SYLLABUS

Bachelor of Science in Forestry

2023

Tribhuvan University

Institute of Forestry

Kirtipur, Kathmandu

FOREWORD

In a changing context, importance of forestry sector is growing every day. Forests are the strong pillar of the national economic development and provides home to life on land. In addition, they not only support for adapting to the adverse impacts of climate but also serves as carbon sink. Recognizing this, Institute of Forestry (IOF) is developing competent human resource, who are not only well-trained on addressing emerging forestry professional need and priorities of the countries but also to work on forest related issues of the global agendas.

Aiming to ensure that our students are well exposed to the recent state of knowledge of forestry science, IOF is periodically revising its syllabus to maintain and enhance its academic excellence nationally and globally. The current revision of the Bachelor of Science in Forestry is fourth times after start of the four years' semester course in 1995/1996, which has integrated theoretical forestry sciences with real ground experiences.

The syllabus has accorded high priority on developing an analytical skill among the students and integrated field work in each semester for having practical learning. Moreover, the courses are revised according to the changing context and in accordance with the guidelines approved by the Academic Council of Tribhuvan University. It further integrated the role of the forestry for economic prosperity of the nation.

The subjects are identified considering these multiple roles of the forestry, where the subject committee and faculty board of the IOF took a leadership role in shaping it. Moreover, many individuals and institutions have contributed directly and indirectly to bring this curriculum to this shape. This is also an outcome of the consultative processes carried out at different levels. I express by sincere thanks to internal and external experts, subject committees' chairs and members, the Faculty Board for their kind co-operation and contributions. I like to extend my special thanks to the Academic Council of Tribhuvan University for approving this curriculum I appreciate the contribution of curriculum revision committee members Prof. Dr. Krishna R Tiwari, Prof. Dr. Rajesh K Rai and Prof. Dr. Raj K Koirala, IOF for taking this challenging task for developing course structure and coordinating with faculties and compiling the syllabus. Special thanks go to Asst. Dean Dr. Sony Baral for coordinating and editing of this curriculum revision and bringing it to this shape.

I am confident that our students will serve as a warrior for addressing the planetary crisis, which we are now currently facing, such as global climate change, biodiversity losses and environmental issues. Moreover, they will serve on sustainable management of the global commons.

Prof. Bir Bahadur Khanal Chhetri, PhD
Dean

CONTENTS

INTRODUCTION

Institute of Forestry (IOF) is one of the five technical institutes under the Tribhuvan University. The mission of IOF is to develop technically competent and socially knowledgeable human resources in the areas of Forestry and Natural Resource Management.

Objectives of IOF

- To design and implement educational programmes in the forestry and natural resources sector
- To develop competent professional foresters and natural resource managers
- To develop an academic environment and encourage faculty members on career development
- To encourage research activities on contemporary areas of forestry and natural resources
- To develop as a centre of excellence in forestry education.

Brief History of Development IOF

IOF is a national-level academic institution, and it has been developing human resources for the forestry sector of the country. The Institute started as the Nepal Forestry Institute at Singha Durbar, Kathmandu, in 1947. It was relocated to Suping (Bhimphedi), Makwanpur, in 1957/58. In 1965, the Institute was moved to Hetauda, in the buildings constructed with the assistance of the Indian Cooperation Mission. The Institute was run by the Government of Nepal, Department of Forests, until July 1972. In the same year, it came under the Tribhuvan University and was amalgamated as a constituent institute as Institute of Forestry. Until the late 1970s, it produced only technician-grade foresters (rangers). In 1981, IOF expanded its academic programmes to two-year Certificate Level in Hetauda Campus and Bachelor in Forestry in Pokhara Campus with better facilities developed through technical and financial assistance of the World Bank, International Development Agencies (IDA) and the United States Agency for International Development (USAID).

Currently, IOF has two constituent campuses, viz Pokhara and Hetauda Campus, and one affiliated campus, Kathmandu Forestry College, Kathmandu. Additionally, IOF established School of Forestry and Natural Resource Management in 2017 in Kathmandu and has been running two Master's programmes. It is implementing three level academic programmes: Bachelor in Forestry, and six MSc programmes: a. Forestry, b. Natural Resource Management and Rural Development, c. Watershed Management, d. Wildlife and Biodiversity Conservation, e. Community Forestry, and f. Mountain Environment and Development Studies. In addition, it is offering PhD in five different subject areas a. Forestry, b. Community Forestry c. Watershed Management, d. Natural Resource Management and Rural Development e. Wildlife and Biodiversity Conservation. Apart from regular academic programmes, IOF organizes short-term national and international training courses in various fields of forestry such as Community Forestry, Forestry Extension, Non-Timber Forest Products Management, Eco-tourism, Forest Surveying, Watershed Management, etc.

Research Programme

Apart from teaching–learning activities, faculty members and students are involved in research projects through Tribhuvan University grants and small grants provided by bilateral forestry projects in Nepal. IOF has carried out different research on forestry-related issues and has been influencing policy processes. Most of the research projects are secured from bilateral and multilateral agencies through competitive bidding processes. Research activities are coordinated through IOF Research Committee, headed by the Dean. The committee also seeks funding from various development agencies to support faculty and students' research proposals.

Extracurricular Activities

Apart from regular academic activities, IOF campus administration, teachers' association, student's union and students' self-help group organize various activities such as sports, tree planting, and poetry, cultural and talk programmes on various occasions. Such extracurricular activities have provided opportunities to faculty members, students and staff for socialization and team-building process.

Physical Facilities

IOF has modern classroom facilities equipped with all necessary audio-video teaching aids. Faculty and students get opportunities to enhance their teaching–learning process in best physical comfort. Both the IOF campuses have laboratories with modest facilities to provide practical training as prescribed in the course. In addition, IOF is using the sophisticated laboratory facilities in government research stations and other academic institutes.

Library and Documentation Centre

Both campuses of IOF have excellent library facilities with huge collections of books, journals, Master's and PhD theses in Forestry and Natural Resource Management. Currently, all the accessions are under the process of computerization. It also has TREE-CD database, which includes abstracts of Agroforestry, Forestry and Forest Products. Computer entry of all accessions has made it easy for the students and researchers to search the books and research journals needed by them. IOF library with computers and internet facility is linked with information super highway. A museum and library-cum-documentation complex at Hetauda Campus is another attractive facility. The complex has several sections ranging from newspapers and magazines to exhibits of forestry and other allied subject areas. After completion of the documentation works, it will be a model teaching-cum-research-cum-extension resource centre in the whole country.

Computer Centre

In order to facilitate the teaching and learning of teachers and students, IOF has established separate computer laboratories for the faculty and students. It also has latest version of GIS software and hardware. Computer facilities are provided to the final year students to work on their project papers and theses.

Nursery

IOF also has research nurseries in both campuses. These nurseries are used for practical training of students. Hetauda Campus has very nice arboreta, which have collections of a number of pine and other forest species. The matured Sal *(Shorea robusta)* forest with dense ground vegetation at Hetauda Campus has provided a natural habitat for spotted deer.

Student Hostels and Campus Cafeteria
The Institute provides separate hostel facilities for boy and girl students at nominal rents in both campuses. It has helped students to access the library and computer facilities and also provided opportunities to interact with their teachers and supervisors. Both the campuses have a cafeteria each, which serve meals and snacks at reasonable prices. The cafeterias are run by individuals or firms selected by respective campus administrations through competitive bidding under the rules and regulations set by the campus.

Faculty and Staff Housing
IOF provides accommodation facilities, and more than 80 teaching faculty members and administrative staff reside in the campus quarters. The Campus administration charges nominal rents for their occupancy.

Transportation and Communication
The Campus owns a pool of transportation vehicles to transport students for educational tours, field training and excursions. In addition, the Campus administration hires vehicles. All the faculty, staffs and students are given access to communication facilities like telephone, and internet facility with nominal rate.

Admission, Evaluation and Award of Degree
Students who have secured a minimum of 40% marks in aggregate in ISc, Diploma in Forestry, +2 Science, A- level or equivalent are eligible to apply for admission in the Bachelor's level programme. All students must appear in the entrance examination administered by the Examination Section of IOF and are selected for admission based on their merit score.

Evaluation and Examination System
Students are internally and externally evaluated based on final exam (theory), internal assessment and practical examination in each semester. Forty percent marks is set aside for internal (assessment and practical) exams and 60 percent marks for the final exam. To pass the examination, students must secure 40% marks in final theory, internal assessment, practical examinations and field training separately. A statement of marks is issued to students after the result is published for that particular semester. Students who do not pass the regular semester examination can appear in the make-up examination.

Attendance Requirement
A student must attend at least 70% classes in each subject. Failure to fulfill the attendance requirement by a student may result in his/her disqualification to appear in the final examination.

After the successful completion of all the requirements prescribed by the course curriculum, a student will be eligible for award of BSc degree in Forestry. An academic transcript is issued by the Controller of Examination of Tribhuvan University to students who have fulfilled all requirements. The academic standard of students is based on the cumulative percentage of marks secured in all examinations. IOF adopted the grading system indicated in credit transfer, grading system and the academic transcript study report of 2020 approved by TU academic council decision no 64 on 2078/1/14. [table 1].

Table 1: Grading system for undergraduate program

Grade	GPA	Grading Scale (in %)	Performance
A	4.0	90-100	Outstanding
A-	3.7	80- less than 90	Excellent
B+	3.3	70-less than 80	Very good
B	3.0	60- less than 70	Good
B-	2.7	50 -less than 60	Satisfactory
C	2.3	40- less than 50	Fair
F	0.0	Less than 40	Fail

In this system, a student has to receive the minimum of 2.3 GPA or letter "C" grade in order to pass each course.

Students will receive marks and GPA in in the mark sheet of each semester. In the transcript, Semester Grade Point Average (SGPA) will be given using the following calculation

$$\text{SGPA} = \frac{Total\ Grade\ Point\ earned\ in\ a\ semester}{Total\ Number\ of\ credit\ registered\ in\ a\ semester}$$

Based on the grades earned in each semester, Cumulative Grade Point Average (CGPA) will be calculated as follows:

$$\text{CGPA} = \frac{Total\ Grade\ Point\ earned}{Total\ Number\ of\ credits\ completed}$$

Course Curriculum

Design and Delivery of Curriculum: Considering the changing context of the government forest policy and national and international requirements, IOF has been constantly revising its curricula to make its graduates work successfully in Forestry and Natural Resources Management. While designing and revising curricula, each of the six subject committees of IOF proposes and designs a draft curriculum in their respective subjects. The Faculty Board at IOF then critically discusses and modifies the contents, wherever necessary. After critical discussion and approval of the Faculty Board, the curriculum is submitted to the Academic Council of Tribhuvan University for final approval. Approved course curriculum is then implemented through the Departments at each campus.

Course Code

The course code listed in this curriculum has a short text of the Subject Matter Committee, number and text in parentheses. The abbreviated text that appears in the beginning of the course code stands for the respective Subject Committee the course falls under. The courses are given 100s to 400s course numbers in the Bachelor's level. The abbreviations of the course codes are as follows:

- BSH: Basic Science and Humanities
- FPE: Forest Products and Engineering
- PWM: Park Recreation and Wildlife Management
- SFB: Silviculture and Forest Biology
- SFM: Social Forestry and Forest Management
- WME: Watershed Management and Environmental Science

Credit Hours
Each course is assigned a certain weightage as full marks. The full mark is divided into Theory, Internal Assessment and Practical classes. One credit hour carries 20 contact hours and 25 marks. One practical class load is equivalent to two theory classes. All courses are three credit hours and five in each semester. The field tour is allocated one to two credit hours. Moreover, one contact lecture hour consists of two hours of student work in each subject.

Core Courses
Students enrolled in the BSc Forestry programme are required to pass all the subjects prescribed in the course curriculum. The core courses are the major subjects related to Forestry, Watershed and Soil Conservation, and Wildlife.

Elective Course
Elective courses are designed to provide greater exposure and specialization in certain areas of Forestry. Electives courses are categorized into two groups. Students in the final year will select one course from each group. Based on the application the campus/department announces the elective courses to be offered in the final semester.

Students' Seminar and Intern/Project Paper
In collaboration with government and relevant organizations, IOF provides opportunities for internship to the final year students to work with prospective employers to obtain hands-on experience, as well as to get to know forestry and other natural resource professionals outside the University. Additionally, students can conduct project work to develop knowledge and skills in research in their Fourth year Second semester. Project papers are selected based on students' interest and specialization. Students are encouraged to conduct original research on the burning issues in Forestry and Natural Resource Management aspects. Each student is assigned an advisor to guide his/her study. In both intern and project work, as an internal examiner of the project paper, the advisor guides the student. Both the project paper and intern report is evaluated by an external/internal expert in the subject matter concerned. After the completion of the project work, students are expected to present their work in a seminar. Students' research projects are supported by various national and international organizations. A few students who do not get outside funding are supported by IOF.

Field Training and Educational Tours
In order to provide field exposure and hands-on experience, students are frequently taken for outside camping. Students visit various research stations, educational institutions, and experimental and demonstration plots.

SEMESTER-WISE COURSE BREAKDOWN

Code	Course	Credit	Marks			Total
			External (Theory)	Internal		
				Assessment	Practical	
	Year 1					
	Semester I					
SFB 111	Forest Resources and Silvics	3	45	15	15	75
SFB 112	Plant Physiology and Dendrology	3	45	15	15	75
SFM 113	Forest Management I	3	45	15	15	75
PWM 114	Wildlife, Protected Area and Ecotourism	3	45	15	15	75
WME 115	Geology and Soil Science	3	45	15	15	75
SFB 116	Tour (Observation)	2				50
	Semester II					
PWM 121	Wildlife Biology	3	45	15	15	75
SFB 122	Forest Ecology	3	45	15	15	75
WME 123	Watershed Hydrology	3	45	15	15	75
SFB 124	Silviculture and Tree Improvement	3	45	15	15	75
BSH 125	Principles of Economics	3	45	15	15	75
	Year 2					
	Semester I					
SFM 211	Forest Resource Economics	3	45	15	15	75
SFM 212	Forest Mensuration	3	45	15	15	75
FPE 213	Forest Surveying and Engineering	3	45	15	15	75
PWM 214	Wildlife Management	3	45	15	15	75
SFB 215	Forest Plantations and Agroforestry	3	45	15	15	75
	Semester II					
SFM 221	Community Based Forest Management	3	45	15	15	75
WME 222	Remote Sensing and GIS	3	45	15	15	75
SFM 223	Silvicultural System	3	45	15	15	75
SFM 224	Forest Management II	3	45	15	15	75
FPE 225	Forest Harvesting and Logging	3	45	15	15	75
SFM 226	Tour (Forest Management and Silvicultural systems)	2				50
	Year 3					
	Semester I					
BSH 311	Statistical Methods and Experimental Design	3	45	15	15	75

WME 312	Climate Change and Forestry	3	45	15	15	75
FPE 313	Forest Product Utilization	3	45	15	15	75
SFM 314	Forest Law and Policy	3	45	15	15	75
SFM 315	Rangeland Management	3	45	15	15	75
	Semester II					
PWM 321	Protected Area Management	3	45	15	15	75
SFB 322	Forest Protection	3	45	15	15	75
WME 323	Integrated Watershed Management	3	45	15	15	75
WME 324	Soil and Water Conservation Engineering	3	45	15	15	75
SFM 325	Project Management	3	45	15	15	75
WME 326	Tour (Watershed and Forest Products)	2				50
	Year 4					
	Semester I					
WME 411	Environmental Management	3	45	15	15	75
BSH 412	Research Methodology and Scientific Writing	3	45	15	15	75
FPE 413	Forest Based Enterprises	3	45	15	15	75
	Elective I	3	45	15	15	75
	Elective II	3	45	15	15	75
PWM 414	Indo-Nepal Tour (Protected Areas)	3				75
	Semester II					
SFM 420	Proposal (Research/Intern) Defense	1	25			25
SFM 421	Field Research/ Intern	9	225			225
SFM 422	Project Paper/Intern Report Presentation	1	25			25
	Total Credits	125				3125

Electives

Course code	Course	Credit	Marks			Total
Elective I			**Marks**	**Total**	**Marks**	
BSH 414	Applied Chemistry	3	45	15	15	75
PWM 415	Wildlife Techniques and Technology	3	45	15	15	75
WME 414	Applied Remote Sensing and GIS	3	45	15	15	75
PWM 416	Ornithology and Mammalogy	3	45	15	15	75
BSH 415	Wood Physics	3	45	15	15	75

FPE 414	Computer Programming in NRM	3	45	15	15	75
Elective II						
SFM 414	Natural Resource Management Planning	3	45	15	15	75
SFM 415	Indigenous Knowledge in NRM	3	45	15	15	75
PWM 417	Ecotourism Management	3	45	15	15	75
FPE 415	Wood Science and Technology	3	45	15	15	75
FPE 416	Non-Timber Forest Products	3	45	15	15	75
SFM 416	Gender Equality and Social Inclusion in NRM	3	45	15	15	75

COURSE DESCRIPTIONS

YEAR 1 SEMESTER I

COURSE TITLE: FOREST RESOURCES AND SILVICS

Course Code	Credit	Lecture Hours	Marks			Total
SFB 111	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The scope of this course is to provide brief knowledge of Forest resources and silvics. The course introduces students with the knowledge of forest types and their distributions in the region and Nepal. The course provides the understanding of locality factors of the forest, mainly the influence of climate, temperature, rainfall, including aspect and slope, and topography. It also introduces the science of silvics to the students and its relationship with silviculture and tree growth. The course also covers major characteristics of important tree, herb/forb and shrub species found in Nepal, their regeneration methods. The contribution of forest resources in the overall economic, social and cultural development of the country.

After the completion of this course, student will be able gain knowledge on the forest resources of the country, and silviculture of commercially important tree, shrub and herb species and hence, the techniques required for their management.

OBJECTIVES

- Understand the types of forest resources and their contribution in the overall economy of the country.
- Understand locality factors
- Learn about silvic science and silvics of major tree species of Nepal
- Gain brief knowledge on application of concepts of silvics in silviculture

EXPECTED LEARNING OUTCOMES

- Acquire the knowledge on types of forest resources and their contribution in the overall economy of the country
- Acquire knowledge on locality factors
- Enable to identify important forest plant species and gain knowledge on their silvics

COURSE CONTENTS

UNIT 1: INTRODUCTION [5]

1.1 Forest resources (flora, fauna, soil, water); difference between forest and vegetation
1.2 Definition of forests (legal and technical); different types of forest in the world
1.3 Forest types of Nepal
  1.3.1 By origin (natural and plantation)
  1.3.2 By regeneration (high and low/coppice)
  1.3.3 By composition (broadleaf and conifer)
  1.3.4 By physiographic zones (Terai, Siwalik, Middle mountains, High mountains and High Himalaya)

1.4 State of forests in Nepal
1.5 Forest of Himalayan region

UNIT 2: ROLE OF FOREST RESOURCES [6]
2.1 Definition and concept of forest ecosystem services
2.1.1 Concept of ecosystem goods and services
2.1.2 Types of ecosystem services according to MEA and TEEB
2.2 Contribution of forest resources in national socio-economy and contribution of forestry sector in Nepal's Gross Domestic Product (GDP)

UNIT 3: VEGETATION CLASSIFICATION [8]
3.1 Factors affecting vegetation (locality factors)
3.2 Types of locality factors
3.2.1 Climatic factors
3.2.2 Topographical factors
3.2.3 Edaphic factors
3.2.3 Biotic factors
3.3 Types of vegetation (vegetation classification)

UNIT 4: INTRODUCTION TO SILVICS [6]
4.1 Concept and important of silvics
4.2 Component of silvics
4.3 Relationship between silvics and silviculture

UNIT 5: SILVICS OF IMPORTANT PLANT SPECIES [8]
5.1 Timber
5.1.1 Native: Sal *(Shorea robusta*),
Asna (*Terminalia alata*),
Chanp (*Michelia champaca*),
Karma (*Adina cordifolia*)
Khair (*Acacia catechu*),
Sissoo (*Dalbergia sissoo*),
Satisal (*Dalbergia latifolia),*
Bijaysal *(Pterocarpus marsupium)*
Katus (*Castanopsis spp*),
Chilaune (*Schima wallichii*),
Utis (*Alnus nepalensis*),
Oak (Quercus spp),
Chir pine (*Pinus roxburghii*),
Blue pine (*Pinus wallichiana*),
Okhar (*Juglans regia*),
Spruce (*Picea* spp)
Fir (*Abies spp*),
Deodar (*Cedrus deodara*),
Bhojpatra (*Betula utilis*)
Lauthsalla (*Taxus wallichiana*)
5.1.2 Introduced: Teak (*Tectona grandis*),
Masala (*Eucalyptus camadulensis*),
Kapur (*Cinnamomum camphora*)
5.1.3 Fodder Tress
Kutmero (*Listea monopetala*),

Badahar (*Artocarpus lakoocha*)
Bhimal (*Grevia optiva*)
Kapro/Kavro (*Ficus lacor*)
Khanyu (Ficus *semicordata*)
Koiralo (*Bauhinia variegata*)

5.1.4 NTFPs

Ritha (*Sapindus mukorosi/detergens)*
Tejpat (*Cinnamomum tamala*),
Lauth salla (*Taxus wallichiana*),
Dhasingare (*Galtheria fragratissima*)
Chirayito (*Swertia chirayita*),
Sarpagandha (*Rouvolfia serpentina*),
Kurilo (*Asparagus officinalis*)
Lokta (*Daphne bholua*)
Argeli (*Edgeworthia gardneri*)
Bamboo and Rattan
Amla
Harro
Bahero

PRACTICAL [20]

SN	Content/title	Equipment/tools	Methods	Link to the course unit
1	Forest cover change analysis	FRA reports, DFRS/FRTC and FAO reports	Review and prepare 300-word report	1
2	List ecosystem services from nearby forests	Field visit	Observation and KII/FGD	2
3	Summarize forest types of Nepal	Literature, reports	Review and prepare 300-word report	1, 3
4	Silvics of species not listed in Unit 5	Literature, reports, field visit	Review, KII	5
5	Presentation of practical 4		Power point presentation	5

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3 Jackson, J.K (1994). *Manual of afforestation in Nepal*. Kathmandu, Forest research and Survey Centre, Volume 2. 2nd Edition.
4 Millennium Ecosystem Assessment Report 2005.
5 Department of Forest Research and Survey (different years). State of Nepal's Forests: Forest Resource Assessment (FRA) and Department of Forest and Research (DFRS), Kathmandu.
6 Jha, P. K., Karmacharya, S. B., Chettri, M. K., Thapa, C. B., & Shrestha, B. B. (2008). Medicinal plants in Nepal. *Ecological Society, Kathmandu, Nepal*.
7 Thakur, R. B. (2003). *A compendium of tree species of Nepal*. Mr. & Mrs. RB Thakur.
8 FAO - Global Forest Resources Assessments

COURSE TITLE: PLANT PHYSIOLOGY AND DENDROLOGY

Course Code	Credit	Lecture Hours	Marks			Total
SFB 112	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course is designed to give students competency to comprehend the physiology of plants such as absorption, translocation, transpiration, hormonal action, nitrogen metabolism and seed germination. Additionally, the course covers the dendrology for tree identification.

OBJECTIVES

- Understand knowledge of mechanisms of water and mineral absorption and their translocation.
- Acquire knowledge why minerals are important for plant growth and development.
- Learn the removal mechanism of excess water from plants.
- Enhance knowledge to apply for seed germination, plant growth and tree identification.

EXPECTED LEARNING OUTCOMES

- Acquire knowledge to solve plant growth problems in the nurseries and in the field.
- Develop the skills of the use of minerals and plant growth hormones.
- Prepare the expert of seed germination in the nurseries for the field plantation.
- Enable to recognize the trees in the forest.

COURSE CONTENTS

UNIT 1: ABSORPTION AND TRANSLOCATION OF WATER AND MINERAL SALTS [8]

1.1 Mechanism of absorption of water (passive and active absorption)
1.2 Mechanism of absorption of mineral salts (passive and active absorption)
1.3 Mycorrhiza and their roles in absorption of mineral salts
1.4 Factors affecting mineral salt absorption
1.5 Roles of essential mineral elements in plant growth and development (macro nutrients and micro nutrients)
1.6 Mechanism of ascent of sap
1.7 Root pressure and cohesion tension theory of ascent of sap
1.8 Translocation of sap (xylem transport)
1.9 Translocation of organic food (phloem transport)

UNIT 2: GROWTH AND PHASES OF DEVELOPMENT [6]

2.1 Definition of Growth and Development
2.2 Phases of Growth and Development
2.3 Concept of Photoperiodism
2.4 Physiology of Flowering
2.5 Biological Clocks
2.6 Physiology of Senescence
2.7 Fruit Ripening

UNIT 3: PHYTOHORMONES [5]

3.1 Distribution and physiological roles of plant growth hormones (auxin, gibberellin, cytokinin, ethylene and abscisic acid)
3.2 Applications of auxin, gibberellin, cytokinin, ethylene and abscisic acid

UNIT 4: SEED PHYSIOLOGY [5]

4.1 Physiology of seed germination
4.2 Seed dormancy and cause of seed dormancy
4.3 Viability of seeds
4.4 Methods of breaking seed dormancy
4.5 Seed treatments for germination
4.6 Mechanism and significance of vernalisation.

UNIT 5: DENDROLOGY [10]

5.1 Concept, scope and importance of dendrology
5.2 Morphology and ecology of woody plants
  5.2.1 Stem and twigs of trees
  5.2.2 Bark of common trees
  5.2.3 Shape and arrangement of leaves
  5.2.4 Root
  5.2.5 Reproductive morphology of trees (morphology of flowers and seeds)

UNIT 6: TAXONOMY AND IDENTIFICATION OF WOODY PLANTS [6]

6.1 Basic principle of plant taxonomy
6.2 Identification of woody plants in different physiographic regions by leaf, bark, flower, fruit, root and overall shape and size

PRACTICAL [20]

SN	Contents	Methods	Link to the Unit(s)
1	Demonstration of primary and secondary growth	Lab demonstration	2
2	Review functions of phytohormones	Literature review	3
3	Determine the effect of different pre-treatments on the rate of seed germination	Lab and Nursery visit	4
4	Tree identification and herbarium preparation	Field visit	5 and 6

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COURSE TITLE: FOREST MANAGEMENT I

Course Code	Credit	Lecture Hours	Marks			Total
SFM 113	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course contains the concept and evolution of forest management with criteria and indicators for sustainable forest management. This also describes forest-human interactions and forest management planning.

OBJECTIVES: Upon completion of this course students will be able to:

- Acquire basic concepts of sustainable forest management.
- Understand human-forest linkages
- Understand the global trend in forest management
- Describe forest management regimes in Nepal
- Understand forest management planning concept

EXPECTED LEARNING OUTCOMES: Upon the completion of this course, the students will enable to:

- Understand the basic concept of sustainable forest management globally and nationally.
- Differentiate management regimes practice in Nepal
- Understand the forest people interaction
- Understand the forest management plan

COURSE CONTENTS

UNIT 1: INTRODUCTION [6]

1.1 Definition, objective and evolution of forest management
1.2 Global trends in forest management (Clear cutting - SFM)
1.3 History of forest management in Nepal
1.4 UN strategic plan for forests and global forest goals
1.5 Ecosystem based forest management

UNIT 2: HUMAN -FOREST INTERACTION [6]

2.1 Forests, society and environment
2.2 Environmental benefits
2.3 Economic benefits
  2.3.1 Human dependence on forest resources
  2.3.2 Employment opportunities
  2.3.3 Role of forests in economic development
2.4 Social Benefits
2.5 Gender equality and social inclusion in forest management
2.6 Roles of indigenous peoples and local communities in forest management

UNIT 3: SUSTAINABLE FOREST MANAGEMENT [8]

3.1 Concept and principles of sustainable forest management
- 3.1.1 Concept and principle
- 3.1.2 Criteria and indicators
- 3.1.3 Importance of criteria and indicators

3.2 Forest Certification
- 3.2.1 Concept and types of forest certification
- 3.2.2 Role of forest certification in sustainable forest management

UNIT 4: ROTATION [8]

4.1. Concept and types of rotation
- 4.1.1 Biological rotation/ Rotation of maximum volume production
- 4.1.2 Financial rotation
- 4.1.3 Technical rotation
- 4.1.4 Silvicultural rotation
- 4.1.5 Rotation of highest income
- 4.1.6 Physical Rotation

4.2 Choice of rotation

4.3 Conversion period

UNIT 5: FOREST MANAGEMENT REGIMES AND MODALITIES PRACTICED IN NEPAL [6]

5.1 State-managed (Government-managed Forest and forest conservation area)

5.2 Community-based (buffer zone community forest, community forest, Partnership Forest, pro-poor leasehold forest, religious forest)

5.3 Local government-led (urban forest and public-land forest)

5.4 Private forest

5.5 Leasehold forest (commercial purpose)

UNIT 6: FOREST MANAGEMENT PLANNING [6]

6.1 Concept, importance and scope of management plan

6.2 History of forest management planning

6.3 Forest management plans and strategies in Nepal

6.4 Elements for effective implementation of forest management plan

6.5 Forest management unit
- 6.5.1 Departments under the forest ministry
- 6.5.2 Organizational hierarchy of Government for forest management (National, province and local level)

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	Visit CFUGs to know about the content of the OP and constitution	- CF -Operational plan	Visit nearby CF and review the documents	5, 6
2	Prepare local criteria/indicators based on the standard criteria/indicators of sustainable forest management	-Criteria/indicators (e.g., ITTO or FSC or PEFC -Objective/expected output	-Document activities -Socio-economic survey -Bio-physical assessment	3
3	Collection information on social, economic and environmental benefits of forest	Visit nearby forests	Report writing	2
4	Test local criteria for sustainable forest management	Nearby forests		3

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13. Amatya, S.M., Thapa, H.B. and Bhatta, B. (2022). Theory and Practice of Forest Management in Nepal. Hetauda, Nepal: Faculty of Forestry, Agriculture and Forestry University

COURSE TITLE: WILDLIFE, PROTECTED AREA AND ECOTOURISM

Course Code	Credit	Lecture Hours	Marks			Total
PWM 114	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course aims to expose students to basic knowledge on Wildlife, Protected Areas and Ecotourism in Nepal. The students will learn the theory and practice related to wildlife, habitat management and population recovery implemented by the Government of Nepal emphasizing field based practical activities and research.

OBJECTIVES:

- Explore the basic concepts of wildlife, their habitat, protected areas and ecotourism management.
- Understand wildlife conservation issues and major threats and their management approach.
- Gain knowledge on the concepts of wildlife habitat and restoration ecology.

EXPECTED LEARNING OUTCOMES

- At the end of the course, students will be able to explore the different wildlife, habitat types and protected areas management approaches in Nepal.
- Students will have gained knowledge on species recovery and habitat restoration initiatives in Nepal.

UNIT 1: WILDLIFE AND THEIR DISTRIBUTION [8]

1.1. Basic technical terms: preservation, protection, utilization, conservation and management; in-situ and ex-situ conservation, protected areas and buffer zones, corridor-connectivity; featured species (keystone, flagship, umbrella, indicator, landscape, threatened)

1.2. General ecology of major wild animal species (IUCN/National Red list, NPWC Act-2029 Schedule species)

1.3. Concept and theories of zoo geography (animal distribution)

1.3.1 Factors affecting animal distribution (geographical barriers)

1.3.2 Types of animal distribution (Uniform or continuous, Random or discontinuous, bipolar distribution)

UNIT 2: CONCEPT OF WILDLIFE HABITAT AND DIVERSITY [6]

2.1 Wildlife habitat

2.1.1 Wildlife habitat: habitat components (food, cover, space, and water)

2.1.2 Home range, territory, niche (fundamental, realized); interspersion and juxtaposition, edge and ecotone

2.2 Biodiversity, carrying capacity, species-area curve, life table, survivorship curve

2.3 Wildlife habitat types: Broadly- terrestrial and aquatic; others-e.g., early successional, mid successional, late successional

UNIT 3: CONSERVATION THREATS, CHALLENGES AND MEASURES [8]

3.1 Cause of habitat loss, habitat fragmentation and their effects on wildlife (e.g., Alien and invasive species of both plant and animal)
3.2 Limiting and welfare factors of wildlife habitat
3.3 Habitat sharing and habitat overlapping (habitat adjustment and partitioning)
3.4 Forest (grassland and riverine forest) diversity (distribution, threat, challenges, values, and management)
3.5 Agro-biodiversity (distribution, threat, challenges, values and management)
3.6 Aquatic biodiversity (distribution, threat, challenges, values, and management)
3.7 Issues, threats, and challenges of wildlife conservation in Nepal
3.8 Habitat restoration and population recovery: e.g., translocation, rewilding, conservation breeding, farming, etc.)

UNIT 4: CONSERVATION APPROACHES AND PROTECTED AREA [6]

4.1 Conservation approach, model and types (e.g. Global, regional, national; biosphere, eco-region, etc.),
4.2 In-situ conservation (PA, outside PA) and ex-situ conservation
4.3 Prospects and strategies of protected areas
4.4 Protected areas of Nepal with IUCN category
  4.4.1 Introduction, objectives, unique features, practices and challenges
  4.4.2 Comparison of management approaches (strict nature reserve, national park, wildlife reserve, hunting reserve, conservation area, buffer zone)
4.5 Paradigm shift in protected area management in Nepal
4.6 CITES criteria (appendices) for the inclusion of species

UNIT 5: ECOTOURISM MANAGEMENT [12]

5.1 Tourist and Tourism: concept, typology and characteristics
5.2 Ecotourism: Definition, evolution, process, principle, importance
5.3 Ecotourism products and services: Scope and Characteristics
  5.3.1 Natural, physical, and cultural product
  5.3.2 Ecotourism potentiality in Nepal (case studies base on ecological belt)
  5.3.3 Ecotourism product development process
5.4 Ecotourism practices: Eco levelling and branding, code of conduct and certification
5.5 Ecotourism impact: Socio economic, Environment (Positive and Negative)
5.6 Mitigation measures of Ecotourism impact

PRACTICAL [20]

Content	Equipment/tools	Methodology/ methods	Link to the course unit(s)
Identification of mammal, birds, reptile and amphibians with their social organization -Identify common large mammals in the terai/hills grassland/rangeland ecosystems -Distinguish (if possible) between males and females of each species - Observe and document social organizations of common large mammals; excursion to	Uses of binocular, camera, reference identification guide books, web-based search techniques for identification of photographed species Excursion for zoo/mini zoo or wildlife museum, visitor center visit	Direct observation at Terai PA or nearby forests or conservation areas or zoological gardens, or wetlands	Unit 1

zoo or nearby zoological garden, bird watching; excursion to Natural history or biodiversity museum of the respective region to help identity from the specimens (6)	and interpretation center along with PA		
Edge, ecotone study (3)		Visit nearby PA or conservation forest	Unit 2
Animal population restoration (e.g. rhino or black buck or vulture or ghariyal, wild water buffalo, etc.) (2)		Visit a nearby relevant park or BZ or CA or vulture restaurant -1 day in one facility (min 1 to be shown)	Unit 3
Comparison of management approaches of two different PA categories (4)		Visit two different categories of PA to compare the management practices (lowland or midhill or mountain PAs)	Unit 4
Visit and interact with one ecotourism site/destination (5)		1 day long visit for interacting with home stay, small to big hotels	Unit 5

Note: Students must submit the field report, present the findings.

TEXTBOOKS

1. Lakhey, S.P. 2014. Wildlife Biology, IOF Hetauda, Nepal.
2. Baral, H.S. and Shah, K.B. (2008) Wild Mammals of Nepal. Himalayan Nature, Kathmandu, ISBN: 9789937202046.
3. Grimmett, R., Inskipp, C. and Inskipp, T. 2000. Birds of Nepal. Christopher Helm (Publishers) Ltd., London. 288 pages.
4. Shah, K. B. and. Tiwari, S. (IUCN 2004). Herpetofauna of Nepal: a conservation companion, viii, 237p.: ill. ISBN: 99933-860-3
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9. Bhatta, D. 2017. Ecotourism in Nepal. A Bhatt Publ., Kathmandu.
10. Bhattarai, B.R., Wright, W., Poudel, B.S., Aryal, A., Yadav, B.P. and Wagle, R., 2017. Shifting paradigms for Nepal's protected areas: history, challenges and relationships. Journal of Mountain Science, 14(5), pp.964-979.

COURSE TITLE: GEOLOGY AND SOIL SCIENCE

Course Code	Credit	Lecture Hours	Marks			Total
WME 115	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course is designed to give students competency to comprehend basic principles and concepts of geology and soil science. This course covers the fundamental understanding of geology and soil focusing on different types of rocks, minerals, geological structures and geologic process for soil formation. Additionally, the course discuses on soil properties classification systems and soils found in Nepal, land capability classification, the global soil environment.

OBJECTIVES

- Understand theories regarding modification of the earth and its various landforms throughout the geological time scale
- Describe types of rocks, their weathering and influence of geologic processes in soil formation and vegetation growth
- Learning about various soil properties
- Acquire knowledge on soil classification systems and land capability classification including soil types found in Nepal
- Understand the sustainable soil management

EXPECTED LEARNING OUTCOMES

- Acquire sufficient basic knowledge in geology and soil science
- Identify rocks and minerals
- Identify criteria of geological structures in the field and analyze stability
- Classify soil based on their properties observed in soil profile.
- Understand land capability classification and its application
- Determination of soil carbon stock
- Enhance knowledge on global soil environment and sustainable soil management

UNIT 1: INTRODUCTION TO GEOLOGY [6]

1.1 Definition, branches, scope, objective and importance of geology

1.2 Minerals: physical and chemical properties and classification of minerals

1.3 Rocks: types and origin and distribution in earth's surface

1.4 Geological structures: origin, classification (primary and secondary) and their identification in the field

1.5 The Earth: origin, age, components, structure

1.6 Plate tectonics, todays' Earth and its landforms

UNIT 2: EARTH'S PROCESSES AND LANDFORMS EVOLUTION [4]

2.1 Earth's processes and their role shaping landforms

2.2 Endogenic and exogenic processes and landscape development

2.3 Landslides, weathering and erosion processes

2.4 Fluvial, glacial, eolian processes and their role in changing earth's surface

2.5 Geomorphological evolution in different geological settings of world (cases and examples)

UNIT3: GEOLOGY OF HIMALAYA REGION (SPECIAL FOCUS TO NEPAL HIMALAYA) [5]

3.1 Geological origin and dynamics of Himalaya

3.2 Present day Himalayan setting and various geological processes

3.3 Geo-disasters in the Himalaya

3.4 Geological evolution of Terai, Siwalik, Midlands, Higher Himalaya and Tibetan-Tethys zone

3.5 Geology, soil development and vegetation in Himalaya (cases and examples)

UNIT 4: INTRODUCTION OF SOIL SCIENCE AND GENESIS [5]

4.1 Concept of soil (edaphological and pedagogical)

4.2 Historical development of soil science

4.3 Soil as a medium for plant growth and soil as a natural body

4.4 Soil forming factors

4.5 Soil development processes:

- 4.5.1 General concept of gain, loss, translocation and transformation,
- 4.5.2 Weathering of rock and minerals,
- 4.5.3 Soil formation processes

4.6 Soil profile and diagnostic horizons

- 4.6.1 Soil profile, concept of soil pedon
- 4.6.2 Masters horizons, surface and subsurface diagnostic horizons

UNIT 5: SOIL PROPERTIES [5]

5.1 Physical properties

5.2 Chemical properties

5.3 Biological properties

5.4. Soil quality index

5.5. Soil properties and its implication on forest management and soil conservation

UNIT 6: SOIL AND LAND CAPABILITY CLASSIFICATION [8]

6.1 Introduction, historical development, purpose and principles of soil classification

6.2 Soil classification systems (USDA Soil Taxonomy and World reference base (WRB for soil resources)

6.3 Soil types found in Nepal and their characteristics (alluvial, colluvial, lacustrine, etc.,)

6.4 Concept on Digital Soil Mapping and its application

6.5 Definition and purpose of land capability classification

6.6 Criteria/ factors influencing land capability classification including slope, soil type, drainage, and vegetation

UNIT 7: SOIL MANAGEMENT FOR 21ST CENTURY [7]

7.1. Essentials plant elements and their functions

7.2. Global soil environment and its importance in forestry

7.3. Soil as a source and sink of carbon

7.4 Modern technology for soil quality assessment

7.5. Sustainable Soil Management and SDGs

PRACTICAL [20]

SN	Content	Equipment/tools	Methodology/ Methods	Link to units
1	-Identification and classification of rocks and minerals -Weathering pattern -Study and analysis of discontinuities data for failure mechanism (kinematic analysis) -Measurement of dip, strike, fold, joint, faults etc.	Sample rocks and minerals Brounton Compass	Field excursion Observation	1, 2
2	Soil profile and taxonomical classification, land classification	Field observation and secondary study Shovel, other related equipment	Field excursion Observation	1,2,3,5
3.	Soil properties : pH, texture, carbon, nitrogen, phosphorus, Potashetc	Field work (soil samples) Shovel, other related equipment	Field and Laboratory experiment	4,5

TEXTBOOKS

1. Dhital, M.R. 2015. *Geology of the Nepal Himalaya*. Springer International Published, Switzerland
2. Weil, R. and Brady, N.C. 2016. The *Nature and Properties of Soils*, Fifteenth edition. Pearson International.
3. Ojha, R.B. and Panday, D. (eds). 2021. The Soils of Nepal, Springer, International Published, Switzerland

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1. Deoja, BB., Dhital, M.R., and Wagner, K.B. Thapa. "*Mountain Risk Engineering Handbooks*", ICIMOD.
2. Ehlers, G.E. and Blatt, H. 1997. *Petrology, Igneous, Sedimentary and Metamorphic Rocks*. CBS Publishers and Distribution, New Delhi-11000, India.
3. Food and Agriculture Organization, 2016. World reference base for soil resources.
4. Ritter, Dale F., R. Craig and Jerry R. Miller. 2011. *Process Geomorphology*. Fifth ed. Waveland Pr. Inc.
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7. USDA. 2014. Soil Taxonomy. U.S. Department Agriculture, U.S. Government Printing Office, Washington D.C.
8. LRMP. 1986. Land Capability Report. Land Resource Mapping Project, Kathmandu.
9. Soil Survey Staff. 1975. Soil Taxonomy. U.S. Department Agriculture Handbook 436, U.S. Government Printing Office, Washington D.C.
10. WRB, 2015. World Reference Base for Soil Resources (WRB). ISRIC - World Soil Information .Wageningen, The Netherlands

COURSE TITLE: OBSERVATION TOUR

Course Code	Credit	Lecture	Total Marks
SFB 116	2	40	50

SCOPE: This 14-day observation tour will cover different aspects of related subjects such as observation of vegetation types, protected areas, watersheds, and major plant and animal species, and plant species identification and specimen collection.

OBJECTIVES: Students will observe:

- Vegetation study
- Protected areas
- Forest Types (Natural and Plantation)
- Tree identification
- Watershed
- Making of herbarium
- Succession
- Division Forest Offices
- Nursery

EXPECTED LEARNING OUTCOMES: After the completion of the tour, students will be able to:

- Identify plant species
- Understand vegetation succession
- Identify forest Types
- Familiarize with relevant stakeholders

Content	Methodology/methods	Link to the course unit(s)
Observe vegetation types at different altitudes	• Plant identification • Herbarium collection	Forest resources and Silvics Plant Physiology and Dendrology
Visit protected areas	• Observation, Lecture	Wildlife and Protected Area
Visit plantation forest	• Observation, Lecture	Forest resources and Silvics
Visit watershed area	• Observation	Soil and Watershed management
Visit DFO and nursery		All

The student should prepare a report of max. 1500 words based on the experience of the tour (Introduction – max. 500 words, Activities – max. 500 words, Experience gained – max. 400 words and Recommendations/Suggestions – max. 100 words)

YEAR 1 SEMESTER II

COURSE TITLE: WILDLIFE BIOLOGY

Course Code	Credit	Lecture Hours	Marks			Total
PWM 121	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: Wildlife Biology prepares students to work on the concerning problems relating to threatened wildlife. The course has focused on the biology of higher vertebrates, particularly herpetofauna, birds and mammals. Students will study these topics through hands-on learning, field visit, data collection, analysis, and creating presentations.

OBJECTIVES: The objectives of this course are to:

- Understand the basic concepts of wildlife biology, wildlife diversity and conservation biology.
- Know the scientific and biological principles relating to wildlife populations.
- Understand the important factors that may affect wildlife populations.

EXPECTED LEARNING OUTCOME

- Familiarize with the concept and foundation of conservation biology as the scientific basis of biodiversity conservation;
- Understand the concepts of different types of animal behavior, wildlife diet, wildlife health and the significance.
- Acquire new skills and practical knowledge, utilize to conserve and manage the threatened wildlife.

UNIT 1: INTRODUCTION TO WILDLIFE BIOLOGY AND WILDLIFE POPULATION [10]

1.1 Introduction to wildlife biology, conservation biology and their scope
1.2 Principles of population biology and ecology
1.3 Population dynamics: Age structure, sex ratio, population patterns (life history strategy: r-selected and k-selected), natality, immigration, mortality, emigration
1.4 Population growth models (calculation methods and exercise)
1.5 Population viability analysis (PVA)-(with the calculation)
1.6 Stochasticity and population decline
1.7 Metapopulation theory and practices

UNIT 2: EVOLUTION AND EXTINCTION [10]

2.1 Conservation genetics (Basics genetics review- conservation of genetic variation; gene; genome; trait; gene pool; alleles; genetic drift: bottleneck effect, founder effect; genetic swamping)
2.2 Heterozygosity and inbreeding
2.3 Evolutionary aspects of diversity and convergent vs. divergent evolution
2.4 Evolution of social behavior
2.6 Evolution measures of diversity (Basic concept on the palaeontological, phylogenetic measure)

2.7 Animal adaptations: Structural, physiological, and behavioral adaptation in high and low altitude animals
2.8 Island biogeography, speciation and extinction
  2.8.1 Island biogeography
  2.8.2 Speciation (allopatric, peripatric, parapatric, and sympatric)
  2.8.3 Species extinction, local extinctions and extinction rate predictions

UNIT 3: ETHOLOGY [10]

3.1 Natural selection
3.2 Defense and territorial behavior
  3.2.1 Predator vs. prey, camouflage, mimicry, aposematism, cryptic behaviors
3.3 Social behavior
  3.3.1 Social organization, social caste, labor division (social animal, e.g., bees)
  3.3.2 Gregarious and solitary behavior
  3.3.3 Altruism, reciprocity, kin selection (with a coefficient of relatedness), Eusocial
3.4 Feeding behavior (basic concept)
3.5 Reproductive behavior
  3.5.1 Sexual selection, male-female arm race, dimorphism, sibling rivalry
  3.5.2 Courtship behavior
  3.5.3 Mating system
  3.5.4 Parental care and parent-offspring conflict
  3.5.5 Reproductive physiology of mammals and birds
3.6 Communal behaviors: commensalism, ammensalism and mutualism
3.7 Other behaviors: Imprinting, aestivation, hibernation, dispersal and migration Communication and signals, Ranging

UNIT 4: FOOD AND FEEDING ECOLOGY [5]

4.1 Definition food and diet
4.2 Ruminant and non-ruminant physiology and adaptations
4.3 Feeding ecology of herbivores, carnivores, omnivores, insectivores
4.4 Competition for food: ideal free distribution
4.5 Essential nutrients: Macro-nutrients, Micro-nutrients
4.6 Response to food shortage, prey-predator relationship
4.7 Food selection as behavior: Quality of food (Nutritional value), Food selection: Quantity of food
4.8 Diet analysis (Tools, techniques, applications)

UNIT 5: WILDLIFE HEALTH [5]

5.1 Introduction to wildlife (zoonosis) disease and causes, disease transmission
5.2 Major bacterial, viral, protozoan, fungal and parasitic diseases of Nepal's wild animals (e.g., TB, canine distemper, Foot and mouth disease, Rabies, etc.)
5.3 Non-infectious diseases
5.4 Disease control measures
5.5 Post mortem examination

PRACTICAL [20]

Contents	Methodology/methods	Link to the course unit(s)
• Study the structure, use and care of simple and compound microscopes (1) • Laboratory identification of major wildlife species (Birds, Mammals and herpetofauna) and their classification (8) • Diet analysis (Micro histological analysis) of carnivore and herbivore scat and dung/pellets (5)	Laboratory	Unit 3, 4
• A body condition score of important mammal species (2) • Study of animal behavior: Visit a nearby zoo or mini zoo or similar facilities (e.g. Case of *Rhesus macaque*, Deer) (4)	Excursion/field work	Unit 2, 3, 5

Note: Students must submit the field report, present the findings, and attend the objective-based examinations.

TEXTBOOKS

1. Dasmann, R. F., 1981. Wildlife biology (2nd ed). Wiley. ISBN: 978-0471080428
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2. Saha, G. K. and Mazumdar, S. 2017. Wildlife Biology: An Indian Perspective. PHI Learning; 1st edition. ASIN: B074J2RK4H
3. Robbins, C. 2012. Wildlife Feeding and Nutrition (Animal feeding and nutrition). Academic Press (December 2, 2012). ASIN: B01D4CME0O
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5. Veech, J. A. 2021. Habitat Ecology and Analysis. Oxford University Press. ISBN: 978-0198829287
6. Rubenstein, D. R. and Alcock, J. 2018. Animal behavior. Sinauer Associates is an imprint of Oxford University Press; 11th edition. ISBN: 978-1605355481COURSE

COURSE TITLE: FOREST ECOLOGY

Course Code	Credit	Lecture Hours	Marks			Total
SFB 122	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course covers the fundamentals of forest ecology, abiotic and biotic conditions for forest regeneration, growth and forest ecosystem dynamics. It also deals with forest environment interactions, autecology, and synecology and restoration ecology. It will combine theory classes with practical to provide students with the knowledge and skills required to address contemporary issues in the fields of forestry and natural resources management.

OBJECTIVES

- To provide knowledge of fundamental ecological processes and their roles in regulating the growth and development of forests.
- To provide exposure to methods to study ecological processes.
- To provide skills to apply their forest ecology knowledge to address contemporary issues in the fields of forestry and natural resources management.

EXPECTED LEARNING OUTCOMES

Students completing the course should be able to:

- Understand the factors and processes (especially disturbance regimes) that regulates the structure and function of forest vegetation as well as its variation in time and space.
- Learn about the interactions between soil factors, meteorological factors and forest production and dynamics.
- Understand the interactions between biotic factors (animals, fungi) and forest structure and function.
- Apply common forest ecosystem component inventory, measurements and data analysis to quantitatively describe various ecological factors and processes and their roles in regulating the growth and development of forests.
- Clearly communicate ecological concepts and ideas verbally and in writing.
- Apply their forest ecology knowledge to address contemporary issues in the fields of forestry and natural resources management.

UNIT 1: INTRODUCTION [5]

1.1 Concept and definition of forest ecology
1.2 Concept of forest ecosystem (understanding of the functional relationship between soil, climate, flora and fauna in forest as ecosystems)
1.3 Attributes of forest ecosystem (biodiversity, function and structure)
1.4 Forest Ecosystems of Nepal

UNIT 2: FACTORS AFFECTING FOREST ECOSYSTEM [5]

2.1 Abiotic factors (climatic, physiographic and edaphic factors)
2.2 Biotic factors (microbes, animals and humans)
2.3 Forest animal ecology and entomology and mycology
2.3 Concept of ecosystem productivity (gross and net primary productivity)
2.4 Liebig's law of minimum and Shelford's law of tolerance

UNIT 3: AUTECOLOGY/POPULATION ECOLOGY [8]

3.1 Concept of population
3.2 Characteristics of population (population size, density, distribution, age structure, sex ratio)
3.3 Major determinants of population size (fecundity, natality, mortality, immigration and emigration)
3.4 Theories about natural regulation of population size (Density dependent and independent limiting factors, metapopulational theory)

UNIT 4: SYNECOLOGY/COMMUNITY ECOLOGY [10]

4.1 Concept of community
4.2 Characteristics of community (trophic organization, dominance, interdependence, community structure, succession, stratification, ecotone)
4.3 Community diversity (species richness and evenness)
4.4 Quantitative analysis of community diversity (α, β and γ diversity, Importance value index, Simpson's diversity index, Shannon diversity index)
4.5 Interactions between species in community (positive and negative interactions)

UNIT 5: VEGETATION ECOLOGY AND SUCCESSION [6]

5.1 structure and function of forest vegetation and their spatial and temporal variation
5.2 Concept and stages of succession and retrogression
5.3 SERAL COMMUNITY AND TYPES OF SERES
5.4 Types of succession (Primary, Secondary and Cyclic)

UNIT 6: RESTORATION ECOLOGY [6]

6.1 Concept of restoration and restoration ecology
6.2 Ecological disturbances (especially fire and grazing) and their effects
6.3 Traditional ecological knowledge and restoration ecology
6.4 Applied ecological restoration

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Link to unit(s)
Visit nearby site for observing and understanding factors affecting forest ecosystem	Observation	Excursion/field visit, 300-word report	2
Quantitative analysis of population (population size, density, distribution)	Measuring tape, Diameter tape, Pegs	Plot survey, 300-word report	3
Quantitative analysis of community diversity (α, β and γ diversity, Importance value index, Simpson's diversity index, Shannon diversity	Measuring tape, Diameter tape, Pegs	Plot survey, 300-word report	4

index)			
Succession observation in nearby site	Observation	Excursion/field visit, 300-word report	5
Visit nearby restoration site for observing and understanding applied ecological restoration	Observation	Excursion/field visit, KII, 10-minute presentation	6

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COURSE TITLE: WATERSHED HYDROLOGY

Course Code	Credit	Lecture Hours	Marks			Total
WME 123	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to provide fundamental knowledge and skill of hydrology require for forest and watershed management. It will cover the watershed hydrological characters, water balance components, forest-water relation, soil and hydrological properties, water quality needed to monitor watershed processes and watershed protection and restoration planning.

OBJECTIVES: The course will provide the

- Fundamental knowledge of hydrology and hydrological characteristics of watershed
- Measurement skill of river flow, spring water, soil moisture and infiltration
- Basic knowledge and skill on soil and water
- Knowledge and measurement ideas of forest and water relationship

EXPECTED LEARNING OUTCOMES: At the end of the course, the students will be able to:

- Know the basic knowledge of watershed and forest hydrology
- Skill to measure water discharge, soil moisture and infiltration
- Know Soil hydrological properties
- Understand role of forest and its management in hydrological functioning

UNIT 1: INTRODUCTION TO WATERSHED HYDROLOGY [6]

1.1 Concept of watershed, watershed delineation and watershed resources
1.2 Climate-Forest-Water-Human linkage
1.3 Concept of hydrology
1.4 Hydrological cycle and water budget
1.5 Hydrological processes
1.6 Watershed hydrology
1.7 Hydrological characteristics of watersheds
1.8 Use of hydrological information for watershed analysis and planning

UNIT 2: WATER BALANCE COMPONENTS [7]

2.1 Water balance components and equation
2.2 Precipitation, interception and its measurements
2.3 Evaporation, evapotranspiration and its measurement (water balance, energy balance, mass transfer, remote sensing)
2.4 Infiltration, permeability, permissively, aquifer and ground water
2.5 Cryosphere; snow and glacier melt

UNIT 3: WATER FLOW [8]

3.1 Surface and ground water flow
3.2 Spring and stream flow measurements
3.3 Stream flow response to watershed characters
3.4 Hydrograph analysis
3.5 Peak flow, frequency and return period analysis
3.6 Sediment flow and its estimation
3.7 Flood prediction
3.8 Concept of E-flow and calculation

UNIT 4: SOILANSD WATER [7]

4.1 Scope of soil science on watershed management
4.2 Soil-Plant-Atmosphere interaction
4.3 Soil hydrological characteristics
4.4 Concept of hydrogeology (formation, movement and quality of ground water)
4.5 Human impacts on soil and water
4.6 Soil water content and plant availability (field capacity, wilting point, water availability)
4.7 Soil moisture and its measurement
4.8 Soil infiltration and its measurement

UNIT 5: WATER QUALITY [6]

5.1 Water quality concept
5.2 Physical, chemical and biological pollutants
5.3 Surface water pollution (river and wetland) and its impacts on ecosystem
5.4 Water quality criteria and standard for drinking, irrigation and fresh ecosystem management (WHO and NDWQS)
5.5 Water quality monitoring (rapid assessment, biological indicators, physio-chemical)
5.6 Water quality index (WQI)
5.7 Watershed management and water quality

UNIT 6: HYDROLOGICAL ROLE OF FOREST [6]

6.1 Forest hydrology concept
6.2 Hydrological functions of forests
6.3 Forest -Water relationship; synergy and tradeoff
6.4 Measurement of forest -water relationship
  6.4.1 Forest interception and its measurement
  6.4.2 Forest transpiration and its measurement
6.5 Monitoring Forest management impacts on ground water and river flow (quantity and quality)

PRACTICAL [20]

SN	Content	Equipment/tools	Hours	Methodology/ methods	Link to the course unit(s)
1	Watershed delineation using topographic map	Topographic map, Tracing paper, Pencil, Measuring scale	2	Manual delineation using contour geometry	Unit 1
2	Spring water source assessment	Survey sheet, GPS, Brunton campus, Measuring bucket, stop watch	2	Site survey and discharge measurement	Unit 3

3	River Discharge measurement	Measuring tape, Current meter, measuring rod, Rope and tag, recording sheet	4	Area velocity method	Unit 3
4	Measurement of soil moisture	Spatula, Soil augur, moisture cane, marker, survey sheet, weighing machine, oven	4	Volumetric method, moisture probe	Unit 4
5	Measurement of soil infiltration	Infiltrometer, stop watch	2	Infiltrometer	Unit 4
6	Observation of weather station in nearby area	Automatic weather station	2	Direct observation and report preparation	Unit 2
7	Water quality assessment	Benthic micro-invertebrates rating score (NEPBIOS score), mesh net, container, magnifying lens, In-situ probes etc.	4	Use of sensorial criteria, benthic micro-invertebrates and In-situ probes	Unit 5

TEXTBOOKS

1. Amatya, D., Williams, T., Bren, L., andde Jong, C. (eds.). (2016). Forest Hydrology: Processes, Management and Assessment. CABI.Oxfordshire, OX10 8DE, UK.
2. Anderson, H. W., Hoover, M. D., & Reinhart, K. G. (1976). Forests and water: effects of forest management on floods, sedimentation, and water supply (Vol. 18). Pacific Southwest Forest and Range Experiment Station, Forest Service, US Department of Agriculture.
3. Black, P.E. (1996). Watershed Hydrology.CRC Press, Boca Raton, Florida.
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5. Chang, M. (2012). Forest Hydrology: An Introduction to Water and Forests. CRC Press, Boca Raton, Florida.
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7. Dixit, A. (2002). Basic Water Science. Nepal Water Conservation Foundation (NWCF), Kathmandu.
8. Dulal, K.N. and Baral S. (2012). Engineering Hydrology, 2ndedition. Apex Educational Academy (AEA), Kathmandu, Nepal.
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2. Budhathoki, A., Babel, M. S., Shrestha, S., Meon, G., &Kamalamma, A. G. (2021). Climate change impact on water balance and hydrological extremes in different physiographic regions of the West Seti River Basin, Nepal. Ecohydrology& Hydrobiology, 21(1), 79-95.
3. Jüttner, I., Sharma, S., Dahal, B. M., Ormerod, S. J., Chimonides, P. J., & Cox, E. J. (2003). Diatoms as indicators of stream quality in the Kathmandu Valley and Middle Hills of Nepal and India. Freshwater Biology, 48(11), 2065-2084.
4. Mahmood, T. H., Putkonen, J., &Sobbe, A. (2021). Spatially Variable Precipitation and Its Influence on Water Balance in a Headwater Alpine Basin, Nepal. Water, 13(3), 254.
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7. Tomscha, S. A., &Gergel, S. E. (2016). Ecosystem service trade-offs and synergies misunderstood without landscape history. Ecology and Society, 21(1).

COURSE TITLE: SILVICULTURE AND TREE IMPROVEMENT

Course Code	Credit	Lecture Hours	Marks			Total
SFB 124	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course covers the fundamental aspects of silviculture and tree improvement. Silviculture science applies ecological principles to the management of forest stands. This course covers different aspects of modern silvicultural theory and practices. The course will cover tree stand dynamics, tree density management, even-aged and uneven-aged management, reforestation principles, and ecological restoration techniques.

OBJECTIVES: Upon completion of this course the students will be able to:

- Understand the fundamental of silvicultural practices for promoting and manipulating forest growth, composition and development desirable forest stand.
- Understand the fundamental of tree improvement and describe the interrelationship between and among silviculture, tree improvement (TI), and sustain able forest management.
- Apply TI technique for forest gene resource conservation and recognize TI for intensive growth and development.
- Learn reforestation and regeneration principles, and ecological restoration techniques.

EXPECTED LEARNING OUTCOMES:

On completion of the course, the students will

- Understand how forests develop, grow and regenerates
- Demonstrate an understanding of how forests develop and regenerate in response to human and natural interventions and disturbances/encroachment and how good silvicultural practices may be used to manipulate ecological processes and reach forest management goal.

UNIT 1: INTRODUCTION [4]

1.1 Concept of silviculture
1.2 Silviculture, plant ecology and Regenerative/applied Ecology
1.3 Relationship of silviculture with other branches of forestry
1.4 Silvicultural Systems: even-aged, selection, irregular/multiple-age systems

UNIT 2: SILVICULTURE OPERATIONS AND SITES [10]

2.1 Components of silviculture
2.2 Site-/plant relationship and plantation system
    2.2.1 Natural regeneration
    2.2.2 Artificial/Assisted regeneration
2.3 Tending operations
    2.3.1 Weeding
    2.3.2 Cleaning
    2.3.3 Selection thinning
    2.3.4 Pruning, lopping and pollarding
    2.3.5 Improvement cutting
    2.3.6 Salvage and sanitation cutting
    2.3.7 Slash and burn
2.4 Harvesting

UNIT 3: TREE DENSITY MANAGEMENT AND THINNING [6]

3.1 Stands and forest dynamics

3.2 Types of thinning

- 3.2.1 Mechanical thinning
- 3.2.2 Low thinning
- 3.2.3 Crown/high thinning
- 3.2.4 Free thinning
- 3.2.5 Maximum thinning
- 3.2.6 Advance/selection thinning

3.3 Effects of thinning

3.4 Regulation of thinning

UNIT 4: TREE IMPROVEMENT [5]

4.1 Concept and purpose of tree improvement

4.2 Phenotypic and genotypic variations

4.3 Principles and strategy of forest gene resource conservation and tree improvement

UNIT 5: GENETIC RESOURCE CONSERVATION [10]

5.1 Plus/mother tree

- 5.1.1 Selection, selection methods, selection for several traits and recurrent selection
- 5.1.2 Elements of tree breeding and its application
- 5.1.3 Seed stand selection and management

5.2 Breeding Seed Orchard (BSO)

- 5.2.1 Seed orchards: importance and scope, establishment, management
- 5.2.2 Breeding seedling seed orchard layout, establishment and evaluation
- 5.2.3 Seed collection, processing, handling and storage

UNIT 6: TREE IMPROVEMENT IN NATURAL FOREST AND IN STAND IMPROVEMENT [5]

6.1 Natural regeneration

6.2 Individual tree and its treatment

6.3 Relationship with forest management

PRACTICAL [20]

SN	Content	Methodology/methods	Link to unit(s)
1	Mother and plus tree selection in nearby forest	Observation, 300-word report	5
2	Tending operation in nearby forest	Field exercise	2
3	Marking for mechanical thinning	Field exercise, 300-word report	3
4	BSO visit	Observation, 300-word report	5
5	Thinning plan preparation (High/Low forests) and sharing	Planning, 1500-word plan	2

Textbooks and References

1 Bunga, J.M. and Durzan, D. J. (1982). Tissue Culture in Forestry. Martinus Nijhoff/DR W. Junk Publishers, The Hague.
2 Chaudhary, Ram. Pd. (1998). Biodiversity in Nepal (Status and Conservation), Know Nepal, Series No. 17, TU
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11 Leopold, A. C. and Krideman, P. B. (1975). Plant Growth and Development. McGraw Hill, New York.
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13 Smith, M, David (1989). The practice of Silviculture (Eighth Edition)
14 Toumey, J. W. (1947). Foundation of Silviculture upon an Ecological Basis. John Willey and Sons, New York.
15 Wright, J. (2012). Introduction to Forest Genetics. Elsevier Science, Amsterdam.
16 Zobel, B. and Talbert, J. (2003). Applied Forest Tree Improvement. Blackburn Press, New Jersey.

COURSE TITLE: PRINCIPLES OF ECONOMICS

Course Code	Credit	Lecture Hours	Marks			Total
BSH 125	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course will encompass the basic understanding of principles of economics. The course mostly covers the content in microeconomics with a particular focus on theory of consumer behavior and the theory of product pricing. Under theory of consumer behavior, the course will include theory of demand, and utility analysis. Essentially, the theory of consumer behavior will demonstrate how a consumer reaches equilibrium (i.e., maximizes his/her utility given the resource constraint) using methods and tools of utility analysis. Under product pricing, the course will include production, cost and revenue analysis, and market structure analysis. The theory of product pricing will demonstrate the producer's equilibrium (i.e. maximization of output or minimization of cost) as well as the price and output determination process in various types of market structures using the tools of production, cost and revenue analysis.

OBJECTIVE: After completion of this course, the students will be able to:
1. Understand basic concept of central economic problem and demand and supply analysis.
2. Apply knowledge of micro-economic theories in analyzing the behavior of individual and organizations.
3. Demonstrate an understanding of the theory of production and product pricing in different markets.
4. Apply basic idea to calculate national income and contribution of natural resource in national economy.

EXPECTED LEARNING OUTCOMES: After completion of this course, the students are expected to have:

1. Basic understanding of the theory and economic models applied in natural resource economics and management.
2. Foundations to develop skills in building microeconomic models applicable in natural resource economics and management.

UNIT 1: INTRODUCTION [6]
1.1 Definition of Economics – Adam Smith: wealth of Nation; Alfred Marshall: material welfare; and Lionel Robbin: scarcity and choice
1.2 Fundamental principles of economics
1.3 Trade-off in Economics: Scarcity, choice and resource allocation (Production possibility curve)
1.4 Micro-economics: Introduction, importance and uses with special reference to resource economics
1.5 Subject matters of micro-economics

UNIT 2: THEORY OF DEMAND, SUPPLY & MARKET EQUILIBRIUM [9]
2.1 Meaning and concept of demand
2.2 Demand function and determinants of demand
2.3 Law of demand, demand schedule and curve (individual and market)
2.4 Elasticity of demand - price, income and cross elasticity of demand

2.5 Measurement of price elasticity of demand by point and arc method with numerical example
2.6 Concept of supply and supply function
2.7 Law of supply, supply schedule and supply curve
2.8 Determinant factors of supply and elasticity of supply
2.9 Market equilibrium and price determination with numerical example
2.10 Case study on application of market equilibrium analysis in resource economics

UNIT 3: THEORIES OF CONSUMER BEHAVIOUR [9]

3.1 Cardinal utility analysis – concept of total and marginal utility
3.2 Law of diminishing marginal utility and Law of Equi-marginal utility
3.3 Derivation of demand curve and concept of consumer surplus
3.4 Weaknesses of cardinal utility analysis
3.5 Ordinal utility analysis: Concept and Assumptions
3.6 Concept of Indifference curve (IC), Principle of Marginal rate of substitution (MRS), IC map and properties of IC
3.7 Budget line and causes of shifts in budget line
3.8 Utility Maximization: Equilibrium of the consumer in IC analysis
3.9 Basic mathematical illustration of Utility Maximization: Unconstrained and constrained optimization
3.10 Price effect, Income effect, and Substitution effect
3.11 Derivation of the demand curve under IC analysis

UNIT 4: THEORY OF PRODUCTION [8]

4.1 Concept of production, factors of production and their return
4.2 Concept of production function in short run and long run
4.3 Concept and derivation of Total product (TP), Average product (AP) and Marginal product (MP) curves
4.4 Law of variable proportions
4.5 Concept of iso-quant and iso-cost line
4.6 Producer's equilibrium and least cost combination
4.7 Law of returns to scale (Increasing, constant and decreasing)
4.8 Concept of Cobb-Douglas production function and its importance/use in building economic models

UNIT 5: COST CURVES, REVENUE CURVES & FIRM EQUILIBRIUM [8]

5.1 Concept of Monetary cost, Real cost, Implicit cost, Explicit cost and Opportunity cost
5.2 Concept and derivation of Fixed cost (FC), Variable cost (VC) and Total cost (TC) curves
5.3 Derivation of Average variable cost (AVC), Average fixed cost (AFC), Average cost (AC), and Marginal cost (MC) curves in the short run
5.4 Concept and derivation of Long Run Average Cost (LRAC) and Long run marginal cost curves (LRMC)
5.5 Concept of Total Revenue (TR), Average Revenue (AR) and Marginal Revenue (MR)
5.6 Derivation of TR, AR and MR curves under perfect and imperfect competition
5.7 Firm Equilibrium: TR-TC and MR-MC approaches

UNIT 6: THEORY OF PRODUCT PRICING [8]

6.1 Perfect competition: Meaning, features and price-output determination in the long and short run
6.2 Monopoly: Meaning, features and price-output determination in the long and short run
6.3 Monopolistic competition: Meaning and features

6.4 Oligopoly: Meaning and features
6.5 Market failure: Meaning and causes
6.6 Deadweight loss: Meaning and Graphical Illustration

UNIT 7: MACROECONOMICS [12]

7.1 Introduction to macroeconomics and its interdependence with microeconomics
7.2 National income accounting: Various concepts of national income, nominal and real GDP, GDP deflator, measurement of national income and difficulties in measuring national income
7.3 Consumption function: concept and determinants
7.4 Investment function: concept and determinants
7.5 Inflation: Meaning, causes, effects and remedies
7.6 Economic growth and development
7.7 Capital formation
7.8 Concept of macro-economic policies: fiscal and monetary

PRACTICAL [20]

SN	Content/Topics	Methods	Output
1	Application of law of demand/supply in different situation related to the production of natural resources	Review	Report preparation
2	Estimation of consumer's surplus and utility maximization	Exercise	Solving exercise
3	Estimation of average cost, marginal cost, average revenue and marginal revenue	Exercise	Solving exercise
4	Forests and Gross Domestic Products	Review	Essay (500 words)
5	Production function (short and long run) in forest growth and yield	Review	Essay (200 words)

TEXTBOOKS

1. Ahuja, H.L. 2017. Advanced Economic Theory. S. Chand Publishing, New Delhi.
2. Mankiw, G.N. 2008. Principles of Economics. Fifth edition. Cengage Learning.
3. Mankiw, G.N. 2012. Macroeconomics. Eighth edition. Worth Publishers.

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1. Chopra, P.N. 2012. Principles of Economics. Kalyani Publishers, New Delhi.
2. Dewett, K.K. 2006. Modern Economic Theory. S. Chand Publishing, New Delhi.
3. Dwivedi, D.N. 2002. Microeconomics: Theory and Policy. Pearson Education, India.
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YEAR 2 SEMESTER I

COURSE TITLE: FOREST RESOURCE ECONOMICS

Course Code	Credit	Lecture Hours	Marks			Total
SFM 211	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course covers introductory concepts to describe forest resource economics, externalities in forestry sector, valuation techniques to ecosystem services, economic evaluation of forestry projects and green economy.

OBJECTIVES: The objectives of this course are to:

- Understand why markets fail to efficiently allocate forest resources and the need for relevant policies to correct market failure
- Familiarize students with the different non-market valuation techniques
- Estimate benefits of important direct and indirect forest resources
- Learn techniques to conduct economic evaluation of forestry projects and policies
- Understand the role of forestry sector to promote green economy

EXPECTED LEARNING OUTCOMES: On the completion of this course, students will be able to:

- Analyze forestry sector from economic perspective
- Estimate the value of ecosystem services
- Internalize PES concept to manage externalities in forestry sector
- Evaluate natural resource management projects
- Understand the role of forestry to promote green economy

UNIT 1: INTRODUCTION [4]

1.1 Forestry from an economic view point
1.2 Introduction of forest resource economics: scope and role in sustainable forest management
1.3 Commonalities and differences of forest resource economics with environmental economics and ecological economics
1.4 Major concerns of forest resource economics
1.5 Concept of different types of goods (public, private, club, commons)

UNIT 2: EXTERNALITIES [8]

2.1 Market failure and externalities in forestry
2.2 Classification of externalities (Negative Vs Positive, Production vs Consumption, Local vs Global)
2.3 Internalizing externalities:
  2.3.1 Coasian solutions (bargaining) – Property right approach and Payment for ecosystem services
  2.3.2 Collective actions (Ostrom) - Community based approach
  2.3.3 Command and control – fixing quota/quantity
  2.3.4 Market based approach – Pigouvian tax, Subsidies, Permits (cap and trade)

UNIT 3: VALUATION OF ECOSYSTEM SERVICES [12]

3.1 Concept of ecosystem services
3.2 The concept of Total Economic Value
3.3 Economic valuation of non-market goods and services, and its importance
3.4 Theory of economic valuation
3.5 Measures of indirect utility – WTP and WTA
3.6 Classification of valuation approaches
- 3.6.1 Market price and production function approaches
- 3.6.2 Cost based approaches
- 3.6.3 Revealed preferences approach (travel cost method, hedonic pricing)
- 3.6.4 Stated Preferences approach (contingent valuation, conjoint analysis, discrete choice)

UNIT 4: ECONOMIC ANALYSIS OF FORESTRY PROJECTS [10]

4.1 Benefit cost analysis
- 4.1.1 Concept of private vs. social benefit-cost analysis and its scope
- 4.1.2 Step in benefit-cost analysis
- 4.1.3 Tools of Benefit-cost ratio, net present value, internal rate of return, break-even point
- 4.1.4 Risk and uncertainty in forestry projects (due to natural disturbance and market fluctuations)
- 4.1.5 Sensitivity analysis

4.2 Land expectation value
4.3 Stumpage value

UNIT 5: GREEN ECONOMY [6]

5.1 Concept and rationale for green economy
- 5.1.1 Sectors of green economy
- 5.1.2 Opportunities and challenges to implement green economy

5.2 Forest accounting
- 5.2.1 Concept and importance of Forest accounting
- 5.2.2 Role of Forest accounting in sustainable natural resource management

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	List out the externalities in forestry sector (infrastructure development, industries)	-Reports - News paper	-Review - Prepare a report	2
2	Coase problem	- Provide hypothetical problem	- Analysis - Report prepare	2
3	Benefit-cost analysis plan/activities (CF, Partnership Scheme, Watershed management plan, protected area management)	- CF operational plan or Partnership forest scheme	-benefit-cost analysis - benefit cost ratio - Internal Rate of return - sensitivity analysis	4
4	Contingent valuation method (Nearby any resources)	-Tour or excursion	Survey instrument preparation	3
5	Travel cost method (nearby recreational areas)	-Tour or excursion	Survey instrument preparation	3

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COURSE TITLE: FOREST MENSURATION

Course Code	Credit	Lecture Hours	Marks			Total
SFM 212	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course covers the measurement of standing trees, calculation of volume and biomass of standing trees and products, preparation of volume table and stand table.

OBJECTIVES: The objectives of the course are to teach students to

- Estimate the volume of standing trees and forest products.
- Prepare biomass and volume table
- Understand and explain the form of trees.
- Determine growth of trees and stands.
- Measure carbon stock.

EXPECTED LEARNING OUTCOMES: After the completion of the course, students will be able to

- Estimate volume of standing trees
- Explain other tree and forest attributes
- Design appropriate sampling strategy to conduct forest inventory
- Quantify carbon stocked in forest resources
- Generate growth models to predict future forest yields.

UNIT 1: MEASUREMENT OF STANDING TREES [7]

1.1 Definition, objectives and scope of forest mensuration
1.2 Diameter measurement and its significance
1.3 Rules for DBH measurement
1.4 Diameter measuring instruments (D-Tape, Caliper)
1.5 Height measurement
    1.5.1 Concept of different tree height and their uses
    1.5.2 Principles of height measurement
    1.5.3 Methods of height measurement
    1.5.4 Measurement of height of trees in plane area
    1.5.5 Measurement of height of trees in slope area
    1.5.6 Height measuring instruments and their use (Abney's Level, Clinometers, Vertex, Range Finders)
1.6 Bark measurement
1.7 Single Tree Canopy measurement
1.8 Bias, precision, and accuracy in forest measurements

UNIT 2: FORMS OF TREES [4]

2.1 Concept of tapering
2.2 Metzger's theory
2.3 Form factor and its types
2.4 Form quotient and its types
2.5 Taper equations and taper table

UNIT 3: MEASUREMENT OF VOLUME AND BIOMASS [9]

3.1 Volume tables and their types
3.2 Preparation of Local Volume Table (graphical and regression technique)
3.4 Forest biomass (Root, leaf, bark, fruits, seed, flowers, stem and branch bio-mass)
3.5 Preparation of biomass table (Regression technique)
3.6 Forest carbon measurement and analysis
3.7 Measurement of logs (Newton's / Huber's / Smalian's / Quarter girth formula)
3.8 Measurement of fuelwood
3.9 Measurement of sawn timber
3.10 Measuring hollowness of trees

UNIT 4: FOREST INVENTORY [8]

4.1 Definition and scope of forest inventory
4.2 Process of forest inventory
    4.2.1 Plot layout
        4.2.1.1 Types of sample plots
        4.2.1.2 Size of sample plots
    4.1.2 Sampling Techniques
        4.1.2.1 Random sampling
            4.1.2.1.1 Simple random sampling
            4.1.2.1.2 Stratified random sampling
                a. Proportional allocation of field plots
                b. Optimum allocation of field plots
    4.2.2 Non random sampling
        4.2.2.1 Line plot sampling
        4.2.2.2 Strip Sampling
    4.2.3 Point sampling (horizontal and vertical)
4.3 Field measurements
4.4 Analysis of growing stock and annual allowable cut

UNIT 5: FOREST GROWTH AND INCREMENT [6]

5.1 Basic concept of diameter, height and volume growth
5.2 Forest increment and its type
5.3 Current Annual Increment (CAI) and Mean Annual Increment (MAI)
5.4 Stand growth and Stand structure
5.5 Stump analysis and stem analysis
5.6 Site quality assessment

UNIT 6: FOREST GROWTH AND YIELD [6]

6.1 Growth and yield of even- aged forest
6.2 Growth and yield of uneven- aged forest
6.3 Different growth and yield modeling approaches
    6.3.1 Stand table projection

6.3.2 Whole stand modeling
6.3.3 Individual tree modeling
6.3.3.1 Distance dependent
6.3.3.2 Distance independent
6.4 Application of growth and yield models

PRACTICAL [20]

S N	Content	Equipment/tools	Methodology/ methods	Unit
1	DBH Measurement	Tape and Caliper	Visit nearby forest	Unit 1
2	Measuring height of vertical and leaning trees	Clinometer, Abneys level, vertex and transponder, laser range finder	Visit nearby forest	Unit 1
3	Tree bark measurement	Bark gauge	Visit nearby forest	Unit 1
4	Canopy cover measurement	Densiometer	Visit nearby forest	Unit 1
5	Form factor estimation	Tape and Caliper	Fell tree	Unit 2
6	Preparation of volume tables	Tape and Caliper	Regression method	Unit 3
7	Stratified random sampling	Textbook	Visit nearby forest	Unit 4
8	Point Sampling	Wedge Prism	Visit nearby forest	Unit 4
9	Growing stock and annual allowable cut estimation	Clinometer, Abneys level, vertex and transponder, laser range finder	Visit nearby forest	Unit 4
10	Preparation of site index curves			Unit 5
11	Volume estimation of logs		Using formula	
12	Biomass estimation of leaf, bark, branch, flowers, fruits, seed			

TEXTBOOKS AND REFERENCES

1. Avery, T.E. and Burkhart, H.E. 2002. Forest Measurements. McGraw Hill Book Company, New York, USA.
2. DoF. 2061 B.S. Community Forestry Inventory Guidelines. Department of Forest. Babarmahal, Kathmandu, Nepal.
3. DoF. 2069 B.S. Non Timber Forest Product Resource Inventory Guidelines. Department of Forest, Babarmahal, Kathmandu, Nepal.
4. Husch, B., Beers, T.W. and Kershaw, J.A. Jr. 2003. Forest Mensuration. John Wiley and Sons Inc., Hoboken, New Jersey.
5. Kangas, A and Maltamo, M. (Eds.). 2009. Forest Inventory Methodology and Applications.Springer, The Netherlands.
6. Khanna, L.S. and Chaturvedi, A.N. 2015. Forest Mensuration and Biometry (Sixth edition). Khanna Bandhu Publishers, India.
7. 8.Philip, M.S. 1994. Measuring Trees and Forests. CABI Publishing, UK.

COURSE TITLE: FOREST SURVEYING AND ENGINEERING

Course Code	Credit	Lecture Hours	Marks			Total
FPE 213	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: Knowledge of theory and practice of surveying and engineering are an important part of forestry professional. The forest surveying involves both field work of taking measurement and office work for computation of data & preparation of maps. Similarly, Forest engineering delivers scientific, technological, economic, social and practical knowledge for planning, designing, building, maintaining and improving the physical infrastructure for forest and natural resource management.

OBJECTIVES: The course aims the students to gain knowledge, skill, experience and build capacities required for mapping, resources estimating, planning, building and improving physical structure for management, protection and administration of forest and natural resource management. The main objectives of the course are to:

- Provide the knowledge and understanding on the principle of surveying, mapping of forest and different land use land cover.
- Record filed data systematically in standard format
- Prepare various map/plan using theodolite.
- Calculate the quantities of materials for resource conservation in situ and estimate the cost.
- Familiarize on planning, design, construction, procurement of work and services.

EXPECTED LEARNING OUTCOMES: After the completion of course, students are expected to be able to:

- Understand about the principle of surveying, measurement, and mapping.
- Explain the process of planning, design, building, improving, management and procurement of work and services for development of physical structures concerning to forest.

UNIT 1: FUNDAMENTALS OF FOREST SURVEYING AND MEASUREMENTS [6]

1.1 Definition of surveying, types, objectives and uses in forestry and natural resource management
1.2 Classification of surveying
1.3 Principle of surveying
1.4 Concept of mapping and scale
1.5 Importance of linear and angular measurement
1.6 Methods of linear measurements, ranging/taping on plain and slope ground, measurement across obstacles.
1.7 Accuracy, errors and mistakes in surveying
1.8 Discrepancy in linear measurements
1.9 Precautions against errors and mistakes, permissible errors in linear measurements

UNIT 2: TRAVERSE COMPUTATION AND TRAVERSING [6]

2.1 Introduction, purpose and types of traversing

2.2 Concept of bearing and angles with numerical example
2.3 Methods of traversing
2.4 Check on open and closed traverse
2.5 Field procedure and plotting of compass traversing
2.6 Adjustment of closing error on compass traversing
2.7 Procedures for theodolite traverse survey
2.8 Computation and plotting of latitude and departure on theodolite traversing
2.9 Balancing the theodolite traverse

UNIT 3: TOPOGRAPHIC SURVEY AND RESOURCE ESTIMATION [6]

3.1 Introduction and objectives of topographic survey
3.2 Concept of leveling on surveying
- 3.2.1 Objectives and use of leveling
- 3.2.2 Terms used in leveling
- 3.2.3 Types of leveling operations
- 3.2.4 Methods of calculation of reduce level
- 3.2.5 Profile leveling and cross section leveling

3.3 Definition, contouring
3.4 Contour interval and characteristics of contours
3.5 Methods of contouring
3.6 Interpolation of contours and map reading
3.7 Procedures and methods of topographical survey
- 3.7.1 Tachometric surveying
- 3.7.2 Total station surveying

3.8 Uses of contour map
3.9 Area and volume estimation
- 3.9.1 Computation of area from plotted plan
- 3.9.2 Trapezoidal rule
- 3.9.3 Simpson's rule
- 3.9.4 Computation of volume from cross sectional area method
- 3.9.5 Trapezoidal rule and prismoidal formula for volume calculation

UNIT 4: BUILDING CONSTRUCTION PLANNING AND CONSTRUCTION MATERIALS [5]

4.1 Construction materials
- 4.1.1 Introduction and types of construction materials
- 4.1.2 Stone, sand, aggregate
- 4.1.3 Brick, cement, reinforcement bar, admixture
- 4.1.4 Cement mortar, PCC, RCC
- 4.1.5 Masonry
- 4.1.6 Wood, aluminum, UPVC, glass

4.2 Building components
- 4.2.1 Foundation/footing
- 4.2.2 Walls
- 4.2.3 Column, beam, slab, staircase
- 4.2.4 Sill and lintel
- 4.2.5 Doors and Windows
- 4.2.6 Plastering and pointing
- 4.2.7 Water supply, sanitation and electrical system

4.3 Building construction planning
- 4.3.1 Concept and understanding of building drawings

4.3.2 Construction site selection, criteria and orientation of building
4.3.3 Requirements of buildings
4.3.4 Building construction process

UNIT 5: FOREST ROAD AND PLANNING [10]

5.1 Concept on forest road
5.2 Classification of road networks in Nepal
5.3 Route location process and alignment survey of forest road
5.4 Geometrics of road
5.4.1 Horizontal alignment elements
5.4.2 Vertical alignment elements
5.4.3 Cross sectional elements
5.5 Typical cross section of plain terrain road and hill terrain road
5.6 Introduction, importance and types of cross drainage structures
5.7 Classification and components of bridge (details on Timber Bridge)
5.8 Activities, techniques, tools and equipment used in road construction
5.9 Construction of earthen, gravel, WBM and bituminous road pavement
5.10 Construction of cement concrete road
5.11 Types of road pavement failures and its causes
5.12 Methods of pavement repair and maintenance
5.13 Characteristics and desirable properties of subgrade soil

UNIT 6: CONSTRUCTION MANAGEMENT AND PROCUREMENT PROCESS [5]

6.1 Estimating & costing: types, norms, specification, district rate, rate analysis
6.1.1 Understanding engineering drawing (plan, elevation, section, isometric view) and its importance in estimating
6.1.2 Estimating and costing for two roomed forest guard house
6.2 Construction planning, management and scheduling
6.2.1 Life cycle phases of construction project
6.2.2 Steps and stages of planning
6.2.3 Scheduling of construction project
6.3 Contract management
6.3.1 Types of contracts
6.3.2 Preparation of tender- cost estimation, BOQ, specification, bid documents
6.3.3 Tendering process- tender notice, evaluation, selection, award and agreement
6.3.4 Quality control and monitoring of construction project
6.4 Basic concept to public procurement act and regulation

PRACTICAL [20]

SN	Content	Equipment/tools	Methodology/methods	Unit
1	Linear measurement	Rods/ocular estimation/tape	pacing and taping with ranging in plain and sloping in ground	5
2	Bearing and angle measurement	Compass/theodolite	Group formation and visit to nearby road	5
3	Tachometric observation, traversing and computation	Theodolite	Group formation visit nearby forest road	5

4.	Demonstration and application of total station	Total station	Visit nearby road	5
5.	Horizontal alignment survey, cross section and profile leveling	Theodolite, Tape, Chain	Visit nearby forest road	5
6.	Preparation of drawing, quantity and cost estimation of round shape hut for forest office		Practice exercise set	6

TEXTBOOKS

1. Punmia, B. C. Surveying Vol. I & II
2. Basak, N. N. *Surveying and levelling*
3. Bhavikatti, S. S. *Building construction*
4. Virendra Kumar Paul and Chaitali Basu, *Construction project planning and scheduling*
5. Dr. S.K. Khanna and Dr. C.E.G.Justo, *Highway engineering*
6. B.N. Dutta, Estimation and Costing
7. Er. Ram Kumar Shrestha, Er. Santosh Kumar Shrestha, Er.Subash Kumar Bhattarai, *A Textbook of Construction Management*

REFERENCES

1. Nepal Road Standard (NRS) & Nepal Rural Road Standard (NRRS)
2. Public Procurement Act and Regulation
3. Standard bidding documents by PPMO

COURSE TITLE: WILDLIFE MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
PWM 214	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to introduce important principles and practices with the application of different technologies, tools and techniques to govern the conservation and management of wildlife resources. In addition, it covers contemporary wildlife management, human wildlife interactions emphasizing research, practical, field visits and case studies to strengthen innovative conservation strategies.

OBJECTIVES: The objectives of this course are to:

- Demonstrate skills in habitat analysis and evaluation.
- Understand the different techniques of wildlife handling, including capturing, handling, trapping wild animals, marking and tagging, and radio (GPS) telemetry.
- Understand the procedures for population estimation and analysis.
- Describe techniques for control of wildlife damage.
- Understand the concept of Ex-situ conservation through the management of the zoo.

EXPECTED LEARNING OUTCOMES

- Students will be introduced to various wildlife habitats and their management techniques and equipment used to manage wildlife species ranging from insects and reptiles to small mammals, birds, and big game.
- Students will gain experience using wildlife survey techniques and hands-on wildlife handling skills.
- Students will learn about habitat evaluation for a single species and the entire community.
- Students will be able to understand and handle wildlife management skills and know the damage valuation techniques which they can apply in the field.

UNIT 1: HABITAT EVALUATION AND MANAGEMENT [12]

1.1 Habitat evaluation
- 1.1.1 Evaluation for specific management objectives: Food production, cover, edge, indicator species, and condition of individual animals
- 1.1.2 Application of biodiversity indexes and assessment results for evaluating natural communities
  - 1.1.2.1 Simpson's diversity index, Shannon-wiener index, Brillouin index
  - 1.1.2.2 Habitat suitability index
  - 1.1.2.3 Important value index
  - 1.1.2.4 Carrying capacity assessment (for herbivores and carnivores)

1.2 Habitat management
- 1.2.1 Adjustment of seral stages: Setting back and advancing succession
- 1.2.2 Manipulation of edge
- 1.2.3 Habitat restoration and Mitigation

1.3 Habitat management techniques

1.3.1 Grassland management for forage production
1.3.1.1 Production/conservation of edible fruits and seeds, grazing and browsing food, production/creation of pasture land, geophasia, salt lick
1.3.1.2 Control-grazing (or rotational grazing, grazing lawn management), control burning and fire-line, and insect control
1.3.1.3 Supplementary feeding
1.3.2 Wetland management and improvement techniques: Water hole development
1.3.3 Cover management
1.3.4 Cliffs/trees/bushes
1.3.5 Fences and trenches

UNIT 2: WILDLIFE CAPTURE AND HANDLING [7]

2.1 Capturing and handling (indigenous and modern techniques): reptiles, birds and mammals
2.2 Marking reptiles, birds and mammals
2.3 Chemical immobilization
2.4 Monitoring (Radio, GPS tracking, Satellite tracking, ID based)
2.5 Translocation (Practices and issues related to introduction and reintroduction)
2.6 Wildlife rescue and management
2.6.1 Orphan, injured, problematic and old aged animal management
2.6.2 Rescue center management

UNIT 3: POPULATION ESTIMATION AND ANALYSIS [10]

3.1 Introduction to population monitoring: Bias, precision, accuracy, variance, census, estimate, direct and indirect survey methods
3.2 Estimation of animal abundance
3.2.1 Mark-and-recapture (e.g., Mark recapture of a closed population of surveying amphibians' density, Camera trapping)
3.2.2 Distance sampling (Strip, and Line transect)
3.2.3 Vantage-point and double observer count
3.2.4 Change-in-ratio method
3.2.5 Pellet-group count
3.2.6 Patch occupancy survey
3.2.7 ID based, block count/sweeping
3.2.8 Roadside counts
3.2.9 Water-hole counts
3.2.10 Scent station surveys
3.2.11 Non-invasive genetics sampling

UNIT 4: HUMAN-WILDLIFE INTERFACE [6]

4.1 Introduction of HW interface (conflict and their cause, wildlife use)
4.2 Consumptive and non-consumptive values of wildlife
4.3 Wildlife farming (policy, possibilities, practices, challenges)
4.4 Wildlife damage
4.4.1 Types and nature of damage: human and wildlife injuries and casualties, crop and property damage (three case studies from each geographical region)
4.4.2 Control techniques – physical, chemical, and biological

4.4.3 Damage relief mechanism (e.g., Wildlife Damage Relief Guideline 2069 (Latest amendment))

4.5 Issues relating to enclave villages and control of human disturbance to the habitat

UNIT 5: ISSUES, THREATS AND WILDLIFE MANAGEMENT [5]

5.1 Issues and threats
- 5.1.1 Population decreases and decline
- 5.1.2 Habitat destruction
- 5.1.3 Poaching and illegal trade
- 5.1.4 Random use of pesticides
- 5.1.5 Wildlife: pests and predator
- 5.1.6 Human-wildlife conflict
- 5.1.7 Political influence and economic impact
- 5.1.8 Habitat protection
- 5.1.9 Wildlife vehicle collision
- 5.1.10 Poorly planned infrastructure development (irrigation canals and hydropower dams, roads, high tension line, airport, railway tract etc.)
- 5.1.11 Rescue, care and rehabilitation
- 5.1.12 Financing issues

5.2 Wildlife management measures
- 5.2.1 Population management (small, isolated, large population, former range)
- 5.2.2 Zoo and zoological garden management
- 5.2.3 Conservation breeding (captive, enclosure within enclosure)
- 5.2.4 Application of green infrastructure

PRACTICAL [20]

Contents	Equipment/tools	Methodology/methods	Link to the course unit(s)
a. Habitat suitability assessment for aquatic life (single species or entire communities) (6) b. Damage assessment (Techniques: attitude survey, valuation of damage assessment) (4)	• Questionnaire/checklist for attitude survey • Calculator • Measuring tape (30m) • Crown Densiometer • Thermometer (soil) • Silva compass • Plastic bottle	a. Four days field visit in nearby habitats or protected areas and conduct the following exercises b. Report preparation and presentation	Unit: 1, 4
A. Population monitoring and estimation (8)	• Permanent marker • Measuring tape • Silva compass • Binocular	c. Field practice and calculation: Mark-recapture (Dummy exercise in closed population)-(2 episodes) 2 days d. Observation: Wildlife habitats and edge	Unit: 1, 3

		effect-1days e. Effectiveness of waterholes development and supplementary feeding (vulture restaurant or salt lick or guzzlers)-1/1days f. Report preparation and presentation	
B. Laboratory (2)	• Lab equipment: GPS, Silva/Sunto, Binocular, range finder, different types of traps, camera for trapping: camera trap, crown Densiometer: local or commercial, telemetry equipment, Drones, etc.	a. Identification and practice (handling) of equipment for wildlife survey and habitat management-5 days b. Report preparation	Unit: 1, 2

TEXTBOOKS

1. Shaw, J. H. 1985. Introduction to Wildlife Management. McGraw Hill.
2. Coetzee, K., 2016. Practical techniques for habitat & wildlife management. A guide for game ranches, conservation areas and farmland. ISBN: 978-0-986-70844-9 (print). Conservation Management Services.
3. Silvy, N.J. 2020 (eds).The Wildlife Techniques Manual: Volume 1: Research. Volume 2: Management. (Volumes 1 and 2), 8th edition. ISBN: 978-1421436692. Johns Hopkins University Press.
4. Krausman, P.R. and Cain, J.W. (eds), 2013. Wildlife management and conservation: contemporary principles and practices. JHU Press.
5. Fowler, M., 2011. Restraint and handling of wild and domestic animals, 3rd edition. ISBN: 978-0813814322. John Wiley & Sons.

REFERENCES

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2. EAZA. 2013. The Modern Zoo: Foundations for Management and Development. European Association of Zoos and Aquaria (EAZA), Netherlands (Available online)
3. Giles, Robert H. Jr. 1978. Wildlife Conservation Techniques. W. H. Freeman and Company, San Francisco.
4. GoN. 2003. National Wetland Policy of Nepal 2003. Kathmandu.

5. GoN. 2018. Nepal Sixth National Report to CBD, 2018. Kathmandu (or the latest one).
6. GoN. 2014. Nepal National Biodiversity Strategy and Action Plan 2014-2020. Kathmandu.
7. GoN. 2012 (2069BS). Wildlife Damage Relief Guideline 2069 (2075; 3rd amendment or the latest one). Kathmandu.
8. GoN. 1973 (2029BS). National Parks and Wildlife Conservation Act, 2029 (5th amendment or the latest one). Kathmandu.
9. Gopal, R. 2012. Fundamentals of Wildlife Management in India. Natraj Publishers, Dehradun.
10. ICIMOD. Ramsar Sites of Nepal. Nepal Biodiversity Resource Book. ICIMOD, Nepal (online).
11. Lakhey, S.P. 2014. Wildlife Biology, IOF Hetauda, Nepal.
12. Nepal Law Books Mgt Committee. 2074 BS. Forest, National Parks, Soil Conservation, Environment and Endangered Wildlife related Acts and Regulations compilation, Nepal Law Books Mgmt Committee, Kathmandu.

COURSE TITLE: FOREST PLANTATION AND AGROFORESTRY

Course Code	Credit	Lecture Hours	Marks			Total
SFB 215	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course covers the scientific and practical concepts and practices of replanting and regenerating, reestablishing forest and related vegetation. It will teach students methods and techniques of artificial and assisted regeneration of the forest vegetation. It will cover afforestation and reforestation practices in different land use systems. The course covers the science of agroforestry, urban forestry and trees outside forest (TOF) and why these are having the worldwide scope in the present context of land degradation, biodiversity loss and climate change. It will also provide theoretical as well as practical knowledge about nursery establishment, seedling and propagules preparation, plantation management technique of different species.

OBJECTIVES: Student will learn about:

- Nursery establishment, management and seedlings storage and transport techniques
- Plantation techniques
- Agroforestry systems and practices
- Urban forestry
- Tree outside forests

EXPECTED LEARNING OUTCOMES: After the completion of the course student will be able to:

- Establish and manage nursery
- Plan sustainable plantation activities (preference for native broad leaf species)
- Design and support agroforestry practices (role of mixed plantation and multi-story plantation)
- Select appropriate species and practices for plantation, agroforestry, family forestry and urban forestry

UNIT 1: NURSERY ESTABLISHMENT AND SEEDLING PRODUCTION [6]

1.1 Seed collection, procurement and testing for planning different types of nursery
1.2 Role of Site selection and preparation including good water access
1.3 Modern Nursery layout and construction
    1.3.1 Site preparation
    1.3.2 Water supply
    1.3.3 Drainage
    1.3.4 Beds (types, size)
    1.3.5 Other facilities
1.4 Seedling production
    1.4.1 Seed procurement and soil preparation (mixture, treatment)
    1.4.2 Sowing (polybag, tray and bed)
    1.4.3 Propagation methods
        1.4.3.1 Seed
        a. Seed treatment
        b. Seed sowing
    1.4.4 Vegetative

a. Cutting
b. Layering
c. Grafting
d. Budding
e. Tissue culture

1.4.5 Transplant
1.4.6 Germination (energy, capacity and percentage)
1.4.7 Nursery tending/caring
1.4.8 Nursery pest and diseases
1.4.9 Hardening

UNIT 2: PLANTATION [8]

2.1 Appraisal of planting sites (Site-plant matching) and its protection,
2.2 Plantation methods: seedling plantation and direct seeding; avoiding failure by planning small size and poor season and site selection)
2.2.1 Seedling plantation
2.2.1.1 Bare root
2.2.1.2 Ball and burlap
2.2.1.3 Container/polypot
2.2.1.4 Cutting
2.2.2 Direct seeding
2.2.2.1 Broadcasting
2.2.2.2 Drilling
2.2.2.3 Bombarding
2.2.2.4 Dibbling
2.3 Plantation design
2.4 Choice of species
2.5 Methods of site/ground preparation,
2.6 Pitting
2.7 Spacing
2.8 Seedling handling
2.9 Concept of fertilization
2.10 Concept of irrigation

UNIT 3: AGROFORESTRY [10]

3.1 Concept, principles and scope of Agroforestry
3.2 Agroforestry and Range/pastureland policies of Nepal
3.3 Agroforestry systems and its classification basis
3.4 Major AF systems and practices in Nepal (Traditional AF, Improved AF, SALT, modified SALT, Terrace Bench)
3.5 Crops and Animal Management in AF
3.6 Importance of Agroforestry in soils and water conservation and climate change adaptation
3.7 Forest, fruit, fodder Trees, shrubs and grass crop interaction in AF
3.8 Rangeland/Forest Grazing land and Pasture Management as Agroforestry practice

UNIT 4: DESIGN AND DEVELOP AGROFORESTRY MODELS [10]

4.1 Concept, types and process of diagnosis and design (D&D) of AF systems
4.2 Design and strategy for different AF system
4.2.1 Ecological zone-based AF design

4.2.2 Farm size and forest type based (e.g. CF, LHF) based AF planning and design (shifting cultivation or slash and burn land conversion into AF)
4.2.3 Socio-economy and geo-climate-based AF design (Farming system-based AF in Mid-hills
4.2.4 High Mountains (Animal and range/pasture management-based AF)
4.3 Food security through Agroforestry (diversified livelihood system-based AF design)
4.4 AF as a climate adaptation (ecosystem-based adaptation EbA) and DRR (community-based adaptation or CBA strategy)
4.5 AF as a Forest Ecosystem restoration strategy

UNIT 5: URBAN FORESTRY [3]
5.1 Concept and scope of urban forestry
5.2 Importance of urban forestry
5.3 Choice of species
5.4 Urban forest management (pruning, harvesting, replacement planting)

UNIT 6: TREE OUTSIDE FORESTS [3]
6.1 Concept, scope and importance of tree outside forests (TOF)
6.2 Nepal's Fodder Tree cultivation system as an example of TOF
6.3 TOF as a part of integrated farming system (based on forest-farm-animal interaction)
6.4 ToF as private or family forest development strategy

PRACTICAL [20]

SN	Content	Equipment/tools	Methodology/methods	Link to unit(s)
1	Nursery preparation	Construction materials (pebbles, soil, top soil, bricks, bamboo, stone, plastic bags, pegs, shade, tags etc.)	At least 4 nursery beds preparation, seed sowing, transplanting in polybag, root cutting	1
2	Plantation techniques	Spade, khanti and pitting machine	Digging of a pit for the plantation or minimum pitting method	2
3	Analysis of AF model		Visit nearby area for the steps followed in the design of AF, Urban area	3 and 4
4	Designing and planning urban plantation		Visit new area of city and prepared Planning	5
5	Assessment of species in TOF		Visit nearby site and observe, 300-word report	6

REFERENCES

1. Evans, J. (1992). Plantation forestry in the tropics: tree planting for industrial, social, environmental, and agroforestry purposes. Oxford University Press.
2. Dwivedi, A. P. (1993). A text book of silviculture. International Book Distributors.
3. Chundawat, B.S. and Gautam, S.K. 2010. Text Book of Agroforestry. Oxford & IBH

Pub. Co. Pvt. Ltd.
4. Dwivedi, A.P. 2017. Agroforestry Principles and Practices. Oxford & IBH Pub. Co.
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8. Amatya et. al (2018) AGROFORESTRY SYSTEMS AND PRACTICES IN NEPAL.
9. Puri, Sunil and Pankaj Panwar. 2007. Agroforestry Systems and Practices. New India
10. Publishing Agency, Pritam Pura, New Delhi 110088.
11. Tejwani, K.G. 2002. Agroforestry in India. Concept Publishing Company.
12. Pandey, K.K. 1982. Tree Fodder and Fodder Trees in Nepal. Swiss Development
13. Corp., Swiss Federal Institute of Forestry Research.
14. Khanna L.S. 2018. Principles and Practice of Silviculture. Fifteenth Edition.
15. Jackson J.K. 1994. Manual of Afforestation. Vol 1 and 2.
16. Ferrini F., van den Bosch C. C. K., and Fini A. (Eds.) 2017. Handbook of Urban Forestry.

YEAR 2 SEMESTER II

COURSE TITLE: COMMUNITY BASED FOREST MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
SFM 221	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course has targeted to educate students about institutional dynamics and attributes of community-based forest management in Nepal by deliberating knowledge of property regimes, governance, and other issues and challenges in CBFM.

OBJECTIVES: The objectives of this course are to:

- Describe the concept and principles of CBFM
- Explain the theory of commons as it applies to forest management
- Share different types (models) and practices of CBFM in Nepal
- Understand role of CBFM on conservation and economic development in Nepal
- Understand issues and challenges of CBFM in Nepal

EXPECTED LEARNING OUTCOMES: Upon the completion of this course, the students will be able to:

- Explain consequences of tragedy of commons and open access on forest resources
- Distinguish successful models of CBFM existing in Nepal
- Identify potential stakeholders of CBFM
- Measure the status of governance in CBFM
- Analyze problems and future perspective of CBFM in Nepal

UNIT 1: INTRODUCTION [5]

1.1 Property Regimes: Open access, Commons, State property, and Private property
- 1.1.1 Tenure and Rights (De facto, de jure and customary)
- 1.1.2 Tragedy of the commons (Hardin)
- 1.1.3 Guiding Principles to manage Commons (Ostrom's 8 principles)

1.2 Concept and Genesis of Community Based Forest Management (CBFM)

UNIT 2: COMMUNITY BASED FOREST MANAGEMENT IN NEPAL [10]

2.1 History of community-based Forest management in Nepal

2.2 CBFM modalities (objective, status, institutional arrangements and benefit-sharing)
- 2.2.1 Community forest
- 2.2.2 Partnership forest
- 2.2.3 Leasehold forest
- 2.2.4 Forest conservation area
- 2.2.5 Religious forest
- 2.2.6 Buffer-zone community forest

UNIT 3: GOVERNANCE IN CBFM [5]

3.1. Concept, elements and indicator of governance

3.2 Tools for governance assessment - public hearing / audit, well-being ranking, participatory

3.3 Stakeholders analysis
    3.3.1 Stakeholders and rights holders
    3.3.2 Key stakeholders in CBFM
3.4 Power, access analysis

UNIT 4: HANDOVER PROCESS OF COMMUNITY-BASED FOREST [10]

4.1 Community Forest handover process
    4.1.1 Preparation of constitution
    4.1.2 Preparation of operational plan
4.2 Partnership Forest Handing over process
    4.2.1 Preparation of constitution
    4.2.2 Preparation of scheme
4.3 Leasehold Forest Handing over process

UNIT 5: CBFM OUTCOMES IN NEPAL [5]

5.1 Forest, biodiversity, ecosystem
5.2 Livelihoods
5.3 Social institutional
5.4 Approaches on services to CBFM
    5.4.1 Domains of service
    5.4.2 Agencies of delivery
        5.4.2.1 DFO
        5.4.2.2 NGO/INGO
        5.4.2.3 Private sector
        5.4.2.4 Local government
5.5 Services
    5.5.1 Administration
    5.5.2 Institutional
    5.5.3 Technical
    5.5.4 Business/Financial
    5.5.5 Capacity Building

UNIT 6: ISSUES AND CHALLENGES IN CBFM [5]

6.1 Federalization and mainstreaming in local planning
6.2 Migration, rapid urbanization, and extended underused Land
6.3 Growing demand for construction Timber;
6.4 Climate smart management practices
6.5 Forest based enterprises
6.6 Tenure rights
6.7 Cutting edge modern technology
6.8 Exposure of hinterland forests to market
6.9 Economic transition
6.10 Equity and Social Justice in benefit sharing

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	Assess governance in CBFM (process and reflection)	Governance assessment tools	focus group discussion, and expert consultation	3
2	Appraise issue and challenges of CBFM	Checklist	Field visit/ Review	6
3	Assess CBFM based on the Ostrom's principles	Checklist	Students will divide into eight groups and each group will assess based on one principle	1
4	Participatory resource mapping	Paper/ Map	Group work with local communities	4
5	Process of forest user group formation	Guidelines, Regulations	Review the process and fill out the annexes required for FUG registration	4

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COURSE TITLE: REMOTE SENSING AND GIS

Course Code	Credit	Lecture Hours	Marks			Total
WME 222	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: After completion of the course the students will be able to understand the basic concept of RS&GIS and acquire practical skills in remote sensing image processing and geospatial data analysis. They will learn to apply geospatial data in natural resources management monitoring.

OBJECTIVES: The main objective of this course is to equip the students with theoretical and practical skills of remote sensing and GIS. The major anticipated learning objective of the course are:

- Learn RS&GIS concepts and hands on skills for geospatial applications
- Sharpen critical thinking skills about geospatial information – its reliability, accuracy and precision;
- Acquire competency in basic knowledge and skills regarding RS&GIS and implement RS&GIS in solving real-life spatial problems in natural resource management.

EXPECTED LEARNING OUTCOMES: Upon completion of the course, students will be able to

- Understand the fundamentals of RS&GIS
- Handle geospatial data and its management
- Analyze the data for decision making support system in natural resource management.

UNIT 1: FUNDAMENTALS OF REMOTE SENSING [8]

1.1 Introduction to aerial photography, photogrammetry
1.2 Remote sensing and its process
1.3 Electromagnetic radiation and spectrum
1.4 Interaction of electromagnetic radiation with earth's surfaces (vegetation, soil and water)
1.5 Spectral response at various target
1.6 satellite platforms, sensors, orbital, and scanning characteristics
1.7 Sensor characteristics (Resolutions and errors)

UNIT 2: BASICS OF GIS [6]

2.1 Introduction to GIS–what, why, history and future
2.2 Geospatial concept
2.3 Component of GIS
2.4 Geographical phenomena (field and object)
2.5 GIS data structure- raster and vector
2.6 Data characteristic - spatial and non-spatial data
2.7 GIS data creation (GPS Data, scanning, geo-referencing and digitizing)
2.8 Data quality and sources of error in GIS

UNIT 3: ACTIVE REMOTE SENSING [4]

3.1 Principles of MWRS
3.2 Sensor systems characteristics, GPS, types and segments of GPS
3.3 Atmospheric and terrain properties
3.4 RADAR geometry
3.5 LiDAR

UNIT 4: GEOSPATIAL DATA: ACQUISITION AND MANAGEMENT [8]

4.1Earth observation and geospatial data and tools
4.2 Satellite Data acquisition
4.3 Preprocessing of satellite data (atmospheric, radiometric and geometric corrections)
4.4 Spatial reference systems
4.5 Geospatial data management system
4.6 Image re-projection, resampling, and interpolation
4.7 Image visualization, color composites, and interpretation
4.8 Concept of map creation

UNIT 5: GEOSPATIAL ANALYSIS AND INTERPRETATION [8]

5.1 Overview of spatial analysis functions
5.2 Vector analysis
5.3 Raster analysis
5.4 Image ratios and indices
5.5 Digital image classification
5.6 Analyzing spatial and temporal patterns
5.7 Surface analysis

UNIT 6: APPLICATION OF GIS AND RS IN NATURAL RESOURCE MANAGEMENT [6]

6.1 Natural resource assessment, monitoring, and management planning
6.2 Forest resource assessment and mapping
6.3 Water resource mapping
6.4 Wildlife habitat mapping and monitoring
6.5 Disaster preparedness planning

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	Familiarization with GIS Software	ArcGIS	Installation process of ArcGIS	2
2	GPS data acquisition	GPS	Field visit	3
3	Geo-portals	Internet browser	Familiarity with Earth explorer/ USGS	4
4	Satellite data acquisition and pre-processing	ArcGIS/ERDAS IMAGINE	Download, Merge, Mask, Image enhancement,	4
5	Digitization, geo-referencing and projection	ArcGIS	Utilize topo-map or digital map of a study area	4
6	Spatial analysis operations	ArcGIS	Buffering, intersection, union, raster calculation, indices	5

7	Land use land cover map preparation	ArcGIS/ERDAS IMAGINE	Supervised and unsupervised classification	5
8	Suitability analysis	ArcGIS	Map algebra and overlay function	6

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COURSE TITLE: SILVICULTURAL SYSTEM

Course Code	Credit	Lecture Hours	Marks			Total
SFB 223	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course explains the concept and types of silvicultural system and summerises the role of the silvicultural system in sustainable forest management. In addition, it also describes the species specific silvilcultural system and process to design silvicultural system.

OBJECTIVES

- Describe the importance of accurate and consistent silvicultural system terminology,
- Design and apply silvicultural systems for sustainable forest management,
- Discuss the factors to be considered in different forest types, while designing and implementing silvicultural system

EXPECTED LEARNING OUTCOMES: After the completion of this course the students are able to:

- Outline the importance of silvicultural system in forest management
- Describe the major silvicultural systems
- Design the appropriate variants of silvicultural systems based on the site conditions
- Evaluate the different dimensions of silvicultural system

UNIT 1: INTRODUCTION [5]

1.1 Definition of silviculture and silvicultural system
1.2 Origin of silvicultural system
1.3 Importance of silvicultural system
1.4 Components of silvicultural systems (Regeneration, Tending, and Felling/Harvest)

UNIT 2: CLASSIFICATIONS OF THE SILVICULTURAL SYSTEM [8]

2.1 Concept of High Forest and Coppice forests
2.2 Even-aged systems
  2.2.1 Clear cut /felling system
  2.2.2 Seed tree system
  2.2.3 Shelterwood system
  2.2.4 Coppice system
  2.2.5 Retention silvicultural system
2.3 Uneven-aged systems
  2.3.1 Selection system
  2.3.2 2.3.2 Two aged and multiple aged system

UNIT 3: VARIANTS OF SILVICULTURAL SYSTEMS [8]

3.1 Clear cut system: Strip and Block
3.2 Seed tree system: Uniform and Group
3.3 Shelterwood system: Uniform, Group, Strip, Irregular
3.4 Selection system: Single tree and Group
3.5 Coppice system: Simple coppice, Coppice with standards, Coppice with reserves

UNIT 4: CONVERSION SYSTEM [4]

4.1 Introduction and objectives of conversion
4.2 Importance in silvicultural system
4.3 Techniques of conversion
4.4 Case studies of the conversion system
    4.4.1 Change in species composition
    4.4.2 Change in the silvicultural system

UNIT 5: CHOICE AND FORMULATION OF SILVICULTURAL SYSTEM [5]

5.1 Factors to be considered while selecting and formulating a silvicultural system
    5.1.1 Objective of forest management
    5.1.2 Forest conditions (growing stock, species composition, forest/stand structure)
    5.1.3 Elevation, aspect, erodibility of soil, and slope of forest
    5.1.4 Damaging agents (natural disasters, invasive species)
    5.1.5 Economic factors (management intensity, labor availability, quantity and quality of produce)
5.2 Selecting a silvicultural system
    5.2.1 Identify Forest management objectives
    5.2.2 Assess Forest conditions
    5.2.3 List options for stand structural design
    5.2.4 Analyze stand structural options
    5.2.5 Choose the best stand structural option
    5.2.6 Select silvicultural system

UNIT 6: APPLICATION OF SILVICULTURAL SYSTEMS OF SOME MAJOR SPECIES [10]

6.1 Appropriate silvicultural systems for major species/forest types in Nepal
    (Hill & Terai- Sal, Khair, Sisso, Katus-Chilaune, Utis, Oak, Chirpine, Bluepine, Teak, Eucalyptus) with the objective of forest management (such as – timber production, pole production, fuelwood production, resin tapping, and multiple uses of forests)
6.2 Effects of the silvicultural system on the provisioning of forest ecosystem services (soil conservation, wildlife habitat, recreation, biodiversity, and carbon sequestration)

PRACTICAL [20]

SN	Content	Methods	Link to unit(s)
1	Observe different silvicultural systems	Visit a site and prepare 300-word report	2 and 3
2	Design silvicultural system for the nearby forests (plantation forests, Natural forests – terai and mid-hills)	300-word report	5
3	Assess the community forest operational plans regarding silvicultural system of at least two forest types	OP review, 300-word report	2 and 3

4	Assess the management plan of scientific forest management and prepare an analytical report on the proposed silvicultural system	300-word analytic report	4
5	Analyze silvicultural system of trees outside forests	10-minute presentation	6

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COURSE TITLE: FOREST MANAGEMENT II

Course Code	Credit	Lecture Hours	Marks			Total
SFM 224	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course covers decision making principles, rotation, yield (forest) regulation, operational plan preparation of forest management. With the completion of this course, the students will be able to regulate and manage forest resources of Nepal through different silvicultural systems and advanced technology.

OBJECTIVES: The objectives of this course are to:

- Evaluate economic potential from wise management of forest resources.
- Appraise different decision-making criteria for the forest management
- Understand methods of rotation determination.
- Regulate yield of different types of forest management systems
- Prepare Forest resource management plan to optimize the benefits as per potential.

EXPECTED LEARNING OUTCOMES: Upon the completion of this course, the students will be able to:

- Set appropriate objectives and their better alternatives for the management of forest resources in sustain basis
- Fix rotation to optimize the benefits of forest resources.
- Regulate the yield/forest as per its potentials (Timber/fuelwood and NTFPs)
- Value the existing forest resources and recommend management interventions
- Prepare the operational plan based on the potentiality of forest resources and human dimension

UNIT 1: INTRODUCTION [3]

1.1 Concept of forest management
1.2 Forest management alternatives and analysis
1.3 Decision-making principles and models

UNIT 2: ROTATION DETERMINATION [5]

2.1 Concept of rotation determination
    2. 1.1 Ecological/Biological criteria (Physical, Silvicultural, MAI/CAI, Pest/Diseases)
    2.1.2 Economical/Financial criteria (Money yield table, Forest rent, Soil/land expectation value, BC ratio, NPV, IRR, Financial maturity)
    2.1.3 Product based criteria (Size and weight)
    2.1.4 Social criteria
2.2 Importance of rotation determination
2.3 Rotation determination practice in Nepal

UNIT 3: NORMAL FOREST AND GROWING STOCK [4]

3.1 Normal Forest
- 3.1.1 Concept of normality
- 3.1.2 Implication of normality in forest management

3.2 Growing stock
- 3.2.1 Concept and importance of growing stock determination
- 3.2.2. Methods of growing stock determination

3.3. Normal growing stock

UNIT 4: YIELD REGULATION [15]

4.1 Concept and practice of yield
- 4.1.1 Yield and its type
- 4.1.2 Concept of sustained yield
- 4.1.3 Prerequisites for sustained yield
- 4.1.4 Management steps for obtaining sustained yield

4.2 Concepts and approaches of yield regulation

4.3 Implication of yield regulation
- 4.3.1 Regulating plantation forest
- 4.3.2 Regulating natural forest

4.4 Method of yield regulation
- 4.4.1 Area control
- 4.4.2 Volume control
- 4.4.3 Stem Controlled
- 4.4.4 Crown controlled
- 4.4.5 Combined (area and volume/stem) controlled

4.5 Silvicultural system-based yield regulation
- 4.5.1 Clear felling system (area control)
- 4.5.2 Shelterwood system (area and volume/ stem control)
- 4.5.3 Selection system (area/volume control and combined)

UNIT 5: REGULATION OF NON-TIMBER FOREST PRODUCTS [8]

5.1 Importance of NTFPs regulation

5.2 Regulation of NTFPs (Kutki/Chiraito, Resin Tapping, Tejpat/Lauth Salla, Lokta/Argeli)

5.3 Challenges of regulating NTFPs in Nepal

UNIT 6: FOREST MANAGEMENT PLAN [5]

6.1 Forest management plan
- 6.1.1 Objective
- 6.1.2 Process

6.2 Preparation of forest management plan
- 6.2.1 General format/Content
- 6.2.2 Blocking and Mapping
- 6.2.3 Data collection - Biophysical / Socio-economical
- 6.2.4 Write up of management plan
- 6.2.5 Importance and method of updating/revision

PRACTICAL [20]

Based on the theoretical part and current context of forest management in Nepal, the following 5 topics seem rational. At least two practical (content/topics) needs to be taught/carried out while delivering this course. Tutor could give an assignment to prepare the report on remaining topics as internal assessment.

SN	Content/Topics	Equipment/ Tools	Methods	Unit(s)
1	Regulation of NTFPs (students will review the regulation of species which are not included in Unit 5)	-Text book -Inventory guideline	-Review -Increment/production assessment -Fixing yield	5
2	Alternative analysis and decision making	-Text book	-Set objective, activities, output -Document foreseen problem/risk and their adjustment	1, 6
3	Yield regulations (Area, volume, stem, crown control) – in group	-Text book -Guideline -Operational plan	-Forest inventory data -Analyze forest condition, stand structure -Set objective, activities, output	4
4	Forest management plan	-Operational plan / Scheme	- Review operational plan or scheme - Summarize yield regulation process	

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COURSE TITLE: FOREST HARVESTING AND LOGGING

Course Code	Credit	Lecture Hours	Marks			Total
FPE 225	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to impart knowledge from harvesting planning and operation to product conversion, transportation and its storage along with minimization of losses. It is intended to provide insight into national and international practices. In addition, students are expected to develop their capacities as forest harvesting managers through theory, field practice and exposure visits.

OBJECTIVES: The objectives of the course are to:

- Understand forest harvesting planning and execution of harvesting operation
- Acquire the knowledge of government procedures on forest harvesting and logging
- Understand appropriate methods for extraction and hauling
- Evaluate timber grading and storage system
- Identify wood and its feature and its time periods

EXPECTED OUTCOMES: Upon the completion of the course, students will be able to:

- Execute sustainable forest harvesting operation with minimization of wastage
- Analyze and application of forest harvesting policy instruments
- Develop the knowledge and skill of logging and hauling based on terrain
- Evaluate the wood for grading

UNIT 1: INTRODUCTION [3]

1.1. Harvesting of timber and non-timber forest products (NTFPs)
1.2. Importance of harvesting in forest management
1.3. Harvesting phases (Pre harvesting, During harvesting, Post harvesting)

UNIT 2: HARVESTING [10]

2.1 Tools and equipment
- 2.1.1 Saw and its types
- 2.1.2 Axe and its types
- 2.1.3 Harvester
- 2.1.4 Wedge and jack
- 2.1.5 Stem tightener
- 2.1.6 Cable puller

2.2 Felling rules
2.3 Methods and techniques
- 2.3.1 Tree length
- 2.3.2 Cut to length
- 2.3.3 Different types of notch (face and back cut)

2.4 Ergonomics in harvesting

UNIT 3: SECTIONING AND TRANSPORTATION [6]

3.1 Log bucking, debarking, deliming
3.2 Log extraction (national context-hill and terai, mechanized system)
3.3 Loading and unloading (manual and mechanized)

3.4 Hauling/transportation
3.5 Residue management

UNIT 4: GRADING AND STORAGE [6]

4.1 Principles and importance of grading and storage
4.2 Grading rule/system (International and National system)
4.3 Storage system (International and National system)

UNIT 5: SUSTAINABLE HARVESTING OF NTFPS [6]

5.1 Harvesting practices
5.2 Post harvesting techniques
5.2.1 Pre-processing (cleaning, washing, drying, cutting)
5.2.2 Grading
5.2.3 Storage
5.2.4 Transportation

UNIT 6: FOREST HARVESTING PRACTICES IN NEPAL [6]

6.1 Government rules and guidelines (Timber)
6.1.1 Permit, Field verification, Tree marking (Chhapan), Registration/Record management
6.1.2 Evaluation methods
6.1.3 Harvesting (Katan), Sectioning, Cutting, Transportation
6.1.4 Log yard (Ghat gaddi) and Verification (grading, volume estimation)
6.1.5 Depot Safety, Protection from fire
6.2 Sales and distribution
6.3 Government rules and guidelines (NTFPs)
6.3.1 Provisions of NTFP collection
6.3.2 Collection permit
6.3.3 Transportation permit

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Links to the course unit(s)
Harvesting tools		Tools introduction in lab	2
Sustainable Harvesting practices of trees	Different types of axes and saws, power chain saws, wedges, bill hooks, hammers, measuring tape, rope, stem tightener, protective gears etc.	Demonstration/ Field practice / Safety	2
Sustainable Harvesting practices of NTFPs		Demonstration/ Field practice / Safety	6
Log bucking, debarking, delimbing, chatta making	Power chain saws, pruning saws, bill hooks, debarking spades, cant hooks etc.	Field practice	3, 4 and 6
Log grading		Field Observation	4
Harvesting methods of NTFPs		Review of major NTFPs, 300-word report	5

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COURSE TITLE: TOUR (FOREST MANAGEMENT AND SILVICULTURAL SYSTEMS)

Course Code	Credit	Lecture Hours	Total Marks
SFM 226	2	40	50

SCOPE: A two-week field tour focuses on acquiring the practical skills and knowledge on preparing the forest management plan and observation of silvicultural systems applied in the field.

OBJECTIVES

- Obtain practical knowledge about forest management system/practices of Nepal
- Enhance the technical skills on developing forest management plans.
- Impart knowledge on different silvicultural system practices

EXPECTED LEARNING OUTCOMES: Upon the completion of tour, students will be able to:

- Understand the potential issues of forest management
- Implement the process of community forest management plan preparation
- Understand the silvicultural systems practiced
- Prepare and write-up of forest management plan

PART I: PREPARATION OF THE OPERATIONAL/MANAGEMENT PLAN

1. Discussion with the members of community-based forest user groups/ forest owner
2. Forest Inventory
3. Household survey
4. analysis of data – estimation of Annual allowable harvest, demand and supply analysis, and benefit-cost analysis of the plan
5. Prepare an operational / management plan of the forest

PART II: OBSERVATION OF SILVICULTURAL SYSTEMS

1. Visit nearby forests adopting different silviultural systems
2. Discuss with users/managers and DFO officials on the design of silvicultural systems

Task:

The students should prepare a report (1500 words) on experience from the tour. It includes

- Introduction – thematic areas and scope (500 words)
- Activities – major activities carried out (500 words)
- Experience gained – skill and lesson learned, how it is linked with theory class (400 words)
- Recommendations/Suggestions – (100 words)

YEAR 3 SEMESTER I

COURSE TITLE: STATISTICAL METHODS AND EXPERIMENTAL DESIGN

Course Code	Credit	Lecture Hours	Marks			Total
BSH 311	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

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.

OBJECTIVES: Upon completion of this course, the students will be able to;

- Demonstrate the concepts of descriptive statistics and their uses
- Understand and calculate probability measures and their use in forestry research.
- Demonstrate basic concepts of inferential statistics,
- Understand and compute correlation and regression analysis.
- Understand and use the logic and reasoning involved in the designing and conducting of Experiments.

UNIT 1: DESCRIPTIVE STATISTICS [8]

1.1 Definition, of statistics, population and sample, parameter and statistic, variables

1.2 Frequency distribution and its presentation: Tables, Diagram ad Graphs Simple, sub-divided, percentage and multiple bar diagrams, pie- diagram, Histogram, frequency polygon, frequency curve and o-give curve

1.3 Measure of central tendency: Introduction, types, properties, merits, demerits and uses of

1.4 Measure of dispersion: Introduction, types, properties, merits, demerits and uses

1.5 Measure of skewness, kurtosis, moments and their uses

UNIT 2: CORRELATION AND REGRESSION ANALYSIS [5]

2.1 Correlation: Introduction, simple linear correlation (scatter diagram, Karl Pearson's and Spearman's rank), properties of correlation coefficient

2.2 Regression: Introduction, simple linear regression, properties of regression coefficients, Coefficient of determination

UNIT 3: PROBABILITYAND PROBABILTY DISTRIBUTION [6]

3.1 Basic concepts of Probability, Random variable: Probability mass function and probability density function,

3.2 Mathematical Expectation

3.3 Probability distribution: Binomial and Normal distribution

UNIT 4: STATISTICAL INFERENCE [9]

4.1 Estimation: Introduction, types of estimation (point and interval), confidence interval for mean

4.2 Hypothesis testing: Introduction, definition of different terms (statistical hypothesis, types of errors, level of significance, critical region, degrees of freedom), procedure of testing of hypothesis, Parametric and non-parametric tests: Z-test, T-test, F-test, Chi-square test

UNIT 5: SIMPLE AND FACTORIAL DESIGNS [12]

5.1 Basic concepts of ANOVA and Experimental design

5.2 The Experimental plan, Allocation of treatments to experimental unit, Linear model and assumptions, Analysis and interpretation, of CRD, RBD and LSD

5.3 Multiple comparisons: LSD and DNMRT tests

5.4 2x 2 and 2x2x2 Factorial experiments

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Links to the course unit(s)
Variable definition, coding, editing and data entry	MS Excel, SPSS, R	Introduction to data analysis tools	1
Computation of mean, median, mode, quartile deviation, mean deviation, standard deviation	Question sets	Practice sets and exercise	2
Calculation of correlation, regression and its test of significance	Question sets	Practice sets and exercise	2
Computation of confidence interval, hypothesis testing, Z-Test, T-Test and F-Test, Chi-square test	Question sets	Practice sets and exercise	4
One-way ANOVA, Two-way ANOVA	Question sets	Practice sets and exercise	5
Completely Randomized Design (CRD), Randomized Block Design, Latin square Design (LSD) and Multiple comparison	Question sets	Practice sets and exercise	5

Note: All students must prepare and submit their own solved question sets.

TEXTBOOKS AND REFERENCES

1. Chacko, V.E. 1965. Manual on Sampling Techniques for Forest Surveys. The Manager of
   Chand and Sons, 23, Daryagunj, Delhi-110002.
2. Cochran, W.G and Cox, G.M. 2000. Experimental Designs, Second edition. John Wiley and Sons (Asia) Private Limited, Singapore.
3. Frank, F. 1967. Elementary Statistical Methods for Foresters, Vol. 317 of Agriculture
4. Gomez, A. K and Gomez, A.A. 2010. Statistical Procedures for Agricultural Research. John Wiley and Sons, Ansari Road, Daryaganj, New Delhi.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. 1994. Fundamentals of Statistics, Volume II.
6. Gupta, S.C. 1992. Fundamentals of Statistics. Himalayan Publishing House, Delhi, India.
7. Gupta, S.C. and Kapoor, V.K. 2010. Fundamentals of Applied Statistics. Sultan Chand and Sons, New Delhi.
8. Gupta, S.C. and Kapoor, V.K. 2013. Fundamentals of Mathematical Statistics. Sultan Handbook, USDA, Forest Service.
9. Huntsberger, David V. and Billingsley, Patrick. 1987. Elements of Statistical Inference.
   International Publishers, New Delhi
10. Jayaraman, K. 2000. A Statistical Manual for Forestry Research. Forestry Research and
11. Jayaraman, K.A. 2000. A Statistical Manual for Forestry Research. FORSPA-FAO
12. Kothari, C.R. 2013. Research Methodology, Methods and Techniques. New Age
13. Shrestha, Sunity and Silwal, D.P. 2011. Statistical Methods in Management. Taleju
14. Steel, R.G.D., Torrie, J.H. and Dicky, D.A. 1997. Principles and Procedures of Statistics: Support Programme for Asia and the Pacific (FORSPA). FAO Regional Office, Bangkok.

COURSE TITLE: CLIMATE CHANGE AND FORESTRY

Course Code	Credit	Lecture Hours	Marks			Total
WME 312	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course will cover basics of climate science, climate change impacts, risks and vulnerability, and disaster risk reduction. Furthermore, it focuses different data and techniques for climate observation and monitoring, possible adaptation and mitigation solutions and efforts of climate change at local, national and international level. The course will in specific look into the issues of climate change within the forestry sector and its significance for both adaptation and nature based solutions.

OBJECTIVES

- Provide the fundamental knowledge of climate science
- Provide the different solutions against climate change impacts
- Train student on climate data analysis
- Enhance knowledge on climate change impacts on forestry and role of forestry on climate change adaptation and mitigation
- Gain knowledge on Disaster Risk Reduction

EXPECTED LEARNING OUTCOMES: After completion of the course student will have;

- Scientific knowledge on climate change, its impacts, solution and role of forestry
- Developed skill on historical climate data analysis
- Ideas to perform climate change vulnerability analysis, adaptation measures, Disaster Risk Reduction.

UNIT 1: CLIMATE CHANGE FUNDAMENTAL CONCEPT [6]

1.1 Understand the basics of weather, climate
1.2 Understand and describe the most important processes involved in climate change, and the interactions between the atmosphere, ocean and land surface
1.3 Basic concepts involved in the economic control of climate change
1.4 Different possible environmental ethics positions with regards to climate change
1.5 Concept of Climate Models

UNIT 2: UNDERSTANDING CAUSE AND IMPACT OF CLIMATE CHANGE (CC) [8]

2.1 Cause of Climate Change
    2.1.1 Natural Causes of CC
    2.1.3 Anthropogenic Causes of CC
2.2. Climate change impacts, vulnerability and risks
    2.2.1 Sectoral impacts of climate change
    2.2.2 Current change vulnerabilities: status and implications
    2.2.3 Climate change risks: baseline, projected
    2.2.4 Assessing the impacts, vulnerabilities, and risks

UNIT 3: CLIMATE CHANGE MITIGATION AND ADAPTATION [8]

3.1 Concept of climate change adaptation and mitigation
3.2 Account of climate change mitigation strategies within various sectors
3.3 Understanding mitigation greenhouse gas emission and stabilization targets;
3.4 GHG's mitigation practices in Nepal (eg. renewable energy, low carbon pathways, technology transfer)
3.5 Understanding adaptation: the need for adaptation; understanding the limits to adaptation
3.6 Mal-adaptation, maldevelopment; relevance of adaptation and mitigation strategies in Nepal
3.7 Sector wise adaption practices (forestry, water, agriculture, energy)

UNIT 4: CLIMATE CHANGE IN RELATION WITH FORESTRY [10]

4.1 Describe global, regional, and local impacts of climate change on land use and in particular forestry
4.2 Summarize how land use and land use change and forestry is affecting climate change
4.3 Outline major regional differences in land use, silvicultural traditions and ecological footprint
4.4 Role of forest management for CC mitigation and adaptation practices
4.5 Forestry and REDD
4.6 Carbon trade/credit and forest management opportunities in Nepal (legal provision and practice)
4.7 Other incentive mechanisms (PES, access and benefit sharing)

UNIT 5: CLIMATE CHANGE AND DISASTER MANAGEMENT [5]

5.1 Basic concepts and definition of hazard, disaster, risk, preparedness, response and recovery
5.2 Types of disasters in Nepal and around, and their classification
5.3 Impact of climate induce natural hazard (Flood, Landslide, GLOF, and Drought)
5.4 Disaster Risk Reduction Management cycle: prevention, preparedness, mitigation, relief, rescue and recovery
5.5 Community- based Disaster Risk Management
5.6 Sendai framework

UNIT 6: LEGAL AND POLICY FRAMEWORK ON CLIMATE CHANGE [8]

6.1 Climate policies and institutions (UNFCC, IPCC, COP) at the international level: debates on climate change mitigation and adaptation; debates on climate justice
6.2 Climate change policy at the National, Province and Local context: national climate change policy; adaptation planning (NAPA, LAPA, NAP), loss and damage (L&D)
6.3 Climate financing, institutions, technology and capacity building,
6.4 Cross cutting issues: Gender, indigenous community, governance, political economy

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Link to the course unit (s)
Historical temperature and precipitation data analysis	MS Excel	Trend and variability analysis	Unit 1
Sectoral brief on the understanding of impacts, vulnerability and risks	Climate change risk analysis framework	Climate change chain analysis	Unit 2
Observation of a weather station in nearby site	Excursion and briefing	Direct observation	Unit 1, 5
Case study DRM	Nearby local municipalities	Group exercise	Unit 5
Case study paper	Policy analysis tool	Policy analysis	Unit 6

TEXTBOOKS

1. Burroughs, W.J. 2007. Climate Change: A Multi-disciplinary Approach, Second edition. Cambridge University Press.
2. Davoudi, S., Crawford, J. and Mehmood, A. (Eds.). 2009. Planning for Climate Change Strategies for Mitigation and Adaptation for Spatial Planners. Earthscan Publishers, London.
3. Wester, P., Mishra, A., Mukherji, A., & Shrestha, A. B. (2019). *The Hindu Kush Himalaya Assessment: Mountains, climate change, sustainability and people* .Springer Nature.

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1. CDKN, GERMANWATCH, UNU. 2012. Loss and damage: Adverse impacts of climate change Loss and Damage (Report).
2. DRR, 2075 BS. Disaster Rsk Reduction Strategic Action Plan, 2018-2030. Ministry of HomeAffiars. Government of Nepal.Kathmandu.
3. GoN. 2021. Vulnerability and Risk Assessment and Identification of Adaptation options. Ministry of Forests and Environment. Nepal.
4. LAPA Framework. 2019. Local Adaptation Plan of Action to Climate Change, National Report. Government of Nepal, Kathmandu.
5. MOE. 2011. Climate Change Policy in Nepal. Ministry of Environment, Government of Nepal, Kathmandu.
6. NAPA. 2010. National Adaptation Plan of Action to Climate Change, National Report. Ministry of Environment, Government of Nepal, Kathmandu.
7. NAP. 2021. National Adaption Plan (NAP) 2021-2050 for Nepal. Ministry of Forest and Environment, Government of Nepal, Kathmandu.
8. IPCC, 2022.Impacts, Adaptation, and Vulnerability.Six Assessment Report of the Intergovernmental Panel on Climate Change, Working Group II.UN.
9. Tiwari, K.R., (2011). Global Environmental Change, Teaching Materials. Institute of Forestry, Pokhara, Nepal.

COURSE TITLE: FOREST PRODUCT UTILIZATION

Course Code	Credit	Lecture Hours	Marks			Total
FPE 313	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course is designed to provide the knowledge and understanding to students about wood/timber [1]and non-wood/timber forest products, their uses, misuses, sustainable extraction and management and socio-economic benefits based on their properties, improvement and management of wood and non-wood products. In addition, it covers phytochemical screening of some important trees shrubs and herbs for investigation and harnessing of active agents for plant based drugs, and methods of sustainable extraction of forest products.

OBJECTIVES: The objectives of the course are to:

- Identify wood (both timber and firewood) through the anatomical structure
- Understand the prolonging techniques of the life (shelf-life) of wood through seasoning and application of preservatives-based treatment
- Analyze wood properties and identify wood defects
- Enhance the knowledge of proper use of wood especially timber
- Understand the ethnobotanical knowledge, chemical constituent

EXPECTED LEARNING OUTCOMES: Upon the completion of this course, students will be able to:

- Identify wood species
- Understand wood seasoning and preservation, treatment
- Acquire knowledge on uses of forest products and their management
- Understand processes of phytochemical screening and chemical extraction

UNIT 1: INTRODUCTION [4]

1.1 Concept and definition of forest products (woo/non-wood; timber/non/timber)
1.2 Concept of Forest product utilization (harvesting/extraction, processing and uses)
1.3 Types of forest products
  1.3.1 Timber (sawn timber, poles)
  1.3.2 Non-timber (including firewood and vegetation products), bamboos, canes, fibers and flosses, tanning and dyes, MAPs, edible products (nuts, berries and mushrooms, oil seeds, honey, rosin and lac, silk etc.)
  1.3.3 Forest land and river-based aggregates (stone, boulder, sand, soil, and mineral substances mainly used for construction and also for agriculture and domestic uses)

1.4 Types and Uses of timber products (raw, processed, natural and composite wood)

[1] Use of Wood (timber and firewood) and non-wood (nuts, berries, fiber and medicinal products) is only in FAO literature because of the way FAO is organized; better to use Timber and Non-timber (including fire wood) in Nepal's context and international trend

1.4.1 Structural
1.4.2 Decorative
1.4.3 Specialized

UNIT 2: STRUCTURE AND PROPERTY OF WOOD [8]

2.1 Wood anatomy, kinds of woody plants
2.2 Mechanism of wood formation; physiology of wood formation
2.3 Macroscopic or gross features of wood formation: bark, sap/heart wood, pith, early wood, growth rings (annual rings), woody rays – sapwood versus heart wood, anatomical differences wood and pith
2.4 Minute (fine) or microscopic features/structure of wood: pores/vessels, fibers, tracheids, parenchymatous elements of wood (soft tissue), resin canals, gum canals, latex canals, pith fleck, ray, ripple mark
2.5 Classification and properties of wood
    2.5.1 Classification: porous and non-porous wood; ring porous and diffuse porous woods
    2.5.2 Wood property: Physical, Mechanical and Chemical property

UNIT 3: WOOD TREATMENTS AND PRESERVATION [6]

3.1 Wood seasoning
    3.1.1 Concept
    3.1.2 Importance
    3.1.3 Methods of wood seasoning
3.2 Wood preservation
    3.2.1 Concept
    3.2.2 Importance
    3.2.3 Types of wood preservatives
    3.2.4 Methods of wood preservation

UNIT 4: WOOD PRODUCTS AND DEFECTS [8]

4.1 Wood products
    4.1.1 Log
    4.1.2 Sawn timber
    4.1.3 Veneer
    4.1.4 Pulp and paper
    4.1.5 Composite products (Block board, Particle board, Fiber board, Plywood and other composite board (bamboo, straw board))
4.2 Wood defects
    4.2.1 Concept
    4.2.2 Types of wood defects

UNIT 5: NTFPs/MAPs [6]

5.1 Classification system of NTFPs (broad categories of NTPFs)
5.2 Ethno-botanical value of NTFPs
5.3 Economic values of NTFPs for Nepal
5.4 Socio-economic importance and scope of MAPs
5.5 National Priority Species of MAPs in Nepal
5.6 Biodiversity value of NTFPs and role of CITES

UNIT 6: PHYTOCHEMISTRY OF TIMBER AND NTFPs [8]

6.1 Concept, scope and classification of photochemistry
6.2 Phytochemical screening of timber and NTFPs/MAPs
6.3 Methods of collection, and drying of timber and NTFPs/MAPs
6.4 Extraction of cellulose, hemicellulose and tannins of timber
6.5 Methods of extraction of MAPs (Percolation, Soxhlet extraction, liquid-liquid Fractination super critical fluid extraction), Ultrasonic extraction
6.6 Isolation Techniques (TLC, Column, HPLC)
6.7 Extraction of essential oil (Hot water distillation, Steam distillation, Simultaneous distillation, Fractional distillation, super critical fluid extraction, cold press,
6.8 Chemical Profiling of Essential oil: GC-MS analysis, Library search (NIST library)
6.9 Standardization of herbal products/essential oil: Chemical Profiling (GC-MS, LC-MS), determination of: adulterant, moisture content, ash value, marker compounds and other related parameters
6.10 Sustainable Harvesting, Processing and Transport of Timber rand NTFPs (brief description of Certification system and GHP, GLP etc.),

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Link to the course units (s)
Identification of wood	Knife, hand lens	Lab work	2
Identification of wood defect	Wood sample (field and lab)	Lab/Field work, 300 word report	4
Determined the moisture content of wood in lab	Oven dry machine /moisture meter	Lab work	3
Visit to Plywood /Paper industries		Excursion/observation, 300 word report	5
Extraction, TLC, Phytochemical screening, Essential oil extraction, Extraction of cellulose and hemicellulose Pulping	TLC Column Soxhlet apparatus Clevenger apparatus, Rotary evaporators	Lab work (Chemical analysis)	6

REFERENCES

1. Baser, K. H. C. (Kemal Hüsnü Can) Handbook of essential oils: science, technology, and applications / K. Hüsnü Can Baser, Gerhard Buchbauer.
2. Dutta, I.C. 2007. Non Timber Forest Products of Nepal (Identification, Classification, Ethnic Uses and Cultivation)
3. FRI, 1970. Indian Forest Utilization, Vol. I and II, Forest Research Institute, Dehradun.
4. Forest Products Laboratory. 2010. Wood handbook—Wood as an engineering material. General Technical Report FPL-GTR-190. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory
5. Handa, S.S., Khanuja, S.P.S., Longo, G., Rakesh, D.D., 2008. Extraction Technologies for Medicinal and Aromatic Plants, International centre for Science and High Technology
6. Jeffery, E.C. 1917. The Anatomy of Wood Plants. University of Chicago Press, Chicago.
7. Joshi, Prabhakar. 1995. Ethnobotany of the Primitive Tribes in Rajasthan. Printwell, Jaipur, India
8. Mehta, T. 2008. A Handbook of Forest Utilization. International Book Distributors, New Delhi.
9. Raaman, N. 2006: Phytochemical Techniques, New India Publishing Agency, Pitam Pura, New Delhi- 110088.
10. Tiên Do, T.D.; Minaglou, F.H.; Antoniotti, S.; Fernandez, X., 2014.Authenticity of essential oils. Elsevier

COURSE TITLE: FOREST LAW AND POLICY

Course Code	Credit	Lecture Hours	Marks			Total
SFM 314	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The students will know about the principles and practices of forest policy, forest law and their implementation activities of the government of Nepal. The students will be able to understand the legal procedures of forest protection and conservation.

OBJECTIVES

- Understand the policy formulation process
- Understand the legal provisions related to forest and environment
- Understand the legal procedure against illegal activities

EXPECTED LEARNING OUTCOMES: After the completion of this course, the students will be able to:

- differentiate between law, policy, strategies and plans
- understand the legal provisions in acts and regulations
- handle the legal procedures against the illegal activities

UNIT 1: INTRODUCTION [8]

1.1 Concept of forest law and policy
1.2 Brief history of Forest law and policy in Nepal
1.3 Constitutional provision of forest policy
1.4 Policy formulation process in
  1.4.1 Federal
  1.4.2 Provincial
  1.4.3 Local
1.5 National Forest Policy of Nepal
1.6 Forest sector strategies
1.7 Forest management periodic plan

UNIT 2: FOREST ACT [12]

2.1 Forest Act,
  2.1.1 Terminology and definition
  2.1.2 Provisions relating to the Government managed forest, protected forest, community forest, leasehold forest, religious forest; Partnership Forest, public land forest, urban forest; and private forest
  2.1.4. Provisions relating to promotion of forest enterprises, ecotourism, Payment for ecosystem services, carbon trading
  2.1.5 Prohibited activities and punishments

2.2 National Park and Wildlife Conservation Act
  2.2.1 Terminology and definition
  2.2.2 Prohibited activities
  2.2.3 Punishments

2.3 Soil and Watershed Conservation Act,
  2.3.1 Terminology and definition

2.3.2 Prohibited activities and punishment
2.3.3 Declaration of watershed areas and preference activities
2.3.3 Practices based on land use systems.

2.4 Environment Protection Act,
2.4.1 Terminology and definition
2.4.2 Environmental Impact Assessment (EIA/IEE/SEA)
2.4.3 Prohibited activities and punishment
2.4.4 Declaration of environment conservation areas and preference activities
2.4.5 Pollution control and prevention mechanism
2.4.6 Environment Management Plan
2.4.7 Issues about Climate Change Management
2.4.8 Council of environment conservation
2.4.9 Environmental auditing and reporting

2.5 Regulate and control international trade in endangered wild fauna and flora Act,
2.5.1 Terminology and definition
2.5.2 Provisions concerning transition of endangered wild fauna or flora or specimen
2.5.3 Provisions concerning management authority and scientific authority
2.5.4 Provisions of offenses and punishment

UNIT 3: MAJOR REGULATIONS [10]
3.1 Forest Regulations,
3.1 Handing over process of Community Forests, Leasehold Forests, and religious Forests
3.2 Provisions relating to the Government managed forest, protected forest, community forest, leasehold forest, religious forest; Partnership Forest, public land forest, urban forest; and private forest
3.2 National Park and Wildlife Conservation Regulations
3.2.1 Provisions of hunting
3.2.2 Provisions of hunting licenses and its types
3.3 Buffer Zone Management Regulations
3.3.1 Terms and definitions
3.3.2 Declarations of Buffer Zone and formulations of Users committee
3.3.3 Prohibited activities in the buffer zone
3.3.4 Roles and responsibilities of Buffer zone users committee
3.3.5 Collection and mobilization of BZUC fund

UNIT 4: LEGAL PROCEDURE AND PROCESS [10]
4.1 अनुसन्धान चरण
4.1.1 मुद्दाको प्रकृति र मुद्दाको प्रकार
4.1.2 जाहेरी प्रतिवेदनरजाहेरी दरखास्त
4.1.3 घटनास्थल प्रकृति मुचुल्का
4.1.4 बरामदी मुचुल्का
4.1.5 पक्राउ पुर्जि
4.1.6 थुनुवापुर्जी
4.1.7 म्याद थप
4.1.8 घटनास्थल मुचुल्का

4.1.9 सर्जमिन मुचुल्का
4.1.10 प्रतिवादीहरुको वयान
4.1.11 खानतलासीको सुचना
4.1.12 खानतलासीमुचुल्का
4.1.13 विगोमुल्यांकनफाराम
4.1.14 सरकारी वकिल कार्यालयको राय
4.1.15 अभियोग पत्र

4.2 अदालती चरण
4.2.1 मुद्धा दर्ता
4.2.2 अभियुक्तको वयान
4.2.3 थुनछेक वहस र आदेश
4.2.4 प्रमाण मुकरर आदेश
4.2.5 साक्षीको वकपत्र
4.2.6 फैसला लेखन
4.2.7 फैसला कार्यान्वयन

4.3 पञ्जिका तयारी र तेरिज पर्चा खडा

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	वन तथा वन्यजन्तु कसुर पहिचान	सम्वन्धि ऐन तथा प्रचलित कानूनहरू	८ जनाको समुहमा कसुर पहिचान	२
2	घटना स्थल प्रकृति मुचुल्का तयारी	सम्वन्धित ऐन तथा प्रचलित कानूनहरू	पहिचान कसुर अनुसार समुहमा कार्य	४
3	सर्जिमिन मुचुल्का	सम्वन्धित ऐन तथा प्रचलित कानूनहरू	पहिचान कसुर अनुसार समुहमा कार्य	४
4	अभियेग पत्र तयारी तथा दर्ता	सम्वन्धित ऐन तथा प्रचलित कानूनहरू	पहिचान कसुर अनुसार समुहमा कार्य	४

TEXTBOOKS AND REFERENCES

1. गोपाल सिवाकोटी र रतन सुवेदी २०७५, प्राकृतिक स्रोत सम्पदा संवन्धी ऐन नियम संग्रह, संकलन सम्पादन (नयाँसस्करण)., पैरवी प्रकासन, काठमाडौं, नेपाल
2. ज्ञाईन्द्र वहादुर श्रेष्ठ. कार्यविधि कानुनको रूपरेखा (नयाँ सस्करण). पैरवी प्रकाशन,काठमाडौं।
3. Forest Act 2076
4. National Park and Wildlife Conservation Act 2029
5. Soil Conservation and Watershed Conservation Act 2039
6. Environment Conservation Act 2076
7. Regulate and Control International Trade in Endangered Wild Fauna and Flora Act, 2073
8. Forest Regulation, 2079
9. National Park and Wildlife Conservation Regulation 2030
10. Buffer Zone Management Regulation, 2052
11. Forest Fire Management Strategy of Nepal 2067
12. Forest Area Encroachment Management Strategy 2068
13. Compensation directives to the wildlife victims, 2069
14. National Forest Policy, 2075
15. www.lawcommission.gov.np-g
16. www.mofe.gov.np (वन तथा वातावरण मन्त्रालय)

COURSE TITLE: RANGELAND MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
SFM 315	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course covers the concept of rangeland management, rangeland ecology and its various techniques for inventorying and monitoring rangeland conditions as well as ecosystem for sustainable use.

OBJECTIVES: The objectives of this course are to:

- Understand rangeland ecology and rangeland ecosystem services.
- Be familiar with the notion of rangeland management strategies.
- Develop the rangeland inventory skills with various techniques.
- Acquire knowledge on the basic concepts of indigenous herding system in Nepal.
- Familiarize with the institutions involved in rangeland management in Nepal.

EXPECTED LEARNING OUTCOMES: After the completion of this course, the students will be able to:

- Understand rangeland as an ecosystem
- Understand the concept of social-ecological system
- Conduct inventory of rangeland resources
- Techniques of rangeland management
- Issues in rangeland management

UNIT 1: INTRODUCTION [4]

1.1 Concept of rangelands
1.2 Characteristics of rangeland
1.3 Types of rangelands
1.4 Range ecosystems in Nepal
1.5 Differentiate between rangeland and pastureland

UNIT 2: RANGELAND AS A SOCIAL-ECOLOGICAL SYSTEM [8]

2.1 Concept of social-ecological system
2.2 Indigenous herding systems in Nepal
2.3 Transhumance pastoralism
    2.3.1 Introduction of transhumant pastoralism
    2.3.2 Contribution of transhumant pastoralism to local livelihood
    2.3.3 Role of transhumant pastoralism in rangeland conservation/ management

UNIT 3: RANGE INVENTORY [8]

3.1 Vegetation assessment
    3.1.1 Direct Observation
    3.1.2 Species survey
    3.1.3 Coverage estimation
    3.1.4 Visual estimation
    3.1.5 Point methods
    3.1.6 Line interception

3.1.7 Density
3.1.8 Occurrence Frequency of sample plots
3.2 Determination of carrying capacity
3.3 Range condition classification for Nepal
3.3.1 Concepts and definitions
3.3.2 Classification systems
3.3.3 Condition trend analysis

UNIT 4: RANGELAND MANAGEMENT [10]
4.1 Objectives of rangeland management
4.2 Range management techniques and tools
4.3 Participatory tools for rangeland management
4.4 Fire as a management tool (prescribed burning)
4.5 Grazing management
4.6 Weeds control measures
4.7 Status of Rangeland resources and strategies for improvement in Nepal
4.7.1 Seed production in rangeland
4.7.2 Pasture development
4.7.3 Fodder plantation in rangeland
4.7.4 Hay and silage production
4.7.5 Introduction of some exotic forage species in rangeland
4.8 Rangeland management plan preparation

UNIT 5: ISSUES AND CHALLENGES IN RANGELAND MANAGEMENT [6]
5.1 Social
5.2 Economic
5.3 Climate
5.4 Policy
5.5 Invasive species and wild vegetation restoration

UNIT 6: INSTITUTIONS IN RANGELAND MANAGEMENT [4]
6.1 Rangeland Policy
6.2 Federal, Provincial and Local Authorities in Rangeland management
6.3 Traditional institutions in rangeland management
6.4 Institutional constraints in rangeland management
6.5 Transboundary issues in rangeland management

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	Range inventory in nearby rangeland/grassland/pasturel and	Required equipment for measurement	In group (grass inventory, cut and carry)	3
2	Estimation of carrying capacity of the inventoried rangeland/pastureland/grassl and	Based on practical 1	- Area estimation - Biomass estimation - Forage demand	3
3	Document the various conflicting issues related to rangeland management	- Literature - News paper - Online media	- Review - Social media survey	5
4	Community forests and transhumant system relationship		- Review - Social media survey - KII	5

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YEAR 3 SEMESTER II

COURSE TITLE: PROTECTED AREA MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
PWM 321	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to introduce the significant principles and practices of landscape level conservation, protected area planning, monitoring, community engagement and integrated protected area management. Moreover, it covers contemporary practices emphasizing research, practical, field visits and case studies to strengthen protected area management.

OBJECTIVES: The objectives of this course are to:

- Demonstrate understanding of modern concepts related to the basis of establishing protected areas.
- Examine planning, implementation, and evaluation of management strategies of protected areas.
- Demonstrate familiarity with conservation education, communications, public relations schemes, integrated approaches used in protected area systems.
- Understand the protected areas of Nepal, discuss their significance and apply management skills.
- Understand park-people conflicts and mitigation approaches to address local needs.

EXPECTED LEARNING OUTCOMES

- Enhancement of managerial capability on protected areas
- Acquire the ability to handle issues and challenges existed in protected areas.

UNIT 1: MANAGEMENT APPROACH AND COOPERATION IN PROTECTED AREAS [8]

1.1. Concept of protected area
1.2. National and international practice of PAs management
1.3. National policies for managing protected areas (acts, regulations, guidelines, directives and administrative order)
1.4. Management zone (buffer zone, wilderness zone, recreation zone, no-take zone, core zone)
1.5. International organizations and their cooperation in PAs management
  1.5.1 Needs and types of assistance
  1.5.2 Organizations: UN agencies, I/NGOs, bilateral, regional and multilateral agencies, volunteer organizations, GTI, GTF, SAWEN; NTNC, WWF, ZSL
1.6. National and International commitment to conservation (WCS, NCS, CBD, Nagoya protocol, Ramsar)

UNIT 2: LANDSCAPE LEVEL CONSERVATION [6]

2.1. Landscape conservation concept and strategies
2.2. Conservation landscapes in Nepal (TAL, CHAL, SHL, KSL, KL, other proposed landscapes)
2.3. Corridors: river and forest corridors (north-south corridor/linkage, east-west corridors), connectivity, bottleneck,
2.4. Upstream-downstream relations in wildlife conservation
2.5. Transboundary conservation initiatives
2.6. Forest conservation area/forest protection area (e.g., Panchase, Barandavar, Khata etc.)

UNIT 3: PLANNING, IMPLEMENTATION, AND EVALUATION OF PROTECTED AREA MANAGEMENT SYSTEMS [10]

3.1 Planning
- 3.1.1 Introduction
- 3.1.2 National strategies for conservation
- 3.1.3 Management plans
- 3.1.4 Annual operation plans
- 3.1.5 Site plans
- 3.1.6 Management zoning
- 3.1.7 Planning research programs for protected areas
- 3.1.8 Action plans

3.2 Protected area planning tools: Importance of the use of ZOPP, APPA, and SWOT/C

3.3 Implementation
- 3.3.1 Introduction
- 3.3.2 Management of staff and their duties
- 3.3.3 Patrolling: joint, short range, medium range, long range, community based)
- 3.3.4 Inspection and supervision
- 3.3.5 Law enforcement, wildlife crime coordination mechanism
- 3.3.6 Role of security unit (Nepal Army)
- 3.3.7 In-service training

3.4 Monitoring and evaluation
- 3.4.1 Introduction
- 3.4.2 Evaluating management and cost-effectiveness
- 3.4.3 Assessing achievement of goals
- 3.4.4 The use of checklists in evaluating management
- 3.4.5 Management effectiveness evaluation (MEE) of protected areas

UNIT 4: RESEARCH AND MONITORING [8]

4.1 Management of small, isolated, rare and endangered species
4.2 Management of over-abundant populations
4.3 Habitat monitoring and restoration
4.4 Subsistence use of plant and animals' products in and around protected areas
4.5 On-going management-oriented research in PAs (with case studies)
4.6 Management trials (e.g., wild water buffalo, swamp deer, black buck, cheetah in India, etc.)
4.7 Wildlife friendly infrastructure design and their effectiveness (underpass, overpass, canopy bridge/flyover, fish ladder, etc.)
4.8 Parks revenue sharing

UNIT 5: PROTECTED AREA, INDIGENOUS PEOPLE AND LOCAL COMMUNITY [8]

5.1 Local people and protected areas
- 5.1.1 Protected area and people
- 5.1.2 Grazing and harvesting from protected areas
- 5.1.3 Local employment from protected areas
- 5.1.4 Provision of social services and environmental services
- 5.1.5 Modalities of the resettlement schemes in Nepalese context (Case studies: Rara, Chitwan, Bardia, Koshi, Shukla, Parsa, Banke)
- 5.1.6 Potentialities of livelihood options of the displaced communities (case studies of visited PAs)

5.2 Community involvement and engagement in protecting wildlife
- 5.2.1 Revenue sharing models: conservation areas and buffer zones
- 5.2.2 Buffer zone management institutions (e.g., management committee, user committee, user group) and conservation area management institutions (e.g., CAMC, user committee, functional groups)
- 5.2.3 Community-based anti-poaching operations/units
  - 5.2.3.1 Information collection and sharing
  - 5.2.3.2 Anti-poaching campaigns and operations

5.3 Conservation education and public awareness
- 5.3.1 Visitor information and interpretation services
- 5.3.2 Local village extension service
- 5.3.3 Promotion and public relations
- 5.3.4 Committees and dialogue

PRACTICAL [20]

Contents	Equipment/ tools	Methodology/methods	Link to the course unit(s)
Studying corridor, connectivity, bottle neck, conservation land scape (e.g., upstream-downstream, east-west, north-south) (3)		Excursion to nearby landscape (e.g., CHAL, TAL)	Unit 2
PA planning exercise (7)		Using SWOT or ZOPP or APPA	Unit 3
PA effectiveness analysis (4)	Questionnaire /checklist	Survey with management personnel, protection unit people (Army or local people), tourists and hoteliers	Unit 3
Study of buffer zone and conservation area management (6)	Checklist	Interaction with respective institutions for exploring management issues, revenue sharing ICDP, anti-poaching operations	Unit 5

Note: Students must submit the filed report, present the findings, and attend the objective-based exams.

TEXTBOOKS

1. McKinnon, J., McKinnon, K., Child, G. and Thorsell, J. 1986. Managing Protected Areas in the Tropics. IUCN, Reprint Natraj Publishers, Dehradun.
2. Lockwood, M., Graeme, W. and Kothari, A. 2006. Managing Protected Areas: A Global Guide. Earthscan Publications Ltd., London.

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COURSE TITLE: FOREST PROTECTION

Course Code	Credit	Lecture Hours	Marks			Total
SFB 322	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course is designed to provide overall concept of maintaining a healthy forest ecosystem by protecting forest vegetation against fungal diseases, insect pest and weeds and harmful invasive alien species that damage and destroy forest trees, plantation and native vegetation and habitats. The course covers, different disease and stress causing agents causing damage to forest and their mechanical, chemical, preventive and biological control measures.

OBJECTIVES: Upon completion of the course, the students will be able to:

- Explain different biological (insect, diseases and weeds) and abiotic factors (climate change, floods and droughts) that cause or aggravate harm forest, seed and seedlings.
- Describe various methods (protective and preventive) to control diseases causing and forest damaging factors.
- Describe life history and characteristics of harmful insects and diseases damaging some of principal species in the natural forest or plantation.
- Describe the role of climate and harmful human activities that aggravate diseases and pest outbreaks and forest damage

EXPECTED LEARNING OUTCOMES

- Identify and manage major biological and human/climate induced factors that are harmful to a forest ecosystem
- Analyze and identify disease and manage them.

UNIT 1: INTRODUCTION [4]

1.1 Concept and importance of forest protection
1.2 Science of Forest Entomology, Forest Pathology and Weed Science in Forest Protection;
1.3 Deforestation and forest degradation aggravating forest ecosystem vulnerability to diseases and insect pests
1.4 Importance of maintain Forest ecosystem health and vitality for sustained forest production
1.5 Factors affecting forest health and vitality including climate change

UNIT 2: MAJOR FACTORS AFFECTING FOREST ECOSYSTEM [10]

2.1 Atmospheric factors (temperature (high and low including frost, drought, extreme rainfall events)
2.2 Invasive alien species
2.3 Injurious or obnoxious plants (weed, climber, parasite)
2.4 Grazers and browsers (domestic and wild animals)
2.5 Fire (natural and anthropogenic)
2.6 Human (deforestation and forest degradation, forest encroachment, shifting cultivation)

UNIT 3: FOREST ENTOMOLOGY [4]

3.1 Concept of forest entomology and major forest insect pests found in Nepal
3.2 General characteristics of harmful insects and diseases pests (insects, fungi and weeds)
3.3 Types of damage to forest resources in Nepal

UNIT 4: LIFE CYCLES OF FOREST INSECTS AND PESTS [8]

4.1 Development and metamorphosis of insects
    4.1.1 Post embryonic development
    4.1.2 Metamorphosis
    4.1.3 Types of insect larvae-pupae
4.2 Life cycle of important forest insects
    4.2.1 Order Coleoptera
        4.2.1.1 Curculionidae (Sissoo leaf-roller)
        4.2.1.2 Bostrichidae (bamboo borer)
        4.2.1.3 Bostrychidae (Sissoo bark borer)
        4.2.1.4 Platypodidae (*Chirpine borer*)
        4.2.1.5 Cerambycidae (*Sal borer*)
    4.2.2 Order Lepidoptera
        4.2.2.1 Geometridae (deodar defoliator)
        4.2.2.2 Hyblaeidae (Teak Defoliator)
        4.2.2.3 Noctuidae (Greasy cutworm and sissoo defoliator)
        4.2.2.4 Oecophoridae (Simal shoot borer)
    4.2.3 Order Isoptera
        4.2.3.1 Termitidae (White ants)

UNIT 5: FOREST PATHOLOGY [11]

5.1 Classification of forest diseases (root diseases, heart diseases, wilt diseases)
5.2 Mode of infection, symptoms and effects of plant diseases
    5.2.1 Fungal disease
    5.2.2 Bacterial disease
5.3 Principle of forest disease control
5.4 Quarantine
5.5 Factors affecting epidemiology of a disease and its control
5.6 Common disease in nursery, plantation and forest and their control
5.7 Disease of major tree species and their control measures: Sal, Sissoo, Khair, Teak, Populus, Eucalyptus, Chir Pine, Blue Pine, Deodar, Utis

UNIT 6: PROTECTION MEASURES AGAINST FOREST INSECTS [5]

6.1 Physical/mechanical control of pests and diseases
6.2 Chemical control (from sites, seeds to stands)
6.3 Biological control (use of predators, parasites, pathogens, pheromones, genetic control)
6.4 Legal control of invasive alien species (policy and regulations)
6.5 Integrated Pest Management (IPM) and economic feasibility analysis
6.6 Animal (domestic and wild) management by habitat improvement, stall feeding and social fencing
6.7 Technological advances in forest protection (electric fences, camera, drone etc.)

PRACTICAL [20]

SN	Content	Methods	Link to units
1	Study of morphology of common insects with help of slides and set specimens (cricket, grass hoppers and other common insects)	Lab work	3 and 4
2	Visit local nursery and nearby forest to study diseases symptoms and their control	Field visit, 300-word report	6
3	Identification of important insect orders and families	Lab work	4
4	Collection and preservation of insects and fungi	Field + Lab work	3, 4, 5 and 6
5	Identification of important diseases of forest trees	Field visit, 300-word report	6
6	Fire control practice	Field work, 300-word report	2

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2. Khanna, L.S (1982). Forest protection
3. Hand book of Forest Protection by S. S. Negi
4. Singh, R. S. (2001). Plant disease management. Science Publishers, Inc..
5. Tainter, F. H., & Baker, F. A. (1996). *Principles of forest pathology*. John Wiley & Sons.
6. The Ecology of forest Insect by C.F.C. Beeson
7. Barrows, K. F., John, H. H., & Alexander, G. S. (1980). Principles of forest entomology. *McGraw-Hill series in forest resources (USA).*
8. Forest Protection by Ralph C. Howley and Paul W.
9. Tropical Forest Insects and their control by P.B. Meshram
10. Forest Entomology by Bipin Bihari
11. Forest Entomology by M.L. Thakur
12. A text book of forest trees entomology by Dr Ajay Sharma
13. Plant pathology by Roberts Boothroyd
14. Forest fire control by R.K. Luna
15. Plant pathology by H.Lewin Devasahayam
16. Forest entomology by Samuel Alexander Graham
17. Forest pathology by John Shaw Boyce

COURSE TITLE: INTEGRATED WATERSHED MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
WME 323	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course is designed to provide the knowledge and skills on integrated watershed management to address the issues of ecosystem services, springshed management, multi-hazard and sub-watershed prioritization in order to contribute on sustainable land management and sustained supply of ecosystem services.

OBJECTIVES: The course will provide

- Fundamental knowledge on integrated watershed management and management approaches
- Methods of data collection, analytical skill and framework for watershed problem analysis
- Skill for managing watershed for ecosystem, land restoration, water supply, and building climate resiliency
- Geospatial analysis skill for watershed delineation, characterization, evaluation and prioritization
- Skill on watershed assessment and management planning

EXPECTED OUTCOMES: After completion of the course students are able to

- Explain the watershed management scope, issues and best management approaches
- Conduct geospatial necessary for watershed delineation, morphometric analysis, muti-hazard mapping and sub-watershed prioritization
- Conduct biophysical and socio-economic assessment of watershed
- Analyze the watershed condition and identify the best management strategy
- Prepare the integrated watershed management plan

UNIT 1: CONCEPT OF WATERSHED MANAGEMENT [7]

1.1 Concept, scope and principle of watershed management
1.2 Watershed products and services
1.3 Upstream and downstream linkage
1.4 Integrated Water Resource management (IWRM)
1.5 Basin approach of watershed management
1.6 Springshed management approach
1.7 Nexus approach of watershed management (WEFE)
1.8 Ecosystem perspective of watershed management
1.9 Fundamental concept of wetland and degradation

UNIT 2: WATERSHED ASSESSMENT AND ANALYSIS [8]

2.1 Biophysical and socioeconomic characteristics and data collection
2.2 Framework analysis of watershed condition, and vulnerability assessment
2.3 Morphometric analysis
2.4 Concept of multi-hazard mapping
2.5 Water balance analysis

2.6 Concept of watershed modelling. (response of climate and land use change)
2.7 Multi-criteria analysis and sub-watershed prioritization

UNIT 3: WATERSHED MANAGEMENT STRATEGY [6]
3.1 Watershed management and SDG linkage
3.2 Watershed based forest management and green infrastructure
3.3 Building climate resiliency
3.4 Watershed strategy for disasters management
3.5 Sustainability of river based mega project (hydropower)
3.6 Watershed based PES schemes

UNIT 4: WATERSHED MANAGEMENT PLANNING [8]
4.1Content of integrated watershed plan
4.2 Process of watershed management planning
4.3 Data collection for watershed planning
4.4 Methods and tools for watershed management planning
4.5 Participatory, Inclusive, Demand driven and Bottom up process
4.6 Formulation of vision, goal, objectives, strategies and activities
4.7 Mainstreaming sustainability concept
4.8 Implementation and monitoring mechanism (Logical framework)
4.9 Monitoring research on watershed (Paired catchment, experimental catchment, response monitoring parameters)

UNIT 5: WATERSHED MANAGEMENT POLICY AND PRACTICES IN NEPAL [6]
5.1 Watershed management related act, regulation and guidelines (Land use policy, soil and water conservation etc)
5.2 Roles and responsibility of local, provincial and federal government
5.3 Institutional/organization arrangement for soil conservation and watershed management
5.4 Program and activities adopted by forest and soil conservation department
5.5 Recharge improvement and spring revival measures
5.6 Biophysical characteristic of Churia
5.7 Churia restoration and related program and strategy

UNIT 6: OPPORTUNITY AND CHALLENGE OF WATERSHED MANAGEMENT [5]
6.1 Opportunity of watershed management
- 6.1.1 Effective management unit for maintaining socio-ecological balance
- 6.1.2 Livelihoods and ecosystem services
- 6.1.3 Generating revenue from riverine project
- 6.1.4 Opportunity of carbon offset projects and REDD+
- 6.1.5Transboundary cooperation
- 6.1.6 Sustainable land management, productivity and development

6.2 Challenges
- 6.2.1 Issue of political versus natural boundary on administration
- 6.2.2 Coordinator among sector, stakeholders and multi-layer government
- 6.2.3 Sensitive topography, climate change and weak institutional capacity
- 6.2.4 Increasing risk of pollution, sedimentation
- 6.2.5 Haphazard development of infrastructure
- 6.2.6 Land fragmentation, fallowing and food security

PRACTICAL [20]
Practical: [12]

	Content	Equipment/tools	Methodology/methods	Link to the course unit(s)
1	Watershed delineation using DEM	DEM	GIS tool	Unit 2
2	Morphometric analysis of watershed (Stream mapping, Stream ordering, Drainage Density, Stream frequency, Texture ratio, Bifurcation ratio, Elongation ratio, Circulatory ratio, Form factor)	DEM	GIS Tool	Unit 2
3	Sub-watershed prioritization exercise using multi criteria analysis	Sub-watershed boundary, spatial layers of watershed attributes, prioritization guideline	GIS tool	Unit 2

Assignment: [8]

SN	Topics	Mode of work
1	Review of watershed/sub watershed management plans representing mountain, hill and Terai region (Problems, Objectives, Strategies and Activities)	Group exercise, Reporting and Presentation
2	Review of National five-year plan and identify the watershed management priority trend	Group exercise, Reporting and Presentation
3	Review of Chure Master Plan	Group exercise, Reporting and Presentation
4	Case studies of successful watershed management projects and programs: lesson learn and best practices	Group exercise, Reporting and Presentation
5	Opportunities and challenge of watershed management at local level	Report from their own watershed area
Note	Watershed management plan will be prepared during tour (WME316)	

TEXTBOOKS

1. Beheim, E., Rajwar, G. S., Haigh, M., &Krecek, J. (Eds.). 2012. Integrated watershed management: perspectives and problems
2. Bonell, M., &Bruijnzeel, L. A. (Eds.). 2004. Forests, water and people in the humid tropics: past, present and future hydrological research for integrated land and water management. Cambridge University Press.
3. Brooks, K.N., Folliott,P.F., Magner, J.A.2013. Hydrology and the management of watershed.Fourth edition. John Wiley & Sons.
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8. World Bank. 2019. Valuing Green Infrastructure: Case Study of Kali Gandaki Watershed, Nepal.
9. नेपालसरकारराष्ट्रपतिचुरे-तराईमधेशसंरक्षणविकाससमिति२०७२, चुरे-तराईमधेशसंरक्षणतथाव्यवस्थापनगुरूयोजना(खण्ड२)- नदीप्रणालीव्यवस्थापनकार्ययोजना।

COURSE TITLE: SOIL AND WATER CONSERVATION ENGINEERING

Course Code	Credit	Lecture Hours	Marks			Total
WME 324	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course aims the students to gain knowledge on recognizing the cause and consequences of the land degradation problems due to erosion and resulting loss of land productive capacity and identifying the soil and water conservation techniques and measures to mitigate and improve land productive capacity in the context of the mixed farming livestock system of Nepal.

OBJECTIVES: At the end of the course, the student will be able to:

1. Understand and identify the causes and consequences of the land degradation problems in the watershed.
2. Understand and explain major agronomic, vegetative, bio-engineering and engineering conservation techniques.
3. Understand the importance of integration of these techniques as a bio-engineering conservation measure.
4. Identify and design the package of these techniques as a bio-engineering conservation measures to mitigate water induced disaster and land degradation and maintain its productivity.
5. Understand erosion monitoring processes.

EXPECTED LEARNING OUTCOMES: At the end of the course, the students are expected

- To identify the land degradation process and gain the skill
- To identify and design the conservation measures
- To tackle the land degradation problems.

UNIT 1: LAND DEGRADATION PROBLEM [6]

1.1. Introduction and consequences of land degradation processes referring to Nepal: (Definition, types, causes and consequences of land degradation problems with some examples of major type of problems relevant to the country)

1.2. Erosion process:(Definition, processes, types of erosion by nature and eroding agents, definition of erosivity and erodibility)

1.2.1 Water erosion: (Definition, Water movement types and consequences, Types of water erosion: Splash, Sheet, Rills, Gully, Basics of water erosion control)

1.2.2. Wind erosion: (Definition, Movement types, Causes or prevailing conditions and Basics of wind erosion control)

1.3 Landslide types: (Definition, Types, Prevailing conditions and Process, Landslide hazard zoning to reduce disastrous consequences)

1.4 Flood (Definition, Causes or prevailing conditions, Flood hazard zoning to reduce disastrous consequences)

1.5 Drought and desertification

UNIT 2: SOIL AND WATER CONSERVATION TECHNIQUES [6]

2.1 AGRONOMIC TECHNIQUES (Definition, function, types, scope, advantage, specification, construction steps and precautions) – (7)

- 2.1.1 Conservation tillage
- 2.1.2 Multiple cropping
- 2.1.3 Cover crop/Green manure/Nitrogen fixing plants
- 2.1.4 Composting
- 2.1.5 Mulching
- 2.1.6 Shelter belts / green belts
- 2.1.7 Agro-forestry

2.2 VEGETATIVE and BIO-ENGINEERING TECHNIQUES (8)
(Definition, function, types, scope, advantage, specification, construction steps and precautions)

- 2.2.1 Plantation/Planting techniques
- 2.2.2 Bamboo and Grass planting/seeding
- 2.2.3 Hedgerows
- 2.2.4 Fruit tree
- 2.2.5 Palisade
- 2.2.6 Brush layering
- 2.2.7 Fascine
- 2.2.8 Rip-rap
- 2.2.9 Watling
- 2.2.10 Jute net
- 2.2.11 Brushwood checkdam
- 2.2.12 Crib wall

2.3 ENGINEERING TECHNIQUES (7)
(Definition, function, types, survey, design and practical considerations)

- 2.3.1 Check dams
- 2.3.2 Retaining walls
- 2.3.3 Waterways
- 2.3.4 Bunds / Bolster
- 2.3.5 Spurs
- 2.3.6 Water harvesting ponds, reservoirs and tanks
- 2.3.7 Terraces/Terracing

UNIT 3: CONSERVATION MEASURES (Definition, Major problems, Scope, Survey, design and practical considerations) [7]

3.1 On-farm Conservation
3.2 Degraded/sloping land rehabilitation
3.3 Gully and landslide treatments
3.4 Spring renovation/water source improvement
3.5 Stream/River bank protection
3.6 Trail/Road slope stabilization

UNIT 4: EROSION MONITORING [3]

4.1 Erodibility of soil and affecting factors
4.2 Erosivity of rainfall-and affecting factors
4.3 Revised Universal Soil Loss Equation
4.4 Erosion monitoring-

- 4.4.1 Run-off plot monitoring
- 4.4.2 Paired catchment studies

4.4.3 Sedimentation survey

UNIT 5: RESTORATION OF DRY LAND [4]

5.1 Concept of restoration and land degradation neutrality

5.1.1 Types of droughts (hydrological, meteorological and agricultural with country specific examples)

5.2 Drought smart land management practices (crop land, grazing and forest land)

5.3 Water efficient technology and its application

UNIT 6: SURVEYING FOR THE DESIGNING CONSERVATION MEASURES AND COST ESTIMATION [3]

6.1. Surveying for designing the soil and water conservation measures

6.2. Runoff estimation

6.3. Basics of Quantity and Cost calculation

PRACTICAL [20]

Content	Equipment/tools	Methodology/ methods	Link to the course unit(s)
Gully and landslide treatment: Field survey in a group for the landslide site to assess conservation measures required and carry out measurement	Clino-Compass, measuring tapes, ranging rods etc.	Preliminary work on Google Earth, Traverse survey, leveling	Unit 3
Bio-engineering slope stabilization: Field survey in a group of a degraded site to assess site conditions and carry out necessary measurements	Clino-Compass, measuring tapes, ranging rodsetc,	Preliminary work on Google Earth, Traverse survey, leveling	UNIT 2:3
Gully and landslide treatment: Design the necessary conservation techniques especially focusing on retaining wall, check dam, planting techniques, water diversion etc.	Field information and other design parameter	Computation of sizes of the structure and preparation of the drawings of the structure	Unit 3
Bio-engineering slope stabilization: Design the necessary bio-engineering measures and prepare a proposal	Field information and other design parameter	Preparation of proposal incorporating both mechanical and bio-engineering measures	UNIT 2:3
Channel designing:	Pre-collected information	Class room exercise on channel designing	UNIT 3:5
Cost estimation: Quantity and cost estimate of mechanical and bio-engineering measures as per proposal	Drawing, norms, district rate	Quantity estimate from the drawing and rate analysis.	UNIT 6:3
Group presentation and interaction	PowerPoint presentation	Each group presents their part of the proposal as per instruction of the tutor	

TEXTBOOKS

1. Sthapit, K. M., 2017 (Compiled). Teaching Material on Soil and Water Conservation Engineering, Bachelor in Science-Forestry, Institute of Forestry, Pokhara.
2. Huffman, R. L., Fangmeier, D. D., Elliot, W. J., Workman, S. R., & Schwab, G. O. (2011). Soil and water conservation engineering. St. Joseph: American Society of Agricultural and Biological Engineers.

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1. Alford, D. 1992. Hydrological Aspects of the Himalayan Region. ICIMOD Occasional Paper No. 18., ICIMOD, Kathmandu.
2. BIWMP/DSCWM, 2003. Engineering Field Manual. Bagmati Integrated Watershed Management Programme, Department of Soil Conservation and Watershed Management, Kathmandu Nepal
3. Bruijnzeel, L.A. and C.N. Bremmer, 1989. Highland - Lowland Interactions in the Ganges Brahmaputra River Basin: A Review of Published Literature. ICIMOD Publication Occasional Paper No. 11. ICIMOD, Kathmandu.
4. DOR, 1999. Roadside Bio-engineering. Reference Manual, Department of Roads, HMG. Kathmandu.
5. DSCWM, 2004. Soil Conservation and Watershed Management Measures and Low-Cost Techniques. Soil Conservation Watershed Management Component (SCWMC), Natural Resource Management Sector Assistance Programme (NARMSAP), Department of Soil Conservation and Watershed Management, Babar Mahal, Kathmandu
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7. DSCWM. 2016. Guideline on Landslide Treatment and Mitigation. Department of Soil Conservation and Watershed Management, Kathmandu, Nepal.
8. Dunne, T. and Leopold, L.B. 1978. Water in Environmental Planning.W. H. Freeman.
9. Dutta, S.K. 2006. Soil Conservation and Land Management. International Book Distributors, Dehradun.
10. FAO. 1977. Guidelines for Watershed Management. FAO Watershed Management Field Manual. FAO Conservation Guide 1. Food and Agriculture Organization of the United Nations (FAO/UN).
11. FAO. 1985. Vegetative and Soil Treatment Measures. FAO Watershed Management Field Manual. FAO Conservation Guide 13/1. FAO/UN.
12. FAO, 2000. The Conservation of Lands in Asia and the Pacific, CLASP, a framework for action. Food and Agriculture Organization.
13. Hudson, Norman. 2015. Soil Conservation, Fully Revised Third Ed. Scientific Publishers, Jodhpur.

COURSE TITLE: PROJECT MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
SFM 325	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course gives a common understanding among students about what goes into a project and the factors that define its success. In addition, it envisions the knowledge and skills related to project planning and appraisal, monitoring and evaluation, and preparing a project framework to strengthen the forest enterprises.

OBJECTIVES: The objectives of this course are to:

- Understand project planning, implementation, and controlling skills
- Acquire knowledge on theory of change, result framework and logical framework
- Understand project finance and project budget management
- Understand the risk of the project and its management
- Familiarize the concept of necessary tools and methods for office management

EXPECTED LEARNING OUTCOMES: After the completion of this course, the students will be able to:

- Design the project proposal
- Develop logical framework and theory of change
- Develop the framework of monitoring and evaluation
- Assess the risks
- Understand the financial aspect of project management

UNIT 1: INTRODUCTION OF PROJECT [6]

1.1 Concept of Project
- 1.1.1 Definition of program, project and plan
- 1.1.2 Characteristics of project
- 1.1.3 Components of project
- 1.1.4 Classification of project
- 1.1.5 Project context and gap analysis, problem analysis and root cause analysis

1.2 Project cycle

1.3 Concept and element of project management

UNIT 2: PROJECT PLANNING AND APPRAISAL [12]

2.1 Concept of project planning

2.2 Project planning process

2.3 Project appraisal
- 2.3.1 Environment
- 2.3.2 Financial
- 2.2.3 Technological
- 2.2.4 Social

2.4 Project framework
- 2.4.1 Concept and types
- 2.4.2 Theory of change
- 2.4.3 Result Framework

2.4.4 Logical Framework
2.4.5 Time schedule (Gant chart)
2.5 Financial planning
2.5.1 Budgeting
2.5.2 Sourcing
2.5.3 Benefit-cost analysis
2.5.4 Project sustainability, replicability

UNIT 3: PROJECT IMPLEMENTATION AND MONITORING [10]
3.1 Project implementation
3.1.1 Implementation planning
3.1.2 Project supervision
3.1.3 Roles and responsibilities analysis of project team
3.2 Project monitoring and evaluation
3.2.1 Guiding principles of monitoring and evaluation
3.2.2 Types of monitoring and evaluation
3.2.3 Criteria and indicator for evaluation
3.2.4 Project evaluation methods
3.3 Project management and information system (PMIS)
3.4 Project report: monthly, quarterly, annually

UNIT 4: RISK ANALYSIS AND MANAGEMENT [6]
4.1 Concept and types of project risk
4.2 Analysis of major source of risk
4.3 Effective management of project risk
4.3.1 Risk management planning
4.3.2 Risk identification
4.3.3 Qualitative and quantitative risk analysis
4.3.4 Risk response planning
4.3.5 Risk monitoring and controlling

UNIT 5: PROJECT ACCOUNTING AND FINANCIAL MANAGEMENT [6]
5.1 Accounting principles and account keeping
5.2 Procurement and contract
5.2.1 Procurement principle
5.2.2 Procurement process
5.3 Project record management
5.3.1 Record keeping, filing, indexing
5.3.2 Financial norms and guidelines (taxation)
5.4 Project Auditing
5.4.1 Internal auditing
5.4.2 External auditing
5.4.3 Resource audit
5.4.4 Public audit
5.4.5 Social audit

PRACTICAL [20]

SN	Content/Topics	Methods	Link with Unit
1	Theory of change	The students will be given a project context	2
2	Result framework/Log frame preparation	Based on practical 1, the students will develop	2
3	Project proposal writing	Based on 1 and 2, students will develop a project proposal	1-5
4	Planning, Implementation, and Monitoring and Evaluation of the Project	Observation of project (forest, forest-based enterprises, community-based forests)	3

TEXTBOOKS AND REFERENCES

1. Agrawal, Govinda Ram. 2006. Project Management in Nepal. M.K. Publishers and Distributors, Kathmandu, Nepal.
2. Cusworth, John W. and T.R. Franks. 2014. Managing Project in Developing Countries, First ed. Routledge, UK.
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4. Lester, A. Project Management, Planning and Control (V edition). Butterworth – heinemann
5. Nagarajan, K. 2001. Project Management. ESBN 81-224-1340-4, New Age International (P) Limited, New Delhi, India.
6. Public Procurement Act 2063 B.S. and Rule 2064 B.S., Public Procurement Monitoring Office, GoN, Kathmandu.
7. Rizal, Dhruba P. 2001. Project Management. First edition. Ratna Pustak Bhandar, Kathmandu.

COURSE TITLE: TOUR (Watershed and forest products)

Course Code	Credit	Lecture Hours	Total
WME 326	2	40	50

SCOPE: Watershed management is utilizing, conserving, and developing land, water, and forest resources to improve livelihood and human development. This tour aims to provide a broad overview of the relationship between humans and environmental systems at the sub-watershed level, including soil, plants, and water resources. The tour aims to capture all the components (water management, soil conservation, agriculture, and socio-economic) of integrated watershed management at the sub-watershed level.

OBJECTIVES

- To learn about watershed characteristics (biophysical, socio-economic) data collection methods, and tools.
- To conduct landslide or flood or drought vulnerability assessments based on sub-watershed characteristics.
- To assess soil and water conservation measures adopted in agriculture, roadside, landslide treatment, river bank, farmland and forest in the sub-watershed.
- To conduct water quality assessment in the sub-watershed.
- To study soil profile and rocks/minerals in sub-watershed.

EXPECTED LEARNING OUTCOMES

- After completion of the tour, students will be able to conduct necessary field reconnaissance, data collection, and analysis of integrated watershed management components.
- The tour report will give a complete picture of the current situation of the watershed conditions with potential recommendations for integrated watershed management.

CONTENTS

Tour will cover field work related to watershed characteristics and conditions, landslide or flood or drought vulnerability assessment based on field situation, soil profile and rock study, water quality assessment, soil conservation and watershed management practices in sub-watershed.

LOGISTICS REQUIREMENT

Field camp will be at a nearby CFUG/sub-Division Forest office. Tour resource persons (2) will be assigned two weeks before the tour to plan the logistics. The tour in charge will be responsible for finalizing field content, schedule, and student group based on the field situation. The theme-based student group will be formed based on their interest a week before the tour; each group will consist of 10 students, and the prerequisite to complete a desk study based on the selected theme before the tour. Tour will be for seven days in the proposed sub-watershed. Every day students need to brief two times a day for 5-10 minutes in the morning before and evening after the field about the difficulties and planning of the field schedule in the group. And final presentation at the end of the tour by all the member in the group.

Proposed study sites were selected based on the importance of the watershed and the distance from campus. (A tour will be conducted in the proposed sub-watershed for at least five years

to generate a long-term dataset of study sites to diagnose watershed health): Proposed study sites: e.g.

- Phewa or Begnas-rupa watershed for Pokhara
- Khulekhani watershed for Hetauda
- Shivapuri watershed for Kathmandu

RESOURCE PERSONS FOR THE TOUR (2)

1. Faculty of Watershed Management
2. Faculty of Remote Sensing/GIS
3. Faculty of Geology/Soil science
4. Faculty of Soil and Water Conservation Engineering

DESK STUDY FOR TOUR PREPARATION (3 days at campus)

- Collection of study area topographic map, geological map, soil map, etc.
- Collection of socio-economic data from CBS, District profiles, and other sources
- Collection of discharge, rainfall, and temperature data of the study area from DHM
- Collecting of land cover map of the study area from FRTC and ICIMOD
- Download satellite image or in GEE platform analysis of land use land cover change
- Watershed delineation in Q/GIS with available high resolution dem
- Digitization of landslide area in google earth
- Flood hazard assessment using HEC-RAS
- Drought hazard assessment analyzing precipitation data

CONTENT (7 days at field site)

Content	Equipment/tools	Methodology/methods	Link to the course unit(s)
Diagnosis of watershed problems: Identification and analysis of biophysical, socio-economic characteristics	Topographic map, Checklist for watershed survey	Study of topographic map and interpretation, Questionnaire survey/FGD	IWM
Identification of rock/minerals and soil profile study, Training sample collection of prominent land use land cover	Topographic map, GPS, Auger, Munsell Soil Color Charts, hammer, Pocket Ph meter, Core	Open pit method or auger boring method, field observation, soil sample collection, training sample collection	Soil Science and Geology
Soil Erosion/Landslide/Flood /Drought vulnerability assessment to identify area, causes, condition, its impact, and possible mitigation measures,	Field observation, GPS, topographic map, Measuring tape, Google image with the landslide, river bank	Landslide inventory sheet, Field observation; Earlier flood marks, Analysis of precipitation data; Standardized Precipitation Index (SPI), Questionnaire/FGD about the past flood, landslide and its impact assessment, perception of drought	Soil and water conservation engineering

Water quality assessment	Field Water Test kit	Test field-based water quality parameters	IWM
Assess soil conservation and watershed management practices and Bio-engineering, technical aspects of infrastructure	Field observation	Field visit to river bank, landslide areas, roadside& drainage, bridge, farm land; visit to relevant organizations, Questionnaire/FGD with farmers	Soil and water conservation engineering

Report and Presentation (4 days at campus): Group based on thematic group will be submit report and also give presentation on outcomes of the field work based thematic area

YEAR 4 SEMESTER I

COURSE TITLE: ENVIRONMENTAL MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
WME 411	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: Environmental protection, conservation, and sustainable resource management are the main aims of environmental management. Environmental management requires critical thinking about ecological processes and relationships, past environmental management practices, principles, tools used for environmental management and impact assessment, policy measures, and collaboration among relevant stakeholders. After completion of this course, students will be able to understand concepts of environmental management, environmental policies, environmental management tools, and environmental impacts assessments through IEE/EIA applicable for development activities.

OBJECTIVES

- To learn the knowledge and skills to manage environmental issues at the local and global levels.
- To learn about global and national policies, rules, and regulations related to environmental management.
- To develop skills in the collection, processing, and analysis of environmental data required for environmental impact assessment through EIA/IEE required for development projects.

EXPECTED LEARNING OUTCOMES

- Students will be equipped with the skills and knowledge required to perform technical and management roles in environmental management
- Understand the national rules and regulation required for IEE/EIA and be able to conduct IEE of development projects.

UNIT 1: BASIC OF ENVIRONMENTAL MANAGEMENT [4]

1.1 Environment and Components
1.2 Common environmental issues and concerns-soil, air, water and biodiversity
1.3 Introduction to Environmental Management
1.4 Concept and importance of environmental management and its dimensions (ecological, social and economic)
1.5 The principles of environmental management-polluter pay principle (PPP), the principle of proportionality
1.6 Benefits of environmental management (ethical, legal compliance and cost saving)

UNIT 2: URBAN ENVIRONMENT [4]

2.1 Concept of urban environment and issues
2.2 Impact of urbanization on environments
2.3 Concept of urban design and planning
2.4 Green infrastructure and technology (road side plantation, garden, green space, etc.)

UNIT 3: ENVIRONMENTAL POLICIES AND LAW [6]

3.1Environmental justice and ethics
3.2 International Environmental Law
- 3.2.1Stockholm Declaration of the United Nations Conference on the Human Environment
- 3.2.2 1992 Rio Declaration on Environment and Development
- 3.2.3 Declaration of the United Nations Conference on the Human Environment

3.3 National Environmental regulations
- 3.3.1Constitution of Nepal
- 3.3.2 Environmental policies in Nepal
- 3.3.3 Environment Protection Council
- 3.3.4 Nepal Environmental Policy and Action Plan
- 3.3.5 Environment Protection Act 2076
- 3.3.6 Environment Protection Regulation 2077and its annexes
- 3.3.7 Forest Act 2019 and others

3.4 Sustainable development goals

UNIT 4: CONCEPT OF ENVIRONMENTAL IMPACT ASSESSMENT [6]

4.1Concept of Environmental Assessment
4.2 Introduction, Development and Basic Principles of IEE and EIA
4.3 Strategic Environmental Assessment
4.4 Social Impact Assessment
4.5 Post implementation assessment tool (Environmental Audit)
4.6 Ethical consideration in EIA studies
4.7 Urgency for a Regional Environmental Assessment in the Third Pole

UNIT 5: PROCESS TO PREPARE IEE/EIA IN NEPAL [15]

5.1 Provision of Environmental Assessment in EPA and ERA in Nepal
5.2 IEE/EIA procedures: screening, scoping, identifying existing conditions, assessing impacts, managing impacts, environmental management plan, reporting, reviewing, monitoring, and auditing.
5.3 Environmental impact assessment of development projects: current issues in EIA; Strength and weakness of EIA (case study of the international airport, hydroelectric projects, railway, NTFPs harvesting, irrigation, industries, cable car and transmission line projects, critical habitats).

UNIT 6: ENVIRONMENTAL MANAGEMENT SYSTEMS [5]

6.1 Concept of Environmental Management System
6.2 Early Environmental Management Systems in Nepal
6.3 Governmental and Non-Governmental environmental institutions in Nepal
6.4 Issues and Challenges in Environmental Management in Forestry, Agriculture, Water Resources and Biodiversity
6.5 An Overview of Selected Environmental Management Tools

PRACTICAL [20]

SN	Content/Topics	Methods	Output
1	IEE/EIA/SEA report and discuss issues and weaknesses.	Review	Discussion
2	Review of the application of environmental management tools in the forest sector.	Review	Identify tools
3	Visit to provincial environment related ministry/municipality to learn about environment assessment process in any development project.	Field/observation	EIA process
4	Investigate an environmental management plan of forest-based industries; describe how they function, what are environmental issues and potential solution measures.	Review and analysis	Report
5	Prepare TOR and scoping study for IEE of the forest-based industry or sand mining.	Review and write up	TOR

TEXTBOOKS

1. Mulvihill and Harris, 2017. Environmental management: Critical thinking and emerging practices, New York: Routledge.
2. Uprety B. K, 2003. Environmental Impact Assessment: Process and practice, Mrs.UttaraUprety, Koteshwor, Kathmandu, Nepal.
3. Barrow, C.J, 2012. Environmental Management for Sustainable Development, 2nd Edition,
4. Routledge, London, New York.
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1. Oli, KP., 1996. Legal Instruments for Sustainable Environmental Management in Nepal, Environment and History, vol. 2.no.2 South Asia (1996), pp. 231-248
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5. United Nations Environment Programme (2022).A Scientific Assessment of the Third Pole Environment.Nairobi, Kenya
6. Belbase, N., 1997. The Implementation of International Environmental Law in Nepal, IUCN
7. GoN, 2077. Environment Protection Act 2076, Government of Nepal
8. GoN, 2078. Environment Protection Regulation 2077, Government of Nepal
9. GoN, 2078. Environment Protection Regulation 2077, Annex, Government of Nepal
10. HMG, 1993. Nepal Environmental Policy and Action Plan, HMG of Nepal
11. GoN, 2018. Hydropower Environmental Impact Assessment Manual, Ministry of Forest and Environment, Ministry of Forest and Environment,

12. Khadka, R.B., Bisset, R., Neame, P.A., 1996.EIA Training Manual for Professionals and Managers, Asian Regional Environmental Assessment Program, IUCN Nepal.
13. Routray, J K. and Mohanty, A. 2006. Environmental Management Tools A Training Manual, AIT and UNEP, ISBN: 978-974-8257-43-3
14. Barry Dalal-Clayton and Barry Sadler, 2005.Strategic Environmental Assessment:A Sourcebook and Reference Guide toInternational Experience, Earthscan
15. DFO, Humla, 2018. Environmental Impact Assessment (EIA) of the Sustainable Harvesting Plan in Humla District, District Forest Office, Humla

COURSE TITLE: RESEARCH METHODOLOGY AND SCIENTIFIC WRITING

Course Code	Credit	Lecture Hours	Marks			Total
BSH 412	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course covers the concept and meaning of research method, scientific report writing and presentation.

OBJECTIVES

- Know the meaning and types of research and their characteristics
- Learn various research designs and their steps
- Learn methods of data collection, analysis and interpretation
- Learn to prepare scientific report, proposal and their presentation.

EXPECTED LEARNING OUTCOMES: Upon the completion of this course, students will be able to:

- Design research
- Collect and analyze data,
- Write research report
- Prepare the research proposal
- Present the research results,

UNIT 1: INTRODUCTION [6]

1.1 Meaning, Objectives, Significance, Characteristics and criteria of Research
1.2 Research Approaches (Induction and Deduction)
1.3 Research Types (Qualitative and Quantitative, Social and Biophysical, Academic and Action)
1.4 Research Methodology and Research Methods
1.5 Research Process
1.6 Terminology in Research
    1.6.1Concept-Construct-Fact-Hypothesis-Theory-Law
    1.6.2 Variable and Measurements of variables (scaling)
    1.6.3 Reliability and validity
    1.6.4 Accuracy, precision and biases

UNIT 2: RESEARCH ETHICS [4]

2.1 Intellectual property
2.2 Consent
2.3 Confidentiality
2.4 Research misconduct
    2.4.1 Fabrication
    2.4.2 Falsification
    2.4.3 Plagiarism

UNIT 3: RESEARCH DESIGN [10]

3.1 Meaning, Nature, Functions, Importance, Components and Features of Research Design
3.2 Types of Research Design
    3.2.1 Descriptive and diagnostic
    3.2.2 Exploratory and Formulative
    3.2.3 Experimental and quasi-experimental Design
3.3 Research problem
    3.3.1 Concept
    3.3.2 Source
    3.3.3 Formulation
3.4 Research Objectives
3.5 Research Hypothesis
3.6 Sampling design
    3.6.1 Sampling methods
    3.6.2 Sample size determination

UNIT 4: DATA COLLECTION AND ANALYSIS [6]

4.1 Types of data
    4.1.1 Primary and secondary data
    4.1.2 Quantitative and qualitative data
4.2 Data collection
    4.2.1 Social methods
        4.2.1.1 Quantitative methods
            i. Questionnaire survey
            ii. Self-administered (online) and interviews
        4.2.1.2 Qualitative data
            i. Focus group discussion
            ii. Key informant interview
            iii. PRA/RRA
    4.2.2 Biophysical methods
        4.2.2.1 Forest inventory
        4.2.2.2 Soil survey
        4.2.2.3 Wildlife survey
    4.2.3 Sources of secondary data
4.3 Data analysis and interpretation
    4.3.1 Statistical test
    4.3.2 Choosing appropriate test
    4.3.3 Interpretation of findings

UNIT 5: SCIENTIFIC WRITING [10]

5.1 Types
    5.1.1 Research Proposal
    5.1.2 Research Reports
    5.1.3 Thesis
    5.1.4 Articles
5.2 Contents of Research Proposal
    5.2.1 Title
    5.2.2 Introduction
    5.2.3 Objectives
    5.2.4 Methods
        5.2.4.1 Study site

5.2.4.2 Data collection
5.2.4.3 Data analysis
5.2.5 Expected outcomes
5.2.6 Time line and budget
5.2.7 References

5.3 Contents of Research Reports/Thesis/Articles
5.3.1 Title
5.3.2 Abstract
5.3.3 Introduction
5.3.4 Literature Review
5.3.5 Materials and methods
5.3.6 Results
5.3.7 Discussion
5.3.8 Conclusions

UNIT 6: PRESENTATION [4]

6.1 Delivery techniques
6.1.1 Methods of delivery
6.1.2 Techniques for effective delivery
6.2 Effective presentation skills
6.2.1 Plan
6.2.2 Preparation
6.2.3 Practice
6.2.4 Presentation

PRACTICAL [20]

SN	Content/Title	Tools/Instruments	Methods	Link to the Unit(s)
1	Selection of research title		Individual	5
2	Problem statement / Gap analysis		Based on research Title	5
3	Methods		Based on 1 and 2	1,3,4
4	Draft proposal		Based on 1 - 3	5
5	Reference Management		Software based	5
6	Questionnaire/Survey Sheet preparation		Based on 1-3	4,5
7	Presentation		Draft proposal	6

REFERENCES

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15. Singh, Y.K. (2006). Fundamental of Research Methodology and Statistics. New International (P) Limited, Publishers, New Delhi.
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COURSE TITLE: FOREST BASED ENTERPRISES

Course Code	Credit	Lecture Hours	Marks			Total
FPE 413	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The scope of this course is to equip students with knowledge and skills of enterprise development and develop marketing strategy and management. This course also aims to impart learning on business plan development and planning business enterprises of micro, mini, small and large size.

OBJECTIVES: The objectives of the course are to:

- Understand the strategies adopted for managing products through the life cycle and the basics of new product development and adoption.
- Lead a team of multidisciplinary and multi-sector professionals and ensure their inclusive engagements in designing business development projects centered on natural resources systems.
- Make key contributions in planning, development and management of natural resources in the role of planner, manager and development worker in the natural resources sector.
- Adapt and apply the professional business-oriented knowledge and skills in the field of biodiversity and ecosystem service marketing strategy and business planning and development.
- Start their own business enterprises including social enterprise and create employment.

EXPECTED LEARNING OUTCOMES:

On the completion of the course, students will be able to:

- Learn about the basic knowledge of enterprise development.
- Develop the business plan, its planning process and design.
- Understand about the value chain and addition of forest products and its market management.
- Develop the positive attitudes towards the business professions and traders with greater attention for inclusivity and collective action.
- Apply critical thinking for problem-solving and decision making and in service design and process development for delivery.

UNIT 1: INTRODUCTION [6]

1.1 Concept of enterprise, intrapreneurship and entrepreneurship
1.2 Forest based enterprises (scope and importance)
1.3 Role of forest-based enterprise in sustainable forest management
1.4 Startup

UNIT 2: FOREST BASED ENTERPRISES IN NEPAL [10]

2.1 Saw mill
2.2 Furniture
2.3 Veneer

2.4 Composite board
2.5 Parqueting
2.6 Pulp and paper
2.7 Cutch & Katha
2.8 Lac & shellac
2.9 Resin (Turpentine & Rosin)
2.10 Charcoal burning, Pellet, Bio-char
2.11Essential oils
2.12 Bamboos and cane
2.13 Other (leaf plate, Lapsi candy, Bel juice)

UNIT 3: ENTERPRISE DEVELOPMENT [6]

3.1 Feasibility study
- 3.1.1 Business description (Raw material, Human resources, Technology, Finance and Market analysis)
- 3.1.2 Existing situation analysis
- 3.1.3 Screening
- 3.1.4 Market survey
- 3.1.5 Enabling environment for enterprise development
- 3.1.6 Risk assessment

3.2 Business plan development

UNIT 4: VALUE CHAIN [6]

4.1 Concept of value-added products and value chain
4.2 Actors, enablers and stakeholders of value chain
4.3 Value chain functions
4.4 Value chain mapping
4.5 SWOT analysis of value chain

UNIT 5: MARKETING [6]

5.1 Fundamentals of marketing
5.2 Marketing strategy
- 5.2.1 Product
- 5.2.2 Price
- 5.2.3 Place
- 5.2.4 Promotion

5.3 Branding
5.4 Consumer feedback and response

UNIT 6: LEGAL PROVISIONS [6]

6.1 Legal classification of enterprise (micro, Small and Medium Enterprise (SME), company)
6.2 Enterprise establishment process
6.3 Product registration process
6.4 Record keeping and financial reporting
6.5 Regulatory framework governing forest-based enterprises

PRACTICAL [20]

Content	Methodology/methods	Link to the course unit(s)
Case study of a successful or failure forest-based enterprises	Review, Social media survey, 300-word report	2
Feasibility study of business	Field visit (300 words)	3
Identify potential forest-based enterprise in your district	Field visit, review, 300 word report	1, 2 and 3
Identify value addition possibility of different forest products	Review	4
Business plan preparation	Field visit, plan preparation	3
Documenting process of establishing forest-based enterprise	Review, document preparation	6

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2. Kotler, P. (2010). Principles of marketing: A South Asian perspective, 13/E (pp. 253256). India: Pearson. European Social Marketing Association. (2013). Retrieved from http://europeansocialmarketing.weebly.com/
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4. Andaleeb, S.S. and Hasan, K. (Ed.).2016. Strategic Marketing Management in Asia, Emerald Group Publishing Limited, Bingley, pp. 527-552. https://doi.org/10.1108/978-1-78635-746- 520161020
5. Azhar Kazmi (2008). Strategic management & Business Policy: Third Edition. New Delhi : Tata McGraw - Hill.
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COURSE TITLE: INDO – NEPAL TOUR (PROTECTED AREAS)

Course Code	Credit	Total
PWM 414	3	75

SCOPE: This course is designed for the practical understanding of varied aspects of forestry, including protected areas and wildlife management in Nepal and India. This visit will promote visualization of the working mechanism for forest-based industries in both countries. Moreover, the on-site reviews on theoretical aspects followed by the practical engagement on the site will help carry out community analysis, population structures, animal behavioral surveys, and the approaches of protected area management.

OBJECTIVES: The objectives of the tour are to:

- Prepare students ready for the survey design, field executions and data analysis from field data.
- Study on tools and techniques used in forestry-based enterprise/industries comparatively.
- Understand the basic approach adopted for site specific PA management

EXPECTED LEARNING OUTCOMES: Upon the completion of the tour, the students will be able to:

- Calculate species abundance/diversity within a given habitat (or in small patches of different habitats)
- Capable of sampling design, field works, and data analysis
- Understand the reasons for particular management approaches on given protected area/s.
- Witness the recent development in wood-based industries in Nepal and India
- Comprehend the production, processing and marketing process of forest-based industries

CONTENTS:

Days	Course contents	Methods	Equipment/ tools	Remarks
Day 1: Departure from Campus			Binoculars, Camera traps, Compass, Dart gun, Darts, Data sheet, General stationery, GPS,	En-route: Observation of underpasses (Aaptari, Narayanghat-Butwal section), canopy bridges (in BaNP or in BNP-towards Surkhet from East Chisapani), fish ladder in
Banke/Bardia National Park and Banke Industrial Estate				
Five days	General briefing on conservation history, biodiversity, habitat management practices and PA management approaches in Bardia/Banke national park	Orientation		

Days	Course contents	Methods	Equipment/ tools	Remarks
	Animal handling and monitoring techniques; prospects and problems in Nepal: -Population survey techniques (camera trap, pellet group or line transect survey) -Radio telemetry, CBAPU/SMART, ID based Rhino monitoring)	Orientation Dummy works and field	Live trap equipment (Sherman's trap, box trap etc.), Measuring tape, Range finder, Office documents (extension materials), Paints Ribbon, Rope	Parewawodar and crocodile basking on the river side-raised bridges of Bardia, dams along highways in Banke (Sikta irrigation-mitigations) implemented)
	Study success stories of Tharu home stay in Banke/Bardia home stays	Orientation/ Discussions		
	Conservation success and issues in Krishnasar conservation area (en-route Khata corridor) from Banke	Lectures/ observation / Discussions		
	Behavioral observation of social animals (Focal animal sampling, scan sampling for activity budget, social interactions, and parent offspring relations of rhesus monkey or spotted deer or blackbuck or elephant in breeding center)	Field works		
	Ex-situ conservation of threatened wildlife: a case study of Gharial and turtle breeding center, elephant breeding center, vulture center, animal hospital and rescue center/facilities	Lectures/ observation		
Day 7: Travel				En-route: observing underpass of elephant movement from Ambassa to Chisapani- Observation of Ghodaghodi Ramsar Site, Laljhadi-Mohana Conservation corridors
Suklaphanta National Park				
Three days	Major conservation issues in Suklaphanta national park (including human-wildlife conflict/trans-boundary conservation issues)	Orientation		
	Key conservation interventions in Suklaphanta national park. Grassland management plot visit/jungle drive along wetland, research site, cultural sites, Blackbuck center in Hirapur	Field works and observation with demonstration		

Days	Course contents	Methods	Equipment/ tools	Remarks
	Observation of HWC mitigation measures (solar fence, machan, GT technology)	Orientation and observation		
	Bird census and monitoring such as point count survey and bird watching	Orientation and observation		
Day 11: Travel				
Forestry Training Academy, Haldwani				
Two days	Modernizing nursery techniques: technological advancement in plant breeding	Orientation and observation		Stay at Haridwar and or Haldwani-FTA
	High altitude zoo management techniques in India (Nainital)	Orientation and observation		
	Production, processing, and marketing of paper and pulp; value chain analysis	Orientation and observation		
Day 14: Travel				
Forest Research Institute (FRI), Dehradun				
Four days	Flood impacts and rehabilitation in Ganges river (Haridwar-Rishikesh river section)	Observation		Stay at FRI or outside of FRI, Dehradun
	Commercialization of medicinal and aromatic plants (MAPs); Identification, use, and conservation status of selected medicinal plants	Orientation and observation		
	Visit Rajaji National Park	Briefing and interaction with Gujjar community		
	Visit Corbett National Park (optional)	Interaction/ observation		
	Visit FRI museum and campus premises	Lectures/observation		
	Visit IIRS: Remote sensing and GIS application in the forestry sector	Orientation and observation		
	Edges and ecotones along altitudinal gradients: Dehradun-Mussoorie hills	Observation		

Days	Course contents	Methods	Equipment/ tools	Remarks
	Technological advancement in wildlife research and animal monitoring in India (Wildlife Institute of India)	Lectures		
Day 19: Travel				Stay at Suklaphanta
Day 20 Travel				Stay at Butwal
Day 21: Visit Butwal zoo, Exam and Travel (Reporting to concerned campus/college)				

Note: Respective campuses or tour in-charge can amend the tour itinerary according to the field situation.

YEAR 4 SEMESTER II

COURSE TITLE: PROPOSAL (RESEARCH/INTERN) DEFENSE

Course Code	Credit	Total
SFM 420	1	25

COURSE TITLE: FIELD RESEARCH/ INTERN

Course Code	Credit	Total
SFM 421	9	225

COURSE TITLE: PROJECT PAPER/INTERN REPORT PRESENTATION

Course Code	Credit	Total
SFM 422	1	25

ELECTIVES

COURSE TITLE: APPLIED CHEMISTRY

Course Code	Credit	Lecture Hours	Marks			Total
BSH 414	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course is designed to provide the knowledge to students about natural products chemistry, its use &benefits based on their chemical constituents in timber &non timber forest products. It also provides idea about chemistry of environmental pollution as well as green chemistry and Nano science and Technology.

OBJECTIVES: The objectives of this course are to:

- Understand the role of natural products in different diseases
- Exposure to chemistry of natural products like alkaloids, terpenoids, flavonoids and other extractive materials.
- Study and application of instrumental, phytochemical analysis and their uses in daily life.
- Understand green chemistry and their role in environment
- Understand the pollutions and their management
- Understand the uses of Nano particles in air, soil, water etc.

EXPECTED LEARNING OUTCOMES: After completion of the course student will have;

- Plants of higher medicinal value would be conserved and people will be encouraged for their plantation. The respective knowledge would be shared with government of Nepal.
- Natural product chemistry of timber and non-timber forest species may furnish isolated and novel compounds for biological importance.
- Students will know the importance of phyto-chemistry
- The alumni of IOF as District Forest Officers, Rangers, Foresters etc. Working in all districts of Nepal will be conscious about the plants in their regions
- A training programme may impart the knowledge
- Biological activities may result into a new lead molecule for the future drug research
- Environmental chemistry will give ideas about environmental conditions in different altitudes
- The provided outcomes will help the students for master programmes

UNIT 1: NATURAL PRODUCT CHEMISTRY [15]

1.1 Role of chemistry in metabolic activities in plants.

1.2 Phytochemical and biological investigation of Medicinal plants of Nepal.

1.2.1 Collection and Identification.

1.2.2 Cold and hot extraction.

1.2.3 Phytochemical screening.

1.2.4 Isolation of extracted material i.e. TLC, column, HPLC etc.

1.2.5 Characterization of Isolated compounds i.e. M.pt, MS, UV, IR, ^{1} HNMR, ^{13}CNMR etc.

1.2.6 Biological activities of their extract and isolated compounds.

UNIT 2: SOURCES OF MEDICINAL PLANTS AND PHARMACOLOGICAL ACTIVITIES IN FOLLOWING BIOACTIVE COMPOUNDS [5]

a) Geraniol b) Taxol c) Ursolic acid d) Licorice e) Anthocyanin f) Stevioside g) Saponin h) Nicotine i) Morphine j) Azadirachtin

UNIT 3: ENVIRONMENTAL CHEMISTRY [8]

3.1 Concept and scope of Environmental chemistry

3.2 Environmental Segments

3.3 Chemistry of O_3 depletion

3.4 Air pollution

3.4.1 Introduction

3.4.2 Classification of air pollutants

3.4.3 Health Hazards due to different emitted gases i.e. H_2S, NH_3, Cl_2, CO, CO_2

3.5 Water pollution

3.5.1 Introduction

3.5.2 Classification of water pollutants

3.5.3 Industrial waste water treatment by activated charcoal and membrane technology

UNIT 4: PHYTOREMEDIATION [5]

4.1 Introduction

4.2 Phytoremediation Technology

4.3 Effectiveness of heavy metals Uptake by plants

4.4 Uses of plant species in controlling Environmental Pollution

UNIT 5: GREEN (SUSTAINABLE) CHEMISTRY [4]

5.1 Definition, basic principles and need of green chemistry (GC)

5.2 Environmental friendly uses of plant species as pesticides, insecticides etc.

5.3 Emerging techniques in development in GC, photo chemistry microwave chemistry, sono chemistry

5.4 Green solvents

5.5 Extraction and isolation of Medicinal plants through Green Chemistry

UNIT 6: NANOSCIENCE AND NANOTECHNOLOGY [3]

6.1 Application of Nanoparticles i.e. ZnO, Fe_2O_3, Ni.
6.2 Merit and demerit of Carbon Nanotube.

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Link to the course unit
Extraction and isolation of different parts of plant species	Soxhlet extractor, TLC, coloumn and HPLC, chemicals etc.	Lab work	Unit 1
Screening of extracted material, terpenoids, flavonoids, steroids etc.	Spray bottle, applicator, TLC plate, TLC chamber, developing chamber, silica gel etc.	Lab work	Unit 1
Screening of biological activities	Cotton swabs, culture media, micropipette tips, autoclave, etc.	Lab work	Unit 1
Environmental Impact Assessment (EIA) of ground water Toxic elements	PH meter, chemicals	Lab work	Unit 3
Air pollutants		Excursion/observation, 300 word report	Unit 3

TEXTBOOKS AND REFERENCES

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21. A Textbook of Organic Chemistry, K.S. Tiwari and others.
22. Advanced organic chemistry, B.S. Bahl and Arun Bahl.

COURSE TITLE: WILDLIFE TECHNIQUES AND TECHNOLOGY

Course Code	Credit	Lecture Hours	Marks			Total
PWM 415	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course introduces the principles, techniques, tools and technologies to monitor wildlife species distribution, occupancy, population density, abundance, behavior, ecology and evaluating their habitat requirements towards their effective conservation and management. In addition, this course especially supports students who want to pursue Master degree in Wildlife and to get diverse opportunities in DNPWC.

OBJECTIVES: The objectives of this course are to:

- Understand different techniques, tools and technologies for wildlife population estimation and analysis.
- Demonstrate skills in handling of modern techniques, tools and technologies applied in wildlife management.
- Understand the different techniques of wildlife handling, including capturing, handling, trapping wild animals, marking and tagging, and radio (GPS) telemetry.
- Gain knowledge and skills in different wildlife and habitat monitoring techniques.

EXPECTED LEARNING OUTCOMES: On the completion of this course, the students will be able to:

- Acquire diverse knowledge and skills in wildlife and become a competent scholar.

UNIT 1: INTRODUCTION [3]

1.1 Overview of technological advancements and its application in wildlife research and management
1.2 Advancement of science and technology in 21st century
1.3 Cross sectorial collaboration for technology development and utilization
1.4 Technology transfer to the third world
1.5 Technology and ethics

UNIT 2: METHODS IN WILDLIFE POPULATION MONITORING [12]

2.1 Basics of wildlife population estimation
2.2 Protocols to monitor wildlife population in and outside of protected areas in Nepal
2.3 Wildlife monitoring techniques: i) population & habitat estimation methods
    2.3.1 Species diversity estimation,
    2.3.2 Species distributions and niche modeling
    2.3.3 Count based methods
        2.3.3.1 Count methods with perfect detection (Census & Sampling; e.g. Rhino count and gharial survey as a case study)
        2.3.3.2 Methods for imperfect detection (e.g. distance sampling for prey survey)
    2.3.4 Mark-recapture methods (Closed population)

2.3.4.1 Trapping methods (small mammals survey, herpetofauna)

2.3.4.2 Non-invasive camera trapping (e.g. Tiger population survey and monitoring as a case study)

2.3.5 Open population models

2.3.6 Occupancy modeling (e.g. prey species presence absence with threat as a case study)

2.4 Machine learning and artificial intelligence

2.4.1 Basic concept of machine learning and neural networks

2.4.2 Use of artificial intelligence for big data analysis and decision manking

2.4.3 AI for biodiversity conservation and wildlife management

UNIT 3: REMOTE SENSORS FOR WILDLIFE RESEARCH [8]

3.1 Camera Trapping

3.1.1 History, advantages, features

3.1.2 Field method/deployment of camera traps and Camera trap data management

3.3.3 Application of camera trapping in wildlife research

3.3.3.1 Presence/absence and species inventory

3.3.3.2 Species and community-level occupancy analysis

3.3.3.3 Abundance and density estimation

3.3.3.4 Behavioral studies (Temporal activity pattern, species interactions)

3.2 Acoustic sensors

3.2.1 Introduction

3.2.2 Application of Acoustic sensors to monitor vocalizing wildlife (terrestrial fauna – birds, bats, insects, etc. and aquatic fauna dolphins, crocodiles, etc.):

3.3 Drone and Radar technology and its application

3.3.1. Visual (RGB) and thermal imaging drones for wildlife surveys (e.g., Rhinos, crocodiles, birds)

UNIT 4: CAPTURE AND HANDLING TECHNIQUES OF WILDLIFE [6]

4.1 Capturing and Handling of Wild Animals (mammals-carnivore, mega-herbivore, deer, reptiles-gharial, python, poisonous snake and birds-prey and large, with beak, feathers)

4.2 Chemical Immobilization (e.g., Tiger, elephant and rhino as a case study)

4.3 Identifying and Handling Contaminant-Related Wildlife Mortality or Morbidity (eg. Rhino and tiger as a case study)

UNIT 5: IDENTIFICATION AND MARKING TECHNIQUES [8]

5.1 Techniques for marking wildlife

5.2 Criteria for determining sex and age

5.3 Tagging and tracking

5.3.1 Types and features of geo-tags for wild animals eg. Satellite tags for birds, gharial etc.

5.3.2 Wildlife Radio telemetry and Remote Monitoring (GPS tags, Satellite tracking, etc for mammals, reptiles and birds)

5.3.3 Application of radio collars and remote monitoring (behavior and home range analysis, demography and interactions)

UNIT 6: CONSERVATION GENETICS AND MOLECULAR ECOLOGY [3]

6.1 Introduction

6.2 Molecular markers, PCR, DNA, eDNA, phylogenomics, etc.

6.3 Hormone level study

PRACTICAL [20]

a) Field Visit and Exercises (14)

Content	Equipment/tools	Methodology/methods	Link to the course unit
Equipment handling and use	Radio Telemetry, GPS/satellite collaring, camera trap, drone, capture equipment	Visit to nearby protected areas and related organization to study	Unit 1,2,3
Field practice and calculation of distance sampling, Mark-recapture, Occupancy analysis	Radio Telemetry, GPS/satellite collaring, camera trap, drone, capture equipment	Visit to nearby protected areas and related organization to study	Unit 3,4,5
Study on-ongoing activities of molecular lab and wildlife hospital	Report writing	Visit to lab and wildlife hospital	Unit 6

a) Lab work (6)

Content	Equipment/tools	Methodology/methods	Link to the course unit
Identification and Equipment handling for wildlife population survey and habitat management	GPS, Silva compass, Binocular, range finder, camera trap, telemetry equipment, conservation drone, AudioMoths, etc	Visit to nearby protected areas and related organization to study	Unit 2, 3and 5
Camera trap image processing for wildlife species inventory	Radio Telemetry, GPS/satellite collaring, camera trap, drone, capture equipment	Visit to nearby protected areas and related organization to study	Unit 2

Note: Students will prepare, submit and present report for each exercises given for the evaluation.

TEXTBOOKS

1. Wich, Serge A., and Alex K. Piel (eds). 2021. Conservation Technology (Oxford, 2021; online edns, Oxford Academic.
2. Jasanoff, S. 2016. The Ethics of Invention: Technology and the Human Future. W. W. Norton & Company.

COURSE TITLE: APPLIED REMOTE SENSING AND GIS

Course Code	Credit	Lecture Hours	Marks			Total
WME 414	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course enhances student's abilities to gather and spatial data required for solving real world geospatial problems in the field of natural resource management. It equips students with essential theoretical and practical skills and methods of gathering, managing, integrating and processing of multisource geospatial data for the production, visualization and sharing of information. The course enhances the analytical capacity for drawing and communicating information in faster and efficient ways for making informed decisions of natural and related resource management.

OBJECTIVES: The objectives of this course are to:

- To introduce emerging scope and application of Remote Sensing and GIS techniques in the field of natural resource management.
- To impart knowledge and skills of different function and capability of Remote Sensing and GIS to develop problem-solving techniques in the field of natural resource management.
- To provide essential skills and hands-on experience to gather, manage and analyze multi-source spatial data for production, visualization and sharing of information.

EXPECTED OUTCOMES: After the completion of the course, students will be able to

- Handle open-source GIS software (QGIS, Google Earth Engine).
- Download and process remote sensing data from different geoportals.
- Assess and map different natural resources (forest, water, land)

UNIT 1: OVERVIEW OF RS/GIS [4]

1.1 Fundamentals of remote sensing
1.2 Review GIS and geospatial data
1.3 Recent advancements/trends in RS/GIS
1.3.1 (Participatory GIS in NRM, Open-Source tools in GIS, Machine Learning Techniques in GIS/RS)

UNIT 2: ADVANCED CONCEPT ON GEO DATABASE MANAGEMENT AND VISUALIZATION [7]

2.1 Spatial and non-spatial database system (SQL/No-SQL database in GIS)
2.2 Modern technology for data acquisition (UV/drone)
2.3 Data editing and thematic layer creation
2.4 Data quality and errors in GIS (including topology building)
2.5 Overview of Projection system and advanced techniques on map making, 3D visualization, web visualization and storytelling using GIS

UNIT 3: GEOSPATIAL DATA ANALYSIS [7]

3.1 Vector and raster based analysis: overlay and buffering operations
3.2 Overview on base query (spatial and non-spatial)
3.3 Basics on geo-statistics (exploratory geospatial data analysis)
3.4 Network analysis
3.5 Surface analysis using interpolation techniques (Kriging and IDW)

UNIT 4: DIGITAL IMAGE PROCCESSING, CLASSIFICATION AND LANDCOVER CHANGE ANALYSIS [10]

4.1 Digital image processing
- 4.1.1 Radiometric and geometric correction,
- 4.1.2 Image enhancement
- 4.1.3 Image transformation

4.2 Image classification techniques
- 4.2.1 Overview of supervised and unsupervised classification
- 4.2.2 Object based image analysis
- 4.2.3 Basics on Machine Learning Techniques
- 4.2.4 LULC/thematic map preparation
- 4.2.5 Forest mapping: type and density mapping
- 4.2.6 Feature extraction indices (NDVI, NDWI, NDSI, NBR etc.)
- 4.2.7 Temporal change analysis of land cover
- 4.2.8 Accuracy assessment

UNIT 5: DIGITAL ELEVATION MODEL (DEM) FOR LANDSCAPE ANALYSIS [5]

5.1 Digital elevation models and its application
5.2 Different Sources of DEM data (SRTM data, ASTER DEM),
5.3 Terrain analysis using DEM (elevation, slope, aspect, hill shade and view-shed)
5.4 LIDAR, RADAR

UNIT 6: APPLICATION OF RS/GIS IN VARIOUS SECTORS [7]

6.1 Forest resource inventory planning
6.2 Deforestation and forest degradation
6.3 Biodiversity characterization
6.4 Wildlife habitat mapping
6.5 Water resource assessment, planning and management
6.6 Disaster assessment and monitoring (Forest fire, landslide/erosion/Flood, Drought)

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Link to the course unit
Familiarization with open source and commercial software	QGIS, ArcGIS, ERDAS IMAGINE	Computer lab	Unit 1
Accessing Rs/GIS data	ArcGIS, Data source (Websites)	Familiarization with Data source, Download, Extraction, Stacking and visualization	Unit 1 and 2
Exploring web based geo-portals	NASA FIRMS, Google Earth Engine, Sentinel hub		

Image classification	ArcGIS, Python, SQL	supervised, unsupervised & Machine Learning techniques	Unit 4
Case- based project work	ArcGIS, GEE, QGIS, ERDAS IMAGINE	-Forestry (e.g. LULC change and analysis, Various indices, forest management planning ,Biomass estimation and carbon mapping, Forest fire risk assessment) -Wildlife (e.g. Habitat suitability and mapping). -Watershed (e.g. Morphometric, Erosion modeling, flood, Soil digital mapping, Drought, Landslide,)	Unit 4, 5 and 6

Note: Students will prepare, submit and present report for each exercises given for the evaluation.

TEXTBOOKS

1. Bhatta, Basudev. 2011. Remote Sensing and GIS, Second edition. Oxford University Press,
   UK.
2. Burroughs, P.A. and McDonnell, R.A. 2015. Principles of Geographical Information System. Oxford University Press, UK.
3. Chang, Kang-tsung. 2015. Introduction to Geographic Information Systems. Tata McGraw-
   Hill Publishing Company Limited, New Delhi, India.
4. Lilles and, T., R.W. Keifer and Jonathan Chipman. 2007. Remote Sensing and Image Interpretation. John Wiley and Sons.

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1. Chrisman, Nicholas. 2001. Exploring Geographical Information System. John Wiley andSons Inc., New York.
2. Heywood, Ian, Sarah Cornelius and Steve Carver. 2012. An Introduction to Geographical Information System. Pearson Education Ltd., England.
3. Jensen, John R. and Ryan R. Jensen. 2012. Introductory Geographical Information Systems.Pearson Education, MA, USA.
4. Shrestha, Basanta, BirendraBajracharya and SushilPradhan. 2001. GIS for Beginners,
5. Introductory GIS Concepts and Hands–on Exercises. MENRIS, ICIMOD, Kathmandu, Nepal.
6. Slocum, Terry A., Robert B, Mc Master, Fritz C. Kessler and Hugh H. Howard. 2008. Thematic Cartography and Geo-visualization. Pearson Education Ltd.
7. Stars, J. and J. Estates. 1990. Geographic Information Systems:
8. Flores, A., Herndon, K., Thapa, R. B., Cherrington, E. (Eds.) (2019), TheSAR Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation. NASA Publication, (DOI: 10.25966/nr2c-s697, 307 pages), fee access.
9. T. Sutton, O. Dassau, M. Sutton, (2009) A Gentle Introduction to GIS, Spatial Information Management Unit, Office of the Premier, Eastern Cape, South Africa, free access, latest version Nov 2022.
10. Paul Bolstad (2016), GIS Fundamentals: A first text on geographic information systems, 5th Edition

COURSE TITLE: ORNITHOLOGY AND MAMMALOGY

Course Code	Credit	Lecture Hours	Marks			Total
PWM 416	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to provide the knowledge about sensory organs, behavior, and general characteristics of aves and mammals. In addition, the students will be able to develop skills for the conservation and management of birds and mammals.

OBJECTIVES: The objectives of this course are to:

- Develop basic knowledge of biology of birds and mammals common to Nepal.
- Familiarize the students with the behavior, ecology, conservation and management of common birds and mammals of Nepal.
- Develop skill to apply the techniques of research on birds and mammals.

EXPECTED LEARNING OUTCOMES:

- Acquire knowledge and skills for the conservation and management of birds and mammals.

GROUP A – ORNITHOLOGY

UNIT 1: INTRODUCTION TO ORNITHOLOGY AND CLASSIFICATION OF COMMON BIRDS OF NEPAL [7]

1.1 Origin and evolution of birds
1.2 Taxonomic classification of birds (sub class, super order, order and families)
1.3 Main habitat and bird species in Nepal (forest, scrub, wetland, grassland, human habitation and agricultural lands)
1.4 Status of Nepal's birds (NPWC act, IUCN, CITES, Nepal red list)
1.5 Terrestrial birds (forest birds, grassland birds)
1.6 Swimming and diving birds (ducks and geese, grebes)
1.7 Birds of prey (owls, osprey, eagles, vultures, falcons)
1.8 Shore and waders (cranes, storks, ibises and spoonbills; herons and bitterns
1.9 Arboreal birds (parrots, pigeons and doves; woodpecker, bee eaters
1.10 Aerial birds (swifts and swallows)

UNIT 2: SENSORY ORGANS [3]

2.1 Sense of smell
2.2 Hearing
2.3 Vocalization
2.4 Homing and navigation
2.5 Orientation

UNIT 3: BEHAVIOUR [10]

3.1 Territory
- 3.1.1 Classification (breeding territory, non-breeding territory)
- 3.1.2 Size and function of territory

3.2 Nesting
- 3.2.1 Classification of nests (ground nest, cavity nest, plateform nest, cupped nest)
- 3.2.2 Nest Building (site selection, participation of sexes, false nest)
- 3.2.3 Reuse and protection of nest

3.3 Mating
- 3.3.1 Kinds of mating (monogamy, polygamy, promiscuity)
- 3.3.2 Mating displays (pre-fertilization display, fertilization display, post fertilization display)

3.4 Egg laying and Incubation
- 3.4.1 Size, shape and coloration of eggs
- 3.4.2 Numbers of eggs in a clutch
- 3.4.3 Incubation (participation of sexes and behavior, length and time involved with examples of some species)
- 3.4.4 Brood parasitism

3.5 Parental care
- 3.5.1 Brooding
- 3.5.2 Feeding
- 3.5.3 Nest sanitation
- 3.5.4 Defense

3.6 Competition

3.7 Migration

3.8 Flock
- 3.8.1 Seasonal variation of food
- 3.8.2 Predation

GROUP B - MAMMALOGY

UNIT 4: MAMMALOGICAL TERMS, CHARACTERS AND CLASSIFICATION OF IMPORTANT MAMMALS OF NEPAL [6]

4.1 Dentition, arboreal, diaphragm, diastema, echolocation, implantation, lactation, juvenile,sweet gland, mammary gland, body temperature, courtship behavior, parental care.

4.2 General characteristics and classification

UNIT 5: PHYSIOLOGY and behavior [10]

5.1 Physiology: Digestive, circulation, respiration, nervous, excretion and reproduction.

5.2 Territory
- 5.2.1 Classification (breeding territory, non-breeding territory)
- 5.2.2 Size and function of territory

5.3 Mating
- 5.3.1 Kinds of mating (monogamy, polygamy, promiscuity)
- 5.3.2 Mating displays (courtship)

5.4 Parental care
- 5.4.1 Feeding
- 5.4.2 Habitat selection
- 5.4.3 Defense

5.5 Competition
5.6 Migration

UNIT 6: INTRODUCTION TO ENDOCRINOLOGY [4]

6.1 Thyroid, pituitary, gonads, pancreas and adrenal glands

PRACTICAL [20]

Contents	Equipment/tools	Methodology/methods	Link to the course unit(s)
General anatomy of pigeon	General Dissecting Box	Dissection	Unit 2 and 5
Pectin of Pigeon	Slide + Dissecting box	Laboratory	Unit 5
Field Identification of birds	Bird photography Camera	Field Observation	Unit 1
General anatomy of rat and skin slide preparation	Dissecting box	Laboratory	Unit 5 and 4
Identification of small mammals in campus area	Bird Photography camera	Field Observation	Unit 3
Bird Identification	Bird photography camera	Field Observation	Unit 1 and 3

TEXTBOOKS

1. Feldhamer, G.A., Drickamer, L.C., Vessey, S.H., Merritt, J. F. and Krajewski, C. 2007. Mammalogy: Adaptation, Diversity and Ecology, Third ed. Johns Hopkins University Press.
2. Fleming, R.L. Snr., Fleming, R.L. Jnr. and Bangdel, L.S. 1984. Birds of Nepal withReference to Kashmir and Sikkim. Nature Himalayas, Kathmandu.
3. Baral, H. S. and Shah, K. B. 2008. Wild Mammals of Nepal. Himalayan Nature. ISBN: 9789937202046
4. Verma, A. K. 2012. Handbook of Zoology (4th ed). Shri Balaji Publications. ISBN: 9789384934088

REFERENCES

1. Grimmett, R., Inskipp, C., Inskipp, T. and Baral, H.S., 2016. *Birds of Nepal*. Bloomsbury Publishing.
2. Gopal, Rajesh. 2011. Fundamentals of Wildlife Management. Natraj Publisher, Dehradun, India.
3. Kotpal, R.L. 2013. The Birds. Rastogi Publications, Meerut, UP

COURSE TITLE: WOOD PHYSICS

Course Code	Credit	Lecture Hours	Marks			Total
BSH 415	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is to expose students to gain the knowledge of Physics applied in forestry

SPECIFIC OBJECTIVES: Upon completion of this course, the students will be able to

- Acquire in depth knowledge and skill of physical concepts applied in forestry.
- Explain phenomena in terms of theories and models;
- To solve mathematical problems in related topic

UNIT: 1. INTRODUCTION [5]
1.1 Introduction to Physics
1.2 Geo Physics and Wood Physics
1.3 Application
1.4 Advantage and problems in geo physics/ wood physics
1.5 Problems in geo physics/ wood physics

UNIT 2: WOOD SYSTEM [5]
2.1 Physical properties of wood
2.2 Density and specific gravity
2.3 Sp. Gravity of woody substance and their experimental determination

UNIT 3: CONDUCTIVITY SYSTEM [10]
3.1 Concept of Thermal Conduction and Thermal resistance
3.2 Series and parallel connection of rods
3.3 Measurements of thermal conductivity of a solid
3.4 Thermal properties of wood
3.5 Thermal expansion
3.6 Specific heat
3.7 Thermal conductivity and diffusivity
3.8 Thermal properties of wood composites

UNIT 5: TIMBER SYSTEM [10]
5.1 Elasticity of timber system
5.2 Stress-strain relationships
5.3 Different type of stresses and strain
5.4 Simple shear
5.5 Principle stress and Mohr circle diagram
5.6 Hook's law and modulus of elasticity
5.7 Directional elastic constants

UNIT 6: ENERGY PHYSICS [10]
6.1 Concept of work power and energy
6.2 Principle of energy
6.3 Forms of Energy:
    6.3.1 Mechanical energy

6.3.2 Heat energy
6.3.3 Light energy
6.3.4 Nuclear energy (fission and fusion)
6.3.5 Wood energy

6.4 Alternative sources of wood energy in context of Nepal (Bio-gas, Solar Battery, and Hydro-electricity)

UNIT 7: PHYSICS OF RADIATION [10]

7.1 Concept of Electromagnetic radiation and their spectrum
7.2 Stefan-Boltzmann law
7.3 Spectrum of black body radiation
7.4 Wien's displacement law
7.5 Plank's radiation law
7.6 Fundamental of Radiometry
7.7 Spectral reflectance
7.8 Introduction to remote sensing and Geographical Information System
7.9 Components of GIS
7.10 Spatial and Non spatial data- data model

PRACTICAL [20]

Contents	**Equipment/ tools and Methodology**
Determination of specific gravity	Lab
Determination of gravity	Lab
Measurement of thermal conductivity	Lab
Determination of the moment of inertia of a fly wheel	Lab

LABORATORY MANUAL

1. Arora, C.L. : B.Sc. Practical, S. Chand and Company, 2010

TEXT AND REFERENCE BOOKS

1. Advanced level physics, M. Nelkon & P. Parkar.
2. Mathur, D.S. : Mechanics, S. Chand and Co. Ltd. New Delhi 2012.
3. Singhal, S.S. Agrawal, J.P. and Prakash S., : Heat and Thermodynamics, Pragati Prakashan, Meerut
4. Murugesan, R. : Modern Physics, S. Chand and Co. Ltd. New Delhi
5. Text book of Space Science, P. B. Adhikari and S. Nepal
6. Concepts of Physics, HC Verma Dept of Physics, IIT Kanpur, Bharati Bhawan
7. Principle of Physics: Brizlal and Subramanum

COURSE TITLE: COMPUTER PROGRAMMING IN NRM

Course Code	Credit	Lecture Hours	Marks			Total
FPE 414	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course contains the fundamentals of the computer programming using "C" language and applies in the field of forestry and natural resource management. It may be enhancing the computer programming skills of the students by introducing C and R languages which includes low level and high level programming concepts.

LEARNING OBJECTIVES: After completion of this course, the students will able to:

- Understand fundamentals of computer language, programming and software
- Acquire basic concept of C programming & R programming
- Knowledge to use appropriate computer language in the field of forestry and natural resource management.

EXPECTED OUTCOMES: After the completion of course, students are expected to be able to:

- Use appropriate computer programming
- Gets knowledge for graphical representation, statistical analysis, and reporting.
- Foundation for high level computer programming for application in forestry and natural resource management.

UNIT 1: INTRODUCTION TO PROGRAMMING [4]

1.1 History of programming
1.2 Hardware and software
1.3 Software features & trends
1.4 System software
1.5 Application software proprietary vs. open-source software
1.6 Types of programming languages and their generations
1.7 Programming paradigm

UNIT 2: C FUNDAMENTALS [6]

2.1 Basic structure of C-program
2.2 Programming style
2.3 Executing a C-program
2.4 Character set
2.5 C tokens, keywords and identifiers
2.6 Constants & variables
2.7 Data types
2.8 Escape sequences
2.9 Preprocessors directives
2.10 Formatted input and formatted output

UNIT 3: C OPERATORS & EXPRESSION [4]

3.1 Arithmetic of operators
3.2 Relational operators

3.3 Logical operators
3.4 Assignment operators
3.5 Increment and decrement operator
3.6 Conditional operators

UNIT 4: C CONTROL STRUCTURES [6]

4.1 Decision Making
4.2 Branching, loops and jumps
4.3 IF statement
4.4 The IF-ELSE statement
4.5 The Switch statement
4.6 The GOTO statement
4.7 The While statement
4.8 The DO statement
4.9 The FOR statement

UNIT 5: C ARRAYS & STRINGS [2]

5.1 Introduction to array and strings
5.2 One - dimensional arrays
5.3 Array of Strings

UNIT 6: C FUNCTIONS AND FILE MANAGEMENT [8]

6.1 Introduction
6.2 The form of C- function
6.3 Return values and their types
6.4 Calling a function
6.5 Data files
6.6 File modes and operation (open, close, read, write)

UNIT 7: R FOUNDATIONAL [10]

7.1 History and overview to R
7.2 R vs. other programming languages like C
7.3 R vs. spreadsheets and point-and-click software
7.4 Basic language elements and data structures
7.5 Data formats and preparation
7.6 Data import and export
7.7 Loops
7.8 Functions
7.9 Data management
7.10 Data analysis and visualization.

PRACTICAL [20]

Part A- C programming

Contents	Equipment/ tools	Methodology/methods	Link to the course unit(s)
C- Fundamentals, operators and expression 1. Control structures 2. Arrays and Strings 3. Functions 4. File management in C	Any suitable application	Personal computer/ Computer lab	Unit 1-6

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Part B – R programming

Contents	Equipment/ tools	Methodology/methods	Link to the course unit(s)
R fundamentals: variables, list, data frame)	R/ R Studio	Personal computer/ Computer lab	Unit 7
R functions: apply(), lapply(), sapply(), tapply()	R/ R Studio	Personal computer/ Computer lab	Unit 7
Data Exploration: Data import and export, correlation, aggregation, select, filter	R/ R Studio	Personal computer/ Computer lab	Unit 7
Data Analysis: charts, plots and histogram, t test and Anova	R/ R Studio	Personal computer/ Computer lab	Unit 7

Note: Students must prepare and submit their individual report

TEXTBOOKS

1. E. Balagurusami, 2019, “Programming in ANSI C”
2. Dennis Ritchie & Brian W. Kernighan, 1988, “The C Programming Language” , Prentice Hall
3. Noel Kalicharan, C by Example, Cambridge University Press

REFERENCES

1. Zed A. Shaw , Learn C the Hard Way, Pearson, 9789353065720
2. Andrew P. Robinson, Jeff D. Hamann, 2010, Forest Analytics with R: An Introduction , Springer
3. Mathew Russell, Statistics in Natural Resources: Applications with R, ISBN 9781032258782, Published August 19, 2022 by Chapman & Hall
4. Mahoney, M. (2019). Introduction to Data Exploration and Analysis with R. https://bookdown.org/mikemahoney218/IDEAR/
5. Phillips, N.D. (2018). YaRrr, The Pirate’s Guide to R. https://bookdown.org/ndphillips/YaRrr

COURSE TITLE: NATURAL RESOURCE MANAGEMENT PLANNING

Course Code	Credit	Lecture Hours	Marks			Total
SFM 414	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course focuses on the preparation of forest management plans of the community-based forests, watershed management plan and review the management plans of protected areas in Nepal.

OBJECTIVES: On the completion of this course, the students will be able to:

- Understand the concept of NRM planning,
- Make students able to prepare community forest operational plan, partnership forest scheme, and watershed management plan,
- Review the protected area management plan

EXPECTED OUTCOMES: After the completion of this course, the students will be able to:

- Prepare the community forest operational plan,
- Prepare the partnership forest scheme,
- Prepare the watershed management plan,
- Understand the protected areas management plan,

UNIT 1: INTRODUCTION [8]

1.1 Definition of natural resources (renewable and non-renewable)
1.2 Concept and principles of Natural Resource Management
1.3 Concept and importance of NRM Planning

UNIT 2: COMMUNITY BASED FOREST MANAGEMENT PLANS [17]
2.1 Preparation of community forest operation plan
2.2 Preparation of partnership forest scheme

UNIT 3: INTEGRATED WATERSHED MANAGEMENT PLAN [10]
3.1 Various components of Integrated Watershed Resource Management Plan (soil and its fertility management water, agriculture, livestock, biodiversity, climate change, land degradation)
3.2 Preparation of Integrated Watershed Management Plans

UNIT 4: PROTECTED AREA MANAGEMENT PLAN [5]
4.1 Contents of PA management plan
4.2 Process of PA management plan preparation
4.3 Review of PA management plan

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	Preparation of CF operational plan	- Forest inventory data	- Data analysis - Write up (individual)	2
2	Preparation of partnership forest scheme	- Forest inventory data	- Data analysis - Write up (individual)	2
3	Preparation of integrated watershed management plan	- GIS maps, - Socio-economic survey	- Data analysis - Write up (individual)	
4	Review of protected area management plan	- Protected area management plan	- Review - Report writing	

REFERENCES

1. Asthana, D.R. and Asthana, M. 2012. Environment: Problems and Solutions. S Chand and Company Pvt. Ltd.
2. Bastakoti, R. C., Shivakoti, G. P., and Lebel, L. (2010). Local irrigation management institutions mediate changes driven by external policy and market pressures in Nepal and Thailand. *Environmental management*, *46*(3), 411-423.
3. Demers, C. and L. Bosworth, 2018. The Northwest Florida Landscape Management Plan: Enhancing landowner engagement and forest certification. The Florida Land Steward, vol. 7, no. 4, Forest Stewardship Publication. Gainesville: University of Florida Institute of Food and Agricultural Sciences.
4. Fallding, M. (2000). What makes a good natural resource management plan?. *Ecological management & restoration*, *1*(3), 185-194.
5. Khadka, N.B. 2008. Natural Resource and Conservation.
6. Miller, G.T. (Jr.) and Spoolman, S.T. 2010. Living in the Environment. Brooks/Cole. Belmont, California, USA: Wardsworth Publishing Company.
7. Owen, O.S., Chiras, D.D. &Reganold, J.P, 1998. Natural Resource Conservation Management for a Sustainable Future (7thEdition). Prentice Hall.
8. Peter, M., Dixit, A. and Athukorala, K. (edited). 2007. Integrated Water Resources Management: Global Theory, Emerging Practice and Local need. Sage Publication.
9. Ramade, F. 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.
10. Sharma, V.K. 1985. Water Resources Planning and Management. Himalaya Pub. House.
11. Thomas, L., & Middleton, J. (2003). *Guidelines for management planning of protected areas* (Vol. 10). Gland, Switzerland/Cambridge, England: IUCN
12. Tiwari, K. R., Bajracharya, R. M., &Sitaula, B. K. (2008). Natural resource and watershed management in South Asia: a comparative evaluation with special references to Nepal. *Journal of Agriculture and Environment*, *9*, 72-89.
13. WECS. 2011. Water Resources of Nepal in the Context of Climate Change. Water and Energy Commission Secretariat. GoN.

COURSE TITLE: INDIGENOUS KNOWLEDGE IN NRM

Course Code	Credit	Lecture Hours	Marks			Total
SFM 415	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course has been designed to orient the students about the importance of study of Indigenous Knowledge and examine its practical application from different perspectives, with a special focus on ethno botany, environment, traditions and culture.

OBJECTIVES: The objectives of this course are to:

- Understand the basic concept of indigenous people, their knowledge and rights in relation to access and management of natural resource management.
- Enhance understanding and knowledge management of IK, research tools, documentation and extension for broader outreach.
- Understand the IK at the global, spatial, physiographic, temporal and cultural perspectives.
- Develop reports/case studies/presentations critically analyzing the case, and efficiently communicating the situation and findings for local, national and global significance.
- Capacitate students on how to apply IK on research and knowledge management, biodiversity conservation, livelihood and primary health care, energy and food management, climate change adaptation, and collaboration for future leveraging.

EXPECTED OUTCOMES: Upon the successful completion of this course, students will be able to:

- Recognize the importance of learning from Indigenous peoples
- Examine indigenous research protocols, ethics, and methodologies
- Identify ethical issues and solutions for research involving indigenous people and their knowledge.

UNIT 1: BASIC CONCEPT OF INDIGENOUS KNOWLEDGE [7]

1.1 Definition: Indigenous Knowledge, Traditional Knowledge, Local Knowledge, and Western Knowledge
1.2 IK in different physiographic zones (Himalaya, Mountain, Hills, Lowland Tarai; East, West and Central Nepal (Stearn 1960)
1.3 Indigenous Knowledge management system in relation to NRM in Nepal
1.4 Indigenous Knowledge and End -users (IK holders and knowledge products)

UNIT 2: SUBDISCIPLINES OF INDIGENOUS KNOWLEDGE [8]

2.1 Ethnobotany
2.2 Ethnomedicine
2.3 Ethnoecology and Ethnotaxonomy
2.4 Zootherapeutics
2.5 Ethnoveterinary

UNIT 3: INDIGENOUS KNOWLEDGE IN NRM [10]

3.1Role and practice of Indigenous knowledge (IK) on

- 3.1.1 Forest management
- 3.1.2 Sustainable management of biodiversity (Flora and fauna)
- 3.1.3 Sustainable management of plant resources (medicinal, wild, edible plants)
- 3.1.4 Fodder, forage and pasture/rangeland management
- 3.1.5 Soil management
- 3.1.6 Disaster risk reduction and climate change adaptation
- 3.1.7 Water resource management
- 3.1.8 FPIC concept and process

3.2 Role and practice of IK in natural resources related conflict management

UNIT 4: INDIGENOUS KNOWLEDGE MANAGEMENT [8]

4.1 Protecting indigenous knowledge, heritage and bio-cultural properties
4.2 Local science vs. global science vs. citizen science approaches to IKM
4.3 Local initiatives of IK conservation and management (Private and communities)
4.4 Government and policy level IK conservation and management
4.5 International agreements, commitments and conventions on IKM: trade-related aspects of Intellectual Property Rights (TRIPs)
4.6 CBD, ABS and Nagoya protocol
4.7 Barriers, challenges and threats of IK conservation/management

UNIT 5: METHODOLOGICAL/ANALYTICAL APPROACH OF IK STUDY [7]

5.1 Documentation of Indigenous knowledge (IK)
5.2 Traditional/classical approach of IK study
5.3 Ethnographic/anthropological approach
5.4 Comparative approach
5.5 Integrated approach
5.6 IK at statistical and IT approach

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	Document Indigenous knowledge	-Published article -Government published profile -Publication regarding *Tharu / Gurung / Tamang / Chepang / Bankariya / Raute* communities)	Desk study	1-5
2	Assess the existing knowledge, skill, and practices of IK in NRM of specific ethnic group	- Check list -Research article Literature	-Review or KII	3，4
3	Exploring the voices of indigenous people	- News paper - online media	-Review - KII	1, 2,5
4	Traditional practice of conflict management in NRM	- Reports - Literature - News paper	-Review -KII	3

5	Provisions related to IK in NRM	- CBD - Nagoya Protocol - ABS	-Review -KII	4

REFERENCES

1. Albuquerque et al. 2014. Methods and Techniques in Ethnobiology and Ethnoecology. Humana Press
2. Alexiades MN and Phillips OL. 1996. Selected Guidelines for Ethnobotanical Researches.
3. Atalya S. 2012. Community-Based Archæology: Research with, by, and for Indigenous and Local Communities. Berkeley, CA: University of California Press
4. Balick M and Cox PA. 1996. Plants, People and Culture: The Science of Ethnobotany
5. Battiste, M. 2008. Research ethics for protecting Indigenous knowledge and heritage: Institutional and researchers' responsibilities. In N. K. Denzin, Y. S. Lincoln, & L. T. Smith (Eds.), Handbook of critical and Indigenous methodologies (pp. 497–510). SAGE.
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8. Cheikhyoussef A, Shapi M, Matengu K, Ashekele HM. 2011. Ethnobotanical study of indigenous knowledge on medicinal plant use by traditional healers in Oshikoto region, Namibia. J EthnobiolEthnomed. 2011 Mar 9;7:10. doi: 10.1186/1746-4269-7-10. PMID: 21388534; PMCID: PMC3062575.
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10. Gnecco C, and Ayala P. 2011. Indigenous Peoples and Archaeology in Latin America. Walnut Creek, CA: Left Coast Press.
11. Kala, C.P. 2012.Traditional ecological knowledge and conservation of ethnobotanical species in the buffer zone of Pachmarhi Biosphere Reserve, Madhya Pradesh. Indian Institute of Forest Management, Bhopal, Madhya Pradesh. 194 pp
12. Loovers, Jan Peter Laurens. 2021. Reading Life with Gwich'in: An Educational Approach. London: Routledge. ISBN 978-1032082462.
13. Martic G. 2004. Ethnobotany: A methods manual.

COURSE TITLE: ECOTOURISM MANAGEMENT

Course Code	Credit	Lecture Hours	Marks			Total
PWM 417	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to introduce the concept, methods and practices for ecotourism planning, development and management. In addition, this course covers the institutional mechanism, ecotourism planning, tools and practice and its marketing strategy for the sustainable development to promote ecotourism in Nepal.

OBJECTIVES: Upon the completion of the course, the students will be able to:

- Understand the concept and status of tourism in Nepal and analyze its potential resources and products planning and development.
- Demonstrate ability to survey the visitors, and evaluate the impacts of and its remedial measures for sustainability.
- Get familiarized with regulatory frameworks and institutional arrangement of ecotourism sites, attractions and related services.

EXPECTED LEARNING OUTCOMES: Upon the completion of this course, the students will be able to:

- Be familiar with the basic concepts, principles, planning process and management of ecotourism in general and ecotourism development, promotion and management practices in particular.
- Have conceptual knowledge on tourism and its typologies with the evolution process.
- Gain experience using visitor survey, tourism products survey techniques and the skills for situation or status analysis by using various tools and to formulate the appropriate strategy for ecotourism development.

UNIT 1: CONCEPT, TYPOLOGY, EVOLUTION AND STATUS [5]

1.1 Definition and typology of tourists, tourism and recreation
1.2 Development process of tourism
1.3 Ecotourism: definition, concept, evolution process
1.4 General principles and practices of ecotourism
1.5 Importance of ecotourism in national and global context

UNIT 2: TRAVEL MOTIVATION, TOURISM RESOURCES AND PRODUCTS [8]

2.1 Basics travel motivators: Physical, cultural, interpersonal motivators, status, prestige and their reasons.
2.2 Concept and scope of tourism resources
  2.2.1 Natural Attractions: Natural landscape, protected areas (national parks, wildlife reserves, national parks, conservation area, hunting area, etc.), biodiversity (flora and fauna), river, lakes and waterfalls, mountains and peaks, caves and cannons etc.
  2.2.2 Cultural attractions: Cultural heritage sites, historic/archaeological monuments, religious/spiritual sites, Yoga & meditation, traditional architects, festivals, dance & music, folk culture etc.
  2.2.3 Built environments: Recreational sites, sports, amusement and theme park, superstructures etc.

2.3 Concept of tourism products
2.3.1 Characteristics of tourism products
2.3.2 Types and inventory model of tourism products
2.3.3 Process of tourism product development: explore, develop, promote and conserve
2.4 Facilities and services
2.4.1 Accessibility and transport related facilities
2.4.2 Accommodation and foods
2.4.3 Communication, information and interpretation facilities
2.4.4 Adventure and entertainment facilities
2.4.5 Financial and shopping facilities
2.4.6 Health, well-ness and safety related measures

UNIT 3: ECOTOURISM REGULATORY FRAMEWORKS AND STAKEHOLDERS IN NEPAL [6]

3.1 Highlights of- Tourism Act, policy, vision, strategy, periodic plan

3.2 Provisions for registration and control of ecotourism business and services: eco-lodge, trekking and mountaineering expedition agencies, rafting agencies etc.

3.3 Role of different level stakeholders (governmental, non-governmental, Community and private sectors) in ecotourism promotion

3.4 Concept, status and Roles of WTO, UNWTO, UNESCO, UNEP, UNDP, PATA, IUCN, ICIMOD, WWF, for ecotourism promotion

UNIT 4: ECOTOURISM MANAGEMENT AND MARKETING IN NEPAL [10]

4.1 Concepts and scope of ecotourism management

4.1.1 Ecotourism Management Frameworks: Limits of Acceptable Change (LAC), Visitor Impact Management (VIM), and Recreation Opportunity Spectrum (ROS)

4.1.2 Tourism Area Life Cycle Model, Ecotourism zoning and destination management

4.1.3 Community awareness, participation and distribution of ecotourism benefits

4.1.4 Visitor information and interpretation

4.1.5 Development and maintenance of ecotourism infrastructures (visitor centers, museums, view tower, viewpoints, hides and *machans*)

4.1.6 Management of risks and safety of ecotourism

4.2 Basic elements of ecotourism marketing: product, price, people, place, promotion

4.3 Ecotourism marketing strategies and tourism product-market mix

4.4 Ecotourism promotional activities: Familiarization trips, festivals, trade fairs, travel mart, media campaign, electronics, print media, and social media promotion.

4.4.1 Public relations, host and guest relation and visitor's satisfaction.

4.4.2 Destination promotion organizations: Roles and activities

UNIT 5: ECOTOURISM PLANNING AND DEVELOPMENT [6]

5.1 Ecotourism Planning: Concept, types, process, scale and level (scope)

5.2 Affecting factors of Ecotourism Planning

5.3 Elements of tourism planning (Vision, objectives, strategy, program & activities)

5.4 Tourism planning approach and tools

5.4.1 Survey of tourism products and resources

5.4.2 Analysis of tourism demand and supply

5.4.3 Tools: Carrying capacity, SWOT/C, ZOPP, SOAR & APPA.

UNIT 6: ECOTOURISM IMPACT AND MITIGATIONS [5]

6.1 Practice and issues (legal, socio economic and cultural) of ecotourism in Nepal

6.2 Ecotourism impact (positive and negative)

6.3 Mitigation measures in Ecotourism (as nature-based solutions)

6.4 Ecotourism sustainability assessment and certification (destination & products).

PRACTICAL [20]

Contents	Equipment/Tools	Methodology/Methods	Link to the course unit (s)
Status of tourism facilities & services	Checklists for observation	Fieldwork excursion (one day)	Unit 1
Tourism potential in Nepal	Checklists for discussion	Group work and presentation	Unit 2
Destination planning	Checklist for APPA and ZOPP	Group work and presentation	Unit 3
Management practice of the ecotourism sites	Checklists and Questionnaires	Excursion for Observation (one day)	Unit 4
Impact Analysis & success case study	Checklists and Questionnaires	Fieldwork with local community- FGDs and KII (3 days)	Unit 5

TEXTBOOKS

1. Collier, Allan. 1989. Principles of Tourism. Pitman Publishing Ltd.
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6. Lohmann, Gui and Alexandre, Panosso Netto. 2017. Tourism Theory Concepts, Models and Systems: CAB International, Sao Paulo
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10. Mill, Robert C. and Morrison, Alastair M. 2009. The Tourism System. Kendall Hunt Publishing.
11. MOTCA. Nepal Tourism Statistics, Tourism Act 2052, Tourism policy 2065, Tourism Vision 2020. MOTCA, Kathmandu.
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COURSE TITLE: WOOD SCIENCE AND TECHNOLOGY

Course Code	Credit	Lecture Hours	Marks			Total
FPE 415	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to pursue professional careers in wood science & technology in the area of forest-based industries. The syllabus comprises basics of wood science technology, properties of wood, adhesives, timber engineering, wood working as well as processing knowledge and techniques to manufacture solid wood, composite products.

OBJECTIVES: The objectives of the course are to:

- Understand wood science and technology and utilize the natural resources for sustainable basis with minimization of wastage of raw materials
- Acquire knowledge of different kinds of wood according to their properties
- Understand appropriate methods for preparing adhesives and their uses
- Utilize timber with different engineering design

EXPECTED OUTPUTS: On the completion of the course, students will be able to:

- Execute the knowledge of sustainable wood products with minimization of wastage
- Identification of wood according to their properties
- Develop the knowledge and skill of making final products
- Contribution of knowledge and skill of wood-based engineering design

UNIT 1: INTRODUCTION OF WOOD SCIENCE AND TECHNOLOGY [2]

1.1 Introduction, scope
1.2 Importance in national, regional and international

UNIT 2: WOOD PROPERTIES [6]

2.1 Properties of wood (Physical and Mechanical) 10 major wood species of Nepal

UNIT 3: ADHESIVE: NATURAL AND SYNTHETIC [10]

3.1 Introduction, importance, types of adhesive
3.2 manufacturing process of adhesive
3.3 Properties (Animal glue, casein glue, blood albumin, soya bean and starch, silicate of soda glues; Synthetic glues: Phenolic and substituted Phenolic adhesives. Urea formaldehyde, melamine formaldehyde, epoxy and polyurethane adhesives. Polyvinyl adhesives
3.4 Importance of viscosity and setting time of glues and adhesives.
3 . 5 Precautionary measures in formulation of glues
3.6 Application techniques, curing factors of safety and hygiene

UNIT 4: WOOD WORKING [10]

4.1 Layout of wood workshop.

4.2 Benefits of mechanization as against traditional carpentry tools; circular saw and range of jobs.

4.3 General features and designs of wood working machines such as planner, thickness or, mortiser, tenonner, molders, routers, turning lathes and drill-boring machines.

4.4 Universal testing machines (UTM), copying lathes, four side planners-cum- molder and CNC router. Saws for panel products, radial arm saws, cross cut-trim saws. Disc and drum sanders. Portable power tools and dowel making machines

4.5 Brushing, spraying, electrostatic spraying, powder coating, UV curing.

4.6 Precautions in the use of finishing materials with special reference to polyurethane finishes

UNIT 5: TIMBER ENGINEERING [6]

5.1 Strength Properties and classification of structural timber

5.2 Dimensional optimization for beams columns and associated structural dimensions in a product, Minimum dimensions of sawn timber essential for timber engineering design

UNIT 6: WOOD BASED INDUSTRIES [6]

6.1 Concept of raw material

6.2 Uses and application of wood based products (Furniture, toys, sports goods, carving, agriculture tools, home appliances and pots, joints and fixtures, doors, windows, framing)

PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Links to the course unit(s)
Adhesives manufacturing process industries and timber engineering design unit,	Visit manufacturing industries in Nepal	Industries attachment educational tour	Unit 3,4, 5
wood working and finishing industries, specialized wood products (Furniture, toys, sports goods, carving, agriculture tools, home appliances and pots, joints and fixtures, doors, windows, framing, match industries	Visit manufacturing industries in Nepal	Industries attachment educational tour	Unit 6
Test: Adhesive viscosity, pH, Solid content, abrasion test, adhesion test, load bearing capacity of panel products	Circular saw, UTM, Oven, weighing balance tensiometer	Oven dry wt. and physical	Unit 3,4, 5

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1. Indian Forest Utilization, FRI Publication, Volumes: I and II, Forest Research Institute (FRI), Dehradun, India, 1970.
2. Forest Products and Wood Science: An Introduction, John G. Haygreen and Jim L. Bowyer, Iowa State University Press/Aims, 1982.
3. Textbook of Wood Technology, A. J. Panshin, C. D. Zeeuw, and H. P. Brown, McGraw Hill Book Company, 1964.
4. Kolamann, F. F. P and W. A. Cote Jr. Principle of Wood Science and Technology of Solid Wood.
5. Forest Products Journals and e- publications on Wood Science and Technology
6. Mehta, T. A Handbook of Forest Utilization. Periodical Expert Book Agency, 2008.
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8. Wadoo, M. S. Utilization of Forest Resources. IDRIS Publication, 1992
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12. Brown, H. P. Manual of Indian Wood Technology. International Books and periodicals supply service, New Delhi, 1985
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16. Wood Handbook: Wood as an Engineering Material, 2010

COURSE TITLE: NON-TIMBER FOREST PRODUCTS

Course Code	Credit	Lecture Hours	Marks			Total
SFM 416	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: This course is designed to provide the knowledge for identification, resource assessment, cultivation and domestication and also for the sustainable harvesting operation of NTFPs. Similarly, it will cover Phyto chemical screening of NTFPs and the chemical extraction process of NTFPs.

OBJECTIVES: Upon completion of this course the students will be able to

- Understand the scope, importance and value of NTFPs
- Identification of valuable NTFPs species
- Develop the knowledge on ethnobotanical indices, resource assessment and sustainable harvesting
- Understand the sustainable harvesting and chemical constituents of NTFPs
- Acquire the knowledge of NTFPs marketing and certification

EXPECTED LEARNING OUTPUTS

- Identification of NTFPs.
- Application of ethnobotanical indices in research
- Acquire skill on NTFPs cultivation and domestication methods
- Understand the process of post harvesting techniques
- Develop skill on phyto-chemical screening and chemical extraction of NTFPs.

UNIT 1: INTRODUCTION [11]

1.1. Concept, Scope and Importance of NTFPs
1.2. Classification of NTFPs
1.3. Ecology and distribution of valuable NTFPs (Yarsha gumba, Jatamasi, Nirmashi, Panchaule, Chiraito, Satuwa, Tejpat, Lemon grass, Asparagus, Sapaganda)
1.4. Role of NTFPs

UNIT 2: ETHNOBOTANY OF NTFPS [3]

2.1. Ethnobotanical value (concept, importance)
2.2 Ethnobotanical indices
  2.2.1 Fidelity level
  2.2.2 Use value
  2.2.3 Relative Frequency of Citation
  2.2.4 Cultural value index

UNIT 3: RESOURCE ASSESSMENT AND DEVELOPMENT [7]

3.1 The resource Inventory:
  3.1.1 Planning

3.1.2 Inventory method/Sampling
3.1.3 Analyzing the result (Dataanalysis/Estimation of NTFPs)
3.1.4 Sustainable harvest levels:
    3.1.4.1 Yield Studies
    3.1.4.2 Regeneration Studies
    3.1.4.3 Sustainable harvest (concept, importance)
    3.1.4.4 Harvesting Practices (harvesting tools, plant parts, harvesting intensity)
    3.1.4.5 Post harvesting practices

UNIT 4: CULTIVATION AND DOMESTICATION OF NTFP'S [6]

4.1. Scope and importance
4.2. Strategies for domestication
4.3. Climate, soil and habitat
4.4. Propagation and seeds germination techniques
4.5. Plantation, irrigation, hoeing and weeding
4.6. Diseases and their control measures

UNIT 5: PHYTOCHEMISTRY [7]

5.1. Concept, scope of primary and secondary metabolites with examples.
5.2. Phytochemical extraction i.e., cold and hot extraction
5.3. Isolation and purification of extracted drug materials by TLC, paper chromatography, column chromatography, HPLC
5.4. Phyto-chemical screening of medicinal plant extract i.e., Alkaloid, Flavonoid, Steroid, Carotenoid, Terpenoids, Saponin, Fat and Oil
5.5. Biological activity of extracts or particular solvent fraction or of the Phyto constituents for different diseases from secondary metabolites

UNIT 6: CERTIFICATION AND MARKETING [6]

6.1 Concept of marketing (selling and networking; 4Ps-place, people, products, price)
6.2 Product concept, branding and patent
6.3 Marketing channel (local, regional and international)
6.4 Problem and prospects of NTFP's marketing in Nepal
6.5 Concept, scope and importance of NTFP's certification
6.6 Policies and legislation of NTFP's certification

PRACTICALS [20]

Content	Equipment/Tools	Methodology	Link to the course unit(s)
Identification of NTFPs (10 species)	Knife, Lens, Paper	Lab/field	1 and 3
Resource Assessment	GPS, Tapes etc	field	2
Post harvesting practices		Field observation	2
Cultivation & Demonstration of 3 government prioritized species	Seeds, nursery equipment	Field Observation/practice	3
Extraction TCL Phytochemistry	Chemical, Plant parts	Lab	5
Marketing		Field observation	6

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17. गैरकाष्ठ वन पैदावार श्रोत सर्वेक्षण मार्गदर्शन-२०६९
18. जडिबुटि तथा गैरकाष्ठ वन पैदावार नीति २०६१
19. बन नियमावली-२०७९

COURSE TITLE: GENDER EQUALITY AND SOCIAL INCLUSION IN NRM

Course Code	Credit	Lecture Hours	Marks			Total
SFM 416	3	60	External (Theory)	Internal		
				Assessment	Practical	
			45	15	15	75

SCOPE: The course tries to deliver basic concepts of the socialization on human behaviour and hence, resulting in gender issues. The concept of gender integration and its importance in the forestry sector have also been discussed.

OBJECTIVES: Upon completion of the course, the students will be able to:

- Understand the basic concept of gender and social inclusion and their importance in natural resource management
- Develop competency in assessing gender equality and social inclusion issues in natural resource management
- Apply the tools and techniques of Gender and SI

EXPECTED LEARNING OUTCOME: Upon the completion of this course, students will be able to

- Understand socialization processes
- Differentiate between gender and sex
- Analyze the gender integration in various areas

UNIT 1: BASIC CONCEPT ON SOCIALIZATION AND GENDER [4]

1.1. Roles of women and men in society
1.2. Domains of power and value of work in the society
1.3. Social construct and process and socialization
1.4. Understanding gender

UNIT 2: UNDERSTANDING GENDER DISCRIMINATION AND BIAS [6]

2.1 Concept of intersectionality, stereotyping and marginalization
2.2 Introduction to bias
2.3 Types of bias – Conscious/Explicit and Unconscious/Implicit bias
2.4 Implication of biasness
2.5 Dimensions of exclusion (dominant and subordinate, and men/boys and women/girls)

UNIT 3: GENDER ISSUES AND SOCIAL INCLUSION [8]

3.1 Implications of socialization on overall work on women and the excluded individuals
3.2 Gender issues and social inclusion
  3.2.1 Understanding gender issues in Nepal
  3.2.2 Gender issues in forestry sector
  3.2.3 Social inclusion, exclusion and the implications
3.3 Driving factors for social exclusion
3.4 Significance of gender in the Nepalese Context.
3.5 Gender issues in developing countries

UNIT 4: GENDER ANALYSIS, MAINSTREAMING AND INTEGRATION [10]

4.1 Gender analysis approaches (social relation, approach, Empowerment, Gender Analysis Matrix, Moser Approach, Harvard Analysis Approach)

4.2 Objective and indicators for Gender analysis

4.3 GESI mainstreaming: Introduction and Principles

4.4 Barriers/challenges of mainstreaming gender and social inclusion

- 4.4.1 Inadequate participation and representation in decision making
- 4.4.2 Lack of recognition as key stakeholders
- 4.4.3 Inadequate technical skills
- 4.4.4 Inadequate representation in decision making
- 4.4.5 Bottlenecks Mapping and process

1.5 Case studies of good practices in gender integration in project design and implementation

UNIT 5: GENDER BASED VIOLENCE [6]

5.1 Approaches to understanding gender-based violence (GBV)

5.2 Types of Gender-based violence

5.3 Gender based violence in Nepal

5.4 Institutional Codes of conduct for safe and dignified violence-free space

5.5 Understanding barrier for gender equality in IOF and Workplace

UNIT 6: NATIONAL POLICY AND INTERNATIONAL COMMITMENTS RELATED TO GENDER AND SOCIAL INCLUSIONS [6]

6.1 Role of different stakeholders to address gender issues

- 6.1.1 Ministry of Forest and Soil Conservation
- 6.1.2 Ministry of Women, Children and Social Welfare
- 6.1.3 Ministry of Environment and Population.
- 6.1.4 Govt/non-govt/private sector role

6.2 National and international policies on gender violence

6.3 Gender Responsive Budget Analysis

PRACTICAL [20]

SN	Content/Topics	Equipment/Tools	Methods	Unit
1	Paper review on Gender issues, Gender mainstreaming and integration	Published national and international journals	Review papers and prepare a short report based on the reviewed paper	Unit 3,4
2	Analysis of gender integration through case studies	Case studies	Site visits/ Excursion /	Unit 4

TEXTBOOKS AND REFERENCES

1. Articles published in the journals such as Journal of Gender and Education, International
2. Journal of Gender Studies in Developing Societies, International Journal of Gender and Women's Studies and other related journals.
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