUCTION TO FOREST BASED INDUSTRY (6)

- 1.1 Primary, secondary, tertiary and quaternary industries
- 1.2 Forest products as food, medicine, fuel and shelter
- 1.3 Forest based raw materials potentials in the different physiographic zones and the provinces of Nepal
- 1.4 Contribution of FBI in the national and local economy (existing and potential)
- 1.5 Import and export statistics of raw and finished forest based products in Nepal
- 1.6 FBI- its scope, challenges, measures and promotion in Nepal
  - Ministry of Industry, Commerce and Supplies (MoICS), Nepal
  - Ministry of Forests and Environment (MoFE), Nepal
  - FNCCI – Forestry Enterprise Division, Nepal
  - Federation of Forest Based Industry and Trade, Nepal (FenFIT)

#### UNIT 2. CLASSIFICATION AND TYPES OF FOREST BASED INDUSTRY (4)

- 2.1 Categories of forest based industry and enterprise (timber, non-timber, by-product) – lumber, wood working, furniture, paper and pulp, tree extract, energy, etc.
- 2.2 Classification based on raw forest resources (timber, non-timber, mines–clay, sand, gravel, stone)



- 2.3 Classification based on ownership (Government, single, private, community, cooperative, shareholder, stakeholder, etc)
- 2.4 Legal classification and protocol (MoICS, MoFE)

### **UNIT 3. PLANNING AND ESTABLISHMENT OF FOREST BASED INDUSTRY (6)**

- 3.1 Forest based enterprise establishment (procedures) and management in coordination and linkages with line agencies and stakeholders
- 3.2 Arrangement of land, infrastructure, equipment, access (road and market) and finance
- 3.3 Arrangement of the skilled and unskilled human resources: Labour, skills, productivity and ageing
- 3.4 Arrangement of raw material: wood and non-wood supply, recycling and sustainability–e.g. long channel of timber and other raw material auction
- 3.5 Input and output flow in an industry: raw material, processing, production, storage, marketing, supply, inventory and accounting

### **UNIT 4. FORET BASED AND PRODUCT INDUSTRIES IN NEPAL (20)**

#### **4.1 FURNITURE INDUSTRIES**

- Importance and scope of furniture industry
- Range and scale of formal and informal furniture manufacturing in Nepal
- Input and output of furniture manufacturing industry and technology in Nepal
- Import and export scenario of furniture

#### **4.2 VENEER, MATCH AND WOOD BOARD INDUSTRIES**

#### **4.3 PAPER AND PULP INDUSTRIES**

##### **4.3.1 Paper and Pulp Industry**

- Importance scope, demand-supply of paper and pulp industry
- Raw materials availability and use: trees, grasses, agri-crops, recycled paper
- Paper and pulp manufacturing industries, scale and technology in Nepal

##### **4.3.2 Nepali Handmade Paper Industry**

- Importance, scope, demand and supply of Nepali handmade paper
- Handmade paper manufacturing industries, scale and technology in Nepal
- Raw materials used, their availability and sustainability

#### **4.4 TREE EXTRACT INDUSTRIES**

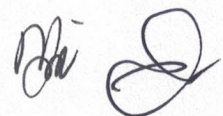
- Importance and scope of tree extract industry
- Major tree extract industries and their technology in Nepal
  - Katha and cutch
  - Resin, dyes and lac
  - Rubber
- Major naturally occurring species and plantations
- Process involved in raw materials extraction, processing, value addition and marketing, annual turnover, and consumption figures

#### **4.5 MEDICINAL AND AROMATIC PLANT INDUSTRIES**

- Importance and scope of MAPs
- Major industries of MAPs with species and products in Nepal
- Harvesting practices and processing technology in Nepal

#### **4.6 BAMBOO AND RATTAN INDUSTRIES**

- Importance and scope of bamboo and rattan industries
- Major bamboo, ningalo and rattan species and their occurrence in Nepal





- Traditional and modern bamboo, ningalo and rattan (cane) processing and manufacturing industries and products in Nepal

#### 4.7 OTHER INDUSTRIES

- Importance, scope, species, volume, employment and industrial production of the following:
  - Bio-energy (biomass power generation) industries
  - Sports goods and toys, handicrafts, home appliances, pots
  - Joints and fixtures, doors, windows, framing, packaging cases
  - Food: honey, maple syrup, spices, fruits and vegetables (bamboo shoots, moringa)
  - Fiber: silk, allo, hemp, simal cotton, bamboo yarn
  - Duna tapari from sal and bhorla leaves, Bidi from tendu leaves (Diospyros melanoxylon),

### UNIT 5. ERGONOMICS AND SAFETY MEASURES (9)

- 5.1 Introduction, importance and scope of ergonomics
- 5.2 The implementation and practices of ergonomics (physical, cognitive and organizational) in Nepal
- 5.3 Workplace hazard assessment and personal protective equipment
- 5.4 Forest Product Harvesting, Collection and Distribution Guidelines (Nepal Government)
- 5.5 Case study of a sawmill, furniture and a NTFP industry and virtual show with a possibility of visit to different forest based industry during the field tour.
- 5.6 Challenges faced by the forest based industries in Nepal - competition, innovation, trade, structural problem (lack of young labor force)
- 5.7 Import-export scenarios, market trends, international competition and trade barriers

### REFERENCES

1. Conway, S. 1976. Logging Practices: Principles of timber harvesting systems. Miller Freeman Publications.
2. FAO, 1982. FAO publication 33 Logging Mountain Forest.
3. FAO, 1982. FAO publication vol. 31 Appropriate Technology in Forestry.
4. FAO-FTP, 1987. Appropriate Forest Operations, Forest Harvesting, FTP publication 24 Finnida.
5. FRI, 1970. Indian Forest Utilization vol. I and II, FRI Dehradun, India.
6. Khanal, T.R. 2004. Prakritik Rubber (in Nepali) (Natural Rubber), Gorakhkali Rubber Industry, Nepal.
7. Kollmann, F. F. P., Kuenzi, E.W., and Stamm, A.J. 1975. Principle of Wood Science and Technology II of Wood Based Materials. Springer-Verlag, Berlin, Heidelberg, New York Inc.
8. Lecup, I. and Nicholson, K. (2000) Community -Based tree and Forest Product Enterprises: Market analysis and Development, FAO Rome Italy.
9. MOI/GON (2067) Policy on Industrial Development in Nepal, Ministry of Industry, GoN Kathmandu Nepal.
10. Negi, S.S. 1997 Wood Science and Technology, International book distributors, India.
11. Negi, S.S. 2008. Handbook of Forestry, International book distributors, India.
12. OR-OSHA. 1994. Logging Operations. Falling and bucking-Safety guide published by Oregon Occupational Safety & Health Division (OR-OSHA), USA. [www.OSHA.gov](http://www.OSHA.gov)
13. Stephan, F. and Haslegrave, C.M. 2065. Body space: Anthropometry, Ergonomics and the Design of Work 3<sup>rd</sup> Ed. Taylor and Francis.



## FMS 355: Forest Mensuration and Biometrics

Course code	Course title	Credit hours (Th + Pr.)
FMS 355	Forest Mensuration and Biometrics	3 (2 + 1)

### SCOPE

The course provides information that support forest management decisions at the stand and forest levels. This course deals with methods used to measure log, tree, stand, and forest-level attributes. Students will also learn how to sample and analyze forest resources data including use of spreadsheets, databases, and computer software platform for statistical analysis. The knowledge and skills learned from the course will be used in many subsequent classes and throughout one's professional career.

### OBJECTIVES

1. Understand the principles of forest-level mensuration and biometrics.
2. Demonstrate skill for instruments handling for log, tree, stand, and forest level measurements;
3. Understand mathematical, statistical, and measurement principles for designing and applying measurement
4. Develop skill for analysis and interpretation that support management decisions.
5. Understand sampling protocols and also demonstrate an understanding of growth and yield modelling to support forest management.

### EXPECTED OUTCOMES

Students will develop skills to measure, acquire, analyze, and describe measurement data and interpret resulting information. In addition, they will be familiar with commonly used instruments and techniques for log, tree, stand, and forest level measurements; understand mathematical, statistical, and measurement principles for designing and applying measurement and sampling protocols and also demonstrate an understanding of growth and yield modelling approaches.

### COURSE DESCRIPTION

#### UNIT 1 INTRODUCTION AND BASIC TREE-LEVEL MEASUREMENTS (8)

- 1.1 Introduction and scope of forest mensuration and biometrics
- 1.2 Diameter measurement
  - 1.2.1 Diameter at breast height (dbh) and its importance
  - 1.2.2 Rules of dbh measurement
  - 1.2.3 Tools for diameter measurement: caliper and diameter tape; their use, advantages, disadvantages and precaution in use
- 1.3 Height measurement
  - 1.3.1 Definition of different tree height (total height, bole height, standard timber bole height, commercial bole height, crown height, crown length, stump height)
  - 1.3.2 Trigonometric and geometric principles of height measurement
  - 1.3.3 Non instrumental methods of height measurement: ocular, shadow, and single pole method
  - 1.3.4 Instrumental methods of height measurement: Christian hypsometer, Abney's level, clinometer, and Haglof vertex IV



- 1.3.5 Measurement of height of vertical trees on plane and slopped areas
- 1.3.6 Measurement of height of leaning trees in plane and slopped areas
- 1.3.7 Sources of error in height measurement
- 1.4 Measurement of bark: bark thickness and bark percent
- 1.5 Measurement of crown: Crown diameter, Crown depth, crown height, Crown surface area, Crown volume, Crown position and crown form
- 1.6 Measurement of tree form
  - 1.6.1 Metzger's theory
  - 1.6.2 Form factors and types
  - 1.6.3 Form quotients and types
  - 1.6.4 Taper table and equation

## **UNIT 2 MEASUREMENT OF LOGS & FUELWOOD (4)**

- 2.1 Measurement of logs
  - 2.1.1 Measurement of length, diameter, sectional areas of logs
  - 2.1.2 Different formulae for the calculation of volume (Newton's, Huber's, Smalian's, and Quarter Girth) of logs
  - 2.1.3 Calculation of volume of sawn timber
- 2.2 Measurement of fuelwood
  - 2.2.1 Calculation of stacked volume of fuelwood
  - 2.2.2 Calculation of solid volume of fuelwood

## **UNIT 3 VOLUME AND BIOMASS OF TREES AND THEIR PRODUCTS (4)**

- 3.1 Volume tables
  - 3.1.1 Definition of volume table and their types
  - 3.1.2 Preparation of volume tables by graphical and regression techniques
  - 3.1.3 Derivation of local volume table from general volume table by graphical and regression techniques
- 3.2 Forest biomass and carbon measurement
  - 3.2.1 Root, leaf, stem and branch bio-mass
  - 3.2.2 Biomass table
  - 3.2.3 Biomass equation
  - 3.2.4 Forest carbon

## **UNIT 4 MEASUREMENT OF STAND-LEVEL ATTRIBUTES (4)**

- 4.1 Species composition
  - 4.1.1 Components of species composition : relative frequency, relative abundance, relative dominance and important value index
  - 4.1.2 Indices of species composition : Species richness index, Simpson diversity index, Shannon-Wiener index
- 4.2 Measures of stand density : Tree per ha, basal area per ha, crown competition factor,
  - 4.2.1 canopy closure, stand density index, relative density
  - 4.2.2 Density management diagram (introduction only)
  - 4.2.3 Site quality and site index

## **UNIT 5 FOREST INVENTORY (8)**

- 5.1 Definition and scope of forest inventory
- 5.2 Definition of terms (sampling, sample, sampling intensity, sampling unit, population, sampling frame, sampling error, non-sampling error)
- 5.3 Sample size determination
- 5.4 Sampling types
  - 5.4.1 Random sampling: Simple random sampling; stratified (random) sampling



- 5.4.2 Non-random sampling : Line plot sampling; Strip sampling
- 5.4.3 Sampling with fixed area plot

- 5.5 Sampling with variable radius plot (point sampling)
- 5.6 Calculation of growing stock and annual allowable cut

#### **UNIT 6 GROWTH AND YIELD (6)**

- 6.1 Basic concept of dbh, height and volume increment
- 6.2 CAI, PAI and MAI and their relationship
- 6.3 Estimation of increment: permanent research plots, increment cores, stump analysis and stem analysis
- 6.4 Growth and yield of even-aged stands
- 6.5 Growth and yield of uneven-aged stands
- 6.6 Growth and yield modelling approaches
  - 6.6.1 Stand table projection
  - 6.6.2 Whole stand modeling
  - 6.6.3 Individual tree modeling : distance dependent and distance independent modelling

#### **PRACTICAL**

1. Measurement of DBH of trees using both diameter tape and caliper at different conditions under the direct supervision of instructor
2. Measurement of tree height in both plane and sloppy areas using different instruments under direct supervision of instructor
3. Measurement of length and girth/cross-sectional area of given logs along different points and volume calculation using different formulae
4. Preparation of volume table by graphical method (in class/lab exercise)
5. Preparation of volume table by regression method (in class/lab exercise)
6. Sampling with fixed radius plot (field exercise)
7. Sampling with variable radius plot (field exercise)
8. Estimation of growing stock and annual allowable cut (field + class exercise)

#### **REFERENCES**

1. Avery, T.E. and Burkhart, H.E. 2002. Forest Measurements. Fifth edition. McGraw Hill. 456 p.
2. DoF. 2061 B.S. Community Forestry Inventory Guidelines. Department of Forest. Babarmahal, Kathmandu, Nepal.
3. Iles, K. 2003. A Sampler of Inventory Topics. Island Press. 869 p.
4. Kershaw, J.A., Jr., Ducey, M.J., Beers, T.W., and Husch, B. 2017. Forest Mensuration. Fifth edition. Wiley-Blackwell. 613 p.
5. Khanna, L.S. and Chaturvedi, A.N. 2015. Forest Mensuration and Biometry. International book distributors, Dehradun, India (Please check this publisher).



## FPU 356: Field Study: Forest Mensuration and Utilization

Course Number	Course Title	Credit (Th + Pr.)
FPU 356	Field Study III: Forest Mensuration and Utilization	2 (0 + 2)

### SCOPE

Students will learn how to sample and analyze forest resources data including use of spreadsheets, databases, and computer software platform for statistical analysis. They will gain practical skills in real field situation. The knowledge and skills learned from the course will be used in measuring different dimensions of the forests and in estimating growing stock and annual allowable cut as well as estimate the cost and benefit of harvesting products that will be used throughout the one's professional career.

### OBJECTIVES

- Understand and demonstrate skill for instruments handling for log, tree, stand, and forest level measurements
- Use computer software to analyze, and summarize data
- Understand technique for storage and grading of logs
- Learn to estimate the quantity of harvested logs and the cost of harvesting these products.

### EXPECTED OUTCOMES

Upon completion of the field work, students will be able to measure and calculate the growth and yield of different patches of forests. In addition, they will understand the storage technique, grading of logs and estimate the quantity and cost of the harvested products (logs).

### COURSE DESCRIPTION

Students will be planned for two-weeks in the real work field situation. They will be allowed to measure DBH of trees using both diameter tape and caliper at different conditions under the direct supervision of instructor. Using, wedge prism/angle guage, GPS, Compass, 30m tape, Abney's level/clinometer/Haglof vertex IV, note copy and pen/pencil, they will be asked to calculate different measures of stand density (such as Tree per ha, Basal area per ha etc.) and species composition (such as relative frequency, abundance etc.); volume per ha and scaling per ha values into stand/forest level. They will also be asked to estimate the quantity of the storage logs, grade these based upon their quality and prepare a report using the data generated in the field.

Note: Field schedule should be arranged as per convenience

### REFERENCES

1. Chowdhury, S. 2003. Manual of Forest Utilization, Institute of Forestry, Tribhuvan University
2. Avery, T.E. and Burkhart, H.E. 2002. Forest Measurements. Fifth edition. McGraw Hill. 456 p.
3. DoF. 2061 B.S. Community Forestry Inventory Guidelines. Department of Forest. Babarmahal, Kathmandu, Nepal.
4. Kershaw, J.A., Jr., Ducey, M.J., Beers, T.W., and Husch, B. 2017. Forest Mensuration. Fifth edition. Wiley-Blackwell. 613 p.