



Tribhuvan University

Institute of Forestry

Course Catalogue

B. Sc. Forestry



2018

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Institute of Forestry
Kirtipur, Kathmandu
Nepal
2018

Institute of Forestry, Tribhuvan University reserves the right to make changes in this course catalogue without notice. Please direct inquiries and comments to:

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FOREWORD

The mission of the Institute of Forestry (IOF) is to develop human resource based on the existing and emerging needs of the country in the area of forestry and natural resources subject areas. The long term objective of IOF is to develop itself as a center of excellence in forestry and natural resources education and research. Unlike traditional forestry, the purpose of forestry education is to produce skilled technical and professional human resources to address local, national and international issues. Given the socio-economic conditions of the country's inhabitants and geographical condition consisting of hilly and mountainous rugged terrain, forests of Nepal deserve prime importance in terms of conservation and management. Destruction of forest resources invites various kinds of environmental hazards threatening the life of every entity, as a result the list of endangered species has been longer and longer.

To conserve and manage forest resources, maintain bio- diversity and ecological balance, Ministry of Forest and Soil Conservation (MOFSC) has been constantly revising its forest policy and legislation. As MOFSC is the major government organization providing employment to IOF graduates, IOF has been interacting with MOFSC and various other institutions and organizations to get feedback to train its graduates as per the need and policy of the government. Accordingly, considering Nepal's socio-political and environmental changes, IOF has also tried to address these changes and has constantly revising its curricula. Curriculum development is a continuous process and as per the policy of Tribhuvan University, IOF has developed a four-year forestry curriculum. The courses and subjects proposed by the Subject Committees were critically discussed and modified by the Faculty Board of IOF.

This course curriculum is the outcome of several formal and informal discussions, meetings and workshops. Many individuals and institutions have contributed directly and indirectly to bring this curriculum to this shape. I like to express my sincere thanks to the members of the Subject Matter Committees and the Faculty Board, and organizations 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. Special thanks also go to Mr. Bishnu Hari Wagle, Lecturer, IOF for compiling and editing this curriculum and bringing it to this shape and to Prof. Mohan Krishna Balla for final editing/ formatting the course catalogue. I am grateful to CARE Nepal/Hariyo Ban Program, Kathmandu for financial support for refining the curriculum.

Dean
Institute of Forestry
Kirtipur, Kathmandu.

INTRODUCTION

Mission of the Institute of Forestry

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

Objectives of IOF

- To design and implement educational programs that can address the current needs and interest of the civil society in the country in the area of forestry and natural resources fields.
- To develop competent and practical oriented professional foresters and efficient managers in the area of Natural Resource Management.
- To develop academic environment and encourage faculty members and students to enhance their professional career.
- To encourage research activities that can address the practical problems of farmers and communities at large.
- To develop IOF as the Center of excellence in the area of forestry education and other natural resources subjects.

Brief History of Development

Institute of Forestry (IOF) is the only national level academic institution which has been providing training and producing grass root level and middle level manpower in the area of Natural Resources Management in Nepal. The Institute started as the Nepal Forestry Institute at Singh Durbar in Kathmandu in 1947. It was shifted to Suping (Bhimphedi), Makwanpur in 1957-58. After the completion of construction of buildings by the Indian Co-operation Mission the Institute was moved to Hetauda in 1965. The Institute was run by the Department of Forest, Nepal until July 1972. It came under the Tribhuvan University system and amalgamated as a constituent institute in the same year as the Institute of Forestry. Until the late 1970s it produced only technician- grade foresters (Rangers). In 1981, IOF expanded its academic programs to a two- year Certificate Level in Hetauda Campus and Bachelor in Forestry in Pokhara Campus with better facilities developed through the technical and financial assistance from the World Bank, International Development Agency (IDA) and the United States Agency for International Development (USAID).

Educational Programs

Currently, IOF has two constitutional campuses, Pokhara and Hetauda Campus and one affiliated campus, Kathmandu Forestry Collage, Kathmandu. IOF is implementing the three-level academic programs: Bachelor in Forestry, M.Sc. in a. Forestry, b. Natural Resource Management & Rural Development, c. Watershed Management and d. Wildlife and Biodiversity Conservation as well as Ph.D. in Forestry. In addition to regular academic programs, IOF has also been organizing short training courses- national and international- in various fields of forestry such as Community Forestry, Forestry Extension, Non-Timber Forest Products Management, Eco- tourism, Forest Surveying, Watershed management, etc.

Research Program

Apart from teaching- learning activities, faculty members and students have been involved in research projects through Tribhuvan University grant and small grants provided by bilateral forestry projects in Nepal. Funds are sought from National and International organizations on competitive basis. Additionally, some funding has been made available from the NORHED-Norway and SIFOR-DANIDA-Denmark Projects for faculty and students' research. Research activities are co-coordinated through the IOF Research Committee, which is headed by the Dean and Research Director. The committee also seeks funding from various donor agencies to support faculty and students' research proposals. Manuscripts based on results of the IOF funded research activities are published in the national and international journals including Forestry Journal of Institute of Forestry.

Extra- Curricular Activities

Apart from regular academic activities, IOF Campus administration, Teacher's Association, Student's union and students' Selfhelp Group organize various activities such as sports, plantation, poetry, cultural and talk-programs on various occasions. Such extra- curricular activities have provided opportunities to faculty members, students and staff for socialization and team- building process.

PHYSICAL FACILITIES

Classrooms and Laboratories

In order to enhance efficiency of teaching and learning process, IOF has modern class room facilities equipped with all necessary audio-video teaching aids. Faculty and students have opportunity to enhance their teaching- learning process at their best physical comfort. Both of the IOF Campuses have laboratories with modest facilities to provide practical training as prescribed in the course curriculum. Some sophisticated laboratory facilities in the Government research stations and other academic institutes located nearby the IOF campuses are also utilized in the teaching-learning process and research.

Library and Documentation Center

Both the campuses of IOF have a good library facility having quite large collections of books, journals, Master's and Ph.D. 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 have made easy for the students and researchers in searching the relevant books and research journals. 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, research and extension resource center in the country as a whole.

Computer Center

In order to facilitate the teaching and learning process of teachers and students, IOF has established separate computer laboratories for 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.

Research Nursery and Sites

Institute of Forestry has many forests as research sites located at different ecological zones ranging from plain (Inner-Terai) to Mid-hills. Some of them are plantations of different species including exotic ones such as Ipil- Ipil (*Leucaena* spp.) and some sites having natural forests of indigenous species of Sal (*Shorea robusta*). IOF also has research nurseries in both the campuses. These nurseries are used for practical training of students. Hetauda campus has very nice forest arboreta, which have collections of number of pine species and other forest species. The matured Sal (*Shorea robusta*) forest with dense ground vegetation at Hetauda Campus has provided a very nice habitat for spotted deers. Hence, faculty and students can conduct their research works on a wide range of subjects.

Students' Housing and Campus Cafeteria

The Institute provides boarding facility to all interested students (male and female) at nominal costs at both campuses in separate hostels for boys and girls. It has helped students to access the library and computer facilities, and also, provided opportunities to interact with teachers and their supervisors. Both the campuses have cafeteria, which serve meals and snacks at reasonable prices. The cafeteria are run by interested individuals and firms selected by respective campus administration through competitive bidding under the rules and regulations set forth by the campus.

Faculty and Staff Housing

IOF is staffed with more than 80 teaching faculty members and enough administrative staffs. Almost all the faculty members and most of the administrative staffs reside on-campus in different categories of apartments. The Campus administration charges the tenants a nominal rent for their occupancy.

Transportation and Communication

To conduct the educational tours, field trainings and excursions, The Campus administration manages bus and jeep as per the necessity. The Campus also maintains a pool of vehicles for transportation. There is a regular bus service for local staff, teachers and students to-and-from the city center. All the faculty, staffs and students have access to communication facilities like telephone, facsimile and electronic mail service for a nominal fee to cover the expenses.

ADMISSION, EVALUATION AND AWARD OF DEGREE

Admission Requirements

Students who have passed securing a minimum of 50% marks in aggregate in I.Sc., Diploma in Forestry, +2 Science, A- level or equivalent are eligible to apply for admission in the Bachelor

Level program. All interested students must appear in the entrance examination administered by the Examination Section of IOF, and are selected based on their merit score for admission.

Evaluation and Examination System

Students are externally evaluated based on theory and practical examinations at the end of each semester. 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 each student after the result is published for that particular semester. Students who do not pass in 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 be subject to disqualify to appear in the final examination.

Award of Degree and Transcript of Academic Records

After the successful completion of all the requirements prescribed by the course curriculum a student will be eligible for award of B.Sc. degree in Forestry. An academic transcript is issued by the Controller of Examination of Tribhuvan University to individual student who has fulfilled all requirements. The academic standard of an individual student will be based on the cumulative percentage of marks secured in all examinations. The grading is as follows:

Grade	Description
Distinction	75% or over
First Division	60% to less than 75%
Second Division	45% to less than 60%
Pass	40% to less than 45%

COURSE CURRICULUM

Design and Delivery of Curriculum

Considering the changing context of the government forest policy and legislation of the country, 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 the 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 the text in parenthesis. The abbreviated text that appears in the beginning of the course code stands for the respective Subject Committee that the course falls under. The courses are given 300s to 600s course numbers in the Bachelor's level. The meaning of the course code is further illustrated 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 & Forest management
WME	Watershed Management and Environmental Science

Credit Hours

Each course is assigned a certain weightage in terms of Full Marks. Again the Full Mark is divided into Theory only or Theory and Practical classes (with practical). One credit hour carries 20 marks.

Core Course

Students enrolled in B.Sc. program in Forestry are expected to pass all the subjects prescribed in the course curriculum. Core courses are major subjects related to Forestry, Soil Conservation and Wildlife.

Elective Course

Elective courses are designed and delivered to expose more in certain areas of Forestry. Students in their Fourth year First semester will have an opportunity to select courses offered by the departments as the elective courses as per their interest. Concerned Department will announce

elective courses offered at the beginning of the academic year (session). Students must meet all requirements as prescribed in the curriculum.

Project Paper and Student's Seminar

To develop knowledge and skills in research works, students in their Fourth year Second semester are required to work on their project papers based on his/her interest and specialization. Students are encouraged to conduct original research works on the burning issues in forestry and natural resource management aspects. Each student will be assigned an advisor to guide his/her study. The advisor will guide and advise and assign appropriate grade to the student as an internal examiner of the project paper. The project paper is also evaluated by an external expert of that subject matter. After the completion of the project work, students are expected to present his/her works in pre-scheduled seminar. Students' research projects are supported by various national and international organizations. A few students who do not get outside funding are also supported by IOF.

Field Training and Educational Tours

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

SEMESTER-WISE COURSE BREAKDOWN

YEAR 1 SEMESTER I COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
BSH 301	Forest Botany and Genetics	50	2	1
BSH 302	Communication and Technical English	50	2	3
BSH 303	Forest Zoology & Mammalogy	50	2	6
BSH 304	Mathematics for Forestry	50	2	8
SFB 305	Silviculture	50	2	10
BSH 306	Wood Chemistry	50	2	14
PWM 307	Biodiversity Conservation and Eco-tourism	50	2	17
SFM 308	Forest Mensuration I	75	3	20
Total		425	17	

YEAR 1 SEMESTER II COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
FPE 351	Forest Surveying	75	3	23
WME 352	Global Environment and Climate Change	50	2	27
PWM 353	Wildlife Biology	75	3	29
SFM 354	Forest Management I	50	2	32
SFM 355	Forest Extension and Education	75	3	35
SFM 356	Gender & Social Inclusion in Natural Resource Management	50	2	38
BSH 357	Geo-physics	50	2	41
SFM 358	Tree Physiology	50	2	43
SFM 359	Field Tour	25	1	46
Total		500	20	

YEAR 2 SEMESTER I COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
BSH 401	Forest Statistics	75	3	47
WME 402	Soil Science	75	3	50
PWM 403	Wildlife Conservation and Management	75	3	54
SFM 404	Forest Law and Policy	50	2	58
SFB 405	Agroforestry	50	2	61
BSH 406	Economics	50	2	65
WME 407	Environmental Science	50	2	68
WME 408	Geology for Forestry	75	3	71
Total		500	20	

YEAR 2 SEMESTER II COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
WME 451	Photogrametry and Remote Sensing	75	3	75
WME 452	Forest Hydrology	50	2	78
SFM 453	Forest Resource Economics	75	3	81
SFM 454	Forest Mensuration II	75	3	84
FPE 455	Forest Harvesting and Logging	50	2	87
SFB 456	Tree Improvement and Silviculture	50	2	90
SFB 457	Forest Ecology	50	2	92
PWM 458	Tourism and Recreation	75	3	95
Total		500	20	

YEAR 3 SEMESTER I COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
FPE 501	Forest Products Utilization	50	2	99
WME 502	Range Management	50	2	102
WME 503	Soil and Water Conservation Engineering	50	2	106
SFM 504	REDD Forestry and Climate Change	50	2	110
SFM 505	Community Based Forest Management	50	2	112
SFM 506	Experimental Design for Forestry	50	2	115
SFB 507	Forest Protection	50	2	118
FPE 508	Forest Engineering	75	3	122
Total		425	17	

YEAR 3 SEMESTER II COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
FPE 551	Non-Timber Forest Products (NTFPS)	50	2	125
WME 552	Watershed Management	50	2	129
WME 553	Introductory GIS	50	2	134
PWM 554	Conservation Biology	75	3	136
SFM 555	Forest Management II	75	3	139
SFM 556	Project Management	50	2	142
SFB 557	Advanced Silviculture	50	2	145
SFM 558	Field Training	50	2	147
Total		450	18	

YEAR 4 SEMESTER I COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
WME 601	Mountain Environment and Development	50	2	148
PWM 602	Protected Area Management	75	3	150
SFM 603	Research Methodology	50	2	154
SFM 604	Community Forestry	75	3	157
SFM 605	Field Training	50	2	161
BSH 606	Bio-Chemistry*	75	3	162
FPE 607	Introduction to Computer Programming*	75	3	165
FPE 608	Wood Science and Technology*	75	3	167
FPE 609	Alternative Energy*	75	3	171
WME 610	Remote Sensing and GIS Application in Natural Resource Management*	75	3	173
WME 611	Environmental Chemistry*	75	3	176
PWM 612	Ornithology and Mammalogy*	75	3	178
SFM 613	Urban Forestry*	75	3	181
Total		450	18	

* Elective Subjects: Select 2 subjects from Elective Subjects

YEAR 4 SEMESTER II COURSES

Course Code	Course Title	Full Marks	Credit Hrs.	Page No.
SFM 651	Student Research/Interns Proposal and Defence	25	1	183
SFM 652	Project Paper/ Internship	200	8	184
SFM 663	Student Seminar	25	1	185
Total		250	10	

	Full Marks	Credit Hrs.
Grand Total	3500	140

COURSE DESCRIPTIONS

YEAR 1 SEMESTER I

Course Title: FOREST BOTANY AND GENETICS

Course Code: BSH 301

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: General objective of this course is to expose students to botany.

SPECIFIC OBJECTIVES:

1. To expose students to plant anatomy and systematic botany.
2. To expose students to genetics and biotechnology.

UNIT 1. PLANT ANATOMY (4)

- 1.1 Introduction to plant tissues and their types
 - a. Meristematic tissues and apical cell theory
 - b. Permanent tissues:- Simple, Complex and Secretory
- 1.2 Anatomical structure of dicot stem
- 1.3 Normal and abnormal secondary growth of dicot stem

UNIT 2. TAXONOMY (10)

- 2.1 Concept of taxonomy
- 2.2 Morphology and economic importance of following families:
 - a. Magnoliaceae
 - b. Rosaceae
 - c. Dipterocarpaceae
 - d. Myrtaceae
 - e. Fagaceae
 - f. Verbenaceae
 - g. Combretaceae
 - h. Leguminoceae
 - i. Betulaceae
 - j. Gramineae

UNIT 3. GENETICS AND PLANT BREEDING (10)

- 3.1 Genetics:
 - a. Concept of Mendalism
 - b. Modifications of Mendel's laws: Deviation from Mendel's law
 - c. Concept of linkage, crossing over and sex-linked inheritance
- 3.2 Mutations
 - a. Concept of chromosome structure
 - b. Concept, types and causes of gene and chromosomal mutation (chromosomal aberration)
 - c. Polyploidy
 - d. Significance of polyploidy
- 3.3 Plant Breeding
 - a. Selection
 - b. Hybridization

UNIT 4. BIO-TECHNOLOGY (6)

- 4.1 Concept, methods and applications of genetic engineering

- 4.2 Concept, methods and applications of plant tissue culture
- 4.3 Bio-fertilizers in soil fertility

PRACTICALS (10)

- 1. Study of transverse section of dicot stem.
- 2. Study of normal and abnormal secondary growth of dicot stem through permanent slides.
- 3. Taxonomic study of angiospermic plants (any one family of theory)
- 4. Herbarium collection of atleast 10 plants.
- 5. Field study of Dendrochronology.

TEXT AND REFERENCES

- 1. Choudary, H.D. Elements of Plant Breeding.
- 2. Dutta , A.C. 2000. A Class- Book of Botany, 17 Revised edition. Oxford University Press, USA.
- 3. Eames, Arthur J. and MacDaniels, Laurence H. 1984. An Introduction to Plant Anatomy. McGraw-Hill Inc.,USA.
- 4. Lawrence, V.S. Taxonomy of Angiospermic Plants.
- 5. Pandey, Surendra Nath. Cytogenetic Evolution and Plant Breeding.
- 6. Saxena. Principles of Genetics.

Course Title: COMMUNICATION AND TECHNICAL ENGLISH

Course Code: BSH 302

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: To equip students with knowledge and skills of technical communication through intensive and extensive reading materials and make them proficient in written as well as oral communication in English through exposure to and practices in rhetorical principles to enable them to communicate technical information effectively and competently in writing and speech with confidence to a variety of audiences.

SPECIFIC OBJECTIVES:

1. To expose the students to a variety of subjects written in English with examples of English in context, and to give them opportunities to read and use English for education and communication.
2. To teach the students new language items and reading skills.
3. To impart knowledge of rhetorical principles to the students and equip them with skills in technical writing and oral communication of technical information.
4. To prepare the students to pursue their regular courses in English.
5. To enable them to communicate confidently and competently in English in all spheres.

UNIT 1. READING (15)

1.1 Intensive Reading

Intensive reading strategies, note taking, summary/précise writing

1.2 Extensive Reading

Extensive reading strategies and skill development

1. Why Go to University? (Nissani)
2. A 1996 Commencement Speech (Rushdie)
3. The Brave Little Parrot (Nepal, adopted by Martin)
4. No Smoke from the Chimneys (Shrestha)
5. Marriage is a Private Affair (Achebe)
6. Don't Cut Down the Trees, Brother Woodcutter (Sama)
7. The Lunatic (Devkota)
8. How Sane Are We? (Chaudhary)
9. The Making of a Scientist (Ramchandran)
10. Scientific Inquiry : Invention and Test (Hempel)
11. Keeping Errors at Bay (Russell)
12. What Is Intelligence, Anyway? (Asimov)
13. Piano (Lawrence)
14. Stopping by Woods on a Snowy Evening (Frost)
15. Where the Mind is Without Fear (Tagore)

UNIT 2. FUNDAMENTALS OF TECHNICAL COMMUNICATION (3)

Introduction to communication, communication process, effective communication, technical writing defined, technical versus non-technical writing, attributes of good technical writers, qualities of good technical writing

UNIT 3. AUDIENCE ADAPTATION (2)

Analyzing audience's needs and point of view, providing needed background (defining terms, explaining concepts, helping the readers through your report)

UNIT 4. ACHIEVING A READABLE STYLE (5)

4.1 Right Words and Phrases

Simple and familiar Words, Concrete and Specific Words, Acronyms and Abbreviations, Active Verbs, Clichés, Jargons, Pompous Vocabulary, Empty Words, Redundancy Circumlocution and Discriminatory Words

4.2 Sentences

Active Versus Passive Voice, First Person Point of View, Clear Sentence Structure, Sentence Length, Sentence Complexity and Density

UNIT 5. WRITING TECHNICAL DOCUMENTS (10)

5.1 Writing technical reports: Variable nature of reports, general structure of a research report, writing research reports (3)

5.2 Writing proposals: Solicited and unsolicited proposals, internal and external proposals, proposal formats-informal and formal formats, writing research proposals (2)

5.3 Visual aids (2)

Purpose of visuals, choosing graphics, integrating text and visuals

5.4 Documentation (3)

When do you document? What do you document? Systems of documentation, general rules, parenthetical notes, footnotes and endnotes, MLA and APA, plagiarism

UNIT 6. Oral Presentation of Technical Information (5)

Oral reports defined, difference between oral and written reports, choosing the best delivery (impromptu delivery, memorized delivery, read delivery, extemporaneous delivery), preparing extemporaneous delivery; giving extemporaneous delivery); technical talk

TEXT BOOKS

1. Nissani, Moti and Lohani, Shreedhar. 2013. Flax-Golden Tales (An Interdisciplinary Approach To Learning English), Shorter edition. Ekata, Kathmandu.
2. Raman, Meenakshi, Sharma, Sangeeta. 2004. Technical Communication: Principles and Practice. Oxford University Press.
3. Singh, Abadhesh. 2013. Essentials of Technical Communication. Memorial Center of Excellence (MemCoE), Institute of Forestry, Pokhara.

REFERENCES

1. Board of Editors. 2010. Contemporary Communicative English for Technical Communication. Pearson Education.
2. Donna Gorrel. 1994. A Writer's Handbook from A to Z. Allyn & Bacon, A Division of Simon and Schuster, Inc., Needham Heights, MA 02194.

3. Houp, Kenneth W., Thomas, E. Pearsall, & Elizabeth Tebeaux. 1995. Reporting Technical Information. Allyn & Bacon, Needham Heights, MA 02194.
4. Lanon, John M. 2008. Technical Communication. Pearson/Longman.
5. Mitra, Barun K. 2006. Effective Technical Communication: A Guide for Scientists and Engineers. Oxford University Press.

Course title: FOREST ZOOLOGY AND MAMMALOLOGY

Course Code: BSH 303

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: This course has been designed to familiarize students with the vital roles and activities of forest dwelling animals.

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

1. Classify different animals in different groups with respect to forestry.
2. Be familiar with the pheasants of Nepal.
3. Be familiar with the important mammalian fauna of Nepal and their status.
4. Understand the structural, functional and environmental adaptations of mammals.

UNIT 1. NON CHORDATES (5)

- 1.1 Basic characteristics, classification and economic importance of Phylum-Annelida and Arthropoda with examples.
- 1.2 Structure, body segmentation, eyes, and mouth parts of insects.

UNIT 2. CLASS-AVES (5)

- 2.1 Important bird areas of Nepal
- 2.2 Importance of feathers in field identification of birds
- 2.3 Types of birds (Flightless birds and Flying birds)
- 2.4 Economic values of birds
- 2.5 Pheasants of Nepal

UNIT 3. ORIGIN AND RELATIONSHIPS OF MAMMALS (6)

- 3.1 Characteristics of mammals
- 3.2 Evolutionary history of mammals (area, climate and evolution)
- 3.3 A family tree of mammals
- 3.4 Classification of mammals up to orders (living orders) with important families and their examples
- 3.5 A brief account of mammals in Nepal

UNIT 4. STRUCTURAL AND FUNCTIONAL ADAPTATIONS OF MAMMALS (5)

- 4.1 Integument and derivatives
 - 4.1.1 Skin
 - 4.1.2 Hair
 - 4.1.3 Molting and coloration
 - 4.1.4 Derivatives of hair
 - 4.1.5 Horns and antlers
 - 4.1.6 Glands of mammals (Sweat, Scent, Sebaceous and Mammary glands)

UNIT 5. FOOD AND FEEDING MECHANISM (3)

- 5.1 Teeth
- 5.2 Feeding types

5.3 Body weight and food consumption

UNIT 6. ENVIRONMENTAL ADAPTATIONS OF MAMMALS (6)

- 6.1 Adaptations for hot environments
- 6.2 Adaptations for cold environments
- 6.3 Migration
- 6.4 Hibernation
- 6.5 Flight and echolocation
- 6.6 Economic values of mammals
- 6.7 Humans and mammals

PRACTICALS (10)

1. Practical note book preparation as regular study
2. Animal and sign collection during field visit
3. Feathers of birds.
4. Jaws, skulls, horns and skins of mammal
5. Derivatives of skin in mammals

TEXT AND REFERENCES

1. Darlington, Philip J. Jr. 2017. Zoogeography: The Geographical Distribution of Animals. First edition, Academic Publishers.
2. Hickman, C. P., Roberts, L. S., Keen, S., Eisenhour, D. J., Larson A. and I'Anson, H. . 2013. Integrated Principles of Zoology, Sixteenth edition. McGraw-Hill Education.
3. Kotpal, R. L. 2015. Modern Textbook of Zoology, Vertebrates. Fourth edition, Rastogi Publication, Meerut, India
4. Kotpal, R.L. 1992. Modern Textbook of Zoology, Invertebrates. Rastogi Publication, Meerut, India.
5. Robert, L. Fleming, Sr., Robert L. Fleming, Jr. and Lain Singh Bangdel. 2000. Birds of Nepal with Reference to Kashmir and Sikkim. Adarsh Books, Delhi, India.
6. Shrestha, T.K. 1997. Mammals of Nepal: With Reference to Those of India, Bangladesh, Bhutan and Pakistan. Steven Simpson Natural History Books.
7. Shrestha, T.K. 2000 and 2001. Birds of Nepal. Vol. 1 and 2, TK Shrestha (Privately Published).
8. Verma, P.S. 1968. A Manual of Practical Zoology (Invertebrate, Vertebrate). S. Chand & Co., Delhi.
9. Verma, P.S. and Jordan, E.L. 2009. Invertebrate Zoology. Fifteenth edition. S. Chand and Co., New Delhi.
10. Villee, Claude A., Warren F. Walker and Robert D. Barends. 1984. General Zoology. Saunders College.

Course Title: MATHEMATICS FOR FORESTRY

Course Code: BSH 304

Credit Hour: 2

(Final Theory: 40, Internal Assessment: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: After the completion of this course, students will be able to use their mathematical knowledge in their profession.

SPECIFIC OBJECTIVE: To provide the basic knowledge of calculus, differential equations, vector algebra, two- and- three dimensional geometry and mensuration.

UNIT 1. DERIVATIVES AND ITS APPLICATION (10)

- 1.1. Basic concept of limit and continuity
- 1.2. Techniques of differentiation
- 1.3. Higher order derivatives
- 1.4. Maxima and minima of one variable

UNIT 2. INTEGRATION AND ITS APPLICATIONS (10)

- 2.1. Basic concept
- 2.2. Techniques of integration: method of transformation, substitution method and integration by parts
- 2.3. Standard integrals
- 2.4. Definite integrals
- 2.5. Numerical integration (Trapezoidal and Simpson's rule)
- 2.6. Area of the plane region

UNIT 3. DIFFERENTIAL EQUATIONS (5)

- 3.1. Introduction, order and degree of differential equations
- 3.2. Differential equation of first order and first degree
 - 3.2.1 Solving separation of variable
 - 3.2.2 Homogeneous equation and its solution
 - 3.2.3 Exact equation and its solution
 - 3.2.4 Linear equation and its solution

UNIT 4. VECTOR ALGEBRA (5)

- 4.1. Concept of vectors
- 4.2. Product of two vectors
- 4.3. Product of three vectors

UNIT 5. TWO- DIMENSIONAL GEOMETRY (5)

- 5.1. Review of circle
- 5.2. Conic sections:
 - a. Parabola
 - b. Ellipse and Hyperbola (only problems)

UNIT 6. THREE- DIMENSIONAL GEOMETRY (5)

- 6.1. Concept of coordinates in space
- 6.2. Direction cosines and direction ratios
- 6.3. Angle between two lines

TEXT AND REFERENCES

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2. Joshi, M.R. Analytical Geometry. Sukunda Pustak Bhawan, Bhotahity, Kathmandu.
3. Panta, G.D. and Shrestha, G.S. 1994. Integral Calculus and Differential Equations. Sunita Prakashan, Bhotahity, Kathmandu.
4. Singh, M.B. and Bajracharya, B.C. 1995. Differential Calculus. Sukunda Pustak Bhawan, Bhotahity, Kathmandu.
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6. Sthapit, Y.R. and Bajrachary B.C. A Text Book of Three Dimensional Geometry. Sukunda Pustak Bhawan, Bhotahity, Kathmandu.
7. Thomas, George B. and Finney, Ross L. 2002. Calculus and Analytical Geometry. Addison Wesley, Delhi.

Course Title: SILVICULTURE

Course Code: SFB 305

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical:10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: Upon completion of this course, the students are expected to understand the concepts and practices of plantation silviculture.

SPECIFIC OBJECTIVES: The course specifically will prepare the students to:

1. Understand locality factors, succession and forest types.
2. Understand nursery operation/management techniques, planting as well as reproduction methods.
3. Understand the role of silvicultural treatments in forest management.
4. Learn the technique of plantation in different types of areas.

UNIT 1. INTRODUCTION (1)

- 1.1 Definition and objectives of silviculture
- 1.2 Common terms in silviculture
- 1.3 Relation of silviculture with other branches of forestry

UNIT 2. ENVIRONMENTAL (LOCALITY) FACTORS (4)

- 2.1 Definition, importance and classification
- 2.2 Climatic factors
- 2.3 Topographical factors
- 2.4 Edaphic factors
- 2.5 Biotic factors
- 2.6 Other factors (Pollution, stress)

UNIT 3. CONCEPT OF SUCCESSION (2)

- 3.1 Introduction
- 3.2 Kinds of succession (Primary, Secondary)
- 3.3 Causes of succession
- 3.4 Concept of climax with its types

UNIT 4. FOREST TYPES OF NEPAL (2)

- 4.1 Types of forests of Nepal on ecological basis (NBS- based)
- 4.2 Types of forests of Nepal on legal basis
- 4.3 Types of forests of Nepal on functional basis (Production and Protection)

UNIT 5. REGENERATION (2)

- 5.1 Natural Regeneration
 - 5.1.1 Natural regeneration from seed
 - 5.1.2 Natural regeneration from root suckers and coppice
- 5.2 Methods of artificial regeneration
 - 5.2.1 Regeneration from seed
 - 5.2.2 Regeneration from vegetative parts

UNIT 6. NURSERY OPERATIONS (4)

- 6.1 Objectives and importance of nursery
- 6.2 Types of nursery
- 6.3 Site selection for nursery
- 6.4 Design and layout of nursery
- 6.5 Nursery construction
- 6.6 Types of nursery beds and their preparation
- 6.7 Seed testing and seed certification
- 6.8 Methods of seed treatments
- 6.9 Seedling production and management

UNIT 7. PLANTATION METHODS (5)

- 7.1 Appraisal of planting sites and its protection,
- 7.2 Plantation design
- 7.3 Choice of species
- 7.4 Methods of site/ ground preparation,
- 7.5 Pitting
- 7.6 Spacing
- 7.7 Handling seedlings,
- 7.8 Plantation versus direct sowing.
- 7.9 Concept of forest fertilization
- 7.10 Concept of irrigation in plantations

UNIT 8. SILVICULTURAL TREATMENTS (6)

- 8.1 Release operations (weeding and cleaning, liberation cutting, use of herbicides)
- 8.2 Pruning and lopping (type and effects)
- 8.3 Thinning (basis, types, effects of thinning, regulation of thinning)
- 8.4 Improvement cuttings (T.S.I.Tree stand improvement)
- 8.5 Salvage and sanitation cutting
- 8.6 Effects of prescribed burning and fire on regeneration
- 8.7 Relationship of silvicultural treatment with biodiversity conservation
- 8.8 Silvicultural treatment impact on wood quality

UNIT 9. AFFORESTATION/REFORESTATION OF DIFFERENT TYPES OF AREAS (6)

- 9.1 Objectives and importance of afforestation and reforestation.
- 9.2 Locality factors, choice of species and methods of plantation in following areas.
 - 9.2.1 Denuded hill slopes
 - 9.2.2 Abandoned cultivated lands
 - 9.2.3 Grasslands
 - 9.2.4 Ravine lands
 - 9.2.5 Dry area with or without Irrigation
 - 9.2.6 Canal banks
 - 9.2.7 Road side plantation
 - 9.2.8 Farm forestry

9.2.9 Afforestation in urban areas

PRACTICALS (8)

1. Tree identification at nearby sites.
2. Nursery visit, preparation of nursery design and layout.
3. Study of primary and secondary succession and concept of climax.
4. Study of forest types (tropical, subtropical and temperate forests)
5. Nursery practices (preparation of beds, sowing, mulching, weeding, root pruning, polybag filling, transplanting).
6. Study of germination percentage and survival in the lab/nursery.
7. Pruning, lopping and thinning exercises nearby sites.
8. Visit to demonstration plots to study silvicultural treatment.

TEXT AND REFERENCES

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2. DFRS. 2017. Thinning Guidelines for *Pinus patula* and *roxburghii* in Nepal. NACRMLP Publication, DFRS, Kathmandu.
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4. Evans, J. and John W Turnball. 2004. Plantation Forestry in the Tropics, Third edition. Oxford University Press, Oxford.
5. Ghosh, R.C. 1977. Handbook on Reforestation Techniques. Controller of Publications, Gov. of India, New Delhi.
6. Gunter, S., Weber, M., Stimm, B. and Mosandi, R. (Eds.). 2011. Silviculture in the Tropics. Springer-Verlag Berlin Heidelberg.
7. Jackson, J.K. 1994. Manual of Afforestation, Second ed., Vol. 1 and 2. Forest Research and Survey Division, Kathmandu.
8. Kayastha, Baban Prasad. 1985. Silvics of Trees of Nepal. Kathmandu Community Forestry Development Project, Nepal.
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16. Smith, D.M., Larson, B.C., Kelty, M.J. and Ashton, M.S. 1996. The Practice of Silviculture: Applied Forest Ecology. Ninth ed.. John Wiley & Sons.
17. Thakur, R.B. and N.K. Phulara. 2014. A Compendium of Tree Species of Nepal. Mr.& Mrs. Thakur, Pipariya VDC - 6, Sarlahi, Nepal.
18. Troup, R.S. 2011. Silviculture of Indian Trees. Natraj Publishers, Dehradun.

Course Title: WOOD CHEMISTRY

Course Code: BSH 306

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: To impart knowledge to students of the basic theory of general chemistry and its role in forestry (particularly in natural products), phyto-chemistry, chemical constituents of wood, nanotechnology, nanomaterial and green chemistry.

SPECIFIC OBJECTIVES:

1. To impart knowledge to students on the role and responsibility of chemistry in natural resources management and sustainable development.
2. To expose them to chemistry of natural products like alkaloids, terpenoids and other extractives.
3. To encourage students to acquire and apply their knowledge of chemistry in forestry.
4. To enable them to apply phyto-chemical analysis tools in forestry.
5. To expose them to social, economic, environmental and technological implications of plants and their uses in various diseases.
6. To enable them to identify phyto-chemical compositions in forest plants and their uses.
7. To expose them to wood and green chemistry and its roles in forestry.

UNIT 1. GENERAL REVIEW OF FUNDAMENTAL CHEMISTRY (3)

- 1.1 General review of basic concept of organic compounds, analytical chemistry
- 1.2 Importance of chemistry in forestry sector

UNIT 2. PLANT CHEMISTRY (6)

- 2.1 Major sources, classification, structure, characteristic and application of carbohydrate
- 2.2 Major sources of protein, lipids (fats/oils), vitamins and their characteristics and uses

UNIT 3. ALKALOIDS (3)

- 3.1 Alkaloids, their sources, structure and characteristics
- 3.2 Biological importance of alkaloids.

UNIT 4. TERPENOIDS AND CAROTENOIDS (4)

- 4.1 Introduction and classification of terpenes and terpenoids
- 4.2 Isoprene rule and structure of geraniol, camphor, pinene, β -carotene
- 4.3 Biological importance of terpenoids and carotenoids

UNIT 5. NATURAL DYES (3) Introduction and classification of dyes

- 5.1 Characteristic and application of natural and artificial dyes
- 5.2 Extraction of dyes from plants

UNIT 6. PHYTO-CHEMISTRY (4)

- 6.1 Introduction and scope of phyto-chemistry
- 6.2 Role of chemistry in natural resources and product development
- 6.3 Extraction, isolation and purification of important organic compounds from plant resources.

- 6.3.1 Extraction techniques (cold and hot solvent),
- 6.3.2 Theory and application Chromatography: Paper, Thin layer chromatography (TLC), CC, GC, GLC, PTLC, HPLC, HPTLC and GC-MS,
- 6.4 Biologic screening of selected plant species (antioxidant, anti-diabetic, anti-malarial anti-cancer activities, etc.)

UNIT 7. CHEMICAL CONSTITUENTS OF WOOD (3)

- 7.1 Classification of wood and its chemical compounds and basic properties
- 7.2 Major chemical constituents of wood: cellulose, hemicelluloses, lignin and extractives
- 7.3 Application of the constituents in based industries: paper, composite products and other allied industries
- 7.4 Concept of Nanotechnology and non-materials

UNIT 8. GREEN CHEMISTRY (4)

- 8.1 Definition, basic principles and need of Green chemistry.
- 8.2 Environmental friendly uses of plant species as pesticides, insecticide etc.
- 8.3 Emerging techniques in development in green chemistry, photo chemistry, microwave chemistry and sono- chemistry
- 8.4 Green solvents
- 8.5 Application of green chemistry in contest of environment

PRACTICALS (10)

- 1) Phyto-chemical screening techniques: Extraction of plants materials, screening of plants extract such as: alkaloids test, phenolic, steroid, flavonoids, saponins, triterpenoids, etc.
- 2) Extraction of natural dyes and its application
- 3) Industrial visit to learn the manufacturing process of plant products: Gorkha Ayurved, rubber industry, Dabur Nepal Pvt. Ltd., Patanjali, rosin and turpentine, essential oil, cutch and katha, etc.

TEXT AND REFERENCES

- 1. Agarwal, O. P. 1997. Chemistry of Natural Products, Vol 1 and 2. Goel Publishing House.
- 2. Anatas, P. T. and Warner, J.C. 2009. Green Chemistry: Theory and Practice. Oxford University Press, Oxford.
- 3. Bhatta, Supriya Kumar. 2005. Hand kook of Aromatic Plants. Pointer Publisher, Jaipur, India.
- 4. Chatwal , Gurdeep and S.K. Anand. 2001. Organic Chemistry of Natural Products. Himalayan Publishing Co., Mumbai.
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- 6. Colegate, Steven M. and Molineux, Russell J. 2007. Bioactive Natural Products. CRC Press.
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10. Finar, I. L. 2012. Organic Chemistry, Vol. 1 and 2. Pearson.
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12. Jain, S.K. and Defilipps, R.A. 1991. Medicinal Plants of India, Vol. 2. Reference Publication, Inc., Michigan.
13. Khadka, N.M. Gautam, S.D. and Yadav, P.N. 2016. Core Experimental Chemistry. Harittase Publication.
14. Rowell, R. (Ed.). 2005. Handbook of Wood Chemistry and Wood Composites. CRC Press.
15. Sarkar, Satyajit D., Latif, Zahid and Gray, Alexander, I. 2005. Natural Products Isolation. Humana Press.
16. Sjostrom, E. 1993. Wood Chemistry: Fundamentals and Application. Academic Press, New York.
17. Stahl, Egon. 2005. Thin Layer Chromatography, A Laboratory Handbook. CBS Publishers & Distributors Pvt. Ltd,
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Course Title: BIODIVERSITY CONSERVATION AND ECO-TOURISM

Course Code: PWM 307

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: Students will gain general knowledge about biodiversity and eco-tourism.

SPECIFIC OBJECTIVES: After the completion of this course, the students will be familiar with:

1. Definitions of important technical terms related to biodiversity, wildlife, ecotourism and conservation.
2. Basic concepts of biodiversity, wildlife, protected areas and eco-tourism.
3. Present status of wildlife and protected areas, their legal provision and needs for conservation.
4. Basic concepts of wildlife habitat.
5. Status and importance of tourism, ecotourism and their impacts.

UNIT 1. INTRODUCTION/DEFINITIONS (8)

1.1 Definition of important technical terms:

- 1.1.1 Biodiversity, Conservation/Management, In-situ Conservation, Ex-situ Conservation, Protected Areas, Buffer Zone, Landscape Ecology, Corridor and Connectivity, Wildlife Biology, Conservation Biology, Ornithology, Mammology
- 1.1.2 Endangered Species, Critically Endangered Species, Vulnerable Species, Threatened Species, Rare Species, Depleted Species, Intermediate Species, Indigenous Species, Endemic Species, Exotic Species, Key Stone Species, Landscape Species, Flagship Species, Umbrella Species, Buffer Species
- 1.1.3 Habitat, Niche, Home Range, Territory, Migration, Dispersion, Edge, Ecotone, Interspersion, Juxtaposition, Nomadism, Biodiversity Hotspots, Carrying Capacity

1.2 Wildlife values (positive and negative)

UNIT 2. INTRODUCTION TO WILDLIFE CONSERVATION IN NEPAL (5)

- 2.1 History of wildlife conservation in Nepal
- 2.2 Policy and legislation concerning wildlife conservation in Nepal
- 2.3 Issues, threats and challenges of wildlife conservation in Nepal
- 2.4 Lesson learnt, opportunities in conserving wildlife in Nepal

UNIT 3. CONCEPT OF WILDLIFE HABITAT (5)

- 3.1 Concept of habitat, ecosystem, and succession
- 3.2 Habitat types, their importance threats and its management implications:
 - 3.2.1 Forests and shrub lands
 - 3.2.2 Grass and range lands
 - 3.2.3 Water bodies and wetlands

UNIT 4. PROTECTED AREAS OF NEPAL (6)

- 4.1 Protected areas of Nepal (NP, WR, HR, BZ, CA, PF) and IUCN categories
- 4.2 IUCN Red list and CITES categories of protected wildlife

UNIT 5. INTRODUCTION TO TOURISM AND ECO-TOURISM (6)

- 5.1 Concept and meaning of visitors, travelers, excursionist and tourist
- 5.2 Concept of tourism: meaning, nature, types and scope
- 5.3 Current status and trend of tourism services in global and Nepal
- 5.4 Sustainable tourism: mass tourism vs alternative tourism
- 5.5 Eco-tourism: definition, principles and importance

UNIT 6. TOURIST ATTRACTION AND SERVICES (6)

- 6.1. Sources of attraction: nature, culture, adventure and super structures
- 6.2. Ecotourism products and services in Nepal
 - 6.2.1 Natural: mountains, rivers, hills, forests, lakes, wildlife, etc.
 - 6.2.2 Physical facility and services: infrastructure and super structure, amusement parks, historical sites and monuments, religious sites, etc.
 - 6.2.3 Socio-cultural: festivals, traditions, hospitality, languages, ethnic groups (e.g. Sherpas, Gurungs, Tharus), etc.
- 6.3 Eco-tourism activities in Nepal: trekking and hiking, camping, rafting, hunting, bird watching, jungle safari, elephant and horse riding, etc.

UNIT 7. IMPORTANCE and EFFECT OF ECOTOURISM (4)

- 7.1. Importance of ecotourism: economic, cultural and educational at global, national and local level.
 - 7.1.1 Effects of tourism on society
 - 7.1.2 Effects of tourism on natural environment
 - 7.1.3 Mitigation measures of negative effects on nature and cultural resources

EXCURSION AND FIELD VISITS

1. Visit local forests, grassland and wetlands and survey birds, mammals
2. Visit local tourist sites and survey tourism facilities, impacts and visitor satisfaction

TEXT AND REFERENCES

1. Bhatta, D. 2017. Ecotourism in Nepal. A Bhatt Publ., Kathmandu.
2. Chauhan, Y.S. 2004. Eco-Tourism in Nepal. Kalinga Publications, New Delhi.
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13. Wall, G. and Matheison, J. 2005. Tourism's Economic, Physical and Social Impacts. Second edition, Prentice Hall.

Course Title: FOREST MENSURATION I

Course Code: SFM 308

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: After completion of this course students will gain knowledge about principles and practices of forest measurement.

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

1. Measure standing and felled trees.
2. Prepare local volume table and use different volume tables.
3. Execute forest inventory.
4. Demonstrate an understanding of increment.
5. Calculate growing stock and annual allowable cut.

UNIT 1. INTRODUCTION (3)

1.1 Definition of forest mensuration

1.2 Objectives of forest mensuration

1.3 Importance of forest mensuration

UNIT 2. MEASUREMENT OF STANDING TREES (18)

2.1 Diameter measurement and its importance

2.1.1 Diameter at breast height (dbh) and its importance

2.1.2 Rules of dbh measurement

2.1.3 Diameter caliper and diameter tape, their use, advantages and disadvantages

2.2 Height measurement and its importance

2.2.1 Definition of different tree height (total height, bole height, standard timber bole height, commercial bole height, crown height, crown length, stump height)

2.2.2 Importance of height measurement

2.2.3 Principal of height measurement

a. Trigonometric principal

b. Geometric principal of similar triangle

2.2.4 Methods of height measurement

2.2.4.1 Non instrumental (ocular, shadow method, single pole method)

2.2.4.2 Instrumental method

a. Abney's level

b. Clinometers

c. Christian hypsometer

2.2.5 Measurement of height of vertical trees on plane areas

2.2.6 Measurement of height of vertical tree on sloped areas

2.2.7 Sources of error in height measurement

2.3 Measurement of bark

2.3.1 Bark thickness

2.3.2 Bark percent

2.4 Measurement of crown

2.4.1 Crown diameter

- 2.4.2 Crown depth and crown height
- 2.4.3 K/d ratio
- 2.4.4 Crown surface area
- 2.4.5 Crown volume
- 2.4.6 Crown position and crown form

2.5 Forms of trees

- 2.5.1 Metzger's theory
- 2.5.2 Form factors
- 2.5.3 Form quotients

UNIT 3. MEASUREMENT OF FELLED TREES & FUELWOOD (6)

3.1 Measurement of logs

- 3.1.1 Measurement of length, diameter, sectional areas of logs.
- 3.1.2 Different formulae for the calculation of volume (Newton's, Huber's, Smalian's, and Quarter Girth) of logs.
- 3.1.3 Calculation of volume of sawn timber

3.2 Measurement of fuelwood

- 3.2.1 Calculation of stacked volume of fuelwood
- 3.2.2 Calculation of solid volume of fuelwood

UNIT 4. VOLUME TABLE (5)

- 4.1 Definition of volume table and their types
- 4.2 Preparation of Local volume table by graphical method
- 4.3 Uses of volume table

UNIT 5. FOREST INVENTORY (12)

5.1 Definition and scope of forest inventory

- 5.1.1 Definition of terms (sampling, sample, sampling intensity, sampling unit, population, sampling frame, sampling error, non sampling error)

5.2 Types of inventory

- 5.2.1 Total enumeration
- 5.2.2 Partial enumeration (Sampling)
 - 5.2.2.1 Random sampling
 - a. Simple random sampling
 - b. Stratified random sampling
 - 5.2.2.2 Non-random sampling
 - a. Line plot sampling
 - b. Strip sampling
 - c. Stratified sampling

5.3. Calculation of growing stock and annual allowable cut

UNIT 6. INCREMENT (4)

6.1 Definition and types of increment

- 6.1.1 Basic concept of dbh, height and volume increment
- 6.1.2 Concept of CAI and MAI

6.1.3 Estimation of increment e.g. diameter growth percentage, volume growth percentage

PRACTICALS (12)

1. DBH measurement of standing trees using caliper and tape.
2. Height measurement of standing tree on plane and slope areas using different instruments.
3. Log volume calculations using different formulae
4. Preparation of Local volume table by graphical method (using basic field data)
5. Preparation of Local volume table by graphical method (derivation from general volume table).
6. Line plot sampling, estimation of growing stock and annual allowable cut

TEXT AND REFERENCES

1. Avery, T.E. and Burkhart, H.E. 1983. 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. Husch, B., Beers, T.W., and Kershaw, J.A. 2003. Forest Mensuration, Fourth edition. John Wiley and Sons, Inc.
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YEAR 1 SEMESTER II

Course Title: FOREST SURVEYING

Course Code: FPE 351

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: After completion of this course the students will be able to prepare and interpret different types of maps and plans correctly by different surveying methods.

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

1. Record field data systematically in standard format.
2. Prepare various maps and plan by compass, theodolite, GPS surveying.
3. Understand terminology, methods and operation of surveying instrument (compass, level, theodolite, total station, GPS).
4. Understand the significance of theory of error in surveying and apply value judgment for accuracy and precision in surveying.
5. Work effectively with user groups in mapping and estimating forest resources in areas.

UNIT 1. FUNDAMENTAL DEFINITION AND CONCEPT (5)

- 1.1 Concept and definition of surveying
- 1.2 Types of surveying: plane and geodetic surveying
- 1.3 Early history of surveying
- 1.4 Classifications of survey
- 1.5 Importance of forest surveying and its objective
- 1.6 Principles of surveying
- 1.7 Types of measurement and their units
- 1.8 Scale, methods of denoting scale (numerical and graphical) and shrunk scale (with numerical examples)
- 1.9 Work of a surveyor - fieldwork, office work, care of instruments

UNIT 2. ERRORS AND ACCURACY (3)

- 2.1 Necessity for accurate surveys
- 2.2 Accuracy and precision
- 2.3 Errors and mistakes
- 2.4 Sources of errors
- 2.5 Systematic and accidental errors/probable error
- 2.6 Accuracy in surveying and permissible errors

UNIT 3. LINEAR MEASUREMENT AND ASSOCIATED ERROR AND CORRECTIONS (7)

- 3.1 Importance of linear measurement, different methods for linear measurement
- 3.2 Instruments for chaining, different types of chains/tapes
- 3.3 Ranging - direct, indirect, chaining/taping on plain ground and sloping ground, numerical based on slope distance

- 3.4 Linear measurement through obstacles (obstacle to chaining/obstacle to ranging/obstacle to both chaining and ranging and numerical related to obstacle)
- 3.5 Chain surveying, its principle and limitations
- 3.6 Distance corrections with numerical
 - 3.6.1 Type of distance corrections
 - 3.6.2 Slope
 - 3.6.3 Wrong length of tape
 - 3.6.4 Temperature variation
 - 3.6.5 Sag
 - 3.6.6 Tension
 - 3.6.7 Combined correction
- 3.7 Common mistakes and errors in taping
- 3.8 Suggestions for good chaining/taping and chaining/taping precision

UNIT 4. COMPASS SURVEYING (5)

- 4.1 Introduction to compass surveying
- 4.2 Types of compass (prismatic and surveyor compass)
- 4.3 Terms associated with compass surveying: meridian, bearing and azimuths
- 4.4 System of bearings, conversion from one system to another. Calculation of angles from bearing and vice versa. Numerical related with angle and bearing calculation
- 4.5 Magnetic declination and dip, variation in magnetic declination, relation between T.B, M.B. and declination. Numerical related with declination
- 4.6 Errors in compass survey (local attraction and observational error)

UNIT 5. LEVELLING (6)

- 5.1 Basic definitions
- 5.2 Methods of leveling
- 5.3 Scope/importance of leveling
- 5.4 Theory of direct leveling
- 5.5 Levels and level rods (name its type)
- 5.6 Temporary adjustment of level and care of the equipment
- 5.7 Methods of direct leveling
 - 5.7.1 Height of instrument (HI)
 - 5.7.2 Rise and fall method
- 5.8 Balancing the back and foresight
- 5.9 Curvature and refraction
- 5.10 Reciprocal leveling
- 5.11 Profile leveling and cross sectioning: Plotting
- 5.12 Common leveling mistakes and errors
- 5.13 Suggestions for good leveling
- 5.14 Precision of differential leveling

UNIT 6. THEODOLITE AND TOTAL STATION SURVEYING (4)

- 6.1 Basic definitions and application
- 6.2 Parts/components of theodolite
- 6.3 Temporary adjustment

- 6.4 Care of the instrument
- 6.5 Reading the theodolite
- 6.6 Sighting
- 6.7 Measurement of horizontal angles
- 6.8 Closing the horizon
- 6.9 Measuring the angle by repetition
- 6.10 Measurement of vertical angles
- 6.11 Sources of errors and mistakes in angle measurement
- 6.12 Introduction and advantage of total station

UNIT 7. TRAVERSING AND TRAVERSE COMPUTATION (5)

- 7.1 Traversing (definition and types)
- 7.2 Methods of traversing (compass, theodolite, total station)
- 7.3 Computation and plotting a traverse
- 7.4 Co-ordinate method in detail (latitude and departure method)
- 7.5 Methods of balancing the closing error
- 7.6 Numerical related to coordinate calculation
- 7.7 Angle distance relationship

UNIT 8. TACHEOMETRY SURVEYING (3)

- 8.1 Definition
- 8.2 Introduction to stadia
- 8.3 Principles of stadia method
- 8.4 The anallatic lens
- 8.5 Distance and elevation formula derivation for staff vertical and related numerical

UNIT 9. CONTOURING (4)

- 9.1 Basic definitions
- 9.2 Contour interval, factors affecting contour interval, horizontal equivalent and characteristics of the contour
- 9.3 Methods of locating the contours
- 9.4 Interpolation of the contours
- 9.5 Contour gradient
- 9.6 Uses of the contour maps

UNIT 10. CALCULATION OF AREA AND VOLUME (4)

- 10.1 Methods of calculating the area
- 10.2 Area computed by subdividing in triangles
- 10.3 Area by coordinates
- 10.4 Area within the irregular boundaries
 - 10.4.1 Trapezoidal rule
 - 10.4.2 Simpson's 1/3 rules
- 10.5 Area by using planimeter
- 10.6 Measurement of volume
 - 10.6.1 Volume by spot levelling
- 10.7 Numerical based on area and volume calculation

UNIT 11. INTRODUCTION TO GPS IN FOREST SURVEYING (2)

- 11.1 Introduction, uses of GPS, Advantages over conventional instruments
- 11.2 Introduction to coordinate system and projection system
- 11.3 GPS segments, working principle
- 11.4 Errors and accuracy
- 11.5 Absolute GPS
- 11.6 Differential GPS method

PRACTICALS (12)

1. Familiarize with different surveying equipment and develop skills for map reading
2. Conduct indirect ranging and carry out linear measurement in slope and plain
3. Prepare simple traverse map by compass surveying.
4. Prepare simple contour map with theodolite (horizontal/vertical angle measurement)
5. Conduct leveling operation for (differential, profile and cross sectioning)
6. Acquire data by GPS and prepare simple map

TEXT AND REFERENCES

1. McCormac, Jack C. 2003. Surveying, Fifth edition. John Wiley & Sons, USA.
2. Prakash, Ram. 1993. Forest Surveying. International Book Distributors, Dehradun, India.
3. Punmia, B.C., A.K. Jain, and Arun K. Jain. 2005. Surveying, Vol. 1. Laxmi Publications, New Delhi, India.

Course Title: GLOBAL ENVIRONMENT AND CLIMATE CHANGE

Course Code: WME 352

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: To make students better equipped to contribute to important debates concerning global environmental change and its implications.

SPECIFIC OBJECTIVES:

1. To make students understand an environmental system functioning at global level.
2. To make students understand environmental change and its impact.
3. To make aware about the local, region and global initiatives against global environmental problems.
4. To enable students on their role in overall environment management.

UNIT 1. CONCEPT OF GLOBAL ENVIRONMENT CHANGE (3)

- 1.1 Major types of global environmental change and their root cause
- 1.2 Global Environment, climate change, disaster related terminology

UNIT 2. METEOROLOGICAL FACTORS AFFECTING ENVIRONMENTAL CONDITION (10)

- 2.1 Structure and composition of the atmosphere
- 2.2 Weather, climate meteorology and climatology
- 2.3 Solar radiation and its functions
- 2.4 Absorption and re-radiation of energy by land and water
- 2.5 Atmospheric circulation: pressure gradient, coriolis and gravitational forces
- 2.6 Cyclones, anticyclones, jet streams, fronts and weather patterns
- 2.7 Weather elements: temperature, humidity, wind and atmospheric pressure
- 2.8 Measurement of weather elements: data gathering instruments and their use

UNIT 3. PHYSICAL PROCESSES OF GLOBAL CHANGE (6)

- 3.1 Physical aspect of change to natural physical, chemical, and biological cycles contributing to Global Change
- 3.2 Origin and evolution of the universe, solar system and early Earth
- 3.3 The Earth's atmosphere and oceans; ecosystems and ecosystem dynamics; atmosphere-biosphere interactions; past and future climate patterns; pollution, sea level change, global warming
- 3.4 Earth's energy balance, ozone, elemental cycles and greenhouse warming

UNIT 4. GLOBAL CHANGE: HUMAN IMPACTS (7)

- 4.1 Effects of economic and social systems on the natural physical, chemical and biological dynamics of our planet
- 4.2 Human role in shaping the planet; transformations in the environment; coastal margins, rivers, forests, fisheries, soil erosion, pollution agriculture and patterns in energy use

UNIT 5. CLIMATE CHANGE POLICIES, INSTITUTIONS AND THEIR ACTIVITIES IN NEPAL (8)

- 5.1 International and national policy on environment and climate change: IPCC-COP, NAPA, LAPA, REDD+ strategy, Montreal protocol)
- 5.2 Different institutions and their involvement in climate change mitigation and adaptation activities
- 5.3 Climate change policy in Nepal
- 5.4 Climate related disaster reduction strategy in Nepal
- 5.5 Sustainable development goals; environmental justice

UNIT 6. CLIMATE CHANGE MITIGATION AND ADAPTATION PRACTICES IN NEPAL (6)

- 6.1 Role of forestry for CC mitigation and adaptation practices
- 6.2 GHG's mitigation practices in Nepal
- 6.3 Different adaptation strategies and practices (HH level; community level)

FIELD AND CLASS EXERCISE

1. Long term temperature data analysis
2. Long term precipitation data analysis
3. Observation of climate change affected areas

REFERENCES

1. Bual, T.K., Ullah, K.M., Tiwari, K.R., McDonald, M.A. 2013, People's Local Knowledge of Climate Change in the Middle Hills of Nepal. *Indian Journal of Traditional Knowledge*, Vol. 12: 585-595.
2. Burroughs, W.J. 2007. *Climate Change: A Multi-disciplinary Approach*, Second edition. Cambridge University Press.
3. Davoudi, S., Crawford, J. and Mehmood, A. (Eds.). 2009. *Planning for Climate Change Strategies for Mitigation and Adaptation for Spatial Planners*. Earthscan Publishers, London.
4. IPCC. 2013. *Fifth Assessment Report*. IPCC, Switzerland.
5. LAPA Framework. 2012. *Local Adaptation Plan of Action to Climate Change*, National Report. Government of Nepal, Kathmandu.
6. MOE. 2011. *Climate Change Policy in Nepal*. Ministry of Environment, Government of Nepal, Kathmandu.
7. NAPA. 2010. *National Adaptation Plan of Action to Climate Change*, National Report. Ministry of Environment, Government of Nepal, Kathmandu.

Course Title: WILDLIFE BIOLOGY

Course Code: PWM 353

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: Students will gain knowledge about wildlife habitat, wildlife population dynamics, animal behavior and common wildlife diseases.

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

1. Demonstrate understanding of the basic concepts of wildlife biology upon which the art of wildlife management is based.
2. Comprehend the components of and concepts related to wildlife habitat.
3. Understand the principles of wildlife populations.
4. Demonstrate understanding of the concepts of animal behavior.
5. Develop understanding on distribution of animals on biosphere.
6. Familiarize and identify common types of wildlife diseases.

UNIT 1. INTRODUCTION AND DEFINITIONS (3)

- 1.1. Basic concept of wildlife biology
- 1.2. Basic concept of animal ecology

UNIT 2. WILDLIFE HABITAT (9)

- 2.1. Habitat components: food, cover, space and water
- 2.2. Types of wildlife habitat and major wildlife associated with these habitats focusing on habitat specific wildlife
- 2.3. Limiting and welfare factors of wildlife habitat
- 2.4. Habitat sharing and habitat overlapping
- 2.5. Habitat loss, habitat fragmentation
- 2.6. Concepts related to wildlife habitat (ecosystem study)
 - 2.6.1 Tropic level
 - 2.6.2 Energy transfer
 - 2.6.3 Carrying capacity
 - 2.6.4 Succession and habitat change (firing, flooding)
 - 2.6.5 The edge and edge effect
- 2.7. Alien and invasive species

UNIT 3. WILDLIFE POPULATIONS (7)

- 3.1 . Population dynamics
 - 3.1.1 Natality and mortality
 - 3.1.2 Age structure and sex-ratio
 - 3.1.3 Dispersal, population fluctuations
 - 3.1.4 Carrying capacity
 - 3.1.5 Population patterns (r-selected and k-selected)
 - 3.1.6 Population growth models
- 3.2 . Population genetics related problems

- 3.2.1 Severe reduction in gene pool (Genetic drift)
- 3.2.2 Genetic swamping (Hybridization)
- 3.2.3 Inbreeding

UNIT 4. ANIMAL BEHAVIOR (8)

- 4.1 Habitat selection and sexual selection (intra sexual selection and inter sexual selection)
- 4.2 Defense and territorial behavior
- 4.3 Social organization and behavior
- 4.4 Mating and courtship behavior
- 4.5 Reproductive physiology and behavior
- 4.6 Parental care
- 4.7 Aggressive behavior
- 4.8 Circadian and circannual rhythms
- 4.9 Imprinting
- 4.10 Migration and their causes
- 4.11 Aestivation and hibernation

UNIT 5. COMMUNITY ECOLOGY IN CONSERVATION (5)

- 5.1 Predation and herbivory
- 5.2 Competition and parasitism
- 5.3 Disease vectors
- 5.4 Commensalism and mutualism
- 5.5 Character displacement

UNIT 6. FOOD AND FEEDING BEHAVIOUR (7)

- 6.1. Food
 - 6.1.1 Carbohydrates
 - 6.1.2 Fats
 - 6.1.3 Proteins
 - 6.1.4 Vitamins
 - 6.1.5 Macro-nutrients
 - 6.1.6 Micro-nutrients
- 6.2. Feeding behavior and defense
 - 6.2.1 Quality of food
 - 6.2.2 Quantity of food
 - 6.2.3 Response to food shortage
 - 6.2.4 Prey predator relationship
- 6.3. Diet analysis
 - 6.3.1 Tools, techniques and applications of diet analysis

UNIT 7. ANIMAL DISTRIBUTION (5)

- 7.1. Biogeographical realms
- 7.2. Zoo geography
 - 7.2.1 Uniform (Continuous) distribution
 - 7.2.2 Random (Discontinuous) distribution
 - 7.2.3 Bipolar distribution
- 7.3. Factors affecting animal distribution (Geographical barriers)

- 7.4. Zoo-geographic distribution of animal
- 7.5. Faunal realms and biomes
- 7.6. Climate change and its consequence in wildlife management

UNIT 8. WILDLIFE DISEASES (6)

- 8.1 Wildlife diseases
 - 8.1.1 Infectious and non-infectious diseases, zoonotic diseases
 - 8.1.2 Agents of disease: bacteria, virus, protozoa, parasites and fungi
- 8.2 Causes, symptoms and preventive measures of some common wildlife diseases:
 - 8.2.1 Bacterial diseases: anthrax, brucellosis, tuberculosis and salmonellosis
 - 8.2.2 Viral diseases: foot and mouth diseases, rabies, rinderpest and canine distemper
- 8.3 Post-mortem examination and its purposes

PRACTICALS (10)

1. Study of types of animal behavior (e.g. Case of *Rhesus macaque*)
2. Visit Bird Museum / Museum/ Mini zoo
3. Diet analysis (locally available one herbivore and carnivore)
4. Post mortem examinations

TEXT AND REFERENCES

1. Alcock, John. 1975 and 2013. *Animal Behavior: An Evolutionary Approach*, Tenth edition. Arizona State University, USA.
2. Bailey, James A. 1984. *Principles of Wildlife Management*. John Wiley and Sons, NY.
3. Bolen, Eric G. and Robinson, William L. 2003. *Wildlife Ecology and Management*. Prentice Hall.
4. Dasman, Raymond F. 1981. *Wildlife Biology*. John Wiley and Sons, University of California.
5. Krebs, J.R. and Davies, N.B. 1987. *An Introduction to Behavioral Ecology*. Blackwell Scientific Publication.
6. Lakhey, S.P. 2014. *Wildlife Biology*. IOF Hetauda.
7. McFarland, David. 1999. *Animal Behavior, Psychobiology, Ethology and Evaluation*. Longman, London.
8. Morica and Burton, Robert. 1977. *Arrival World*. Macmillan Ltd., London.
9. Saunders, W.B. 1986. *Zoo and Wild Animal Medicine*, Second edition. Philadelphia, USA.
10. Shaw, James H. 1985. *Introduction to Wildlife Management*. McGraw Hill Co.
11. Smith, Robert L. 2002. *Ecology and Field Biology*, Benjamin Cummings.

Course Title: FOREST MANAGEMENT I

Course Code: SFM 354

Credit Hour: 2

(Final Theory: 30; Internal Assessment: 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: With the completion of this course, the students will gain knowledge and skills in forest management techniques.

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

1. Explain the definition scope, logic and principles of forest management.
2. Understand and explain the interactions and interdependence between human, forest resources, and the environment.
3. Estimate the growing stock of a given forest.
4. Prepare an operational plan of a given forest area.
5. Understand and explain the concept and importance of multiple use forest management.
6. Understand classification of forest and normal forest concept.
7. Understand the concept of yield and yield regulation.

UNIT 1. INTRODUCTION (4)

- 1.1 Definition and scope of forest management
- 1.2 Goal and objectives of forest management
- 1.3 History of forest management in Nepal

UNIT 2. INTERACTION OF HUMAN AND FOREST (4)

- 2.1 Human dependence on forest resources in Nepal (historical): food, firewood and fodder
- 2.2 Human impact on the forest of an area
 - 2.2.1 Wood/ firewood collection
 - 2.2.2 Grazing systems
 - 2.2.3 Agriculture /shifting cultivation
- 2.3 Scarcity of forest products and local adaptation measures

UNIT 3. CLASSIFICATION OF FORESTS (3)

- 3.1 Purpose and classification of forests on the basis of
 - 3.1.1 Geographical and climatic factors
 - 3.1.2 Functional factors (Protective and productive)
 - 3.1.3 Legal factors

UNIT 4. NORMAL FOREST (3)

- 4.1 Definition and concept
- 4.2 Implication of the concept to forest management

UNIT 5. GROWING STOCK, INCREMENT AND SITE QUALITY (5)

- 5.1 Growing stock and increment
 - 5.1.1 Introduction and definition of growing stock, determination of growing stock by various methods.
 - 5.1.2 Concept and types of increment

5.1.3 Importance and determination of site quality

UNIT 6. ROTATION (5)

- 6.1. Definition and concept of rotation
- 6.2. Rotation in regular and irregular forest
- 6.3. Types of rotation
 - 6.3.1 Physical and silvicultural
 - 6.3.2 Rotation of max. volume production
 - 6.3.3 Rotation of highest income
- 6.4 Choice of rotation
- 6.5 Conversion period
- 6.6 Rotation determination methods
 - 6.6.1 Biological criteria
 - 6.6.2 Financial/ economic criteria
 - 6.6.3 Social and environmental criteria

UNIT 7. YIELD REGULATION (4)

- 7.1 Concept and importance of yield regulation
- 7.2 Sustained yield
- 7.3 Yield table
- 7.4 Yield regulation in clear felling system

UNIT 8. FOREST MANAGEMENT PLAN (2)

- 8.1 Concept, importance and scope of management plan
- 8.2 Prerequisite for community forest operational plan
- 8.3 Write up of operational plan

UNIT 9. CONCEPT OF MULTIPLE USE MANAGEMENT (2)

- 9.1 Concept, scope and practicality multiple use management
- 9.2 Scientific forest management: Concept and lesson learned

PRACTICALS (8)

1. Study of government managed forest, leasehold forest, religious forest and CF (Indicator, effectiveness practicality analysis and reporting) management
2. Study of human response to forest resource scarcity
3. Observation and classification of forests and forest land
4. Preparation of operational plan (including steps and methods)

TEXT AND REFERENCE

1. Clutter, J.C. et al. 1983. Timber Management: A Quantitative Approach. John Wiley and Sons.
2. Davis, L.S. and Johnson, K.N. 1987. Forest Management. McGraw Hill Book Company, New York.

3. Davis, L.S., Johnson, K.N., Bettinger, P.S. and Howard, T.E. 2001. Forest Management. McGraw Hill Book, New York.
4. DOF. 2061 BS. Community Forestry Inventory Guideline. Department of Forest, Babarmahal, Kathmandu.
5. Duerr, William A., Dennis E. Teeguarden, Sam Guttenberg (Eds.) . 1982. Forest Resource Management. OSU Bookstore, Ohio.
6. Leuchner, W.A. 1984. Introduction to Forest Resource Management. John Wiley and Sons.
7. Mathur, V.P. 1968. Forest Management for Forest Colleges and Working Plan, Surya Prakashan.
8. Osmaston, F.C. 2011. The Management of Forests. Natraj Publishers, Dehradun.
9. Prakash, R. 1986. Forest Management. International Book Distributors, Dehradun.
10. Tiwari, Krishna Babu. Nepali Banko Aaitihasik Sinhawalokan.

Course Title: FOREST EXTENSION AND EDUCATION

Course Code : SFM 355

Credit Hour: 3

(Final Theory: 60, Internal Assessment: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVES: To provide students broad knowledge in the field of forest extension and make them work confidently in rural development activities.

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

1. Understand the concept and principles of forest extension.
2. Communicate and work with rural communities.
3. Design and evaluate specific programs for rural setting.
4. Apply participatory tools.
5. Plan and produce simple extension materials.

UNIT 1. INTRODUCTION TO EXTENSION EDUCATION (8)

- 1.1 Definition, concept of extension education
- 1.2 Importance of extension education
- 1.3 The basic principles and objectives of extension education
- 1.4 Roles and qualities of an extension course

UNIT 2. COMMUNICATION IN EXTENSION EDUCATION (10)

- 2.1 Basic concepts and principles of communication
- 2.2 Types and importance of communication in forestry
- 2.3 Elements of communication
- 2.4 One- way and two- way communication
- 2.5 Barrier of communication
- 2.6 Solutions to communication barriers
- 2.7 Motivation in communication process

UNIT 3. MOTIVATION AND ADOPTION (10)

- 3.1 Definition and concept of motivation
- 3.2 Maslow's hierarchy of human needs
- 3.3 Theories of motivation
 - 3.3.1 McGregor's theory X and Y
 - 3.3.2 Contingency theory (Z)
 - 3.3.3 Hygiene maintenance theory of Herzberg
 - 3.3.4. Application of motivation theory in the context of forestry (field based)
 - 3.3.4.1 Adoption
 - 3.3.4.2. Process of adoption
 - 3.3.4.3. Categories of adoption

UNIT 4. EXTENSION METHODS (10)

- 4.1 Individual methods
- 4.2 Group methods
- 4.3 Mass methods (including ICT- based communication like mass SMS)

UNIT 5. FOREST EXTENSION TEACHING AIDS (8)

- 5.1 Definition and importance of teaching aids
- 5.2 Types and uses of teaching aids (Audio, visual, audio-visual, written and printed materials)
- 5.3 Evaluation of teaching aids
- 5.4 Preparation of smart extension and communication materials
- 5.5 Utilization of teaching aids (1 day field- based exercise)

UNIT 6. EXTENSION PROGRAM PLANNING (8)

- 6.1 Extension program and project
- 6.2 Principles of outcomes-focused planning
- 6.3 Extension program planning cycle
- 6.4. Case study analysis of implemented extension programs

UNIT 7. SOCIAL MOBILIZATION FOR FORESTRY (6)

- 7.1 Concept and importance of social mobilization
- 7.2 Tools and techniques for social context analysis
- 7.3 Case study analysis and social analysis

TEXT AND REFERENCES

1. Adedoyin, S.F. 2005. Agricultural Extension in Nigeria. Agricultural Extension Society of Nigeria, Nigeria.
2. Agbam, J.U. 2009. Perspectives in Agricultural Extension and Development. Springfield Publishers Ltd.
3. Articles published in the journals such as Journal of Extension Education, Journal of Extension-Sharing knowledge, Enriching Extension, The Journal of Agricultural Education and Extension-Competence for Rural Innovation and Transformation, Indian Research Journal of Extension Education and other related journals.
4. Ekong, E.E. 2003. Rural Sociology. Dove Educational Publishers.
5. FAO. 1985. Guide to Extension Training. FAO, Rome.
6. Gerlach, Vernon S. and Donald P. Ely. 1980. Teaching and Media. Prentice Hall, Englewood Cliffs, N.J.
7. Jamias, J.F. (Ed.). 1975. Reading in Development Communication. Department of Development Communications, UP Los Banos, The Phillippines.
8. Joshi, N.N. 1992. A Textbook of Extension Education. Institute of Agriculture and Animal Science, Rampur, Chitwan, Nepal. (With B.B.S. Dongol).
9. Muhammed, K.Y. 2003. Development Communication. Corporate Graphics Ltd.
10. Ortigas, Carmela D. 2008. Group Process and Inductive Methods. Ateneode Manila University Press, The Phillippines.
11. Plopino, R., Martinez V. and Valbera J. 1987. An Introduction to Extension Delivery Systems. Cachs Publishing House, Manila.
12. Quebral, N.C. and E.D. Gomez. 1977. Development Communication Process. Department of Development and Communications, UP Los Banos, The Phillippines.

13. Schramm, W., Wilbur Lang Schramm and Donald F. Roberts. 1971. *The Process and Effects of Communication*. University of Illinois Press, Illinois.
14. Wayne, P. et al. 1979. *Techniques of Effective Communication Reading*. Addison-Wesley, Massachusetts, USA.

**Course Title : GENDER AND SOCIAL INCLUSION IN NATURAL RESOURCES
MANAGEMENT**

Course Code: SFM 356

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: To provide concepts and in-depth knowledge and skills in gender and social inclusion to the students and acquaint them with its importance in natural resource management.

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

1. Understand the basic concept of gender and social inclusion and their importance in natural resource management.
2. Describe the role of women and indigenous people to economic development and natural resources management.
3. Develop competency in assessing gender equality and social inclusion issues in natural resource management.
4. Describe the frameworks and different approaches for gender mainstreaming and social inclusion.
5. Apply the tools and techniques of Gender and SI.

UNIT 1. BASIC CONCEPT ON GENDER ISSUES AND SOCIAL INCLUSION (7)

- 1.1. Concept of inclusion and exclusion
- 1.2. Concept of gender and social inclusion
 - 1.2.1. Gender, importance of gender and gender relation
 - 1.2.2. Social construction of gender
 - 1.2.3. Dimensions of exclusion (dominant and subordinate, and men/boys and women/girls)
- 1.3. Special target group -STG (women, poor, indigenous and ethnic minorities (Dalit, Janjati, Madhesi), conflict victims, disabled
- 1.4. Gender issues and social inclusion
 - 1.4.1. Key gender issues incurred in the Nepalese rural areas
 - 1.4.2. Understanding gender issues and social exclusion
 - 1.4.3. Gender issues and social exclusion: a concern of human right
 - 1.4.4. Factors responsible for social exclusion
- 1.5. Significance of gender in the Nepalese Context.
- 1.6. Relation between Gender and Poverty Reduction Strategy of Nepal.
- 1.7. Gender issues in other developing countries of Asia, Africa and Latin America.

UNIT 2. STG IN NATURAL RESOURCE MANAGEMENT (7)

- 2.1 Role of STG in participatory forestry (CF, CFM, Bufferzone and LHF)
- 2.2 Role of STG in biodiversity conservation and water resources
- 2.3 Role of STG in farming (Ag/Ls)
- 2.4 Role of STG in Tourism

UNIT 3. NATIONAL POLICY AND INTERNATIONAL COMMITMENTS RELATED

TO GENDER AND SOCIAL INCLUSIONS (5)

- 3.1 Elimination of discrimination against STG
- 3.2 Role of different stakeholders in elimination of discrimination
 - 3.2.1 Ministry of Forest and Soil Conservation
 - 3.2.2 Ministry of Women, Children and Social Welfare
 - 3.2.3 Ministry of Environment and Population.
 - 3.2.4 Adibasi Janjati Commission
 - 3.2.5 Poverty alleviation fund?
 - 3.2.6 Govt/non-govt/private sector role
- 3.3 Gender Responsive Budget Analysis

UNIT 4. METHODS, TOOLS AND INDICATORS FOR ANALYZING GENDER/SI (10)

- 4.1 Social analysis tools (PWBR, Power mapping, mobility, exploitation, resource and social mapping) and process
- 4.2 Problem identification and analysis
- 4.3 Barriers/challenges of mainstreaming gender and social inclusion
 - 4.3.1 Inadequate participation by women and marginalized groups
 - 4.3.2 Lack of recognition as key stakeholders
 - 4.3.3 Inadequate technical skills
 - 4.3.4 Inadequate representation in decision making
 - 4.3.5 Bottlenecks
- 4.4 Steps to integrate gender in NRM
- 4.5 Objective and indicators for Gender and SI analysis
- 4.6 Monitoring and Evaluation Indicators for GESI and natural resources management
- 4.7 Analysis of differential impacts due to climate change

UNIT 5. GENDER MAINSTREAMING AND SOCIAL INCLUSION (11)

- 5.1 GESI (Gender Equality & Social Inclusion)
 - 5.1.1 Strategy approach
 - 5.1.2 Access of participation and leadership (leadership by women and disadvantaged in vital positions)
 - 5.1.3 Equitable benefit- sharing
 - 5.1.4 Accountability of forestry stakeholders
- 5.2 Women and development approaches and social inclusion
 - 5.2.1 WID, WAD and GAD approaches
 - 5.2.2 Right- based approach
 - 5.2.3 Participatory approach
 - 5.2.4 Evidence- based approach
- 5.3 Gender analysis (social relation, approach, Empowerment , Gender Analysis Matrix, Moser Approach, Harvard Analysis Approach)
- 5.4 Gender equality results and indicators (Education, energy, sustainable NRM and climate change, health, law, justice, food security, patron client relationship)
- 5.5 Framework for gender mainstreaming and social inclusion
 - 5.5.1 National policy
 - 5.5.2 Local governance
 - 5.5.3 Gender responsive budgeting

- 5.5.4 Monitoring
- 5.6 Gender issues in Sustainable Livelihood Framework
- 5.7 GESI mainstreaming across all
- 5.8 Good practices and lessons learnt from other developing countries.

TEXT AND REFERENCES

1. Articles published in the journals such as Journal of Gender and Education, International Journal of Gender Studies in Developing Societies, International Journal of Gender and Women's Studies and other related journals.
2. GeMSIP. 2009. Gender Mainstreaming and Social Inclusion: Basic Training Manual. GeMSIP, GON, Kathmandu.
3. Naomi, Black. 1981. The Future for Women and Development. SAGE Publication, India.
4. Narayan, D. 2000. Voices of the Poor: Can Anyone Hear Us?. World Bank, Washington D.C. USA.
5. ODC. 200. Guidelines on Gender and Natural Resource Management. Organizational Development Center, Kathmandu.
6. Upadhyay, B. 2005. Women and natural resource management: Illustration from India and Nepal. *Natural Resources Forum*, 29: 224 – 232.
7. World Bank. 2001. Engendering Development. A World Bank policy research report, Oxford University Press, Washington D.C., USA.

Course Title: GEO-PHYSICS

Course Code: BSH 357

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

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

1. Acquire in depth knowledge and skills of physical concepts applied in forestry.
2. Explain phenomena in terms of theories and models.
3. Apply the knowledge for higher studies and research in NRM.

UNIT 1. INTRODUCTION (3)

Introduction, application and ambiguity of Geo-Physics

UNIT 2. SPACE SYSTEM (7)

Basic orbit of mechanics, concepts of orbits-propulsion, Kepler's law for planetary orbit, manned and unmanned space travel, rocket launch technology, natural and artificial satellites, launching of artificial satellites, expression for orbital and escape velocities, synchronous satellite, height of synchronous satellite from earth surface

UNIT 3. PHYSICS OF REMOTE SENSING (10)

Introduction to remote sensing - electromagnetic spectrum, effects of atmosphere, fundamentals of radiometry, spectral reflectance for vegetation, water soil, snow, physical basis of signatures, remote sensor, optical-infrared sensor, microwave sensor, geographical information system

UNIT 4. EARTH SYSTEM (5)

Components of the earth system- atmosphere-hydrosphere-cryosphere-lithosphere-biosphere, earth crust and mantle.

UNIT 5. TIMBER SYSTEM (5)

Different types of stress and strain, stress-strain relationships, simple shear, principle stress and Mohr circle diagram, Hook's law and modulus of elasticity, directional elastic constant

PRACTICALS (10)

- Determination of the acceleration due to gravity using simple pendulum
- Determination of the moment of inertia of a fly wheel
- Determination of specific gravity
- Familiarization of remote sensing in GIS software

TEXT AND REFERENCES

1. Campbell, J.B. 2008. Introduction to Remote Sensing, Fourth edition. The Guilford Press.
2. Hale, F.J. 1994. Introduction to Space Flight. Prentice Hall.
3. Joseph, G. 2005. Fundamental of Remote Sensing, Second edition. Universities Press.
4. Nelkon, M. and Parker, P. 1995. Advanced Level Physics. Heinemann Educational.
5. Singhal, S.S. Agrawal, J.P. and Prakash, S. 2012. Heat Thermodynamics and Statistical Physics. Pragati Prakashan, Meerut, India.
6. Wallace, J.M. and P.V. Hobbs. 2006. Atmospheric Science, An Introductory Survey. International Geophysical Series. Elsevier, Amsterdam.

LABORATORY MANUAL

1. Arora, C.L. 2010. B. Sc. Practical. S. Chand and Company.
2. Handout notes on the Erdas Imagine software from the internet

Course Title: TREE PHYSIOLOGY

Course Code: SFB 358

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVES: By the end of this course, the students will:

1. Possess and be able to utilize a general knowledge of various physiological processes, which govern the growth and development of trees and the regeneration and management of both natural and manmade forests.
2. Develop a stronger sense of curiosity through investigation.

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

1. Be familiarized with the physiological processes i.e. photosynthesis, respiration, water relations, mineral nutrition, translocation, growth and development.
2. Demonstrate understanding of the mechanism and role of various physiological processes governing growth and development of trees.
3. Be able to apply their knowledge of tree physiology in silviculture and forest management.
4. Be exposed to procedures used to study physiological processes.

UNIT 1. INTRODUCTION (2)

- 1.1 The science of plant physiology
- 1.2 Principles of plant physiology

UNIT 2. PHENOMENON OF WATER LOSS (3)

- 2.1 Transpiration
 - 2.1.1 Mechanism of transpiration
 - 2.1.2 Types of transpiration
 - 2.1.3 Mechanism of stomatal movement
 - 2.1.4 Role of transpiration
 - 2.1.5 Factors affecting the rate of transpiration
- 2.2 Guttation and bleeding

UNIT 3. ABSORPTION OF WATER AND MINERAL SALTS (4)

- 3.1 Root hairs and Mycorrhizae
- 3.2 Mechanism of passive absorption
- 3.3 Mechanism of active absorption
- 3.4 Factors affecting absorption of water and salt.

UNIT 4. TRANSLOCATION (5)

- 4.1 Ascent of sap
 - 4.1.1 Vital theories
 - 4.1.2 Physical force theories
 - 4.1.3 Root pressure and atmospheric pressure theories
 - 4.1.4 Cohesion tension theory
- 4.2 Translocation of mineral salts
- 4.3 Translocation of organic food

(Phloem transport theories)

UNIT 5. PHOTOSYNTHESIS (5)

- 5.1 Mechanism of photosynthesis
- 5.2 Light reaction (Hill reaction)
- 5.3 Dark reaction (Calvin's cycle or C-3 cycle)
- 5.4 C-4 cycle
- 5.5 CAM pathway
- 5.6 Factors affecting photosynthesis

UNIT 6. RESPIRATION (4)

- 6.1 Mechanism of respiration
- 6.2 Glycolysis
- 6.3 Fermentation
- 6.4 Krbs' cycle
- 6.5 Electron transport chain
- 6.6 Pentose phosphate shunt

UNIT 7. NITROGEN METABOLISM (2)

- 7.1 Concept of nitrogen fixation (physical and biological)
- 7.2 Metabolism of Nitrite and Nitrate ions
- 7.3 Transamination reaction

UNIT 8. PLANT GROWTH AND DEVELOPMENT (5)

- 8.1 Concept of growth and development
- 8.2 Photoperiodism
- 8.3 Vernalization
- 8.4 Properties and role of Phytochrome
- 8.5 The florigen concept

UNIT 9. SEED PHYSIOLOGY (2)

- 9.1 Physiology of seed germination
- 9.2 Seed dormancy and viability
- 9.3 Methods of breaking seed dormancy
- 9.4 Seed treatment

PRACTICALS (8)

- 1. Measurement of rate of transpiration
 - Ganong's Potometer
 - Whole Plant weighing method
- 2. Experiments on photosynthesis
- 3. Experiments on respiration
 - Aerobic
 - Anaerobic
- 4. Effect of different pre-treatments on the rate of seed germination

TEXT AND REFERENCES

1. Devlin, R.M. 1983. Plant Physiology, Fourth revised edition. Revised by F.H. Witham. PWS, London.
2. Jain, V.K. 2000. Fundamentals of Plant Physiology. S.Chand & Company Ltd, Ram Nagar, New Delhi.
3. Kramer, P.J. and Kozlowsky, T.T. 1960. Physiology of Trees. McGraw-Hill.
4. Leopold, A.C. and P.B. Kriedemann, 1975. Plant Growth and Development, Second ed. McGraw Hill, N.Y.
5. Malik, C.P. and A.K. Srivastava. 2015. Textbook of Plant Physiology. Kalyani Publishers, Daryaganj, New Delhi.
6. Noggle, G.R. and G.I. Fritz, 1983. Introductory Plant Physiology. Prentice-Hall Inc., Englewood Cliffs.
7. Pandey, S.N. and B.K. Sinha. 2009. Plant Physiology, Fourth ed. Vikash Publishing House, New Delhi.
8. Salisbury, F.B. and C.W. Ross. 1992. Plant Physiology, Fourth ed. Wadsworth Publishing Co., Belmont, California.
9. Wilkins, M.B. 1976. Physiology of Plant Growth and Development. McGraw-Hill Publishing Company Limited.
10. Wilkins, M.B. 1987. Advanced Plant Physiology, First ed. ELBS Longman Group, UK.

Course Title : FIELD TOUR
Course Code : SFM 359
Credit Hour: 1
(Theory and Practical)

Lecture Hour: 20
Full Mark : 25

Practical field observation training related to forestry, soil conservation and wildlife management for one week will be conducted in- and- around Gorkha, Sauraha, Daman, or any suitable area closer to these areas. The respective campuses will provide the field visit program. At the end of field training students' evaluation will be done by the supervising faculty.

YEAR 2 SEMESTER I

Course title: FOREST STATISTICS

Course code:BSH 401

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: At the end of this course, the students will be able to demonstrate the basic concepts and limitations of standard statistical procedures by computing different descriptive measures, probability of various events and their applications in applied research.

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

1. Demonstrate the concepts of descriptive statistical measures, probability distribution and their uses in forestry research.
2. Demonstrate basic concepts of hypothesis testing and correlation and regression analysis.
3. Be prepared for the forthcoming course on experimental design of B. Sc. Forestry, Third year.

UNIT 1. BASIC STATISTICAL CONCEPTS (3)

1.1 Definition, use, scope and limitation of statistics

1.2 Definition of standard terms: population and sample, parameter and statistic, variables

UNIT 2. DESCRIPTIVE STATISTICS (12)

2.1 Introduction

2.2 Frequency distribution: discrete, continuous

2.3 Diagrammatic and graphical presentation of data

2.3.1 Simple, sub-divided, percentage and multiple bar diagrams, pie- diagram

2.3.2 Histogram, frequency polygon, frequency curve and o-give curve

2.4 Measure of central tendency: Introduction, types, properties, merits, demerits and uses of mean, median and mode

2.5 Measure of dispersion: Introduction, types, properties, merits, demerits and uses of range, quartile deviation, mean deviation, standard deviation, coefficient of variation and Lorenz curve

2.6 Measure of skewness, kurtosis, moments and their uses

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

2.8 Regression: Introduction, simple linear regression, properties of regression coefficients

2.9 Coefficient of determination

UNIT 3. PROBABILITY (4)

3.1 Terminology used in probability

3.2 Definition of probability

3.3 Theorems of probability: Addition and multiplication theorems

UNIT 4. RANDOM VARIABLE AND MATHEMATICAL EXPECTATION (6)

- 4.1 Random variable: Discrete and continuous
- 4.2 Probability mass function and probability density function
- 4.3 Distribution function
- 4.4 Mathematical expectation

UNIT 5. PROBABILITY DISTRIBUTION (8)

- 5.1 Introduction
- 5.2 Discrete and continuous probability distribution
- 5.3 Binomial distribution
- 5.4 Normal distribution
- 5.5 Normal probability curve and area calculation

UNIT 6. STATISTICAL INFERENCE (15)

- 6.1 Estimation: Introduction, types of estimation (point and interval), confidence interval for mean
- 6.2 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

PRACTICALS (12)

1. Computer applications in statistics: Variable definition, coding, editing and data entry
2. Frequency distributions, diagrams and graphs
3. Computation of mean, median, mode, quartile deviation, mean deviation, standard deviation, comparisons of distributions by using coefficient of variation
4. Probability and probability distribution (Binomial, Poisson and Normal)
5. Computation of correlation and regression and its test of significance
6. Computation of confidence interval, hypothesis testing, Z-test, T-test and F-test, Chi-square test

TEXT AND REFERENCE

1. Chacko, V.E. 1965. Manual on Sampling Techniques for Forest Surveys. The Manager of Publication, Delhi.
2. Frank, F. 1967. Elementary Statistical Methods for Foresters, Vol. 317 of Agriculture Handbook, USDA, Forest Service.
3. Gupta, S.C. 1992. Fundamentals of Statistics. Himalayan Publishing House, Delhi, India.
4. Gupta, S.C. and Kapoor, V.K. 2013. Fundamentals of Mathematical Statistics. Sultan Chand and Sons, 23, Daryaganj, Delhi-110002.
5. Huntsberger, David V. and Billingsley, Patrick. 1987. Elements of Statistical Inference. Allyn & Bacon, Boston.
6. Jayaraman, K.A. 2000. A Statistical Manual for Forestry Research. FORSPA-FAO Publication, Bangkok.
7. Kothari, C.R. 2013. Research Methodology, Methods and Techniques. New Age International Publishers, New Delhi.

8. Shrestha, Sunity and Silwal, D.P. 2011. Statistical Methods in Management. Taleju Prakashan, Kathmandu.
9. Steel, R.G.D., Torrie, J.H. and Dicky, D.A. 1997. Principles and Procedures of Statistics: A Biometrical Approach. Third edition, McGraw Hill, Inc. Book Co., New York.
10. Wackerly, D., Mendenhall, W. and Sheaffer, R.L. 2008. Mathematical Statistics with Applications, Seventh edition. Thomson Brooks/Cole.

Course Title: SOIL SCIENCE

Course Code: WME 402

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVES: Upon completion of this course, students will have a basic understanding of soil composition, properties, classification and sustainable soil management for 21st century.

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

1. Identify physical, biological properties of the soil and understand their effect on soil.
2. Understand aerobic and anaerobic process and microbes on soil.
3. Understand the soil development and classification.
4. Understand the effect of soil management for plant growth and environment management.

UNIT 1. INTRODUCTION TO SOIL SCIENCE (3)

- 1.1 Concept of soil (edaphological and pedagogical)
- 1.2 Historical development of soil science
- 1.3 Soil as a medium for plant growth and soil as a natural body

UNIT 2. SOIL PROPERTIES (8)

- 2.1 Physical properties:
 - 2.1.1 Soil texture, structure, color, consistency, plasticity
 - 2.1.2 Soil moisture content and pH curve
 - 2.1.3 Soil moisture and temperature regimes
 - 2.1.4 Soil porosity, bulk density, particle density, soil aeration
- 2.2 Chemical properties
 - 2.2.1 Soil pH and its relationship with nutrients uptake.
 - 2.2.2 Soil reaction: acidic soils, sodic, saline sodic soils and their management
 - 2.2.3 Ion exchange phenomenon in soil; cation and anion exchange capacity
 - 2.2.4 Buffering of soils, lime and soil fertility management
- 2.3 Soil moisture and temperature regimes

UNIT 3. SOIL ORGANIC MATTER (7)

- 3.1 Humus formation and characteristics
- 3.2 Amount and distribution of organic matter in soil and their function
- 3.3 Significance of carbon/nitrogen ratio in soil
- 3.4 Classification of organic soil
- 3.5 Carbon, nitrogen and phosphorous cycles in soil

UNIT 4. SOIL MACRO AND MICROBIAL SYSTEM (4)

- 4.1 Microbial population of the soil
- 4.2 Process of aerobic and anaerobic organisms
- 4.3 Role of algae, fungi, actinomycetes, protozoa and bacteria on soil
- 4.4 Role of earthworm, termites, ants, and nematodes in soil

UNIT 5. SOIL GENESIS (6)

- 5.1 Soil forming factors
- 5.2 Soil development processes:
 - 5.2.1 General concept of gain, loss, translocation and transformation,
 - 5.2.1 Weathering of rock and minerals,
 - 5.2.3 Soil formation processes
- 5.3 Soil profile and diagnostic horizons
 - 5.3.1 Soil profile, concept of soil pedon
 - 5.3.2 Masters horizons, surface and subsurface diagnostic horizons

UNIT 6. SOIL CLASSIFICATION (8)

- 6.1 Introduction, historical development, purpose and principles,
- 6.2 Soil classification systems
 - 6.2.1 USDA Soil Taxonomy
 - 6.2.2 World reference base (WRB) for soil resources
- 6.3 Soil orders and their characteristics
- 6.4 Soils of Nepal
 - 6.5.1 Characteristics of soils found in Nepal
 - 6.5.2 Soil types (alluvial, colluvial, lacustrine, etc.,)

UNIT 7. PLANT NUTRIENTS, MANURE AND FERTILIZER (7)

- 7.1 Essential nutrients (macro and micro-elements) and their functions for plant growth
- 7.2 Types of manure and fertilizer
- 7.3 Methods of solid and liquid fertilizer application for trees growth
- 7.4 Fertilizer and its effect on environment
- 7.5 Biological nitrogen fixation and soil fertility
- 7.6 Green manure and bio-fertilizers production and their importance in Nepal
- 7.7 Leaching losses of nutrients
- 7.8 Soil management for 21st Century
- 7.9 Need of nutrient balance in soil

UNIT 8 GLOBAL SOIL ENVIRONMENT (5)

- 8.1 Carbon sequestration and global environment (Soil as a source and sink of carbon)
- 8.2 Role of soil carbon in global environment
- 8.3 Methods of carbon sequestration
- 8.4 Measurement of soil carbon / mechanisms of increasing soil carbon
- 8.5 Role of forest in carbon sequestration.

PRACTICAL IN FIELD AND LAB (12)

Soil Excursion Tour (5 days soil survey tour in different ecological zones of Nepal)

- 1. Site description
- 2. Soil pedon description
- 3. Soil taxonomy/classification
- 4. Field soil sampling

5. Soil analysis in laboratory
5. Report submission and presentation

PRACTICALS (12)

1. Identification and function of soil science laboratory equipment in laboratory of soil science and geology
2. Soil pedon description in the field and field measurement of soil properties
3. Soil sampling and preparation of soil sample for laboratory analysis
4. Soil particle size determination
5. Soil pH determination
6. Measurement of soil bulk density and soil particle density
7. Soil moisture determination and field capacity
8. Determination of soil organic matter content (SOM)
9. Laboratory soil analysis for nitrogen, phosphorous and potash
10. Carbon estimation in soil tons per hectare

TEXT AND REFERENCES

1. Baver, L.D., W.H. Gardner and W.R. Gardner. 1978. Soil Physics. Wiley Eastern Limited, New Delhi.
2. Buol, S.W., F.D. Hole and R.J. McCracken. 1989. Soil Genesis and Classification. The Iowa State University Press, Ames.
3. Carson, B. 1992. The Land, the Farmer and the Future: A Soil Fertility Strategy for Nepal. ICIMOD, Kathmandu.
4. Foth, Henry D. 1991. Fundamentals of Soil Science, Eighth edition. John Wiley and Sons.
5. Howell, J.H., 1986. Guidelines for Soil Profile Description. Soil Technical Note No. 5, F.S.R.O.
6. IARI. 1970. Soil Survey Manual, Revised edition. All India Soil and Landuse Survey Organization, I.A.R.I., New Delhi, India.
7. IRRI, 1991. Biological Nitrogen Fixation for Sustainable Agriculture. IRRI, The Phillippines.
8. IUSS Working Group WRB. 2015. International Soil Classification System for Naming Soils and Creating Legends for Soil Maps. World Reference Base for Soil Resources 2014, update 2015, World Soil Resources Reports No. 106, FAO, Rome.
9. Jenny, Hans. 1994. Factors of Soil formation. Dover Publications, Inc. Mineola, New York.
10. Klute, A. (Ed.). 1986. Methods of Soil Analysis, Part I. Second ed. Agronomy Monograph 9, Madison, WI.
11. Lal, Ratan and D.J. Greenland (Eds.). 1979. Soil Physical Properties and Crop Production in the Tropics. John Wiley and Sons, U.K.
12. Lal, Ratan. 1996. Methods and Guidelines for Assessing Sustainable Use of Soil and Water Resources in the Tropics. Scientific Publishers, P.O. box 91, Jodhpur, India.
13. Lee, K.E. 1985. Earthworm: Their Ecology and Relationships with Soils and Land Use. Academic Press, London, U.K.
14. LRMP. 1986. Geological Report. Land Resource Mapping Project, Kathmandu.

15. LRMP. 1986. Land Capability Report. Land Resource Mapping Project, Kathmandu.
16. Namowitz, Samuel N. and Donald B. Stone. 1960. Earth Science. Van Nostrand Reinhold Inc.,U.S.
17. Sanchez, Pedro, A. 1976. Properties and Management of Soils in the Tropics. John Wiley and Sons, New York.
18. Soil Survey Staff. 1962. Soil Survey Manual. U.S. Department Agriculture Handbook 18, U.S. Government Printing Office, Washington D.C..
19. Soil Survey Staff. 1975. Soil Taxonomy. U.S. Department Agriculture Handbook 436, U.S. Government Printing Office, Washington D.C.
20. Sthapit, K.M. 1987. Land Capability Classification. Watershed Planning Manual No. 4., Watershed Management Project, Department of Soil Conservation, Kathmandu.
21. Sthapit, K.M. 1989. Soil Mapping Handbook, Watershed Planning Manual No. 3. Watershed Management Project, Department of Soil Conservation, Kathmandu.
22. Tiwari, K.R. 2008. Management Option for Sustainable Soil Conservation in Nepal. PhD Thesis, Norwegian University of Life Sciences, Norway.
23. USDA. 2014. Soil Taxonomy. U.S. Department Agriculture, U.S. Government Printing Office, Washington D.C.
24. Weil , Ray R. and Brady, N.C. 2016. Nature and Property of Soils, Fifteenth edition. Pearson International.

Course Title: WILDLIFE CONSERVATION AND MANAGEMENT

Course Code: PWM 403

Lecture Hour: 60

Credit Hour: 3

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical:15)

GENERAL OBJECTIVE: After completion of the course students will gain knowledge about application of tools and techniques used for the conservation and management of wildlife and their habitants.

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

1. Demonstrate understanding of the basic concepts of wildlife conservation.
2. Discuss the different techniques of wildlife management, including capturing, handling and trapping wild animals, marking and tagging, radio telemetry and other tools.
3. Demonstrate skills in habitat analysis and evaluation.
4. Understand the procedures for population estimation and analysis.
5. Describe techniques for control of wildlife damage.
6. Understand the concept of Ex-situ conservation through management of zoo.
7. Deliver knowledge about wetland and its implication in wildlife.
8. Impart knowledge on research and monitoring of wildlife.
9. Discuss on the adaptation of high altitude animals.

UNIT 1. INTRODUCTION (2)

- 1.1 Concept of wildlife conservation and management
- 1.2 Practices of wildlife conservation in Nepal
- 1.3 Issues of wildlife conservation in Nepal

UNIT 2. WILDLIFE MANAGEMENT TECHNIQUES (7)

- 2.1. Capturing and handling (indigenous and modern techniques): reptiles, birds and mammals
- 2.2. Marking reptiles, birds and mammals for identification, research and monitoring
- 2.3. Chemical immobilization
- 2.4. Use of Technology and Science
 - 2.4.1 Radio telemetry
 - 2.4.2 Camera trapping
 - 2.4.3 GPS &GIS applications
 - 2.4.4 Drone
 - 2.4.5 Range finder
 - 2.4.6 Pedometer

UNIT 3. HABITAT EVALUATION AND MANAGEMENT (7)

- 3.1 Habitat evaluation
 - 3.1.1 Evaluation for specific management objectives:
Food production, cover, edge, indicator species, and condition of individual animals
 - 3.1.2 Evaluation of natural communities:
Species diversity, Ecosystems diversity

- 3.1.3 Assessment procedures for species diversity
 - 3.1.3.1 Standard evaluation procedures
 - 3.1.3.2 Habitat mapping using remote sensing
 - 3.1.3.3 Simpson's diversity index
 - 3.1.3.4 Shannon-wiener index
- 3.2 Habitat Management
 - 3.2.1 Adjustment of seral stages:
 - Setting back and advancing succession
 - 3.2.2 Manipulation of edge
 - 3.2.3 Mitigation (compensating habitat loss)
- 3.3 Habitat Management techniques:
 - 3.3.1 Food production (fruits, fodder, flowers etc)
 - 3.3.2 Water hole development (natural & man made)
 - 3.3.3 Wetland improvement (shallow marshes, potholes)
 - 3.3.4 Cover management (protective nesting)
 - 3.3.5 Grassland management (natural regeneration, plantation)
 - 3.3.6 Cliffs/tree/bushes
 - 3.3.7 Fences and trenches
 - 3.3.8 Fire management

UNIT 4. POPULATION ESTIMATION AND ANALYSIS (5)

- 4.1 Population census and its importance
- 4.2 Estimation of animal abundance (direct and indirect count)
 - 4.2.1 Mark-and-recapture
 - 4.2.2 Line Transect surveys
 - 4.2.3 Change-in-ratio method
 - 4.2.4 Pellet-group counts
 - 4.2.5 Patch occupancy survey
 - 4.2.6 Direct count (observation)
 - 4.2.7 Genetic study
 - 4.2.8 Sweeping method
 - 4.2.9 Roadside counts
 - 4.2.10 Water- hole counts
 - 4.2.11 Road kills
 - 4.2.12 Scent station surveys
- 4.3 Population analysis: Estimating rate of increase; estimating mortality and survival; life table and survivorship curves
- 4.4 Application of population genetics to wildlife management

UNIT 5. WILDLIFE DAMAGE AND CONTROL TECHNIQUES (3)

- 5.1 Types and nature of damage: human injuries and casualties, livestock damages, crop and property damages
- 5.2 Damage assessment
- 5.3 Control techniques – physical, chemical and biological
- 5.4 Problem animals (rescue and management)
- 5.5 Relief and compensation schemes

UNIT 6. ZOO AND ZOOLOGICAL PARK MANAGEMENT (4)

- 6.1. Objectives and role of zoo in wildlife management
- 6.2. Planning and administration of zoos
- 6.3. Care, maintenance and welfare of captive wild animals
- 6.4. Enclose designer and barrier
- 6.5. Isolation/quarantine ward and postmortem facilities
- 6.6. Visitors' facilities and safety
- 6.7. Breeding animals in captivity
- 6.8. Animal handling, restraint and veterinary facilities

UNIT 7. WETLAND MANAGEMENT (4)

- 7.1. Concept of wetland and its types
- 7.2. Wetland function and values
- 7.3. Wetland biodiversity
- 7.4. Problems of wetlands
- 7.5. Sustainable use of wetland, its conservation and management
- 7.6. Status of Nepal's RAMSAR sites and other wetlands
- 7.7. Institutions in wetland management in Nepal

UNIT 8. HIGH ALTITUDE WILDLIFE MANAGEMENT (3)

- 8.1 Structural, physiological and behavioral adaptation in high altitude
- 8.2 Factors in decline of wildlife
 - 8.2.1 Habitat destruction
 - 8.2.2 Poaching
 - 8.2.3 Random use of pesticides
 - 8.2.4 Wildlife, pests and predator
- 8.3 Conservation and Management
 - 8.3.1 Impact of political and economic climate
 - 8.3.2 Habitat protection

UNIT 9. ECONOMICS OF WILDLIFE CONSERVATION (3)

- 9.1 Consumptive and non-consumptive values of wildlife
- 9.2 Valuation techniques
- 9.3 Tourism and wildlife conservation
- 9.4 Wildlife farming
- 9.5 Game ranching

UNIT 10. WILDLIFE RESEARCH AND MONITORING IN NEPAL(2)

- 10.1. Issues of wildlife research and monitoring
- 10.2. Needs and priorities of wildlife research,
- 10.3. Potentialities of research in wildlife species in Nepal
- 10.4. Use of scientific tools and techniques in wildlife research

PRACTICALS (10)

Field tour in nearby habitats or protected areas and conduct following exercises:

1. Census techniques (Transect survey, pellet group count, call count and nest counts)
2. Habitat suitability assessment
3. People's attitude survey
4. Radio-telemetry, camera trap, Sherman trap, share trap, species diversity index
5. Writing field trip report

TEXT AND REFERENCES

1. Berwick and Sahana. 2000. Wildlife Management-Asian and American Approach. Natraj Publishing House, India.
2. EAZA. 2013. The Modern Zoo: Foundations for Management and Development. European Association of Zoos and Aquaria (EAZA), Netherlands (Available online)
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4. GoN. 2003. National Wetland Policy of Nepal 2003. MoFSC, Kathmandu.
5. GoN. 2009. Nepal Fourth National Report to CBD, 2009. MoFSC, Kathmandu.
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14. Sharma, B.D. 1994. High Altitude Wildlife of India. Oxford & IBH Publishing Co Pvt.Ltd ,India.
15. Shaw, James H. 1985. Introduction to Wildlife Management. McGraw Hill.
16. The Wildlife Society. 1981. Wildlife Management Techniques. The Wildlife Society, Washington, D.C.
17. Woodroffe, Gorden. 1981. Wildlife Conservation and Modern Zoo. Saiga Publishing, England.

Course Title: FOREST LAW AND POLICY

Course Code: SFM 404

Credit Hour : 2

(Final Theory: 40, Internal Assessment: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: The students will gain knowledge about the principles and practices of forest policy, forest law and policy of Government of Nepal.

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

1. Understand the legal procedures of forest protection and conservation.
2. Understand the implementation and procedures of forest rules and regulations.

UNIT 1. INTRODUCTION (20)

Definition of Act / Law, policy, rule and regulation, guidelines, strategy and their importance

1.1 Forest Act 2049

1.1.1 Terms and definition

1.1.2 Provisions relating to the Government managed forest, protected forest, community forest, leasehold forest, religious forest and private forest

1.1.3 Provisions relating to the constitution of users' group

1.1.4 Offence and punishment

1.1.4.1 Prohibited functions in the national forest

1.1.4.2 Punishment

1.1.5 Investigation of Offences and Procedures Act

1.2 National Park and Wildlife Conservation Act 2029

1.2.1 Terms and definition

1.2.2 Prohibited activities

1.2.3 Punishments

1.2.4 Investigation of offences and procedure

1.2.5 List of wild animals

1.3 Soil and Watershed Conservation Act 2039

1.3.1 Terms and definition; watershed area, protected watershed area, land use system

1.3.2 Declaration of watershed areas and preference activities

1.3.3 Proper agriculture practices based on land use system

1.4 Environment Conservation Act 2053

1.4.1 Terms and definition: Environment, pollution, biodiversity, national heritage, Environmental Impact Assessment (EIA), Initial Environmental Examination (IEE)

1.4.2 Declaration of environment conservation areas and preference activities

1.4.3 Pollution control and prevention

1.5 Regulation and their importance

1.5.1 Forest Regulation 2051

1.5.1.1 Provisions relating to the Government managed forest, protected forest, community forest, leasehold forest religious forest and private forest

1.5.1.2 Collection, sale and distribution of NTFPs

- 1.5.1.3 Sale and distribution of forest products
- 1.5.1.4 Procedure of marking trees, measuring timber and firewood and calculating their volume and transportation of forest product
- 1.5.2 National Park and Wildlife Conservation Regulation 2030 (Overview)
 - 1.5.2.1 Game and hunting (provision of hunting and prohibited activities for hunting)
 - 1.5.2.2 Hunting license and its types
- 1.5.3 Wildlife Reserve Regulation 2034 (overview and its necessity)
 - 1.5.3.1 Entry provision
 - 1.5.3.2 Prohibited activities
- 1.5.4 Bufferzone Management Regulation 2052 (overview and its necessity)
 - 1.5.4.1 Terms and definition
 - 1.5.4.2 Declaration of bufferzone and formulation of user groups
- 1.5.5 Environment Conservation Regulation 2054 (overview and its necessity)
 - 1.5.5.1 Provision of EIA / IEE in development activities
 - 1.5.5.2 Prohibited activities in environment conservation area
- 1.6 Dismissal and amendment of Act and Regulation and its importance
- 1.7 Major strategies/policies/guidelines:(Salient features only)
 - 1.7.1 Forest Area Encroachment Management Strategy 2068
 - 1.7.2 Forest Fire Management Strategy 2067
 - 1.7.3 Wildlife Damage Guideline 2074
 - 1.7.4 Community Forest Development Guideline 2071 (Third edition)
 - 1.7.5 Forest Carbon Guideline 2071
 - 1.7.6 National Forest Policy 2071
 - 1.7.7 Constitution of Nepal 2072

UNIT 2. LEGAL PROCEDURE AND PROCUREMENT (15)

2.1 Legal procedure

- २.१.१ अनुसन्धान चरण
 - २.१.१.१ जाहेरी प्रतिवेदन
 - २.१.१.२ बरामदी मुचुल्का
 - २.१.१.३ पक्राउ पुर्जि
 - २.१.१.४ म्याद थप
 - २.१.१.५ घटनास्थल मुचुल्का
 - २.१.१.६ सर्जिमिन मुचुल्का
 - २.१.१.७ प्रतिवादीहरुको वयान
 - २.१.१.८ जिल्ला सरकारी वकिल कार्यालयको राय
 - २.१.१.९ अभियोग पत्र
- २.१.२ अदालती चरण
 - २.१.२.१ मुद्धा दर्ता
 - २.१.२.२ अभियुक्तको वयान
 - २.१.२.३ थुनछेक वहस र आदेश
 - २.१.२.४ प्रमाण मुकरर आदेश

- २.१.२.५ साक्षीको वकपत्र
- २.१.२.६ फैसला लेखन
- २.१.२.७ फैसला कार्यान्वयन

UNIT 3. CONCEPT ON TREATY, MEMBERSHIP AND CONVECTION (5)

- 3.1 Convention on International Trade in Endangered Species (CITES)
- 3.2 Ramsar Convention
- 3.3 UN (United Nation)
- 3.4 UNFCCC (United Nations Framework Convention on Climate Change)
- 3.5 WTO (World Trade Organization)

TEXT AND REFERENCES

1. Environment Conservation Act 2053
2. Environment Conservation Regulation 2055
3. Forest Act 2049
4. Forest Area Encroachment Management Strategy 2068
5. Forest Fire Management Strategy of Nepal 2067
6. Forest Regulation 2051
7. National Park and Wildlife Conservation Act 2029
8. National Park and Wildlife Conservation Regulation 2030
9. Soil Conservation and Watershed Conservation Act 2039
10. Website of Concerned Treaty, Convention and Code of Conduct
11. Wildlife Damage Relief Guideline 2074
12. www.lawcommission.gov.np(नेपालको सम्पूर्ण कानूनहरुको लागि)
13. गोपाल सिवाकोटी र रतन सुवेदी २०६२, प्राकृतिक स्रोत सम्पदा संवन्धी ऐन नियम संग्रह, संकलन तथा सम्पादन दोस्रो संस्करण २०६७, पैरवी प्रकासन, काठमाडौं, नेपाल

Course Title: AGROFORESTRY

Course Code: SFB 405

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical:10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: Students will gain knowledge and skills regarding the concepts and practices of agroforestry and issues in developing, designing and implementing agroforestry projects.

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

1. Understand constraints and issues related to the agroforestry systems in Nepal.
2. Collect and analyze soil, crop and tree information (agro-ecosystem analysis of farming system analysis).
3. Select species suitable for different agroforestry practices.
4. Describe tree-crop-animal interactions.
5. Design, develop and analyze an agroforestry project.

UNIT 1. INTRODUCTION (5)

- 1.1 Historical development of agroforestry in the world and in Nepal
- 1.2 Definitions, concepts and principles of agroforestry
- 1.3 Policies related to agroforestry

UNIT 2. DESCRIPTION AND ANALYSIS OF DIFFERENT AGROFORESTRY SYSTEMS (6)

- 2.1 Farming systems in Nepal
 - 2.1.1 Cereal- based production system
 - 2.1.2 Fruit- and vegetable- based production system
 - 2.1.3 Animal- based production and its management
- 2.2 Principles of classification of agroforestry systems
- 2.3 Major agroforestry systems
 - 2.3.1 Agri-silviculture
 - 2.3.2 Horti-silviculture
 - 2.3.3 Silvi-pasture
 - 2.3.4 Agri-horti-silviculture
 - 2.3.5 Aqua silviculture
 - 2.3.6 Agroforestry systems for commercial purpose in Nepal (tea, coffee, mushroom, beekeeping, sericulture, vegetables, medicinal plants and fruits)
- 2.4 Alley cropping
- 2.5 Hedge row planting
- 2.6 Taungya System
- 2.7 Integrated AF farming system, management of tree outside forestry

UNIT 3. CRITERIA AND CHARACTERISTICS FOR SELECTION OF AGROFORESTRY TREE SPECIES IN DIFFERENT CLIMATIC ZONES (3)

- 3.1 Timber
- 3.2 Fuelwood

- 3.3 Food-fruit-vegetables
- 3.4 Fodder and forage
- 3.5 Shade
- 3.6 Green manuring
- 3.7 Windbreak and shelter belts

UNIT 4. TREE-CROP INTERACTIONS AND COMBINATIONS (3)

- 4.1 Symbiotic relationship
- 4.2 Allelopathic relationship
- 4.3 Crop stratification
 - 4.3.1 Above-ground and underground relationship
- 4.4 Tree- crop combination and management

UNIT 5. SOIL AND WATER CONSERVATION UNDER AGROFORESTRY SYSTEMS (5)

- 5.1 Problems and potentials
- 5.2 Concept of land capability classification in AF
 - 5.2.1 Potential of A.F. systems in soil conservation
 - 5.2.2 Sustenance of soil fertility and regulated supply of multiple products
- 5.3 Agroforestry methods of improving soil productivity
 - 5.3.1 Soil productivity trends in agroforestry
 - 5.3.2 Case studies (Integrated pest management, Bio-char)
 - 5.3.3 SALT
- 5.4 Techniques for soil and water conservation
 - 5.4.1 Farming system approach
 - 5.4.2 Rainfed- based agriculture
 - 5.4.3 Cropping systems

UNIT 6. AGROFORESTRY PROJECT DESIGN, DEVELOPMENT AND EVALUATION (3)

- 6.1 Concept, types and process of diagnosis and design (D&D)
- 6.2 Design and strategy guideline for different AF system
 - 6.2.1 Terai
 - 6.2.2 Mid-hills
 - 6.2.3 Mountains
- 6.3 AF project development and evaluation process

UNIT 7. AGROFORESTRY IN CHANGING CONTEXT (5)

- 7.1 Actors, institutions and governance in AF
- 7.2 Management of AF (economic, environmental and social aspect)
- 7.3 Linkage of AF in global context (CC, REDD/PES, SDG)
- 7.4 Challenges and issues (food security, entrepreneurship, policy)

PRACTICALS (10)

- 1. Visit any AF system for the identification of AF species, combination and interaction

2. Application of SALT technology , Biochar preparation
3. Case study of different agroforestry system nearby college e.g. sericulture, apiculture, Shitake mushroom and commercialized crop,
4. Diagnosis and design of one agroforestry project.

TEXTBOOK AND REFERENCES

1. Agroforestry Systems – International Journal (Monthly). Kluwer Academic Press, The Netherland.
2. Amatya, S.M and S.M. Newman. 1993. Agroforestry in Nepal: Research and Practice. *Agroforestry Systems* 21: 215-222.
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8. Khosla, P.K. and Khurana, D.K. (Eds.). 1987. Agroforestry for Rural Needs – Vol. I. Indian Society of Tree Scientists, Solan.
9. Khosla, P.K. and Khurana, D.K. (Eds.). 1993. Agroforestry for Rural Needs – Vol. II. Indian Society of Tree Scientists, Solan.
10. MacDicken, Kenneth G. and Vergera, Napoleon T. (Eds.). 1990. Agroforestry – Classification and Management. Wiley-Interscience, Third Avenue, New York.
11. Naire, P.K. 1989. Agroforestry System. Kluwer Academic Publishers in association with ICRAF.
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14. Pandey, K.K. 1982. Tree Fodder and Fodder Trees in Nepal. Swiss Development Corp., Swiss Federal Institute of Forestry Research.
15. Puri, Sunil and Pankaj Panwar. 2007. Agroforestry Systems and Practices. New India Publishing Agency, Pritam Pura, New Delhi 110088.
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17. Singh, Panjab and Pathak, P.S. 1995. Agroforestry Systems for Degraded Land. Roy, M.M. (Ed). Science Pub. Inc.
18. Singh, S.P. 2006. HandbBook of Agroforestry, Second ed.. Agrotech Publishing Academy, Udaipur.
19. Tejwani, K.G. 2002. Agroforestry in India. Concept Publishing Company.
20. Tewari, D.N. 1995. Agroforestry for Increased Productivity, Sustainability and Poverty Alleviation. International Book Distributors, 9/3 Rajpur Road , Dehradun, India.

Course Title: ECONOMICS

Course Code: BSH 406

Credit Hour: 2

(Final Theory: 40, Internal Assessment: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: After completion of this course, the students will be able to understand and apply the theories and principles of micro- economics and concept of macro- economics to planning, management and decision- making schemes at various levels in the natural resources sector.

SPECIFIC OBJECTIVES: 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 individuals 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.

UNIT 1. INTRODUCTION (3)

- 1.1 Concept of Economics Science – wealth of Nation, material welfare and scarcity and choice
- 1.2 Mankiew ten principles of economics
- 1.3 Introduction to micro-economics
- 1.4 Subject matters of micro-economics

UNIT 2. THEORY OF DEMAND, SUPPLY & MARKET EQUILIBRIUM (6)

- 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

UNIT 3. THEORIES OF CONSUMER BEHAVIOUR (6)

- 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 Concept of Ordinal utility and indifference curve analysis approach
- 3.5 Concept of IC, Principle of MRS, IC map and properties of IC

- 3.6 Budget line and causes to shifting the budget line
- 3.7 Equilibrium of the consumer in IC analysis
- 3.8 Income effect, price effect, and substitution effect
- 3.9 Derivation of the demand curve under IC analysis

UNIT 4. THEORY OF PRODUCTION (6)

- 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 TP, AP and 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 Laws of returns to scale (Increasing, constant and decreasing)
- 4.8 Concept of CD production function.

UNIT 5. COST CURVES, REVENUE CURVES and FIRM EQUILIBRIUM (6)

- 5.1 Concept of Monetary cost, Real cost, Implicit cost, Explicit cost and Opportunity cost
- 5.2 Concept and derivation of Fixed cost, Variable cost and Total cost curves.
- 5.3 Derivation of AVC, AFC, AC and MC curves in short run
- 5.4 Concept and derivation of LRAC and LRMC curves
- 5.5 Concept of Total Revenue, Average Revenue and Marginal Revenue
- 5.6 Derivation of TR, AR and MR curves under perfect and imperfect competition.
- 5.7 Firm Equilibrium: TR and TC approach and MR and MC approach.

UNIT 6. THEORY OF PRODUCT PRICING (5)

- 6.1 Meaning and features of perfect competition market
- 6.2 Price determination under perfect competition
- 6.3 Price and output determination under perfect competition in long run and short run
- 6.4 Meaning and features of imperfect markets
- 6.5 Price and output determination under monopoly in long run and short run

UNIT 7. MACRO-ECONOMICS (8)

- 7.1 Introduction to macro-economics
- 7.2 Subject matters of macro-economics
- 7.3 National income concepts: GDP, GNP, NNP, NI, PI, DI and per capita income
- 7.4 Measurement of national income by Product, Income and Expenditure methods
- 7.5 Difficulties in measuring national income
- 7.6 Consumption function: concept and determinants
- 7.7 Investment function: concept and determinants
- 7.8 Concept of macro-economic policies: fiscal and monetary

TEXT AND REFERENCES

1. Ahuja, H.L. 2017. Advanced Economic Theory. S. Chand Publishing, New Delhi.
2. Chopra, P.N. 2012. Principles of Economics. Kalyani Publishers, New Delhi.

3. Dvette, K.K. 2006. Modern Economic Theory. S. Chand Publishing, New Delhi.
4. Dwivedi, D.N. 2002. Microeconomics: Theory and Policy. Pearson Education, India.
5. Jhingan, M.L. 2010. Macro Economic Theory. Vrinda Publications, Delhi.
6. Koutsoyiannis, A. 2008. Modern Microeconomics. International edition, Macmillan Press Ltd.
7. Mankiew, G.N. 2012. Macroeconomics. Eighth edition. Worth Publishers.
8. Ministry of Finance. 2017. Economic Survey. Ministry of Finance, GoN Nepal
9. Shrestha, Rajendra Gopal. 2006. Microeconomics. Asia Publications, Kathmandu.
10. Shrestha, Rajendra Gopal. 2007. Macroeconomics. Asia Publications, Kathmandu.

Course Title: ENVIRONMENTAL SCIENCE

Course Code: WME 407

Credit: 2

(Final Theory: 40, Internal Assessment: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVES: Upon completion of this students will be able to gain general knowledge about ecosystem and habitat, environmental management strategies, environmental impact assessment, etc.

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

1. Understand concepts of environmental science and its interrelationship with other disciplines.
2. Explain the main policy and laws of environmental protection of a given sector.
3. Prepare a case study report on environmental impact of one of the aspects in relation to a given development activity using IEE/EIA tool.

UNIT 1. INTRODUCTION (4)

- 1.1 Concept and scope of environmental science
- 1.2 Components of environment
- 1.3 Elements of environment
- 1.4 Environmental education in Nepal

UNIT 2. ENVIRONMENTAL DEGRADATION (7)

- 2.1 Introduction to environmental degradation
 - 2.1.1 Causes environmental degradation (overpopulation, deforestation, pollution, waste, urbanization, acid rain, desertification)
 - 2.1.2 Human environment interaction
 - 2.1.3 Environmental pollution (concept, effects and controlling measures)
- 2.2 Air pollution
- 2.3 Water pollution
- 2.4 Land pollution
- 2.5 Noise pollution
- 2.6 Solid waste pollution
- 2.7 Hazardous waste

UNIT 3. ENVIRONMENTAL MANAGEMENT (10)

- 3.1. Environmental management (concept, need and approaches)
- 3.2. Environment and sustainability (issues and scientific principle)
- 3.3. Environmental ethics
- 3.4. Environmental institutions
- 3.5. International cooperation
- 3.6. Environmental policies and law (national and international);

UNIT 4. ENVIRONMENTAL ASSESSMENT AND MONITORING (14)

- 4.1 Introduction to environmental assessment
- 4.2 Tools of environmental assessment

- 4.2.1 Initial environmental examination (IEE)
- 4.2.2 Environmental Impact assessment (EIA)
- 4.3 Environmental monitoring
- 4.4 Environmental auditing

FIELD EXERCISES

1. Case study of water pollution in a lake or pond
2. Case study of air pollution near buspark or polluted area
3. Case study of the impact of road construction
4. Case study of damage of trees due to atmospheric pollution (e.g. cement factory).
5. Case study of waste management system of a specific site
6. Case study of a degraded land or deforested area (include improvement strategy)
7. Case study of IEE on a forest area.

Note: Field visit to all above activities but case study preparation is required on any three cases.

TEXT AND REFERENCES

1. IUCN. 1994. National Environmental Impact Assessment Guidelines 1993. National Conservation Strategy Implementation Project, National Planning Commission in collaboration with IUCN, Kathmandu.
2. IEM/EPSP/DANIDA. 2004. IEE Training Resource Kit. Institute of Environmental Management/ EPSP/ DANIDA, Kathmandu.
3. IEM/EPSP/DANIDA. 2004. EIA Training Resource Kit. Institute of Environmental Management/EPSP/DANIDA, Kathmandu.
4. Reports on EIA of Arun III Project by UNDP/ KMTNC/WORLD BANK.
5. Barnes, B.V., Zak, D.R., Denton, S. and Spurr, S.H. 1998. Forest Ecology, Fourth edition. John Wiley & Sons, Inc.
6. Sarre, Philip and Smith, Paul. 2009. One World for One Earth: Saving the Environment. Earth Scan Publications Limited, London.
7. MOPE. 1998. State of the Environment Nepal. His Majesty's Government, Ministry of Population and Environment, Kathmandu.
8. वातावरण संरक्षण ऐन, २०६३ र वातावरणनियमावली, २०६४ श्री ५ को सरकार जनसंख्या तथा वातावरण मन्त्रालय
9. IUCN. 1996. EIA Training Manual for Professionals and Managers. IUCN, Nepal.
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11. REDP. 1997. Environment Management Guidelines. Rural Energy Development Programme, NEP, 95/016, HMG, UNDP.
12. 1995. IUCN. Guidelines for Phewa Lake Conservation. IUCN, Nepal.
13. Sir A. Hillary. 1984. Ecology 2000: The Changing Face of Earth. Kampmann & Co.
14. IUCN. 1995. EIA Forestry Sector Guidelines, IUCN, Nepal.
15. Miller, G. Tyler and Scott Spoolman. 2009. Introduction to Environmental Science. Cengage Learning.
16. Krishnamoorthy, Bala. 2009. Environmental Management, Text & Cases. Second edition. PHI Learning.

17. Sen, Ranen. 2009. Environmental Management, Economics and Technology, First edition. Levant Books.

Course Title: GEOLOGY FOR FORESTRY

Course Code: WME 408

Credit Hour: 3

Lecture Hour: 60

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

GENERAL OBJECTIVES: Upon completion of this course, the students will have a basic understanding of geology.

SPECIFIC OBJECTIVE: The students will be able to:

1. Understand theories regarding modification of the earth and its various landforms throughout the geological time scale.
2. Name the major rocks and minerals and understand their origin and composition.
3. Describe weathering of rocks and influence of geologic processes in soil formation and vegetation growth.

UNIT 1. INTRODUCTION TO GEOLOGY (3)

- 1.1 Definition and concept of geology
- 1.2 Components of geology
- 1.3 The interior of the earth

UNIT 2. INTRODUCTION TO STRUCTURAL GEOLOGY AND ITS SIGNIFICANCE ON LANDFORM / OUTCROPS (8)

- 2.1 Attitude of beds (strike, dip amount and dip direction)
 - 2.1.1 Application of attitude of beds in stability of land.
- 2.2 Fractures
 - 2.2.1 General introduction to fractures
 - 2.2.2 Role of fractures in stability of land/out croups and infiltration/ percolation
- 2.3 Joints
 - 2.3.1 General introduction to joint
 - 2.3.1 Geometric classification of joints
 - 2.3.1 Joint sets and its role in stability of land/ out croups
- 2.4 Fold
 - 2.4.1 General introduction to fold
 - 2.4.2 Parts of fold
 - 2.4.3 Classification of fold (based on cross section)
 - 2.4.4 Role of folds in stability of land/ out croups
- 2.5 Fault
 - 2.5.1 General introduction to fault
 - 2.5.2 Genetic classification of faults
 - 2.5.3 Role of fault in stability of land/ out croups

UNIT 3. PLATE TECTONICS (3)

- 3.1 General introduction to plate tectonics
- 3.2 Features of plate tectonics
- 3.3 Plate boundaries
- 3.4 Significance of plate tectonics in modification of earth crust

UNIT 4. MINERALS (4)

- 4.1 General introduction to minerals
- 4.2 General classification of minerals
- 4.3 Physical properties of minerals
- 4.4 Chemical composition of rocks forming minerals
- 4.5 Role of properties of minerals in weathering of rocks/ soil formation

UNIT 5. TYPES OF ROCKS (10)

- 5.1 Igneous rocks
 - 5.1.1 General introduction to igneous rocks
 - 5.1.2 Origin of magma
 - 5.1.3 Volcanism
 - 5.1.4 General texture (on the basis of fabrics)
 - 5.1.5 Structure of igneous rocks
 - 5.1.6 Forms of igneous rocks
 - 5.1.7 Classification of igneous rocks (on the basis of mode of origin and SiO₂ content and dark colored mineral content)
- 5.2 Sedimentary rocks
 - 5.2.1 General introduction to sedimentary rocks
 - 5.2.2 Mode of formation of sedimentary rocks
 - 5.2.3 Sedimentary textures and structures
 - 5.2.4 Classification of sedimentary rocks
- 5.3 Metamorphic rocks
 - 5.3.1 General introduction to metamorphic rocks
 - 5.3.2 Agents of metamorphism
 - 5.3.3 Types of metamorphism
 - 5.3.4. Structure of metamorphic rock
- 5.4 Relations among rocks, soils and plant growth

UNIT 6. STRATIGRAPHY AND FOSSILS (4)

- 6.1 General introduction to stratigraphy
- 6.2 Principles of stratigraphy
- 6.3 General introduction to chrono-stratigraphy, litho-stratigraphy and bio-stratigraphy
- 6.4 Fossils, types of fossils and conditions of fossilization
- 6.5 Importance of fossils in forestry science
- 6.6 Geological Time scale.

UNIT 7. WEATHERING OF ROCKS (3)

- 7.1 General introduction to weathering
- 7.2 Processes of weathering
- 7.3 Types of weathering
- 7.4 Controlling factors on weathering
- 7.5 Significance of weathering in relation to soil formation and vegetation growth

UNIT 8. GEOMORPHOLOGY AND GEOMORPHIC PROCESSES (4)

- 8.1 General introduction to different landforms
- 8.2 Exogenous processes
 - 8.2.1 Introduction of earth surface processes
 - 8.2.2 Types of earth surface processes
- 8.3 Endogenous processes
- 8.4 Role of geomorphic processes in land stability, plant germination, regeneration and plant growth

UNIT 9. GEOLOGICAL WORK OF GLACIERS AND RIVER (6)

- 9.1 Geological work of glaciers
 - 9.1.1 Erosional and depositional features of glaciers and its effects/roles in relation to plant growth
- 9.2 Geological work of rivers
 - 9.2.1 Erosional and depositional features of rivers and its effects/roles in relation to plant growth

UNIT 10. GEOLOGY OF NEPAL (5)

- 10.1 Geological framework of Nepal
- 10.2 Tectonics of Nepal Himalayas (HFT, MBT, MCT, STDFS, MT, CCT)
- 10.3 Geological history of Nepal Himalayas

PRACTICALS (10)

- 1. Study and identification of minerals and rocks
- 2. Familiarization of geological maps
- 3. Stability analysis

FIELD WORK (5 days field tour)

- 1. Familiarizations of regional geomorphic features
- 2. Field visit to Siwalik and Lower Himalayan zone of Nepal to:
 - 2.1 Study of rocks and minerals and their role in species richness
 - 2.2 Study of erosional and depositional features
 - 2.3 Study of weathering pattern and its role in soil formation and soil profile
- 3. Submission and presentation of field report.

REFERENCES

- 1. Ehlers, G.E. and Blatt, H. 1997. Petrology, Igneous, Sedimentary and Metamorphic Rocks. CBS Publishers and Distribution, New Delhi-11000, India.
- 2. Kizaki, Koshiro. 1994. An Outline of Himalayan Upheaval: A Case Study of the Nepal Himalayas. JICA, Kathmandu.
- 3. Mahapatra, G.B. 2015. A Text Book of Geology. CBS Publishers & Distributors Pvt. Ltd.
- 4. Mahapatra, G.B. 2008. Physical Geology. CBS Publishers & Distributors, New Delhi-11000, India.
- 5. Matthews, William H. 2013. Geology: The Made Simple Series. Butterworth-Heinemann.
- 6. Mukharjee, P.K. 2013. A Text Book of Geology. World Press Private Ltd.
- 7. Read, H.H. and Watson, J. 1962. Introduction to Geology. Macmillan.

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YEAR 2 SEMESTER II

Course Title: PHOTOGRAMMETRY AND REMOTE SENSING

Course Code: WME 451

Lecture Hour: 60

Credit Hour: 3

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

GENERAL OBJECTIVE: After completion of this course students will gain knowledge about photogrammetry and remote sensing imageries.

SPECIFIC OBJECTIVES:

1. Understand fundamentals of aerial photography and photogrammetry.
2. Understand fundamental of remote sensing systems with their principles.
3. Familiarization and capable to utilize satellite imageries for natural resource management.

UNIT 1. OVERVIEW OF REMOTE SENSING (2)

- 1.1 Introduction (history and development)
- 1.2 Application of Remote Sensing

UNIT 2. ELEMENTS OF PHOTOGRAPHIC SYSTEMS (6)

- 2.1 Photographic basics
- 2.2 Film photography
- 2.3 Digital photography
- 2.4 Aerial cameras
- 2.5 Spatial resolution of camera systems

UNIT 3. BASIC PRINCIPLES OF PHOTOGRAMMETRY (10)

- 3.1 Basic geometric characteristics of aerial photographs
- 3.2 Photographic scale
- 3.3 Ground coverage of aerial photographs
- 3.4 Stereoscopic photography
- 3.5 Measurement (distance, area, height)
- 3.6 Relief displacement of vertical features
- 3.7 Image parallax
- 3.8 Ground control for aeriels photography

UNIT 4. FUNDAMENTAL CONCEPTS OF REMOTE SENSING (12)

- 4.1 The electromagnetic spectrum (EMR), remote sensing in visible, IR spectrum thermal IR spectrum
- 4.2 Energy source and radiation principles
 - 4.2.1 Wave theory
 - 4.2.2 Particle theory
- 4.3 EMR interaction in the atmosphere
 - 4.3.1 Emission

- 4.3.2 Scattering (Raleigh, Mie and non- selective)
- 4.3.3 Absorption
- 4.3.4 Transmission
- 4.3.5 Reflectance
- 4.4 EMR interaction with the earth surface
 - 4.4.1 Spectral reflectance
 - 4.4.2 Spectral response pattern
- 4.5 Remote sensing sensors and scanning systems
 - 4.5.1 Multi-spectral scanning systems (Whisk broom and push brown)
 - 4.5.2 Platforms and characteristics
 - 4.5.3 Sensor systems characteristics: detectors, IFOV

UNIT 5. REMOTE SENSING DATA ACQUISITION AND PROCESSING (4)

- 5.1 Data acquisition and correction
 - 5.1.1 Methods of satellite data acquisition
 - 5.1.2 Resolution and its types
 - 5.1.3 Radiometric and geometric correction

UNIT 6. DIGITAL IMAGE PROCESSING (6)

- 6.1 Spectral pattern recognition
 - 6.1.1 Supervised classification
 - 6.1.2 Unsupervised classification
 - 6.1.3 Merit and demerit of supervised and unsupervised classification
- 6.2 Image enhancements techniques (resampling, spatial filtering)

UNIT 7. MICROWAVE AND LIDAR (5)

- 7.1 Principles of MWRS
- 7.2 Sensor systems characteristics
- 7.3 Atmospheric and terrain properties
- 7.4 RADAR geometry
- 7.5 Application of radar data (Envisat, JERS, ALOS, Radarsat)
- 7.6 LiDAR

PRACTICALS (15)

1. Familiarization with aerial photographs
2. Establishment of photo coordination and their measurements (pp, cpp, fiducial Mark, photo annotations, effective area)
3. Stereoscopic depth perception
4. Determination of crown closure, crown density, forest areas, and scale)
5. Familiarization of satellite image Bands, True and false color composite
6. Visual interpretation of satellite imageries,
7. Image classification (Supervised and unsupervised classification)

REFERENCES

1. Avery, Thomas Eugene. 1985 Interpretation of Aerial Photographs, Fourth ed.. Burgess Pub. Co., Berlin.
2. Bhatt, A.B. 1994. Aerial Photography and Remotes Sensing. Bishen Singh Mehendrapal Singh, Dehradun.
3. Heinen, J.T. 1985. A Basic Course in Remote Sensing for Nepal. Instructional Manual, Tribhuvan University, Institute of Forestry, Pokhara Campus, Nepal.
4. International Journal of Remote Sensing
5. Jensen, J.R. 2015. Introductory Digital Image Processing: A Remote Sensing Perspective. Pearson Education, USA.
6. Lillesand, Thomas M. and Ralph W. Kiefer. 2008. Remote Sensing and Image Interpretation. John Wiley & Sons.
7. Paul, R Wolf. 1986. Elements of Photogrammetry. Second edition. McGraw-Hill Book Company.
8. Photogrammetric Engineering and Remote Sensing Journal. Published by ASPRS, Bethesda, USA
9. Rampal, K.K.1982.Text Book of Photogrammetry. Oxford & IBH Publishing Company.
10. Sharma, M.K. 2001. Remote Sensing and Forest Surveys. Oscar Publications, New Delhi.
11. Spurr, Stephen H.1948. Aerial Photographs in Forestry. The Ronald Press Company, New York.
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Course Title: FOREST HYDROLOGY
Course Code: WME 452
Credit Hour: 2
(Final Theory: 40, Internal Assessment: 10)

Lecture Hour: 40
Full Mark: 50

GENERAL OBJECTIVES: Upon completion of this course, students will be able to understand the concept of the hydrological cycle, assessment of hydrological variables, hydrological functions of forest and other watershed characteristics, and also, can apply hydrologic knowledge for sustainable water and natural resources planning and management.

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

1. Understand the concept of hydrological cycle and energy balance.
2. Understand the hydrological processes and their quantitative assessment techniques.
3. Understand various biophysical and climatic factors affecting the hydrological regime.
4. Apply the hydrologic knowledge in sustainable planning and management.
5. Know the impacts of forest on hydrological processes.

UNIT 1. INTRODUCTION (5)

- 1.1 Hydrology as science of water
- 1.2 Hydrologic cycle and water distribution
- 1.3 Water balance equation
- 1.4 Concept of forest hydrology
- 1.5 Properties and function of water
- 1.6 Human influence on the hydrologic cycle
- 1.7 Importance of hydrologic knowledge in natural resource planning and management
- 1.8 Concept of hydrological modeling and its application

UNIT 2. PRECIPITATION (8)

- 2.1 Introduction
- 2.2 Forms of precipitation
- 2.3 Weather system for precipitation
- 2.4 Characteristics of precipitation in Nepal
- 2.5 Measurement of precipitation
- 2.6 Rain- gauge network and adequacy of rain- gauge stations
- 2.7 Preparation of data (estimation of missing data, test for consistency of record)
- 2.8 Presentation of rainfall data (mass curve, hyetograph, point rainfall, moving average)
- 2.9 Average precipitation over an area (arithmetic mean, Thiessen mean, Isohyetal method)
- 2.10 Depth –area-duration relationships
- 2.11 Frequency of point rainfall
- 2.12 Maximum intensity/depth –duration –frequency relationship
- 2.13 Probable maximum precipitation (PMP)
- 2.14 Forest and precipitation (atmospheric moisture, precipitation formation, interception, snow accumulation)

UNIT 3. EVAPORATION AND EVAPOTRANSPIRATION (5)

- 3.1 Introduction (evaporation, transpiration and evapo-transpiration)
- 3.2 Factor affecting evapo-transpiration
- 3.3 Estimation of evaporation (evaporimeters, empirical equations, analytical methods, water budget, energy balance, mass-transfer)
- 3.4 Measurements of evapotranspiration
- 3.5 Evapotranspiration equations (Penman's equation, reference crop evapo-transpiration, Blaney-Criddle formula and Thornthwaite formula)

UNIT 4. INFILTRATION AND INFILTRATION CAPACITY (3)

- 4.1 Definitions and concepts
- 4.2 Factors affecting infiltration capacity
- 4.3 Measurement and estimation of infiltration capacity: infiltrometer, soil moisture depletion
- 4.4 Forest and infiltration

UNIT 5. SOIL WATER AND GROUNDWATER (5)

- 5.1 Definition and concepts
- 5.2 Energy of water in soil
- 5.3 Soil moisture and its measurement
- 5.4 Soil water movement
- 5.5 Ground water recharge and discharge
- 5.6 Ground water in Nepal
- 5.7 Ground water flow

UNIT 6. RUNOFF AND STREAM FLOW (6)

- 6.1 Definition and concepts of runoff-process
- 6.2 Variable Source Area Concept
- 6.3 Factors affecting runoff
- 6.4 Measurement of runoff: equipment and techniques
- 6.5 Computational methods of estimating runoff
- 6.6 Hydrographs
- 6.7 Unit hydrograph and S-hydrograph: theory and application
- 6.8 Flood forecasting: flood routing
- 6.9 Forest and stream flow quality, quantity and sediments

UNIT 7. WATER QUALITY (3)

- 7.1 Measures of water quality
- 7.2 Water quality and hydrologic cycle
- 7.3 Polluted water
- 7.4 Collection and handling of water samples
- 7.5 Water quality assessment methods (physio-chemical parameters, rapid field bio-assessment method, water quality index)

UNIT 8. HYDROLOGICAL IMPLICATION OF DIFFERENT LAND MANAGEMENT (4)

- 8.1 Hydrological response of different land use land cover

- 8.2 Hydrological effect of forest cover change at landscape scale
- 8.3 Hydrological effect forest management
- 8.4 Combined effect climate and land use on hydrological regime

PROBLEM SOLVING AND FIELD EXERCISES

1. Field trips to visit and understand the meteorological station layout and the equipment.
2. Field trip to visit and understand river gauging stations.
3. Exercises in measuring precipitation and other weather elements.
4. Exercise in measuring stream flow.
5. Problem solving sessions on -
 - 5.1. Time series, moving mean, double mass analysis
 - 5.2. Frequency, return period
 - 5.3. Average rainfall over a watershed and missing precipitation
 - 5.4. Evapotranspiration
 - 5.5. Infiltration and soil moisture
 - 5.6. Rational formula, Manning-Chezy formula, etc.
 - 5.7. Unit hydrograph
 - 5.8. Ground water (Darcy's Law, aquifer, well hydraulics)

REFERENCES

1. Amatya, Devendra N., Thomas M. Williams, Leon Bren and Carmen de Jong. 2016. Forest Hydrology: Process, Management and Assessment. CAB International, USDA.
2. Brooks, Kenneth N., Ffollott, Peter F., and Magner, J.F. 2012. Hydrology and the management of watershed, Fourth edition. Wiley-Blackwell.
3. Chang, Mingteh. 2013. Forest Hydrology, An Introduction to Water and Forests, Third edition. CRC press, New York.
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6. Hewlett, John D. 1982. Principles of Forest Hydrology, First edition. the University of Georgia Press, Georgia, USA.
7. Reddy, P. Jaya Rama. 2004. A Text Book of Hydrology. Laxmi Publication Pvt. Ltd., India.
8. Subramanya, K. 2013. Engineering Hydrology, Fourth edition. McGraw Hill Education Private Ltd. India.

Course Title: FOREST RESOURCE ECONOMICS

Course Code: SFM 453

Credit Hour: 3

(Final Theory: 60, Internal Assessment: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: Upon completion of this course, the students will be able to apply useful economic theories in the collection of quantitative information for analysis and use in the decision-making process in forest resource management.

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

1. Demonstrate familiarity with applied economic theories in forest resource-related projects.
2. Apply economic evaluation techniques to be effective natural resource managers.
3. Utilize skills in pricing and market analysis for forest products.
4. Use quantitative valuation techniques of non-market goods.
5. Analyze forest product demands and consumption trends.

UNIT 1. INTRODUCTION (5)

- 1.1 Concept and scope of forest resource economics
- 1.2 Relevance of economic theories in forest resource management and conservation
- 1.3 Concept of green economy and economic accounting
- 1.4 Importance of forest resource in national economy in Nepalese context

UNIT 2. DEMAND ANALYSIS OF FOREST PRODUCTS (7)

- 2.1 Concept and determinants of demand function in forest product
- 2.2 Measurement and application of price, income, cross and promotional elasticity of demand by point and arc method
- 2.3 Relation of price elasticity of demand and marginal revenue of forest products
- 2.4 Concept of derived function of cost and production
- 2.5 Derived demand by a firm and derivation of demand curve

UNIT 3. THEORY OF OPTIMIZATION (10)

- 3.1 Production concept of renewable natural resources
 - 3.1.1 Economic method of multiple productions (vertically, horizontally and rival products)
 - 3.1.2 Production possibility curve (optimum use of resources)
- 3.2 Basic assumption and components of Linear Programming (LP)
- 3.3 Formulation of LP problem and solution by graphical and simplex method (two variables)
- 3.4 Management and planning process of the firm
 - 3.4.1 Concept of business forecasting by a firm

- 3.4.2 Purpose of business forecasting and planning process of the firm.
- 3.4.3 Steps in demand forecasting and planning
- 3.4.4 Techniques of demand forecasting.

UNIT 4. FOREST PRODUCT PRICING AND MARKETTING (9)

- 4.1 Concept and characteristics of monopolistic competition market
- 4.2 Pricing in monopolistic competition in long run and short run
- 4.3 Pricing in oligopoly market (Collusion model)
- 4.4 Pricing practice of joint and multiple products
- 4.5 Approach of marketing: functional, institutional and commodity

UNIT 5. VALUATION OF FORESTRELATED NON-MARKET RESOURCES (9)

- 5.1 Total economic value (use and non use value, existence, option and bequest value)
- 5.2 Classification of valuation approaches
 - 5.1.1 Revealed preferences approach (travel cost method, hedonic pricing)
 - 5.1.2 Stated Preferences approach (contingent valuation, conjoint analysis)
- 5.3 Forest stumpage: economic rent and stumpage value, determination of stumpage price
- 5.4 Externalities and production of public goods
- 5.5 Concept of shadow pricing and shadow wage rate

UNIT 6. INVESTMENT CRITERIA AND PROJECT EVALUATION (10)

- 6.1 Concept of investment criteria:
 - 6.1.1 Time value of money, interest rate (market and real) and discount rate
 - 6.1.2 Social interest rates and its effects on production
 - 6.1.3 Social marginal productivity criteria
 - 6.1.4 Capital turn-over criteria
- 6.2 Concept of risk and uncertainty to investment in forest sectors.
 - 6.2.1 Risk management, decision making with uncertainty
- 6.3 Concept and use of Benefit cost analysis: Net Present Value (NPV), B/C ratio and Internal Rate of Return (IRR)

UNIT 7. DEVELOPMENT AND WELFARE ECONOMICS (10)

- 7.1 Concept and scope of development economics
 - 7.1.1 Economic growth vs development and resource management
 - 7.1.2 Indicators of development and role of natural resource
- 7.2 Concept of positive, normative and development of welfare economics
 - 7.2.1 Concept of individual and social welfare
 - 7.2.2 Pigovian welfare economics
 - 7.2.3 Conditions of Pareto optimality

CASE STUDIES

1. Derivation of demand, cost and revenue function using calculus.
2. Profit maximization with linear programming
3. Planning of a forest products producing firm

4. Practicing the non-market goods valuation

TEXT AND REFERENCES

1. Dewett K.K. and Navalur, M.H. 2006. Modern Economic Theory. S. Chanda and Company Ltd., New Delhi.
2. Duerr, William A.1960. Fundamentals of Forestry Economics. McGraw Hill, New York.
3. Dwivedi, D.N. 2015. Managerial Economics. Vikas Publication Pvt. Ltd., New Delhi.
4. FAO. 1979. Economic Analysis of Forestry Project. Forestry Papers 17-1, 17-2, FAO, Rome.
5. GoN. 2071 BS. National Forestry Plan. GoN, Kathmandu.
6. Gregory, R.1972. Forest Resource Economics. Ronald Press, New York.
7. Leushner, William A. 1984. Introduction to Forest Resource Management, John Wiley and Sons.
8. Nautiyal, J.C. 2011. Forest Economics: Principles and Applications. Natraj Publishers, Dehra Dun.
9. Price, C. 1989. The Theory and Application of Forest Economics. Basil Blackwell Ltd., 108 Cowley Road, Oxford, OX4 1JF, UK.
10. Randall, A. 1981. Natural Resource Economics. University of Kentucky Press, Lexington.
11. SANDEE Publication on Economic Valuation and Green Economy Accounting.
12. Todaro, M.P. 2014. Contemporary Economic Development, Twelvth edition. Trans-Atlantic Publications, England.

Course Title: FOREST MENSURATION II

Course Code: SFM 454

Lecture Hour: 60

Credit Hour : 3

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical:15)

GENERAL OBJECTIVE: After completion of the course, the students will have knowledge and skills of measuring forest products and forest area.

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

1. Estimate the volume of trees.
2. Prepare biomass and volume table and use them.
3. Understand and explain the form of trees.
4. Execute forest inventory.
5. Determine growth of trees as well as stands.
6. Understand and explain growth and yield relationships using different models.
7. Measure carbon stock.

UNIT 1. MEASUREMENT OF TREES (7)

1.1 Concept of Bias, Accuracy and Precision

1.2 Diameter measurement

1.2.1 DBH measurement and its significance.

1.3 Height measurement

1.3.1 Measurement of height of leaning trees in plane and slope areas.

1.3.2 Instruments used in height measurement (Abney's Level, Clinometers, Vertex)

UNIT 2. MEASUREMENT OF FORM (3)

2.1 Form factor and its types

2.2 Form quotient and its types

2.3 Taper table and formulae

UNIT 3. VOLUME AND BIO-MASS OF TREES AND PRODUCTS (6)

3.1 Volume tables

3.1.1 Preparation of Local Volume Table (regression technique)

3.1.2 Preparation of General Volume Table (regression technique)

3.2 Forest biomass

3.2.1 Root, leaf, stem and branch bio-mass

3.2.2 Biomass table

3.2.3 Biomass equation

3.3 Forest carbon

UNIT 4. FOREST INVENTORY (12)

4.1 History of forest inventory

4.2 Types of sampling

4.2.1 Random sampling

4.2.1.1 Simple random sampling

4.2.1.2 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
 - 4.2.2.1 Strip Sampling
- 4.3 Inventory with point sampling (horizontal and vertical)
- 4.4 Issues of NTFP inventory in Nepal
- 4.5 Inventory of important NTFPs (based on parts used)
 - a) Chirayito-*Swertia chirayita* (entire plant)
 - b) Amala- *Embllica officinalis* (fruits)
 - c) Kurilo *Asparagus racemosus*(root)
 - d) Machhino *Gaultheria fragrantissima* (leaf)
 - e) Lokta *Daphne bholua* (bark)

UNIT 5. GROWTH PREDICTION (10)

- 5.1 Diameter growth
- 5.2 Basal area and volume growth
- 5.3 Stand growth
- 5.4 Current Annual Increment (CAI) and Mean Annual Increment (MAI)
- 5.5 Stand structure and site quality
- 5.6 Yield and yield tables
- 5.7 Stump analysis, stem analysis

UNIT 6. GROWTH AND YIELD (10)

- 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

PRACTICALS (12)

1. Measurement of height of leaning trees
2. Form factor estimation
3. Preparation of Local Volume Table (regression method)
4. Preparation of General Volume Table (regression method)
5. Stratified random sampling
6. Strip sampling
7. Inventory with point sampling
8. Growth predictions (CAI and MAI)
9. Preparation of site index curves

TEXT AND REFERENCES

1. ANSAB, FECOFUN and ICIMOD. 2010. Forest Carbon Stock Measurement: Guidelines for Measuring Carbon Stocks in Community-Managed Forests. Kathmandu, Nepal.
2. Avery, T.E. and Burkhart, H.E. 2002. Forest Measurements. McGraw Hill Book Company, New York, USA.
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7. Khanna, L.S. and Chaturvedi, A.N. 2015. Forest Mensuration and Biometry (Sixth edition). Khanna Bandhu Publishers, India.
8. MFSC. 2067 B.S. Forest Carbon Measurement Guideline. Government of Nepal, Ministry of Forest and Soil Conservation, Kathmandu, Nepal.
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10. Philip, M.S. 1994. Measuring Trees and Forests. CABI Publishing, UK.

Course Title: FOREST HARVESTING AND LOGGING

Course Code: FPE 455

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: Students will have competent knowledge in application of sustainable harvesting and logging

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

1. Apply the various techniques of forest harvesting and logging.
2. Explain and demonstrate the application of ergonomics in forestry.
3. Use the appropriate methods for storage and grading of logs.
4. Know the cost estimation of harvesting products.

UNIT 1. FOREST HARVESTING (4)

- 1.1 Harvesting planning
- 1.2 Concept of sustainable harvesting
- 1.3 Agencies involved in harvesting practices in Nepal
- 1.4 Laws/ policies/ directives of Govt. related harvesting

UNIT 2. HARVESTING PRACTICES (9)

- 2.1 Trends of forest harvesting practices in Nepal
- 2.2 Harvesting tools (axe, saw, power chain- saw, bill hooks, cant-hook, debarking spade, ropes, steam tightener and wedges), advantages and their maintenance
- 2.3 Season of felling trees
- 2.4 Felling with different tools and their advantages
- 2.5 Introduction of mechanical felling
- 2.6 Forest harvesting technology and their impacts on climate change
- 2.7 Scientific forest management felling operation

UNIT 3. LOG EXTRACTION (3)

- 3.1 Log bucking, debarking, delimiting
- 3.2 Sliding and skidding of logs
- 3.3 Log extraction from hill and terai
- 3.4 Residue collection and management

UNIT 4. LOADING AND UNLOADING OF TIMBER (2)

- 4.1 Loading and unloading of timber and its planning
- 4.2 Mechanism of loading and unloading by manual and mechanical
- 4.3 Logging and transportation related rules of Government

UNIT 5. TRANSPORTATION (HAULING) OF LOGS (3)

- 5.1 Different transportation system (by water, by air, by ground)
- 5.2 Transportation of logs in Nepalese context (cart, truck, tractor)

UNIT 6. GRADING AND STORAGE OF LOGS (4)

- 6.1 Principles and importance of grading
- 6.2 Grading rule/ system in Nepal
- 6.3 Logs storage system in Nepal
- 6.4 Protective measures of logs in storage in the Depot

UNIT 7. SAW MILLING (3)

- 7.1 Principle of saw milling
- 7.2 Type of saw milling
- 7.3 Importance and application of saw milling in Nepal

UNIT 8. ERGONOMY (2)

- 8.1 Introduction and importance
- 8.2 Application of ergonomics in forestry

UNIT 9. COST ESTIMATION OF HARVESTING PRODUCTS (2)

- 9.1 Manual production cost
- 9.2 Mechanical production cost
- 9.3 Auction related rules of forest products

PRACTICALS (8)

1. Introduction to harvesting tools (axe, type of axe, saw, power chain saw, and other tools)
2. Maintenance of harvesting tools
3. Felling and conversion of log
4. Grading of logs, Chhata making and harvest record keeping practice

TEXT BOOKS AND REFERENCES

1. Chowdhury, S. 2003. Manual of Forest Utilization. Institute of Forestry, Tribhuvan University
2. Conway, Steve. 1982. Logging Practices: Principals of Timber Harvesting Systems. Miller Freeman Publications.
3. FAO. 1982. Appropriate Technology in Forestry. FAO 31, FAO, Rome.
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9. RECOFTC. 2015. Appropriate Small Scale Forest Harvesting Technologies: a Guide Book for South East Asia, Bangkok, Thailand
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11. Asia-Pacific Forest Commission. 1999. Code of Practice for Forest Harvesting in Asia-Pacific. RAP PUBLICATION: 1999/12. Bangkok, Thailand.

12. GoN. 2017. District Forest Products Supply Committee Working Modality Guideline 2017. Ministry of Forests and Soil Conservation, Government of Nepal, Kathmandu, Nepal
13. GoN. 2003. Forest Products Auctioning Procedure 2003. Ministry of Forests and Soil Conservation, Government of Nepal, Kathmandu, Nepal
14. वन पैदावार (काठ/दाउरा) संकलन तथा विक्रि वितरण निर्देशिका २०५७, नेपाल सरकार ।
15. सामुदायिक वनको काठ दाउरा संकलन तथा विक्रि वितरण निर्देशिका २०७१, नेपाल सरकार ।

Course Title: TREE IMPROVEMENT AND SILVICULTURE

Course Code: SFB 456

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: Upon completion of this course the students will gain knowledge about silvics of important trees and tree improvement.

SPECIFIC OBJECTIVES: The course will prepare the students to:

1. Gain a basic silvicultural and ecological understanding of some important forest species of Nepal.
2. Learn about the tree improvement techniques.

UNIT1. INTRODUCTION (2)

- 1.1 Introduction to tree improvement (objective and importance)
- 1.2 Silvics and its importance

UNIT2. TREE IMPROVEMENT (7)

- 2.1 Provenance tests
- 2.2 Sources of variation (biological and others).
- 2.3 Seed production areas
- 2.4 Plus and elite tree selection
- 2.5 Seed orchards (types establishment and management)
- 2.6 Breeding seed orchards (BSOs) in Nepal

UNIT3. SILVICULTURE OF MAJOR SPECIES (14)

- 3.1 Terai: *Shorea robusta*, *Dalbergia* spp. (*D. sissoo* and *D. latifolia*), *Acacia catechu*, *Bombax ceiba*, *Adina cordifolia*, *Gmelina arborea*, *Terminalia* spp. (*T. tomentosa*, *T. bellerica*, *T. chebula*), *Albizia* spp. (*A. procera* and *A. lebbek*), *Anthocephalus chinensis*, *Azadirachta indica*, *Melia azadirach*, *Lagerstroemia parviflora*, *Ougenia dalbergoides*, *Cederella toona*, *Diospyros melanoxylon*.
- 3.2 Hills: *Castanopsis* spp. (*C. indica*, *C. hystrix*, *C. tribuloides*), *Schima wallichii*, *Alnus nepalensis*, *Michelia champaca*, *Pinus roxburghii*, *Quercus* spp. (*Q. incana*, *Q. lamellose*), *Q. semicarpifolia*
- 3.3 Mountain: *P. wallichiana*, *Juglans regia*, *Abies pindrow*, *Picea smithiana*, *Cedrus deodara*, *Juniperus* spp., *Cupressus* spp. *Tsuga dumosa*, *Betula utilis*, *Rhododendron* spp.
- 3.4 Silviculture of bamboo and rattan.

UNIT4. SILVICULTURE OF EXOTIC SPECIES (4)

Eucalyptus spp., *Tectona grandis*, *Populus* spp. (*P. deltoidea* and *P. ciliata*), *Acacia auriculiformis*, *Cassia Siamea*, *Cinnamomum camphora*, *Grevillea robusta*, *Pinus* spp. (*Pinus petula* and *P. caribea*), *Casurina* spp., *Leucaena leucocephala*, Paulownia, Malasian Sal

UNIT5. SILVICULTURE OF IMPORTANT FODDER SPECIES (5)

Acacia nilotica, Artocarpus lakoocha, Bauninia variegata, B. purpurea, Morus alba, Sesbania grandiflora, Ficus spp.(F. nemoralis and F. cunia), Garuga pinnata, Litsea monopetala

PRACTICALS (8)

1. Plus tree selection (excursion)
2. Visit to BSO's (excursion)
3. Plant identification and preparation of herbaria of above mentioned tree species will be done during excursions and field visits.

TEXTAND REFERENCES:

1. Jackson, J.K. 1987. Manual of Afforestation in Nepal. Nepal-United Kingdom Forestry Research Project, Forest Survey and Research Office, Dept. of Forest, Kathmandu.
2. Jackson, J.K. 1994. Manual of Afforestation in Nepal, Vol. 2. Nepal-United Kingdom Forestry Research Project, Forest Survey and Research Office, Dept. of Forest, Kathmandu.
3. Kayastha, B.P. 1985. Silvics of the Trees of Nepal. Community Forestry Development Project, Kathmandu.
4. Pandey, K.K. 1982. Fodder Trees and Tree Fodder in Nepal. TISC, Swiss Development Corp., Swiss Federal Institute of Forestry Research, Kathmandu.
5. Thakur, Ram Bichari and Nirmala K Phulara. 2014. A Compendium of Tree Species of Nepal. Mr.& Mrs. Thakur, Pipariya VDC - 6, Sarlahi, Nepal.
6. Troup, R.S. 2008. Silviculture of Indian Trees. Asiatic Publishing House, Delhi, India.
7. Zobel, Bruce and John Talbort. 1984. Applied Forest Tree Improvement. John Wiley and Sons.

Course Title: FOREST ECOLOGY

Course Code: SFB 457

Lecture Hour: 40

Credit Hour : 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: Students will gain the general knowledge about eco-system plant-variability and diversities, forest environment, etc.

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

1. Understand the fundamentals of ecology.
2. Describe the interactions and interrelationships between biotic and abiotic factors and their relation to vegetation/forest growth.
3. Apply this knowledge in the management of natural resources.

UNIT 1. INTRODUCTION (3)

- 1.1 Concept and application of forest ecology.
- 1.2 Habitat, patches, edge and ecotone, edge size and characteristics, habitat connectivity, fragmentation.
- 1.3 Theory of metapopulation
- 1.4 Concept of population ecology, behavioral ecology, community ecology

UNIT 2. ECOSYSTEM (6)

- 2.1 Type of ecosystems (terrestrial and aquatic)
- 2.2 Attributes of ecosystem (structure, function, regulation)
- 2.3 Analysis of ecosystem
- 2.4 Ecosystem productivity: gross and net primary production
- 2.5 Quantities assessment of biodiversity

UNIT 3. PLANT VARIABILITY AND DIVERSITY (4)

- 3.1 Phenotypic and genotypic variations
- 3.2 Genetics (genetic drift, natural selection and the evolutionary sequence)
- 3.3 Effective population size
- 3.4 Gynecology: concept of the ecotype, ecophene and types of ecotype
- 3.5 Ecological considerations at the species level

UNIT 4. AUTECOLOGY (WITH EMPHASIS ON THE FOREST ENVIRONMENT) (14)

- 4.1 Introduction to concept of site productivity and law of minimum
- 4.2 Factors affecting ecosystems
 - 4.2.1 The light
 - 4.2.2 The temperature
 - 4.2.3 The water: evapo-transpiration, and forests and water yield.
 - 4.2.4 Climate: general concepts and its role in vegetation development.
 - 4.2.5 The soil and its importance on vegetation
 - 4.2.6 The nutrient cycle
 - 4.2.6.1 Nutrient input, accumulation and return

- 4.2.6.2 Nutrient cycling (N, P, K, S cycle) in the ecosystem
- 4.2.7 Fire: adaptations to it and wildlife habitat and fire
- 4.2.8 The role of animals in ecosystems
 - 4.2.8.1 Plant defense adaptation
 - 4.2.8.2 Damage in forest stands.
- 4.3 Restoration Ecology
 - 4.3.1 Restoration of ecosystem processes and characteristics
 - 4.3.2 Degradation ecosystems to self – functioning systems
 - 4.3.3 Conservation biology and natural resource management

UNIT 5. SYNECOLOGY: THE STRUCTURE, FUNCTIONS AND MANAGEMENT OF PLANT COMMUNITIES (5)

- 5.1 Site
 - 5.1.1 Direct measurement of productivity
 - 5.1.2 Site index
 - 5.1.3 Plant indicators of site
 - 5.1.4 Environmental factors as a measure of site
 - 5.1.5 Multiple factor methods of site classification
- 5.2 Concepts of competition and survival
 - 5.2.1 Forest communities, structure and diversity
 - 5.2.2 Plant communities and changes in the ecosystem
 - 5.2.3 Competition
 - 5.2.4 Tolerance
 - 5.2.5 Forest stand structure
- 5.3 Natural and artificial disturbances, their effects and management
 - 5.3.1 Human impacts on ecological systems
 - 5.3.2 Global environmental change in ecological systems
 - 5.3.3 Ecosystem management, integrated management, adaptive management

PRACTICALS (8)

1. Estimation of biomass (leaf litter fodder, fuelwood- production, accumulation and decomposition)
2. Demonstration of intra and inter specific competition
3. Observation of forest site – Terai and Hill forests
4. Observation of impact of abiotic factors on distribution of plants
5. Ecological analysis of a forest stand: determination of sampling size, density, frequency, dominance, IVI and biodiversity index (Simpson's diversity index, Shannon wiener index)
6. Survey of forest structure and environment

TEXT AND REFERENCES

1. Agarwal, S.K. 2008. Fundamentals of Ecology. A.P.H. Publishing Corporation, New Delhi 110059.
2. Arnold, Van der Valk (Ed.). 2009. Forest Ecology: Recent Advances in Plant Ecology. Springer, Dordrecht, Netherlands.

3. Barnes, B.V., Donald R. Zak, Shirley R. Denton and Stephen H. Spurr. 2014. Forest Ecology, Fourth ed.. Wiley India.
4. Daubenmire, R.F. 1974. Plants and Environment- A Text Book of Autecology. Third ed. John Wiley & Sons.
5. Dept. of Medicinal Plants. 1976. Flora of Langtang and Cross Section Vegetation Survey (Central Zone). Dept. of Medicinal Plants, Nepal.
6. Etherington, J.R. and William Armstrong. 1975. Environment and Plant Ecology. John Wiley & Sons Ltd.
7. Kershaw, K.A. 1974. Quantitative and Dynamic Plant Ecology. American Elsevier Pub. Co.
8. Kimmins, J.P. 2003. Forest Ecology, Third ed. Benjamin Cummings.
9. Kormondy, E.J. 2001. Concepts of Ecology, Fourth ed. Prentice Hall of India Pvt. Ltd., New Delhi 110001.
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11. Myers, W.L. and Ronald L. Shelton. 1980. Survey Methods for Ecosystem Management. John Wiley & Sons Inc.
12. Odum, E.P. and Gary W. Barrett. 2004. Fundamentals of Ecology, Fifth edition. Cengage Learning.
13. Puri, G.S., V.M. Meher-Homji, R.K.Gupta and S.Puri. 1989. Forest Ecology, Vol-I (Phytogeography and Forest Conservation). Oxford & IBH Publishing Co. New Delhi.
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15. Smith, R.L. and Smith, T.M. 2001. Ecology and Field Biology: Hands-on Field Package, Sixth ed.. Benjamin Cummings.
16. Stainton, J.D.A. 1972. Forests of Nepal, First ed.. John Murray, London.
17. Singh, J.S., S.P.Singh and S.R. Gupta. 2015. Ecology Environmental Science and Resource Conservation. S. Chand and Co. Limited.
18. Singh, Pramod. 1987. Ecology of Rural India, Vol –I. Ashish Publishing House, Punjabi Bagh, New Delhi 110026.
19. Verma, P.S. and Agrawal , V.K. 2001. Cell Biology, Genetics and Ecology: Evolution and Ecology. S. Chand and Co. Limited.

Course Title: TOURISM AND RECREATION

Course Code: PWM 458

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVES: By the end of the course, students will gain general understanding of tourism, its planning process, facilities, etc.

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

1. Understand the status of tourism in Nepal and analyze its potentials and pitfalls.
2. Get familiarize with requirements and attractions related services.
3. Demonstrate ability for planning and developing tourism.
4. Evaluate the impacts of tourism.
5. Take actions to minimize tourism impacts.

UNIT 1. INTRODUCTION (6)

- 1.1 Define: tourists, tourism and recreation
- 1.2 Evolution process and history of tourism in the World and Nepal
- 1.3 Current status of tourism in Nepal and global context.
- 1.4 Importance of tourism in national and global economy.

UNIT 2. TOURISM TYPOLOGY AND MOTIVATIONAL FACTORS (6)

- 2.1 Tourists and tourism typology
- 2.2 Characteristics of tourists (visitors survey and data analysis)
- 2.3 Purpose and motivations of travel
 - 2.3.1 Basics travel motivators: P
 - 2.3.2 physical, cultural, interpersonal motivators, status, prestige and their reasons.
 - 2.3.3 Determinant factors of travel and tourism.

UNIT 3. TOURISM PRODUCTS, RESOURCES AND SERVICES (8)

- 3.1 Concept of tourism products
 - 3.1.1 Characteristics of tourism products
 - 3.1.2 Inventory model of tourism products
 - 3.1.3 Process of tourism product development: explore, develop, promote and conserve
- 3.2 Concept and scope of tourism resources
 - 3.2.1 Natural resources: natural attractions, protected areas (wild life reserves, national parks, conservation area, etc.)
 - 3.2.2 Physical resources: recreation sites, sports, amusement and themepark, superstructures, etc.
 - 3.2.3 Socio-cultural resources: heritage sites, festivals, dance and music, folk culture.
 - 3.2.4 Components of tourism and their management
- 3.3 Tourism facilities and services
 - 3.3.1 Accommodation and foods: hotel, resorts, lodge, guest house, restaurant, etc.

- 3.3.2 Adventure and entertainment facilities: mountaineering, trekking, rafting, jungle safari, rock climbing, bungee jumping, sports, paragliding, etc.
- 3.3.3 Financial and shopping facilities: money exchange, credit card, curio and gift shop.
- 3.3.4 Transportation facilities: air, land and others.
- 3.3.5 Health and safety: rescue, Yoga and nature therapy.

UNIT 4. TOURISM, PLANNING AND DEVELOPMENT (9)

- 4.1 Concept of tourism development and management
- 4.2 Tourism development plan and affecting factors of tourism
- 4.3 Tourism planning: concept, needs, elements, types, scale and level
- 4.4 Scope of tourism planning (national/regional and local)
- 4.5 Basic tourism planning process
- 4.6 Tourism planning approach and tools
 - 4.6.1 Survey of tourism products and resources
 - 4.6.2 Analysis of tourism demand and supply
 - 4.6.3 Tools: carrying capacity, ZOPP, APAA, SOAR

UNIT 5. TOURISM MANAGEMENT AND MARKETING IN PROTECTED AREAS (9)

- 5.1 Tourism management at different level
 - 5.1.1 National level by government and tourism organizations
 - 5.1.2 Tourism business level and local initiation
 - 5.1.3 Tourism zone and destination management
 - 5.1.4 Tourism management practices in PAs of Nepal
 - 5.1.4.1 Tourism awareness and hospitality training in CBOs
 - 5.1.4.2 Community house, visitor centers, museums, etc.
 - 5.1.4.3 View tower, view points, hides and Machans, signs and map in trail
 - 5.1.5 Information centers and interpretation (brochures, pamphlets and posters, etc.)
- 5.2 Basic elements of tourism marketing: product, price, people, place, promotion.
- 5.3 Tourism marketing strategies and tourism marketing mix.
- 5.4 Promotional activities in tourism: FAM trip, trade fair, travel mart, media campaign, electronics and print media.
- 5.5 Public relation, host and guest relation and visitor's satisfaction.

UNIT 6. TRAVEL AND TOURISM RESOURCE AND SERVICES IN NEPAL (8)

- 6.1 Tourism potentials in Nepal (as per ecological zones)
 - 6.1.1 Natural attraction: physiographic, climate and biodiversity.
 - 6.1.2 Cultural attraction: religion, events and festivals, ethnicity, heritage sites, etc.
 - 6.1.3 Adventure activities: mountaineering, trekking, rafting, jungle safari, rock climbing, air sports, hot air balloon, bungee jumping, para gliding, ultra light aircraft, cannoning, fishing, mountain flight, cable car, jungle safari, mountain biking, rock climbing, etc.
- 6.2 Establishment and legal provision of operation: hotel, lodges and restaurants, tours and travel agencies, trekking agencies, mountaineering expedition agencies, rafting agencies

- 6.3 Rural /village tourism (community-based home stay and tourism cooperative society)
- 6.4 Village tourism development committee

UNIT 7. INSTITUTIONAL POLICY AND ORGANIZATIONS INVOLVED IN TOURISM (5)

- 7.1 Concept and functions: Nepal Tourism Council, Ministry of Tourism and Civil Aviation, NTB, Tara Gaun Bikas Samiti, NATHM, CTEVT (Tourism Training Centre), NPC, DCC, urban and rural municipality
- 7.2 Concept and functions: FNCCI, TAAN, NATA, HAN, REBAN, NARA, TURGAN, NMA, PTC, TTC, VITOF Nepal
- 7.3 Highlights of: Tourism Act 2052, Tourism Development Policy of Nepal 2065 and Vision 2020
- 7.4 Concept and Roles of: WTO, UNWTO, PATA, WWF, SASTA, GCET, UNDP, SNV, DFID

UNIT 8. TOURISM IMPACT AND MITIGATIONS (5)

- 8.1.1 Concept of tourism impact (positive and negative)
- 8.1.2 Economic impact of tourism and mitigation measures.
- 8.1.3 Socio-cultural impact of tourism and mitigation measures.
- 8.1.4 Environmental impact of tourism and mitigation measures.

1. FIELD VISIT (4):

- 1. Observation and evaluation of tourism facilities and services
- 2. Visitor survey
- 3. Local community and tour operator survey
- 4. Impact analysis.
- 5. Case study of promotional practices

2. EXCURSION: Local tourism centers

TEXTS AND REFERENCES

- 1. Bhatta, Damodar. 2015. Ecotourism in Nepal: Concepts, Principles and Practices, Publisher, Anju Bhatt, Kathmandu.
- 2. Boo, Elizabeth. 1990. Potentials and Pitfalls of Eco-tourism, Vol. 1 and 2. WWF.
- 3. Chauhan, Y.S. 2010. Ecotourism in Nepal. Kalinga Publications, New Delhi.
- 4. Collier, Allan. 1989. Principles of Tourism. Pitman Publishing Ltd.
- 5. DNPWC. Nepalese Tourism Immigration and Wildlife Conservation Laws
- 6. Fennell, David. 1999. Ecotourism: An Introduction. Routledge, London.
- 7. Kunwar, Ramesh Raj. 2006. Tourists and Tourism: Science and Industry Interface. International School of Tourism and Hotel Management, Kathmandu.
- 8. Malhotra, R.K. 2002. Encyclopedia of Tourism and Hotel Management. Anmol Publications Pvt Ltd, New Delhi.
- 9. Mason, Peter. 2008. Tourism Impacts Planning and Management, Second ed.. Taylor & Francis.

10. McIntyre, George. 1993. Sustainable Tourism Development: Guide for Local Planners. World Tourism Organization, Madrid, Spain.
11. Mill, Robert C. and Morrison, Alastair M. 2009. The Tourism System. Kendall Hunt Publishing.
12. MOTCA. Nepal Tourism Statistics, Tourism Act 2052, Tourism policy 2065, Tourism Vision 2020. MOTCA, Kathmandu.
13. Sharma, Prem. 2011. Village Tourism in Nepal. Village Tourism Forum of Nepal/NTB.
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YEAR 3 SEMESTER I

Course Title: FOREST PRODUCT UTILIZATION

Course Code: FPE 501

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: Students will have knowledge and skills regarding the concept of the proper utilization of forest products.

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

1. Identify wood through the anatomical structures.
2. Understand the wood properties and its moisture relationship.
3. Understand the defects in wood and their prevention.
4. Understand the proper uses of wood.
5. Understand the importance of wood seasoning and preservation.

UNIT 1. WOOD STRUCTURE (4)

- 1.1. Wood formation
- 1.2. Gross structure of wood; bark, sap /heart wood, growth rings (annual rings), early and late wood, grain, texture, luster and pith
- 1.3. Minute (fine) structure of wood; pore (vessel), fiber, tracheid, wood parenchyma (soft tissue), pith fleck, ray, ripple mark
- 1.4. Wood structures of soft and hard wood species

UNIT 2. PROPERTY OF WOOD (4)

- 2.1. Importance
- 2.2. Density of wood, specific gravity and its variation
- 2.3. Physical property
- 2.4. Mechanical property
- 2.5. Chemical property

UNIT 3. WOOD AND WATER (3)

- 3.1. Location of water in wood
- 3.2. Nature of water in wood
- 3.3. Measurement of moisture content
- 3.4. Role of water in wood quality

UNIT 4. WOOD SEASONING (3)

- 4.1. Principle and scope
- 4.2. Importance
- 4.3. Method of wood seasoning

UNIT 5. WOOD DEFECTS (3)

- 5.1. Natural defects
- 5.2. Non-natural defects

UNIT 6. USES OF WOOD (2)

- 6.1. Structural
- 6.2. Decorative
- 6.3. Specialized

UNIT 7. WOOD PRESERVATION (3)

- 7.1. Importance
- 7.2. Preservatives and its types
- 7.3. Methods of preservative treatment

UNIT 8. COMPOSITE PRODUCTS, MANUFACTURING PROCESS AND APPLICATION (5)

- 8.1. Plywood and block board
- 8.2. Particle board
- 8.3. Fiber board
- 8.4. Other composite board (bamboo and straw boards) parqueting

UNIT 9. PULP AND PAPER TECHNOLOGY (3)

- 9.1. Raw material extraction
- 9.2. Pulping (mechanical, chemical and semi- chemical) and paper manufacturing process
- 9.3. Paper manufacturing (Lokta/Argeli)

UNIT 10. BIO-ENERGY (2)

- 10.1. Concept and importance
- 10.2. Wood charcoal, biochar and briquette
- 10.3. Fuelwood value of different tree species

PRACTICAL (8)

1. Identification of wood samples (at least 10 species)
2. Moisture content determination
3. Identification of wood defects

FIELD TRIP

- Visit to forest based industries, for uses of wood and observing (seasoning , preservation, composite products, pulp and paper, rosin and turpentine)

TEXT AND REFERENCES

1. Brown, H.P. 2015. An Elementary Manual of Indian Wood Technology. Palala Press, United States.
2. Chowdhury, S. 2003. Manual of Forest Utilization. Institute of Forestry, Tribhuvan University. Dehradun.

3. Haygreen, J.G., Bowyer and L. Jim. 1982. Forest Products and Wood Science: An Introduction. State University Press, Ames, Iowa.
4. Jeffery, E.C. 1917. The Anatomy of Wood Plants. University of Chicago Press, Chicago.
5. Journal of Wood Sciences, 1998-2018, Official Journal of the Japan Wood Research Society.
6. Kollmann F.F.P. and W.A. Cote Jr. 1968. Principle of Wood Science and Technology I Solid wood. Springer-Verlag, Berlin Heidelberg.
7. Mehta, T. 2008. A Handbook of Forest Utilization. International Book Distributors, New Delhi.
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11. Troup, R.S. 1907. Indian Forest Utilization. Superintendent of Government Printing, Calcutta, India.
12. 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.
13. White, Eric M. 2010. Woody biomass for bioenergy and biofuels in the United States—a briefing paper. Gen. Tech. Rep. PNW-GTR-825. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.
14. TRAFFIC India. Timber Identification Manual. 'Manual of Timbers Used by Wood Based Handicrafts Industry of Kerala, Uttar Pradesh and Rajasthan'. New Delhi. available at <https://www.scribd.com/>
15. Journal of Forest Products Society, available at: <http://forestprodjournals.org/>

Course Title: RANGE MANAGEMENT

Course Code: WME 553

Credit Hour: 2

Lecture Hour: 40

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: By the end of the course, the students will gain knowledge and skills regarding the concepts and practices of forage resource management in the context of the mixed farm-forest-grazing land system of Nepal.

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

1. Understand concepts of range science and be able to apply such concepts in management scenarios.
2. Understand and apply the principles of vegetation management to improve wildlife habitat and livestock production.
3. Understand and practice the concepts of carrying capacity in range management decision making.
4. Describe and discuss problems and prospects of integrated forage resource management and how such issues differ in the different physiographic regions of Nepal.

UNIT 1. INTRODUCTION (3)

- 1.1 Concept of rangeland
- 1.2 Characteristics of rangeland
- 1.3 Types of rangeland of the World
- 1.4 Definitions: pasture, grassland, forage, herbage, browse, range science, range management
- 1.5 Range ecosystems of Nepal (by physiographic region)
- 1.6 Importance of livestock in Nepal agro-ecosystems

UNIT 2. RANGELAND ECOLOGY AND ANIMAL BEHAVIOR (4)

- 2.1 Physiological and morphological effects of grazing
 - 2.1.1 Defoliation effects on the physical environment
 - 2.1.2 Plant tolerance to defoliation
 - 2.1.2.1 Timing, frequency and intensity of defoliation
 - 2.1.2.2 Completion of plant replacement cycle
 - 2.1.2.3 Avoidance
 - 2.1.2.4 Maintenance of growth rate
 - 2.1.2.5 Survival under stress
 - 2.1.2.6 Carbohydrate cycle in grasses
- 2.2 Plant succession and community composition in range ecosystems
 - 2.2.1 Factors that define "artificial" and "natural" grassland
 - 2.2.1.1 Physical factors causing stress
 - Definition of stress
 - Climate
 - Edaphically and physiographic
 - 2.2.1.2 Human and natural disturbances, definition of disturbance
 - Fire

- Land-clearing
- Grazing
- Landslides, etc.
- 2.2.1.3 Competition
 - Definition of plant competition
- 2.2.2 Successional response to grazing in different environments
- 2.2.3 Examples from Nepal and relevant management objectives
- 2.3 Grazing behaviors of livestock and wildlife
 - 2.3.1 Grazing habits of different animals (domestic and wild)
 - 2.3.2 Palatability of forage species
 - 2.3.3 Preference for range plants by livestock and wildlife

UNIT 3. RANGE INVENTORY (5)

- 3.1 Purpose of range inventory
- 3.2 Vegetation analysis
 - 3.2.1 Species listing including important fodder species
 - 3.2.2 General observations
 - 3.2.3 Cover
 - Visual estimation
 - Point methods
 - Line interception
 - 3.2.4 Density
 - 3.2.5 Frequency
- 3.3 Determination of carrying/grazing capacity
 - 3.3.1 Definitions
 - 3.3.2 How to determine carrying/grazing capacity
 - 3.3.3 Limitations of the carrying capacity concept
- 3.4 Range condition classification for Nepal
 - 3.4.1 Concepts and definitions
 - 3.4.2 Classification systems
 - 3.4.3 Condition trend analysis

UNIT 4. RANGE IMPROVEMENTS (3)

- 4.1. Nutrient management / nutrient cycle
- 4.2. Vegetation manipulation of rangelands
 - 4.2.1 Manipulating vegetation with grazing animals
 - Grazing systems - definitions
 - 4.2.2 Fire as a management tool (summary)
 - 4.2.3 Weed control with pesticides

UNIT 5. GRAZING MANAGEMENT (4)

- 5.1 Indigenous herding systems in Nepal
 - 5.1.1 Local herding systems
 - 5.1.2 Trans-humane sheep herding
 - 5.1.3 Rotation systems
- 5.2 Socio-economic factors influencing livestock population and structure

- 5.2.1 Markets
- 5.2.2 Labor availability
- 5.2.3 Cultural/religious taboos
- 5.2.4 Constraints to livestock production
- 5.2.5 Conflict analysis and management

UNIT 6. FORAGE MANAGEMENT IN CONTEXT OF COMMUNITY FORESTRY (3)

- 6.1 Forage resource development in community forestry plantations
- 6.2 Over story / understory vegetation management
 - 6.2.1 Secondary growth forest
 - 6.2.2 Plantation forest
- 6.3 Multiple uses of forest grazing land
 - 6.3.1 Fodder production
 - 6.3.2 Fuel wood and timber production
 - 6.3.3 Litter production
 - 6.3.4 Biodiversity
 - 6.3.5 Recreational
 - 6.3.6 Tourism
 - 6.3.7 Carbon sequestration

UNIT 7. FORAGE MANAGEMENT IN CONTEXT OF THE FARMING SYSTEM (4)

- 7.1 Terrace and bund improvements
- 7.2 Utilization of non-agricultural inclusions (gullies, kharbari)
- 7.3 Improved management of fodder trees
- 7.4 Improved crop residue management
- 7.5 Proper feeding techniques (improved stalls, concentrates)
- 7.6 Silage and hay production
- 7.7 Pasture improvement
 - 7.7.1 Seeding
 - 7.7.2 Fertilization
 - 7.7.3 Seed production

UNIT 8. INTEGRATED FORAGE RESOURCE MANAGEMENT (4)

- 8.1 Integration of farm/forest/livestock systems
- 8.2 Planning the annual forage budget
- 8.3 Problems and prospects
 - 8.3.1 Bottlenecks to implementation of forage resource development
 - 8.3.2 Policy recommendations to overcome limitations

UNIT 9. INSTITUTIONAL ASPECTS OF RANGELAND MANAGEMENT (3)

- 9.1. Introduction to traditional management
- 9.2. Stakeholder analysis of rangelands
- 9.3. Modern institutional management
- 9.4. Policy and tenure system
- 9.5. Rangeland Policy 2012

PRACTICALS (8)

1. Vegetation identification nearby sites.
2. Calculating carrying capacity and grazing capacity.
3. Calculating plant diversity, frequency and biomass.
4. Observation excursion on silage and hay production area of nearby sites.
5. Observation excursion on livestock farm near by sites.

TEXT AND REFERENCES

1. Heady, Harold F. 1975. Range Management. McGraw Hill Book Company, New York.
2. Lal, R.B. 1990. Principles and Practices of Range Management. International Book Distributors, Dehradun, India.
3. McIlroy, R.J. 1964. An Introduction to Tropical Grasslands Husbandry. Oxford University Press, London.
4. Mohammad, Noor. 1989. Rangeland Management in Pakistan. ICIMOD, Kathmandu, Nepal.
5. Stoddart, Laurence A. and Arthur D. Smith. 2000. Range Management, Third ed. McGraw Hill Book Co., New York.
6. Vallentine, John F. 1989. Range Development and Improvement, Third ed., Elsevier Science & Technology Books.

Course Title: SOIL AND WATER CONSERVATION ENGINEERING

Course Code: WME 503

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: By the end of the course, the students will gain knowledge and skills regarding the concepts and practices of watershed management in the context of the mixed farming livestock system of Nepal.

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

1. Identify the causes of land degradation in the watershed.
2. Explain the conservation measures to mitigate land degradation and maintain its productivity.
3. Able to design major erosion control structures.
4. Understand conservation techniques and measures.
5. Understand erosion monitoring processes.

UNIT 1. LAND DEGRADATION PROBLEMS IN NEPAL (4)

- 1.1. Introduction to land degradation and its consequences
- 1.2. Water erosion
 - 1.2.1. Types of water erosion: sheet, rill, gullies, landslides and flood
 - 1.2.2. Agents active in water erosion
 - 1.2.3. Water erosion prediction equation
- 1.3. Wind erosion
 - 1.3.1. Factors causing wind erosion
 - 1.3.2. Soil movement due to wind erosion
 - 1.3.3. Control of wind erosion

UNIT 2. DESIGN AND CONSTRUCTION OF EROSION CONTROL AND RIVER TRAINING STRUCTURES (19)

- 2.1. Introduction to mechanical control measures
 - 2.1.1. Check dams
 - 2.1.1.1. Types of check dams
 - 2.1.1.2. Design of check dams
 - 2.1.1.3. Stability analysis of check dams
 - 2.1.1.4. Construction consideration and layout procedure of check dams
 - 2.1.2. Spurs
 - 2.1.2.1. Types of spurs
 - 2.1.2.2. Design of spurs
 - 2.1.2.3. Stability analysis of Spurs
 - 2.1.2.4. Construction consideration and layout procedure of Spurs
 - 2.1.3. Embankments
 - 2.1.3.1. Types of embankments
 - 2.1.3.2. Design of embankments
 - 2.1.3.3. Stability analysis of embankments
 - 2.1.3.4. Construction consideration and layout procedure of Embankment

- 2.1.4 Waterways/frainage
 - 2.1.4.1 Types of waterways/drainage
 - 2.1.4.4 Construction consideration and layout procedure of waterways / drainage
- 2.1.5 Bunds
 - 2.1.5.1 Types of bunds
 - 2.1.5.2 Design of bunds
 - 2.1.5.3 Consideration in the stability of bunds
 - 2.1.5.4 Construction consideration and layout procedure of bunds
- 2.1.6 Terraces
 - 2.1.6.1 Types of terraces
 - 2.1.6.2 Design of terraces
 - 2.1.6.3 Consideration in the stability of terraces
 - 2.1.6.4 Construction consideration and layout procedure of terraces
- 2.1.7 Water harvesting and recharge structures
 - 2.1.7.1 Types of water harvesting and recharge structures
 - 2.1.7.2 Design of water harvesting and recharge structures
 - 2.1.7.3 Consideration in the stability of water harvesting and recharge structures
 - 2.1.7.4 Construction consideration and layout procedure of water harvesting and recharge structures
- 2.1.8 Bolster
 - 2.1.8.1 Design of bolster
 - 2.1.8.2 Construction consideration and layout procedure of bolster

UNIT 3. BIO-ENGINEERING TECHNIQUES (5)

- 3.1. Introduction / definitions / concepts / engineering functions of plants
- 3.2. Soil bio-engineering techniques/practices
 - 3.2.1. Plants and planting techniques
 - 3.2.2. Grass planting / seeding
 - 3.2.3. Strip planting
 - 3.2.4. Crib wall
 - 3.2.5. Brush layering
 - 3.2.6. Turfing / sodding
 - 3.2.7. Wattle fence/watling
 - 3.2.8. Palisade
 - 3.2.9. Fascine
 - 3.2.10. Jute netting
 - 3.2.11. Hedge-brush layering
 - 3.2.12. Brush mattressing
 - 3.2.13. Rip-rap / joint planting
 - 3.2.14. Brushwood checkdam

UNIT 4. CONSERVATION TECHNIQUES (6)

- 4.1. Gully and landslide treatments
- 4.2. Slope stabilization
- 4.3. Stream / river bank erosion control
- 4.4. Road erosion control

- 4.5. Cultivated, forest lands and pasture lands

UNIT 5. CONSERVATION FARMING TECHNIQUES (3)

- 5.1. Shelter belts / green belts
- 5.2. Hedgerows
- 5.3. Minimum tillage
- 5.4. Relay cropping
- 5.5. Mixed cropping
- 5.6. Multiple cropping
- 5.7. Strip cropping
- 5.8. Cover cropping
- 5.9. Mulching
- 5.10. Green manure
- 5.11. Compost manure
- 5.12. Nitrogen fixing plants

UNIT 6. EROSION PROCESS AND MONITORING (3)

- 6.1 Erodibility of soil
- 6.2 Erosivity or rainfall-factor
- 6.3 Revised Universal Soil Loss Equation
- 6.4 Erosion monitoring
 - 6.4.1. Run-off plot monitoring
 - 6.4.2. Paired catchment studies
 - 6.4.3. Sedimentation survey

FIELD OBSERVATIONS

- a. Field observation of check dams and other conservation structures
- b. Field observation and design of hydraulic channel for peak flow for a small catchment
- c. Field observation and comparison between bio engineering practice and mechanical protection works.

TEXT AND REFERENCES

- 1. Alford, D. 1992. Hydrological Aspects of the Himalayan Region. ICIMOD Occasional Paper No. 18., ICIMOD, Kathmandu.
- 2. 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.
- 3. DSCWM. 2016. Guideline on Landslide Treatment and Mitigation. Department of Soil Conservation and Watershed Management, Kathmandu, Nepal.
- 4. Dunne, T. and Leopold, L.B. 1978. Water in Environmental Planning. W. H. Freeman.
- 5. Dutta, S.K. 2006. Soil Conservation and Land Management. International Book Distributors, Dehradun.
- 6. 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).

7. FAO. 1985. Vegetative and Soil Treatment Measures. FAO Watershed Management Field Manual. FAO Conservation Guide 13/1. FAO/UN.
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9. Pereira, H.C. 1989. Policy and Practices in the Management of Tropical Watersheds. Westview Press.
10. Rimal, B.K. and M.D. Joshi. 1991. Soil Conservation and Watershed Management. In Background papers to the National Conservation Strategy for Nepal, Vol. 1. National Planning Commission / HMG and IUCN, Kathmandu.
11. Sharma, P.N. (Ed.). 1997. Recent Developments, Status and Gaps in Participatory Watershed Management and Training in Asia, PWMTA-FARM Field Document No. 6. FARM Programme and Participatory Watershed Management Training in Asia, Kathmandu.
12. Sthapit, K.M. 1987. Land Capability Classification. Watershed Planning Manual No. 4. Watershed Management Project, Department of Soil Conservation, Kathmandu.
13. Sthapit, K.M. 1988. Flood Control and Watershed Management. A paper presented to the workshop on River Training / Embankment Protection. Organized by Department of Irrigation and UNDP-ILO. 9 to 13 May, 1988, Kathmandu.
14. WECS. 1987. Erosion and Sedimentation in the Nepal Himalaya. Water and Energy Commission Secretariat, Kathmandu.

Course Title: REDD FORESTRY AND CLIMATE CHANGE

Course Code: SFM 504

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: To equip students with the knowledge related to the role of forests in climate change management, adaptation planning and REDD+ to be applied in their respective professional field.

SPECIFIC OBJECTIVES: The specific objectives of other courses are:

1. To equip students with the knowledge on role of forests in climate change management.
2. To impart knowledge on climate change impacts in different sectors and respective adaptation planning process.
3. To share about REDD+ related policies and institutional development at inter/national level.

UNIT 1. CONCEPT OF CLIMATE CHANGE (6)

- 1.1 Theory of climate variability, climate change, greenhouse gas emission scenario; GHGs inventory, black carbon
- 1.2 Paleo-climatology
 - 1.2.1 CC over geological time scale
 - 1.2.2 Glacial and interglacial cycles
 - 1.2.3 Dating methods for climate change detection (Tree cores, sediment deposits, pollen analysis)

UNIT 2. CLIMATE CHANGE VULNERABILITY ASSESSMENT AND ADAPTATION (10)

- 2.1 Theory of vulnerability, risk, resilience and climate change adaptation
- 2.2 Climate change impact in different sectors
- 2.3 Vulnerability assessment (sectoral and spatial)
- 2.4 Approaches of climate change adaptation
 - 2.4.1 Ecosystem based adaptation
 - 2.4.2 Community based adaptation
 - 2.4.3 Integrated approach

UNIT 3. REDUCING EMISSION FROM DEFORESTATION AND FOREST DEGRADATION (REDD+) (10)

- 3.1 Dawn of RED, REDD, REDD+ concept
- 3.2 REDD+ Finance and emerging donors
- 3.3 Required components for REDD+ implementation at national level (e.g. institutional arrangement, MRV, REL/RL, monitoring and reporting)
- 3.4 Initiatives on REDD+ (international and national)
- 3.5 REDD+ co-benefits and other opportunities of REDD+ implementation
- 3.6 REDD+ issues/challenges at national and international level

UNIT 4. LEGAL AND POLICY INSTRUMENTS (10)

- 4.1 International – negotiation on climate change, CoP decisions, Kyoto protocol, Montreal protocol and global climate change politics
- 4.2 National – National Adaptation Programme of Action (NAPA) and Local Adaptation Plan of Action (LAPA), Readiness Preparatory Proposal, REDD+ Strategy

UNIT 5. CASE STUDY REVIEW (4)

- 5.1 Forest Carbon Accounting pilot project
- 5.2 REDD+ strategy and other relevant emerging policies at national level
- 5.3 Piloting of REDD+ benefit sharing mechanism project in Nepal

TEXT AND REFERENCES

1. Acharya, K.P., Dangi, R.B., Tripathi, D.M., Bushley, B.R. and Bhandary, R.R. (Eds). 2009. Ready for REDD, Taking Stock of Experience, Opportunities and Challenges in Nepal. Nepal Foresters' Association, Nepal.
2. UNFCCC Website, <http://unfccc.int/2860.php>
3. Critchfield, H.J. 1999. General Climatology. Prentice-Hall, New Delhi and Earthscan, London.
4. Davoudi, S. Crawford, J. and Mehmood, A. (Eds.). 2009. Planning for Climate Change : Strategies for Mitigation and Adaptation for Spatial Planners. Earthscan Publishers, London.
5. GoN/MoFSC. 2014. Nepal Biodiversity Strategy and Action Plan 2014-2020. Ministry of Forest and Soil Conservation, Kathmandu.
6. GoN/MoFSC. 2015. Forest Policy. Ministry of Forest and Soil Conservation, Kathmandu.
7. IPCC. 2006. Guidelines for National Green House Gas Inventories. IPCC, Geneva.
8. IPCC. 2007. Synthesis Report. IPCC, Geneva.
9. IPCC. 2013. Fifth Assessment Report. IPCC, Geneva.
10. Jha, B.N. and Paudel, G. 2010. REDD Monitoring, Reporting and Verification System in Nepal. Gaps, Issues and Challenges, *Journal of Forest and Livelihood*. Vol. 9(1), p21-32.
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12. MOE. 2010. Climate Change Vulnerability Mapping for Nepal. Ministry of Environment, GoN, Kathmandu.
13. MOE. 2010. NAPA to Climate Change. MOE, GoN, Kathmandu.
14. MOE. 2011. Status of Climate Change of Nepal. MOE, GoN, Kathmandu.
15. MOE. 2012. LAPA Framework to Climate Change. MOE, GoN, Kathmandu.
16. UNFCCC. 2011. CDM Methodology. Booklet information including EB 63. UN Framework Convention on Climate Change, Bonn.

Course Title : COMMUNITY BASED FOREST MANAGEMENT

Course Code : SFM 505

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: To provide students basic concepts and in-depth knowledge in community- based forest management worldwide.

SPECIFIC OBJECTIVES: By the end of the course, the students will be able to:

1. Discuss the genesis of the CBFM in the World in general and in Nepal.
2. Describe the principles of CBFM as applied to the needs of developing countries.
3. Analyze the factors involved in the development (emergence) of CBFM in Nepal.
4. Describe and discuss different types (models) and practices of CBFM in Nepal.
5. Advise user groups (designing and) in implementing CBFM for sustainability.

UNIT 1. INTRODUCTION (8)

- 1.1 Definition and concept of CBFM
- 1.2 Emergence of CBFM (in the world and in Nepal)
- 1.3 Decentralization concepts and reasons
- 1.4 Global practices of CBFM (social forestry, village forestry, joint forest management, other participatory forestry)
- 1.5 CBFM models in Nepal (community forestry, leasehold forestry, buffer zone , forest mgt. in conservation area, collaborative forest management, religious forestry and public land forestry, private forestry, intergrated conservation and development, agroforestry)

UNIT 2. PRINCIPLES AND PROCESS OF CBFM (12)

- 2.1 Devolution: opportunities and constraints
- 2.2 Property rights, collective action, and co-management
- 2.3 Common principles in CBFM (Ostrom's 8 principles for managing a commons)
 - 2.3.1 Clearly defined resource and user group boundary
 - 2.3.2 Operational rules suited to local conditions
 - 2.3.3 Collective choice arrangements
 - 2.3.4 Monitoring
 - 2.3.5 Graduated sanctions
 - 2.3.6 Conflict resolution mechanisms
 - 2.3.7 Recognition of rights
 - 2.3.8 Multiple layers of nested enterprise
- 2.4 Key principles of CBFM
 - 2.4.1 Security (ownership)
 - 2.4.2 Flexibility
 - 2.4.3 Participation
 - 2.4.4 Devolution
 - 2.4.5 Property rights
- 2.5 People's participation in forestry
 - 2.5.1 Purpose of people's participation
 - 2.5.2 Principles of participation

- 2.5.3 Type of participation
- 2.5.4. Level of participation
- 2.5.5 Criteria for quality of participation

UNIT 3. SUSTAINABILITY OF CBFM (8)

- 3.1 Concept of sustainability
- 3.2 Sustainable forest management (issues of sustainable CBFM)
- 3.3 Criteria and indicators for sustainability for CBFM
- 3.4 Participatory monitoring and evaluation (PME)

UNIT 4. ROLE OF DIFFERENT STAKEHOLDER IN CBFM (6)

- 4.1 Definition and type of stakeholders (primary/secondary)
- 4.2 Roles and responsibilities of different stakeholder (GO, I/NGOs and civil society) in different stages of CBFM planning?
- 4.3 Stakeholder analysis and its processes

UNIT 5. DECENTRALIZED GOVERNANCE AND CBFM IN NEPAL (6)

- 5.1 Forest management plan
- 5.2 Master Plan for Forestry Sector (MPFS)
- 5.3 Forest Policy 2001 and 2015

Excursion

Review of case studies of community- based forest management

TEXT AND REFERENCES

1. Bhattacharya, P., Pradhan, L. and Yadav, G. 2010. Joint forest management in India: Experience of two decades. *Resource Conservation and Recycling*, 54: 469 – 480.
2. Cornwall, A. 2008. Unpacking Participation: Models, meanings and practices. *Community Development Journal*, 43(3): 269 – 283.
3. Ghate, R. and Ghate, S. 2010. Autonomy necessary but not sufficient: Comparative study of CFM, Nepal and JFM, India. *Journal of Forest and Livelihoods*, 9 (1): 33 – 44.
4. Guitjt, I. 1999. Participatory Monitoring and Evaluation for Natural Resource Management and Research. IIED, London.
5. IED. 2005. Stakeholders Power Analysis. Institute for Environment and Development (IED), London.
6. Knox, A. and Meinzen-Dick, R. 2001. Collective Action, Property Rights, and Devolution of Natural Resource Management: Exchange of Knowledge and Implications for Policy. A Workshop Summary Paper. IFPRI.
7. Measham, T.G. and Lumbasi, J.A. 2013. Success factors for CBNRM: Lessons from Kenya and Australia. *Environmental Management*, 52: 649 – 659.
8. Ministry of Agriculture and Forestry. 2001. Village Forestry Training Manual. Provincial Agriculture and Forestry Office, Lao.
9. Ojha, H.R., Timsina, N.P., Kumar, C., Belcher, B. and Banjade, M.R. 2007. Community based forest management programs in Nepal: An overview of issues and lessons. *Journal of Forest and Livelihoods*, 6 (2): 1 – 7.

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11. Pokharel, Ridish K. 1998. Participatory forestry development activities in the Tarai region of Nepal: A study with special reference to Jhapa district. In T.B.S. Mahat and Chiranjibi P. Upadhyaya (eds.), *Community Participatory Forestry Development Experience in the Tarai Region of Nepal*, IOF/ITTO, Pokhara: 91 – 105.
12. Pokharel, Ridish K. 1999. An overview of participatory forestry in Nepal's Tarai. *Banko Jankari*, 9 (1): 15 – 19.
13. Twymen, C. 2000. Participatory conservation? Community based natural resource management in Botswana. *The Geographical Journal*, 166 (4): 323 – 335.

Course Title: EXPERIMENTAL DESIGN FOR FORESTRY

Course Code: SFM 506

Lecture Hour: 40

Credit Hour : 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical:10)

GENERAL OBJECTIVE: Upon completion of this course, the students will be able to understand and use the logic and reasoning involved in the designing and conducting of experiments.

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

1. Apply basic skills in designing an experiment.
2. Analyze and calculate the data obtained from an experiment.
3. Draw valid inferences and conclusions about the results of an experiment.

UNIT 1. BASIC STATISTICAL CONCEPT (2)

- 1.1 Descriptive Statistics
- 1.2 Hypothesis testing
- 1.3 F-test / t-test review
- 1.4 Dot notation
- 1.5 Fixed, mixed and random effect models

UNIT 2. ANALYSIS OF VARIANCE (ANOVA) (5)

- 2.1 Introduction
- 2.2 One- way ANOVA
- 2.3 Two- way ANOVA

UNIT 3. BASIC CONCEPT IN EXPERIMENTAL DESIGN (2)

- 3.1 Definition of different terminology in experimental design
- 3.2 Principal of experimental design

UNIT 4. COMPLETELY RANDOMIZED DESIGN (CRD) (3)

- 4.1 The experimental plan
- 4.2 Allocation of treatments to experimental unit (EU)
- 4.3 Linear model and assumptions
- 4.4 Analysis and interpretation

UNIT 5. RANDOMIZED BLOCK DESIGN (RBD) (3)

- 5.1 The experimental plan
- 5.2 Allocation of treatments to experimental unit (EU)
- 5.3 Linear model and assumptions
- 5.4 Analysis and interpretation

UNIT 6. LATIN SQUARE DESIGN (LSD) (4)

- 6.1 The experimental plan
- 6.2 Allocation of treatments to experimental unit (EU)
- 6.3 Linear model and assumptions

6.4 Analysis and interpretation

UNIT 7. MULTIPLE COMPARISONS (2)

7.1 Introduction

7.2 Least Significance Difference (LSD) test procedure

7.3 Duncan's New Multiple Range Test (DNMRT) procedure

UNIT 8. FACTORIAL EXPERIMENT (6)

8.1 Introduction

8.2 The 2X2 factorial experiment

8.3 Analysis and interpretation

8.4 Generalization of 2X2 factorial experiment to 2^3

UNIT 9. ANALYSIS OF COVARIANCE (ANACOVA) (3)

9.1 Introduction

9.2 ANACOVA in CR design

9.3 Analysis and interpretation

UNIT 10. OTHER DESIGNS (INTRODUCTION ONLY) (2)

10.1 Confounding

10.2 Nested design

10.3 Split plot design

PRACTICALS (8)

1. One- way ANOVA

2. Two- way ANOVA

3. Completely Randomized Design (CRD)

4. Randomized Block Design (RBD)

5. Latin Square Design (LSD)

6. Paired Comparison: LSD and DNMRT

7. Two- and three-factor factorial design

8. Analysis of covariance

9. Field visit to experimental plots

10. Computer use in experimental design based on biophysical and economical measurement data including statistical software like SPSS, GenStat, R.

TEXT BOOKS AND REFERENCES

1. Cochran, W.G and Cox, G.M. 2000. Experimental Designs, Second edition. John Wiley and Sons (Asia) Private Limited, Singapore.

2. Gomez, A. K and Gomez, A.A. 2010. Statistical Procedures for Agricultural Research. John Wiley and Sons, Ansari Road, Daryaganj, New Delhi.

3. Goon, A.M., Gupta, M.K. and Dasgupta, B. 1994. Fundamentals of Statistics, Volume II. The World Press Private Limited, Calcutta.

4. Gupta, S.C. and Kapoor, V.K. 2010. Fundamentals of Applied Statistics. Sultan Chand and Sons, New Delhi.

5. Huntsberger, D.V. and Billingsley P. 1981. Elements of Statistical Inference. Allyn and Bacon Inc., London.
6. Jayaraman, K. 2000. A Statistical Manual for Forestry Research. Forestry Research and Support Programme for Asia and the Pacific (FORSPA). FAO Regional Office, Bangkok.
7. Lentner, M and Bishop, T.A. 1983. An Introduction to Analysis of Variance and Experimental Design Blacksburg, VA : Valley Book Co.

Course Title: FOREST PROTECTION

Course Code: SFB 507

Lecture Hour: 40

Credit Hour : 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: At the end of the course students will gain the general knowledge about basic forest protection, forest entomology, forest pathology, etc.

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

1. Explain different factors harmful to a forest and seedlings in the nurseries.
2. Describe various methods (protective and preventive) to control damaging agents.
3. Describe the life history and characteristics of harmful insects and diseases damaging some of principal species in the natural forest or plantation.

SECTION A BASIC PROTECTION

UNIT 1. INTRODUCTION AND IMPORTANCE OF FOREST PROTECTION (1)

- 1.1 Role of forest protection
- 1.2 Difficulties in forest protection

UNIT 2. PROTECTION AGAINST ATMOSPHERIC AGENCIES (2)

- 2.1 Temperature
- 2.2 Frost
- 2.3 Drought
- 2.4 Rainfall
- 2.5 Wind
- 2.6 Smoke and poisonous gas
- 2.7 Lightening

UNIT 3. PROTECTION AGAINST DAMAGE CAUSED BY HUMANS (2)

- 3.1 Deforestation
- 3.2 Encroachment
- 3.3 Shifting cultivation practices
- 3.4 Illegal felling
- 3.5 Heavy constructions inside forest lands
- 3.6 Defective forest policies

UNIT 4. FOREST FIRES AND CONTROL MEASURES (3)

- 4.1 Causes of fires
- 4.2 Classification of fires
- 4.3 Damage by fire
- 4.4 Factors Influencing the spread and severity of forest fire
- 4.5 Prevention and control methods (mechanical, biological, social and educational)
- 4.6 Rehabilitation of burnt areas
- 4.7 Beneficial effects of fires (as management tool)

- 4.8 Community based forest fire management

UNIT 5. PROTECTION AGAINST GRAZING (2)

- 5.1 Forest grazing intensity
- 5.2 Effect of grazing,
- 5.3 Regulation of forest grazing
- 5.4 Protection from grazing by domestic and wild animals
- 5.5 Damage by birds

UNIT 6. PROTECTION AGAINST INJURIOUS PLANT (2)

- 6.1 Weeds, climbers and Phanerogamic parasite
- 6.2 Excessive number of the plants

**SECTION B
FOREST ENTOMOLOGY**

UNIT 7. PROTECTION AGAINST INSECT DAMAGE (3)

- 7.1 Introduction: concept of forest entomology
- 7.2 General harmful characteristics of insects
- 7.3 Damage to forest resources
- 7.4 Development and metamorphosis of insects
 - 7.4.1 Post embryonic development
 - 7.4.2 Metamorphosis
 - 7.4.3 Types of insect larvae-pupae
- 7.5 Insect control
 - 7.5.1 Applied control
 - a. Physical control
 - b. Chemical, mechanical, silvicultural, biological, cultural, genetic and legal control measures
 - 7.5.2 Natural control (climate, topography)
 - 7.5.3 Use of predator, parasite, pathogens, pheromones, keromones and sex hormones.
 - 7.5.4 Integrated pest management (IPM)
 - 7.5.5 Nursery pests and their management

UNIT 8. LIFE CYCLES AND CONTROL OF IMPORTANT FOREST INSECTS (7)

- 8.1 Order Coleoptera
 - 8.1.1 Curculionidae (Sissoo leaf-roller)
 - 8.1.2 Bostrichidae (Bamboo borer)
 - 8.1.3 Buprestidae (Sissoo bark borer)
 - 8.1.4 Scarabaeidae (Cockchafers)
 - 8.1.5 Platypodidae (Chirpine borer)
 - 8.1.6 Scolytidae (Conifers bark beetle)
 - 8.1.7 Cerambycidae (Sal borer)
- 8.2 Order Lepidoptera
 - 8.2.1 Geometridae (Deodar defoliator)

- 8.2.2 Hyblaeidae (Teak defoliator)
- 8.2.3 Noctuidae (Greasy cutworm and sissoo defoliator)
- 8.2.4 Pyralidae (Teak skeletoniser)
- 8.2.5 Oecophoridae (Simal shoot borer)
- 8.3 Order orthoptera
 - 8.3.1 Grallidae (Crickets)
- 8.4 Order Isoptera
 - 8.4.1 Termitidae (White ants)

SECTION C FOREST PATHOLOGY

UNIT 9. PLANT DISEASE SYMPTOM AND CONTROL MEASURES (3)

- 9.1 Plant diseases: symptoms, effects
- 9.2 Host-parasite relationship
- 9.3 Factors affecting epiphytology of a disease and its control
- 9.4 Principles of Forest Disease management

UNIT 10. PROTECTION AGAINST DAMAGE BY DISEASES (7)

- 10.1 Classification of forest tree diseases (root diseases, stem diseases, foliar diseases and bark diseases)
- 10.2 Concept on Pythium, Polyporous, Fomes, Ganoderma, Poria, Lenzites, Fusarium, Armillarea, and their control
- 10.3 Symptoms, pathogenic organisms, mode of infection, Life cycle and control measures for: Sal, Sissoo, Khair, Teak, Populus, Eucalyptus, Chir Pine, Blue Pine, Deodar, Utis.

PRACTICALS (8)

1. Regions of insect body (Simple and compound eyes, types of antenna, mouth parts and legs)
2. Visit local nursery and study the insects, pests, and diseases of nursery.
3. Identification of important insect orders and families.
4. Collection and preservation of insects and fungi.
5. Identification of important diseases of forest trees.
(Heart rot, root rot, butt rot, white rot, brown rot, soft rot, canker, gall, and foliar diseases)
2. Fire control practice

TEXT AND REFERENCES

1. Artsybashev, E.S. 1974. Forest Fires and Their Control. Oxonian Press Pvt. Ltd., New Delhi.
2. Bakshi, B.K. 1976. Forest Pathology: Principles and Practice in Forestry. Controller of Publication, New Delhi.
3. Beeson, C.F.C. 1993. The Ecology and Control of Forest Insect. Bishen Singh Mahendra Pal Singh, Dehradun.
4. Boyce, John Shaw. 1961. Forest Pathology. McGraw-Hill Book Company, Inc.

5. Chattopadhyaya, S.B. 1993. Principles and Procedures of Plant Protection. Oxford & IBH Publishing Co.
6. Devasahayam, H. Lewin. 2009. Plant Pathology. New India Publishing Agency, New Delhi.
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10. Knight, F.B., Herman John Heikkinen and S.A. Graham. 1980. Principle of Forest Entomology. McGraw-Hill Book Co., New York.
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Course Title: FOREST ENGINEERING

Course Code: FPE 508

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: The students will have the basic engineering background necessary to work with simple engineering structures in natural resource planning and management.

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

1. Understand about construction materials and their use in structure.
2. Design building components of forest houses.
3. Align and supervise forest road construction.
4. Calculate the quantities of materials for resource conservation in situ and estimate the cost.

UNIT 1. CONSTRUCTION MATERIAL AND STRUCTURAL DESIGN (12)

- 1.1 Introduction to construction materials
- 1.2 Masonry and its types (stone, brick, wooden)
- 1.3 Mortar and its types (cement, lime, mud)
- 1.4 Introduction to PCC, RCC, pointing, plastering, scaffolding, shuttering
- 1.5 Building components: definition and types (walls, doors, windows, lintels, roofs, beam, column, foundation, water supply and sanitation systems and electrical system)
- 1.6 Site selection criteria and orientation of a building
- 1.7 Definition and calculation: forces, stresses, moments and reactions
- 1.8 Analysis of simply supported beam with different loading (with BMD and SFD)
- 2.5 Design concept: allowable stress, wooden beam design, wooden column design, simple foundation and footing design with numerical examples

UNIT 2. FOREST ROAD AND TRAILS (20)

- 2.1 Introduction to road development process in Nepal (strategic road network, local road network, NRS, NRRS)
- 2.2 Introduction and necessity of forest roads
- 2.3 Types of forest road pavement (earthen, graveled, WBM road, bridle path, inspection path).
- 2.4 Forest road alignment and survey
 - 2.4.1 Alignment requirement
 - 2.4.2 Factors controlling alignment (obligatory points; plain and hill; preliminary survey, location, survey)
 - 2.4.3 Steps in a new road project work
- 2.5 Geometric design of road
 - 2.5.1 Elements of road (cross sectional / horizontal / vertical alignment)
 - 2.5.2 Requirements of a good forest road
 - 2.5.3 Factors controlling geometric design of roads

- 2.5.4 Cross-section of road in cutting and filling
- 2.5.5 Camber, types, recommended value of camber for different road surface, providing camber in the field
- 2.5.6 Super elevation (Cant), derivation, simple procedure for super elevation design
- 2.5.7 Extra widening, types, derivation
- 2.5.8 Sight distance, types and derivation
- 2.5.9 Gradient, types
- 2.5.10 Curves (types- horizontal, vertical and transition)
- 2.6 Road sub-grade soil
 - 2.6.1 Significance of sub-grade soil
 - 2.6.2 Characteristics of sub-grade soil
 - 2.6.3 Desirable properties
 - 2.6.4 Soil compaction, moisture content, dry density and soil strength at OMC
- 2.7 Base course design by linear method
- 2.8 Road construction: technology
 - 2.8.1 Earthen road
 - 2.8.2 Graveled road
 - 2.8.3 WBM road
- 2.9 Special consideration of hill roads (a typical cross section of hill road showing all components of the road)
- 2.10 Failure and maintenance of road
 - 2.10.1 Need for maintenance
 - 2.10.2 General causes of pavement failure and maintenance (earth road, gravel road and WBM)
 - 2.10.3 Classification of maintenance work.
- 2.11 Stabilization of road pavement

UNIT 3. SIMPLE BRIDGES AND CULVERTS IN FOREST ROAD (4)

- 3.1 Bridges: definition, importance of bridges, selection of bridge sites, component of bridges, loads on the bridges, types of forest bridge (girder, suspension, cantilever), principles of construction, economic span.
- 3.2 Culvert: types of culverts and cause-ways used in forest roads

UNIT 4. DESIGN AND ANALYSIS OF ROAD SIDE DRAINAGE, RETAINING / BREAST WALLS (7)

- 4.1 Definitions of road drainage and its importance
- 4.2 Types of road side drainage (rectangular, trapezoidal, triangular and circular)
- 4.3 Design of longitudinal drains for peak run off with numerical example
- 4.4 Retaining walls and breast walls; materials used, forces acting upon them; design and stability analysis

UNIT 5. QUANTITY AND COST ESTIMATION (5)

- 5.1 Estimating and costing: types, norms, specification, district rate, rate analysis

- 5.2 Understanding engineering drawing (plan, elevation, section, isometric view) and its importance in estimating
- 5.3 Estimating and costing for two roomed forest guard house
- 5.4 Estimating and costing for retaining walls, breast walls and check dams (dry stone, gabion and brick or stone masonry with cement sand mortar)
- 5.5 Estimating earthwork for forest roads/trails and side drains
- 5.6 Factors affecting the cost of a construction projects.

PRACTICALS (12)

1. Practice to draw plan, elevation, section and isometric view of simple objects
2. Practice to draw plan, elevation, and section of retaining wall, check dam, two roomed building
3. Prepare quantity and cost estimate of two roomed building, retaining wall, check dam (gravity type)
4. Prepare quantity and cost estimation of earthwork of forest roads

FIELD TRIP

- Field observation of simple building and road drainage structure

TEXT AND REFERENCES

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2. Dutta, B.N. 2016. Estimating and Costing in Civil Engineering. BUBS Publisher Distributors Pvt Ltd., India.
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YEAR 3 SEMESTER II

Course Title: NON-TIMBER FOREST PRODUCTS (NTFPs)

Course Code: FPE 551

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: Upon completion of the course the students will understand the value and the potentiality of the NTFPs.

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

1. Understand the importance and scope of NTFPs.
2. Understand the economic cultivation and processing of NTFPs.
3. Understand the importance of medicinal plants.
4. Select and recommend the uses of NTFPs.
5. Understand the importance of sustainable harvesting and value addition.

UNIT 1. INTRODUCTION OF NTFPs (2)

- 1.1 Introduction
- 1.2 Importance and scope of NTFPs
- 1.3 NTFPs category (Classification of NTFPs)

UNIT 2. NTFPs AND LIVELIHOOD (2)

- 2.1 Role of NTFPs in livelihood
- 2.2 Employment and income generation
- 2.3 Ethno-botanical value of NTFPs

UNIT 3. RESOURCE ASSESSMENT (3)

- 3.1 NTFPs Inventory
- 3.2 Sampling and measurement
- 3.3 Estimation and assessment of NTFPs

UNIT 4. SUSTAINABLE HARVESTING OF NTFPs (3)

- 4.1 Importance
- 4.2 Harvesting practices
- 4.3 Sustainable harvesting
- 4.4 Post harvesting technique

UNIT 5. MEDICINAL AND AROMATIC PLANTS (MAPs) (3)

- 5.1 Importance and scope
- 5.2 Identification of MAPs
- 5.3 Nursery and cultivation of important MAPs
- 5.4 Collection, extraction and processing

UNIT 6. COMMERCIAL VALUE OF NTFPs (3)

- 6.1 Cutch and katha

- 6.2 LAC, honey, silk, mushroom
- 6.3 Tans and dyes
- 6.4 Leaf, fiber, flosses, oil seed and essential oil

UNIT 7. RESIN COLLECTION AND PROCESSING (3)

- 7.1 Importance of resin collection in rural income
- 7.2 Resin collection technique
- 7.3 Manufacturing process rosin and turpentine
- 7.4 Grading and marketing of rosin and turpentine
- 7.5 Uses of rosin and turpentine
- 7.6 खोटो संकलन (कार्यविधि) निर्देशिका, २०६४

UNIT 8. BAMBOO AND CANE PRODUCT (3)

- 8.1 Bamboo products and their use
- 8.2 Cane products and their use

UNIT 9. VALUE CHAIN AND ENTERPRISES DEVELOPMENT (3)

- 9.1 Definition of value addition/ chain
- 9.2 Types of value chain
- 9.3 Value chain analysis of important NTFPs (any one)
- 9.4 Business plan and its preparation process
- 9.5 Introduction of entrepreneurship

UNIT 10. MARKETING OF NTFPs (3)

- 10.1 Importance
- 10.2 Marketing channel (local, regional and international)
- 10.3 Revenue sharing mechanism
- 10.4 Problem and prospect of NTFP marketing in Nepal

UNIT 11. CERTIFICATION OF NTFPs (4)

- 11.1 Importance of Certification
- 11.2 Certification criteria
- 11.3 Quality standard of value added product
- 11.4 Policy and legislation with NTFPs Certification

PRACTICALS (8)

1. Identification of at least 10 important NTFPs species
2. Value addition processing exercise (Drying, cleaning, storing etc.)
3. Business plan preparation

FIELD TRIP

Visit to nearby NTFPs processing and marketing

TEXT AND REFERENCES

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26. खोटो संकलन (कार्यविधि) निर्देशिका, २०६४

Course Title: WATERSHED MANAGEMENT

Course Code: WME 552

Credit Hour: 2

(Final Theory- 30, Internal Assessment:- 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: By the end of the course, the students will gain knowledge and skills regarding the concepts and practices of watershed management in the context of the mixed farming livestock system of Nepal.

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

1. Understand and describe the various watershed characteristics and integrated watershed management, and the important interactions among watershed components.
2. Integrate climatic, hydrology, soil conservation, forest, range, agriculture and livestock and people in watershed management.
3. Explain the conservation program and activities to mitigate land degradation and maintain its productivity.
4. Understand management strategies for the implementation of the soil conservation and watershed management program.
5. Conduct the necessary field reconnaissance and data collection for the watershed management planning and prepare watershed management plan.

UNIT 1. INTEGRATED WATERSHED MANAGEMENT (8)

- 1.1 Concept and cope
- 1.2 Watershed as a management unit
- 1.3 Watershed characteristics
 - 1.3.1 Soil
 - 1.3.2 Geology
 - 1.3.3 Climate, Climatic zones of Nepal, Agro-climatic zones of Nepal (Department of Soil Conservation), Factors affecting micro-climatic patterns
 - 1.3.4 Landuse (agriculture, forest, grass lands, shrub lands, urban and industrial)
 - 1.3.5 Land capability
 - a. Land evaluation
 - b. Land capability classification
 - c. Land suitability classification
 - 1.3.6. Social, cultural and economic factors
 - 1.3.6.1 Socio-cultural (demographic, cultural obstacle, insecurity and uncertainties, awareness and knowledge)
 - 1.3.6.2. Economic (market availability, economic class stratification, outward migration and labor availability, tourism impacts on local Resource use)
 - 1.3.7. Topography and geometry of watershed)
 - 1.3.8 Watershed delineation, parametrization and morphometric analysis (tools and techniques)

UNIT 2. APPROACH TO WATERSHED MANAGEMENT (5)

- 5.1. Introduction to the watershed management approaches
- 5.2 Management approach

- 5.2.1 Line agency implementation / participatory - decentralized approaches
- 5.2.2 Sectoral / integrated (holistic) approaches
- 5.2.3 Conservation in individual farm / community lands
- 5.2.4 River basin / watershed / sub-watershed / micro-watershed / political unit
- 5.2.5 Model farmer / group approach
- 5.2.6 Project / programme approach
- 5.3 Development strategies to enhance local management capacity
 - 5.3.1 Ownership building
 - 5.3.2 In-situ institution
 - 5.3.3 Networking and linkages
- 5.4. Management in changing context
- 5.5. Springshed management (Importance, issues and management approach)

UNIT 3. LEGAL ASPECTS (3)

- 4.1 Land tenure
- 4.2 Water laws in Nepal
- 4.3 Soil and Watershed Conservation Act, Regulation, and Guidelines
- 4.4 Other legislation related to water and land resources in relation to watershed management (e.g water resource strategy, National water plan, protected areas, and forest)
- 4.5 Land use policy and practices in Nepal

UNIT 4. WATER INDUCED DISASTER MANAGEMENT (2)

- 2.1 Components-Mitigation, preparedness, response and recovery
- 2.2 Disasters risk reduction strategies and measures
- 2.3 Communities involvement to manage water induced disaster risks
- 2.4 Problems in disaster management in Nepal

UNIT 5. MAJOR ISSUES IN WATERSHED MANAGEMENT (3)

- 3.1. Physical problem
- 3.2. Resource use and socio-economic problem
- 3.3 Land fragmentation, fallowing and food security
- 3.4 Road erosion risk
- 3.5 Water quality and sedimentation
- 3.6. Upstream and downstream connectivity mechanism
- 3.7. Collaboration among line agencies and multiple stakeholders

UNIT 6. SOIL CONSERVATION PROGRAM AND ACTIVITIES (4)

- 6.1 Landuse planning
- 6.2 Sustainable land management/productivity conservation
- 6.3 Disaster risk reduction and natural hazard prevention
- 6.4 Water and sediment management
- 6.5 Development infrastructure protection
- 6.6 Climate change adaptation/resilience development
- 6.7 Conservation extension
- 6.8 Community mobilization, capacity development and livelihood improvement
- 6.9 Churia conservation activities and programme

UNIT 7. WATERSHED MANAGEMENT PLANNING (7)

- 7.1 Introduction to integrated watershed management planning
- 7.2 Data required and their collection methods for watershed planning
- 7.3 Sub-watershed prioritization using landuse, land system and demographic data
- 7.4. Watershed project planning
- 7.5. Watershed management planning practices in Nepal
- 7.6. Evaluation and monitoring of the watershed management program

PRACTICALS (8)

1. Demonstration of socio-economic survey and analytical framework required to assess watershed condition
2. Familiarization with different maps used in watershed characterization
3. Delineation of watershed using topographic map
4. Computation of watershed area from different maps
5. Sub-watershed prioritization exercise (Manual)

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Course Title: INTRODUCTORY GIS

Course Code: WME 502

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: After completion of the course the students will be able to understand the basic concept of GIS and its application in natural resources management.

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

- Understand the basic concepts of GIS.
- Familiarize with GIS softwares.
- Obtain basic knowledge of data base creation and database management system.
- Develop ideas on spatial analysis.
- Develop basic ideas of mapping and visualization techniques.
- Know the GIS applications in natural resource management.

UNIT 1. GEOGRAPHICAL INFORMATION SYSTEM AND DATA TYPE (4)

- 1.1 Introduction to GIS (definition and functions)
- 1.2 Components of GIS
- 1.3 Geographical phenomena
- 1.4 Computer representation of geographical information (raster and vector)
- 1.5 Spatial and non-spatial data inputs for GIS

UNIT 2. DATA MANAGEMENT AND PROCESSING SYSTEM (5)

- 2.1 Hardware and software requirement
- 2.2 GIS data creation and organization system
- 2.3 Spatial and non-spatial data base management systems
- 2.4 Data quality and sources of error in GIS

UNIT 3. GEO-SPATIAL ANALYSIS AND MAPPING (8)

- 3.1 Vector- based spatial data analysis
- 3.2 Raster- based spatial data analysis
- 3.3 Concept of map, coordinate system projection
- 3.4 Cartography

UNIT 4. APPLICATION OF GIS IN FORESTRY AND OTHER NATURAL RESOURCE MANAGEMENT (3)

- 4.1 Resource assessment, monitoring, and management planning
- 4.2 Resource mapping
- 4.3 Database development and sharing
- 4.4. Measurements: area, perimeter and grouping

PRACTICALS (20)

2. Familiarization with GIS software (2)
3. Geo-referencing and projection (4)

4. Spatial and attribute data entry from different sources, data base query, editing, linking spatial and non-spatial data (4)
5. Creation of point, line and polygon data from digitization (2)
5. Perform different spatial analysis operation (buffering, intersection, union, raster calculation) (2)
6. Calculation of distance and area
7. Map composition (2)

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Course Title: CONSERVATION BIOLOGY

Course Code: PWM 554

Credit Hour: 3

(Final Theory: 60, Internal Assessment: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: The overall objective of the course is to make students understand the concepts and principles of conservation biology and make them able to apply these principles in sustainable management biological resources.

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

1. Describe the major approaches to conservation, including their differences and common threats.
2. Demonstrate an understanding of the ecological principles upon which conservation are based.
3. Demonstrate how ecological principles are currently applied to the conservation, and cite examples.
4. Demonstrate an appreciation for, and some understanding of the social, political, and economic factors that affect conservation.
5. Demonstrate an understanding of basic conservation biology issues.

UNIT 1. INTRODUCTION (5)

- 1.1 Conservation biology and its scope
- 1.2 Biodiversity
 - 1.2.1 Species diversity
 - 1.2.2 Genetic diversity
 - 1.2.3 Ecosystem diversity
- 1.3 Loss of biodiversity: rates, causes, consequences, perspectives
- 1.4 Implication for biological conservation and its linkage with human society.

UNIT 2. EVOLUTION AND EXTINCTION (14)

- 2.1. Basic genetics review
- 2.2. Heterozygosity and inbreeding
- 2.3. Genetic models in conservation
- 2.4. Evolutionary aspects of diversity
- 2.5. Evolution of social behavior
- 2.6. Population bottlenecks and genetic diversity
- 2.7. Speciation and evolution measures of diversity
- 2.8. Rates of extinction
 - 2.8.1 Extinction rates in aquatic environments
 - 2.8.2 Extinction rates on island
 - 2.8.3 Island biogeography and extinction rate predictions
 - 2.8.4 Local extinction
- 2.9. Non-invasive genetics
- 2.10. DNA based PCR Marker
- 2.11. Genetic base population survey

2.12. Sex and individual ID

UNIT 3. POPULATION BIOLOGY IN CONSERVATION (10)

- 3.1 Basic population growth models
- 3.2 Stochasticity and population decline
- 3.3 Social effects of population decline
- 3.4 Population viability analysis
- 3.5 Metapopulation analysis
- 3.6 Predation and herbivory

UNIT 4. COMMUNITY ECOLOGY IN CONSERVATION (8)

- 4.1 Community ecology: habitat and fragmentation
- 4.2 Pattern and effects of landscape change: disturbance, ecosystem process
- 4.3 Mating systems and conservation
- 4.4 Territoriality and dispersal
- 4.5 Commensalism and mutualism
- 4.6 Keystone and Umbrella Species

UNIT 5. HABITAT DIVERSITY (9)

- 5.1 Forest diversity (distribution, threat, challenges, values and management)
- 5.2 Agricultural and livestock diversity (distribution, threat, challenges, values and management of crop genetic resources)
- 5.3 Aquatic biodiversity (distribution, threat, challenges, values and management)
- 5.4 Conservation of biodiversity and sustainable development (Government actions, conservation programmes and international approaches in Nepal)

UNIT 6. RESTORATION OF BIODIVERSITY (9)

- 6.1. Restoration ecology (principle, aim and practices)
- 6.2. Restoration of site and animal population.
- 6.3. Site condition, ecosystem and habitat parameters
- 6.4. Animal population restoration
- 6.5. Wildlife species recovery program: rhino, tiger, wild water buffalo, black buck.
- 6.6. Setting conservation priorities: diversity, rarity, red list, naturalness, restorability
- 6.7. Government actions, conservation programmes and international approaches in Nepal

UNIT 7. APPLICATIONS (CASE STUDIES) (5)

- 7.1. Translocation and reintroduction (rhinoceros, blackbuck, swamp deer, wild water buffalo, Gharial, etc.)
- 7.2. Breeding centers (crocodile, elephant, vulture, other) in Nepal
- 7.3. Human settlement relocation from protected areas of Nepal (e.g. CNP, PNP, ShNP, KTWR¹)

TEXT AND REFERENCES

¹CNP-Chitwan National Park, PNP-Parsa National Park, Shey Phoksundo National Park, KTWR-Koshi Tappu Wildlife Reserve

1. Primack, R.B., Paudel, P.K. and Bhattarai, B.P. 2013. Conservation Biology: A Primer for Nepal. Dreamland Publication Pvt. Ltd., Kathmandu, Nepal.
2. Caughly, G. and Gunn, A. 1996. Conservation Biology in Theory and Practice. Blackwell Scientific, UK.
3. Eldridge, N. (Ed.). 1992. Systematics, Ecology and the Biodiversity Crisis. Columbia University Press, New York.
4. Ehrlich, P.R. 1981. Extinction: The Causes and Consequences of the Disappearance of Species. Random House, New York.
5. Falconer, D.S. 1981. Introduction to Quantitative Genetics. Longman, New York.
6. Fiedler, P.L. and Jain, S.K. 1992. Conservation Biology: Theory and Practice of Conservation, Preservation and Management. Chapman and Hall, New York.
7. Gilpin, M. and I. Hanski (Eds.). 1991. Metapopulation Dynamics: Empirical and Theoretical Investigations. Academic Press, San Diego.
8. Hudson, W. (Ed.). 1991. Landscape Linkages and Biodiversity. Island Press, Washington, DC.
9. Hunter, M.L. Jr. and Gibba, J.P. 2007. Fundamentals of Conservation Biology, Third edition. Blackwell Publishing Ltd., UK.
10. Soule, M.E. (Ed.). 1987. Viable Populations for Conservation. Cambridge Univ. Press, New York.

Course Title: FOREST MANAGEMENT II

Course Code: SFM 555

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: Upon completion of this course, the students will gain knowledge of basic forest management principles and will acquire the skills needed to achieve improved management of Nepal's forest resources.

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

1. Evaluate various management strategies.
2. Understand role of forest in economic development.
3. Appraise different decision making criteria.
4. Apply tools of regulating different types of forest production systems and apply concepts of allowable cut.
5. Understand methods of optimal rotation determination.
6. Understand the forest policy and its formulation process.
7. Demonstrate ability to write forest resource management plan.

UNIT 1. INTRODUCTION (5)

- 1.1 Definition and objective of forest management
- 1.2 Forest management alternatives and analysis
- 1.3 Decision-making principles and models
- 1.4 Different forest management strategies in Nepal
- 1.5 Role of forests in economic development
 - 1.5.1 Contribution in national economy
 - 1.5.2 Role in local economy
 - Agriculture
 - Rural enterprises
 - 1.5.3 Role of forest in livelihood
- 1.6 Forests, society and environment
 - 1.6.1 Social benefits of forests
 - 1.6.2 Environmental benefits of forests

UNIT 2. SUSTAINABLE FOREST MANAGEMENT (10)

- 2.1 Concept and principles of sustainable forest management
 - 2.1.1 Concept and principle of sustainable forest management
 - 2.1.2 Criteria and indicators of sustainable forest management
 - 2.1.3 Forest certification, types and importance
 - 2.1.4 Forest certification schemes (FSC/PEFC)
- 2.2 Concept and practice of sustained yield
 - 2.2.1 Concept, definition of sustained yield
 - 2.2.2 Prerequisites for sustained yield
 - 2.2.3 Limitations in Nepal's conditions
 - 2.2.4 Yield type

2.2.5 Management steps for sustained yield

UNIT 3. FOREST VALUATION (5)

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

UNIT 4. YIELD REGULATION (13)

- 4.1 Concepts and approaches
 - 4.1.1 The normal forest concept
 - 4.1.2 Yield tables and yield regulations
- 4.2 Regulating plantation forest
 - 4.2.1 Concepts
 - 4.2.2 Applications
- 4.3 Regulating natural forests
 - 4.3.1 Concepts
 - 4.3.2 Applications
- 4.4 Allowable cut methods
 - 4.4.1 Area control
 - 4.4.2 Volume control
 - 4.4.3 Combined area and volume control

UNIT 5. FOREST POLICY (4)

- 5.1 Forest Policy of Nepal
- 5.2 Policy formulation process
 - 5.2.1 Local
 - 5.2.2 National

UNIT 6. FOREST RESOURCE MANAGEMENT PLAN (5)

- 6.1 Forest resource management plan
 - 6.1.1 Concept, importance and scope of preparation of management plan
 - 6.1.2 Objective and Limitation
 - 6.1.3 Forest management unit
- 6.2 Preparation of forest management plan
 - 6.2.1 Data collection
 - Biophysical

- Socio-economical

- 6.2.2 Map and sketch
- 6.2.3 General format/Content
- 6.2.4 Write up of management plan
- 6.2.5 Method of updating
- 6.3 Scientific Forest Management Plan
 - 6.3.1 Concept of SFM
 - 6.3.2 Strategy and policy
 - 6.3.3 Role of stakeholders
 - 6.3.4 Issues and challenges in Nepal (Hill vs Terai, effect on biophysical factors, knowledge gap and human resource ?)

PRACTICALS (12)

1. Preparation and write- up of forest management plan (community forest and scientific forest)
2. Case study analysis of SFM (in relation with CC, biodiversity, cost benefit analysis, and social inclusion)
3. Comparative analysis of local criteria and indicators with standard criteria and indicators
4. Logical Framework Analysis of some management issue of community forest, bufferzone community forest, leasehold forest, religious forest)

TEXT AND REFERENCE

1. Clutter, J.C. et al. 1983. Timber Management: A quantitative Approach. John Wiley and Sons.
2. Davis, L.S. and Johnson, K.N. 1987. Forest Management. McGraw Hill Book Company, New York.
3. Davis, L.S., Johnson, K.N. Bettinger, P.S. and Howard, T.E. 2001. Forest Management. McGraw Hill Book, New York.
4. Duerr, William A. D.E. Teeguarden, N.B. Christiansen and S. Guttenberg . 1982. Forest Resource Management: Decision Making Principles and Cases. O.S.U. Bookstore, Corvallis, Ohio.
5. Leuchner, W.A. 1984. Introduction to Forest Resource Management. John Wiley and Sons.
6. Mathur, V.P. 1981. Forest Management. Jugal Kishore and Company, Dehradun.
7. MFSC. 2071 B.S. Scientif
8. ic Forest Management Guideline 2071. Ministry of Forest and Soil Conservation, Nepal.
9. Osmaston, F.C. 2010. The Management of Forests. Natraj Publication, Dehradun.
10. Prakash, Ram. 2006. Forest Management. International Book Distributors, Dehradun.

Course Title : PROJECT MANAGEMENT
Course Code : SFM 556
Credit Hour: 2
(Final Theory: 40, Internal Assessment: 10)

Lecture Hour: 40
Full Mark: 50

GENERAL OBJECTIVE: The overall objective of the course is to make students able to formulate project management plan of concerned field.

SPECIFIC OBJECTIVES : The specific objectives are:

1. To introduce the basic knowledge on project and project management.
2. To provide the sound knowledge of project planning, implementation and controlling
3. To provide the knowledge of project finance.
4. To provide the concept of modern trends and techniques of project management.
5. To provide the knowledge of office management and record keeping and financial management.
6. To give skills on budgegeting for strategic management.

UNIT 1. INTRODUCTION OF PROJECT (5)

- 1.1 Concept of project
- 1.2 Characteristics of project
- 1.3 Components of project
- 1.4 Classification of project
- 1.5 Project life cycle
- 1.6 Relation between plan, programme and project

UNIT 2. PROJECT MANAGEMENT (4)

- 2.1 Concept of project management
- 2.2 Elements of project management
- 2.3 Project manager and its role
- 2.4 Project mgmt. experiential learning and issues in forestry sector

UNIT 3. PROJECT PLANNING AND APPRAISAL (7)

- 3.1 Concept of project planning
- 3.2 Project planning process
- 3.3 Project appraisal
 - 3.3.1 Environment
 - 3.3.2 Financial
 - 3.3.3 Technological
 - 3.3.4 Relevance
- 3.4 Project Framework

- 3.4.1 Logical framework
- 3.4.2 Work breakdown structure (WBS)
- 3.5 Project finance (Cost)

UNIT 4. PROJECT IMPLEMENTATION AND MONITORING (6)

- 4.1 Implementation planning
- 4.2 Project supervision
- 4.3 Project monitoring and evaluation
- 4.4 Project Management Information System (PMIS)
- 4.5 Case study analysis of forestry project in nepal.

UNIT 5. PROJECT ACCOUNTING AND FINANCIAL MANAGEMENT (7)

- 5.1 Accounting principles
- 5.2 Auditing
 - 5.2.1 Internal auditing
 - 5.2.2 External auditing
- 5.3 Procurements and contracts
 - 5.3.1 Procurement principles
 - 5.3.2 Procurement process (GO, NGO, Doners)
- 5.4 Financial record management
 - 5.4.1 Account keeping
 - 5.4.2 Trail balance, balance sheet, profit and loss/income expenditure account
 - 5.4.3 Financial norms and guidelines (taxation)

UNIT 6. PROJECT ORGANIZATION AND MANAGEMENT (6)

- 6.1 Project organization
- 6.2 Human resource and staffing
- 6.3 Record keeping, filing and indexing
- 6.4 Project reporting: monthly, quarterly, annually

UNIT 7. DEVELOPMENT PROJECTS IN NEPAL (5)

- 7.1 NGOs
- 7.2 Multi-lateral agencies
- 7.3 Bi-lateral agencies
- 7.4 Issue in co-ordinational of NGO, multi-lateral agencies and bilateral agencies

TEXT BOOKS AND REFERENCE

1. Agrawal, Govinda Ram. 2006. Project Mangement in Nepal. M.K. Publishers and Distributors, Kathamandu, Nepal.

2. Cusworth, John W. and T.R. Franks. 2014. Managing Project in Developing Countries, First ed. Routledge, UK.
3. Nagarajan, K. 2001. Project Management. ISBN 81-224-1340-4, New Age International (P) Limited, New Delhi, India.
4. Public Procurement Act 2063 B.S. and Rule 2064 B.S., Public Procurement Monitoring Office, GoN, Kathmandu.
5. Rizal, Dhruva P. 2001. Project Management. First edition. Ratna Pustak Bhandar, Kathmandu.

Course Title : ADVANCED SILVICULTURE

Course Code: SFB 557

Credit Hour: 2

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

Lecture Hour: 40

Full Mark: 50

GENERAL OBJECTIVE: Upon completion of this course, the students will be able to understand silviculture system, apply and advice the silvicultural techniques in improving the forest management practice.

SPECIFIC OBJECTIVES: The course specifically will prepare the students to:

1. Be able to design and apply silvicultural systems and advice both the user groups and forest department on appropriate silvicultural practices.
2. Learn about appropriate silvicultural techniques for community forests.

UNIT 1. INTRODUCTION (2)

- 1.1 General introduction about the systems
- 1.2 Classification and concept of silvicultural systems

UNIT 2. MAJOR SILVICULTURAL SYSTEMS AND THEIR ADVANTAGES AND DISADVANTAGES (15)

- 2.1 Clear felling system
 - 2.1.1 With artificial regeneration
 - 2.1.2 With natural regeneration
- 2.2 Seed tree system
- 2.3 Shelter wood systems
 - 2.3.1 Uniform system
 - 2.3.2 Group
 - 2.3.3 Strip
 - 2.3.4 Irregular
- 2.4 Selection system
 - 2.4.1 Single tree selection
 - 2.4.2 Group selection system
- 2.5 Accessory systems
 - 2.5.1 Two storied high forest system
 - 2.5.2 High forest with reserve system
- 2.6 Coppice systems
 - 2.6.1 Simple coppice
 - 2.6.2 Coppice with standards
 - 2.6.3 Coppice with reserves
 - 2.6.4 Other variations of coppice systems

UNIT 3. CONVERSION (3)

- 3.1 Objective of conversion
- 3.2 Techniques of conversion
- 3.3 Examples of conversion

UNIT 4. CHOICE AND FORMULATION OF SILVICULTURAL SYSTEMS (4)

- 4.1 Factors to be considered while selecting and formulating a system:
 - 4.1.1 Identification of objective of management
 - 4.1.2 Provision for regeneration
 - 4.1.3 Efficient use of growing spaces
 - 4.1.4 Control of damaging agencies
 - 4.1.5 Provision for sustained yield
 - 4.1.6 Optimum use of forest capital
- 4.2 Resolution of conflicting consideration

UNIT 5. APPLICATION OF SILVICULTURAL SYSTEMS (8)

- 5.1 Silvicultural systems applicable to following Forest types: Sal, Asna, Karma, Khair, Sissoo, Katus- Chilaune, Utis, Oak, Chir pine, Blue pine, Spruce- Fir, Deodar, Teak
- 5.2 Application of silviculture system in Nepal
- 5.3 Effects of silviculture system on soil, wildlife, recreation and biodiversity

PRACTICALS (8)

- 1. Observation of silvicultural system during India tour
- 2 Visit nearby scientific forest management applied forest

TEXT AND REFERENCES

- 1. Champion, Sir Harry G. and S.K. Seth. 2005. General Silviculture for India. Natraj Publishers, Dehradun.
- 2. Daniels, T.W., J. Helms and F.S. Baker. 1980. Principles of Silviculture. McGraw Hill. New York.
- 3. Jackson, J.K. 1994. Manual of Afforestation in Nepal, Vol. II. Forest Research and
- 4. Khanna, L.S. and Ram Prakash. 1991. Theory and Practice of Silvicultural System. International Book Distributors, Dehradun.
- 5. Publications from IOF, Nepal Australia Community Forestry Project and Sagarnath Forestry Project.
- 6. Smith, D.M. 2014. The Practice of Silviculture: Applied Forest Ecology. John Wiley and Sons.
- 7. Troup, R.S. 2008. Silvicultural Systems: The Techniques of Raising Tending and Reeneration of Forest Crops. Asiatic Pub. House, Delhi.
- 8. Troup, R.S. 2011. The Silviculture of Indian Trees. Natraj Publishers, Dehradun.

Course Title: FIELD TRAINING

Course Code: SFM 558

Credit Hour: 2

Lecture Hour: 40

Full Mark: 50

A two- weeks field training program will be conducted with one week in Nepal for exposing students to different management practices/approaches and another week in India (Haldwani, Dehradun,) to cover the practical field observation and exercise of the third year courses. The concerned campuses will provide detail of the program. The supervising faculty will evaluate the field training of the students.

YEAR 4 SEMESTER I

Course Title: MOUNTAIN ENVIRONMENT AND DEVELOPMENT

Course Code: WME 601

Lecture Hour: 40

Credit Hour: 2

Full Mark: 50

(Final Theory: 40, Internal Assessment: 10)

GENERAL OBJECTIVE: Upon completion of the course, the students will be able to understand the mountain environment, explore the diversity of mountain environments, environment changing processes, and the role that people play in using, transforming, and conserving them as well as development processes.

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

1. Understand background issues of mountain environment.
2. Gain knowledge about the resources management issues and strategies in mountain.
3. Learn about the relationship between mountain environment and people.
4. Explore the possible strategies for mountain development.

UNIT 1. UNDERSTANDING MOUNTAIN ENVIRONMENT (12)

- 1.1. Mountain ecosystem
- 1.2. Mountain climate and weather
- 1.3. Mountain system and climate change
- 1.4. Geomorphology of the mountain
- 1.5. Socio cultural and spiritual importance of mountain

UNIT 2. MOUNTAIN RESOURCES AND MANAGEMENT (14)

- 2.1 Water resources and management
- 2.2 Forest resource and management
- 2.3 Land resources and management
- 2.4 Ecotourism
- 2.5 Mountain farming and comparative advantage
- 2.6 Agroforestry
- 2.7 Livestock farming
- 2.8 Ecosystem services /PES

UNIT 3. MOUNTAIN ENVIRONMENT AND PEOPLE (8)

- 3.1 Resource use and dependency
- 3.2 Livelihood of the mountain community
- 3.3 Mountain hazards
- 3.4 Migration
- 3.5 Indigenous environmental practices of mountain communities

UNIT 4. ISSUES OF MOUNTAIN DEVELOPMENT (6)

- 4.1 Concept, components, tools and indicators of sustainable development
- 4.2 Poverty, environment and development linkages
- 4.3 Resource management and development; traditional and indigenous knowledge

- 4.4 Development of highland agriculture, sustainable use of sloping land
- 4.5 Biodiversity, agro-biodiversity and food security
- 4.6 High land forest and ecotourism development
- 4.7 Governments intervention in these issues
- 4.8 Tools of mountain development
 - Mountain risk engineering
 - Sloping agricultural land technology
 - Renewable energy technology
 - Integrating bioengineering.

REFERENCES

1. Chambers, Robert. 1983. Rural Development: Putting the Last First. Longman Scientific and Technical, New York.
2. DFRS/ FRA. 2014. Terai Forests of Nepal (2010-2012). Forest Resource Assessment Project/DFRS, Babarmahal, Kathmandu, Nepal.
3. Ives, Jack D. 2006. Himalayan Perceptions: Environmental Change and the Well-being of Mountain Peoples. Himalayan Association for the Advancement of Science (HimAAS).
4. Ives, J.D. and Messereli, B. 1989. The Himalayan Dilemma: Reconciling Development and Conservation. Routledge, UK.
5. Journal of Mountain Research and Development
6. Koirala M., Ramkrishnan, P.S. and Saxena, K.G. 2011. Environmental Determinants of Livelihood Related Food Production System in Mid Himalayan Landscape. East Nepal. Livelihood Linked Environment Determinant in Himalayan Landscape. Lambert Academic Publishing, Saarbraken.
7. Lekhak, H.D. and Lekhak, B. 2003. Natural Resource Conservation and Sustainable Development. Kshitiz Publication, Kathmandu.
8. Messerli, Bruno and Jack D. Ives (Eds.). 1997. Mountains of the World: A Global Priority. Parthenon Pub. Group, New York.
9. Poudel, K.C. 2003. Watershed Management in Himalayas : A Resource Analysis Approach. Adroit Publisher, New Delhi.
10. Primak, R.B., Paudel, P.K. and Bhattarai, B.P. 2013. Conservation Biology: A Primer for Nepal. Dreamland Publication Pvt. Ltd., Kathmandu, Nepal.
11. Redclift, Michael. 2005. Sustainable development (1987-2005): An oxymoron comes of age. *Sustainable Development*, 13: 212-227.

Course Title: PROTECTED AREA MANAGEMENT

Course Code: PWM 602

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

GENERAL OBJECTIVE: At the end of the course students will be able to gain the general knowledge about planning, implementation, and evaluation of protection area management .

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

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

UNIT 1. INTRODUCTION (4)

- 1.1. Concepts and management paradigms of protected areas
- 1.2. Categories and criteria for selecting protected areas
- 1.3. International policy, law and conventions for managing protected areas

UNIT 2. PROTECTED AREAS OF NEPAL (8)

- 2.1. National policies, law, guidelines, directives and administration for managing protected areas
- 2.2. Protected areas and their unique features.
- 2.3. Analysis of problems, prospects and strategies of protected areas.
- 2.4. Comparison of management approaches:
 - 2.4.1 National park
 - 2.4.2 Wildlife reserve
 - 2.4.3 Hunting reserve
 - 2.4.4 Conservation area
 - 2.4.5 Buffer zone

UNIT 3. LANDSCAPE LEVEL CONSERVATION (7)

- 3.1. Landscape conservation concept and strategies
- 3.2. Conservation landscapes in Nepal (TAL, CHAL, SHL, KSL, KL)
- 3.3. Corridors, connectivities, bottleneck, north-south corridor/linkage, east-west corridors
- 3.4. Upstream-downstream
- 3.5. Corridor forests/ protected forests (e.g. Panchase, Barandavar, etc.)
- 3.6. Transboundary conservation initiatives

UNIT 4. PLANNING, IMPLEMENTATION, AND EVALUATION OF PROTECTED AREA MANAGEMENT SYSTEMS (10)

- 4.1 Planning
 - 4.1.1 Introduction
 - 4.1.2 National strategies for conservation
 - 4.1.3 Management plans
 - 4.1.4 Annual operation plans
 - 4.1.5 Site plans
 - 4.1.6. Management zoning
 - 4.1.7 Planning research programs for protected areas
 - 4.1.8 Action plans
- 4.2 Protected area planning tools
 - 4.2.1 ZOPP (Objective Oriented Project Planning)
 - 4.2.2 APPA (Appreciative Project Planning and Action)
 - 4.2.3 Use of GIS and GPS as planning tools
 - 4.2.4 Results Based Planning
- 4.3 Implementation
 - 4.3.1 Introduction
 - 4.3.2 Management of staff and their duties
 - 4.3.3 Patrolling
 - 4.3.4 Inspection and supervision
 - 4.3.5 Law enforcement
 - 4.3.6 Role of security unit (Nepal Army)
 - 4.3.7 In-service training
- 4.4 Monitoring and evaluation
 - 4.4.1 Introduction
 - 4.4.2 Evaluating management and cost effectiveness
 - 4.4.3 Assessing achievement of goals
 - 4.4.4 The use of checklists in evaluating management
 - 4.4.5 Management effectiveness evaluation (MEE) of protected areas

UNIT 5. RESEARCH AND MONITORING (6)

- 5.1 Management of genetic diversity
- 5.2 Management of rare and endangered species
- 5.3 Management of over abundant populations
- 5.4 Restoration of vegetation
- 5.5 Subsistence use of plant products in and around protected areas
- 5.6 Sustainable extraction of wild animals in and around protected areas
- 5.7 Management oriented research studies(research monitoring (tiger, rhino, red panda)
- 5.8 Management trials

UNIT 6. INTEGRATED PROTECTED AREA APPROACH AND LOCAL PEOPLE (10)

- 6.1. Integrating protected areas in regional land use program
 - 6.1.1 Protected area and development
 - 6.1.2 Environmental and sanitation services
- 6.2. Local people and protected areas

- 6.2.1 Protected area and people
- 6.2.2 Grazing and harvesting from protected areas
- 6.2.3 Local employment from protected areas
- 6.2.4 Provision of social services
- 6.2.5 Plant and animal products in and around protected areas
- 6.3. Resolving conflicts between park/people
 - 6.3.1 Causes and consequences of human wildlife conflict
 - 6.3.2 Retaliation against wildlife damage
 - 6.3.3 Mitigation
- 6.4. Conservation education and public relations
 - 6.4.1 Visitor information and interpretation services
 - 6.4.2 Local village extension service
 - 6.4.3 Publicity and public relations
 - 6.4.4 Committees and dialogue
 - 6.4.5 Internal newsletter and other information dissemination media
- 6.5. Community involvement and engagement in protecting wildlife
 - 6.5.1 Community based anti-poaching operations/units
 - 6.5.2 Information sharing and
 - 6.5.3 Anti-poaching campaigns

UNIT 7. INTERNATIONAL ORGANIZATIONS AND COOPERATION (3)

- 7.1. Introduction
- 7.2. Needs
- 7.3. Types of assistance
- 7.4. Organizations: UN agencies, I/NGOs, bilateral and multilateral agencies, volunteer organizations

PRACTICALS (12)

1. Visit Mountain/Mid-hills/Terai PA to study the management system (to be covered during Nepal-India tour).
2. Evaluation of park management with SWOT, ZOPP and APPA exercises.
3. Survey of management personnel, protection unit people and local people, tourists and hoteliers.
4. Study of buffer zone and conservation area management.
5. Assignments to the students: at least one assignment from each units.
6. Writing field trip report

TEXT AND REFERENCES

1. Bennett, F. 1999. Linkages in the Landscape: The Role of Corridors and Connectivity in Wildlife Conservation. IUCN.
2. DNPWC. 2074 B.S. Protected Areas of Nepal. DNPWC, Kathmandu.
3. Dudley, Nigel (Ed.). 2008. Guidelines for Applying Protected Area Management Categories. IUCN. Switzerland.
4. GoN. 2002. Nepal Biodiversity Strategy 2002. MFSC, Nepal.

5. GoN. 2014. Nepal National Biodiversity Strategy and Action Plan 2014-2020. MFSC, Nepal.
6. GoN. 2015. Terai Arc Landscape-Nepal 2015. MFSC, Nepal.
7. Hawkins et al. 2008. Evaluating Effectiveness: A Framework for Assessing Management Effectiveness of Protected Areas, Second ed. Best Practice PA Guideline series 14. WCPA, IUCN.
8. James P.G. Malcolm L. H Jr. and Elaenor J. Sterling. 2008. Problem Solving in Conservation Biology and Wildlife Management: Exercises for Class, Fieldwork and Laboratory. John Wiley and Sons.
9. Kalemani, Jo Mulongoy and Staurt Chape. 2004. Protected Areas and Biodiversity. UNEP, WCMC.
10. Lakhey S. P. 2014. Wildlife Biology. Institute of Forestry, Hetauda Campus, Hetauda, Nepal. Ganga Jamuna Press P. Ltd. Naya Bazar, Kathmandu, Nepal.
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13. Lockwood , Michael, Graeme Worboys and Ashish Kothari. 2006. Managing Protected Areas: A Global Guide. Earthscan Publications Ltd., London.
14. Majupuria, T.C. and Majupuria, R.K. 2006. Wildlife and Protected Areas of Nepal. S. Devi, Saharanpur, India.
15. McKinnon, J. and McKinnon, K. 1990. Buffer Zone Management in the Tropics. IUCN, Switzerland.
16. McKinnon, J., McKinnon, K., Child, G. and Thorsell, J. 1986. Managing Protected Areas in the Tropics. IUCN, Reprint Natraj Publishers, Dehradun.

Course Title: RESEARCH METHODOLOGY

Course Code: SFM 603

Lecture Hour: 40

Credit Hour : 2

Full Mark: 50

(Final Theory: 30, Internal Assessment: 10, Practical: 10)

GENERAL OBJECTIVE: After completion of this course the students will be able to understand general concepts, meaning and philosophy of research methods and develop basic skills of scientific report writing.

SPECIFIC OBJECTIVES: Students are expected to develop the following specific knowledge and skills:

1. Meaning and types of research and their characteristics
2. Various research designs and their steps
3. Methods of data collection, analysis and interpretation
4. Preparing scientific report and its presentation.

UNIT 1. MEANING AND PHILOSOPHY OF RESEARCH (2)

- 1.1 Meaning
- 1.2 Philosophy/theory of science
- 1.3 Basic characteristics of research
- 1.4 Type of research (deductive and inductive, qualitative and quantitative, academic and action, social and biophysical)

UNIT 2. TERMS AND STEPS USED IN RESEARCH (3)

- 2.1 Concept-construct-hypothesis-theory
- 2.2 Variable
- 2.3 Measurements of variables (scaling)
- 2.4 Reliability and validity
- 2.5 Accuracy, precision and biases
- 2.6 steps used in scientific research

UNIT 4. RESEARCH DESIGN (4)

- 4.1 Meaning and nature
- 4.2 Exploratory and descriptive/diagnostic research design
- 4.3 Experimental design
 - 4.3.1 Causality and causal inferences
 - 4.3.2 Types of experimental design
- 4.4 Sampling design

UNIT 5. METHODS OF DATA COLLECTION (8)

- 5.1 Social methods
 - 5.1.1 Quantitative methods
 - 5.1.1.1 Questionnaire survey,
 - 5.1.1.2 Self administered (mail and internet) and interviews
 - 5.1.2 Qualitative

5.1.2.1 PRA (group discussion, participants, observation, semi structured interviews) and RRA

5.2 Biophysical methods

- 5.2.1 Forest inventory case studies
- 5.2.2 Nursery research case studies
- 5.2.3 Wildlife research case studies

UNIT 6. DATA ANALYSIS AND INTERPRETATION (5)

- 6.1 Classification and organization of data.
- 6.2 Statistical tests (parametric and non-parametric)
- 6.3 Choosing an appropriate test
- 6.4 Interpretation of findings

UNIT 7. REPORT WRITING AND PRESENTATION (10)

- 7.1 Technical Writing
 - 7.1.1 The substance of Technical writing
 - 7.1.2 The Technicality of Technical writing
 - 7.1.3 Attributes of effective technical writers
- 7.2 Design elements of proposal and report
 - 7.2.1 Writing proposal
 - 7.2.2 Writing reports
- 7.3 Oral presentation of technical information
 - 7.3.1 Delivery techniques:
 - 7.3.2 Presentation skills

PRACTICALS (8)

- 1. Selection of research topic by students in group
- 2. Literature review/problem statement/objectives/hypothesis
- 3. Methods/schedule/budget
- 4. Presentation by groups

TEXT BOOKS AND REFERENCES

- 1. Angelsen A., Larsen, H.O., Lund, F.J., Smith-Hall, C. and Wunder, S. 2011. Measuring Livelihoods and Environmental Dependence. Methods for Research and Fieldwork. Earthscan, London.
- 2. Blake, G. and Robert, W.B. 1993. The Elements of Technical Writing. McMillan, New York.
- 3. Chapin, P.G. 2004. Research Projects and Research Proposals. A Guide for Scientists Seeking Funding. Cambridge University Press, UK.
- 4. Day, R.A. 1979. How to Write and Publish a Scientific Paper. Publications Board of the American Society for Microbiology.
- 5. Houp, K.W., Thomas E.P. and Elizabeth, T. 1995. Reporting Technical Information. Allyn and Bacon, Needham Heights, Massachusetts.

6. Kerlinger, F.N. 2004. *Foundation of Behavioral Research*. Surjeet Publications, New Delhi, India.
7. Kothari, C.R. 2005. *Research Methodology, Methods and Techniques*. New Age International (P) Limited, New Delhi.
8. Kumar, R. 2012. *Research Methodology, A Step-by-Step Guide for Beginners*. Sage Publications Private Limited, New Delhi, India.
9. Lannon, J.M. 1988. *Technical Writing*. Scott, Freshman and Company, Glenview, Illinois.
10. Raj, H. 2005. *Theory and Practice in Social Research*, Third edition. Surjeet Publications, New Delhi, India.
11. Walliman, N. 2006. *Social Research Methods*. Sage Publications, New Delhi, India.
12. Young, P.V. 1996. *Scientific Social Surveys and Research*. Prentice Hall, New Jersey, USA.

Course Title: COMMUNITY FORESTRY

Course Code : SFM 604

Credit Hour : 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark : 75

GENERAL OBJECTIVE : To provide in-depth knowledge in Nepal's community forestry as well as an awareness of an emerging issues to the students.

SPECIFIC OBJECTIVES: By the end of the course, the students will be able to:

1. Understand the concept of community forestry and community forestry program.
2. Understand the potential issues of community forestry and its impacts on rural livelihoods.
3. Analyze the potential conflicts in community forestry.
4. Advise user groups designing and implementing community forestry projects.

UNIT 1. COMMUNITY FORESTRY IN NEPAL (6)

- 1.1 Evolution of community forestry in Nepal
- 1.2 Aims and objectives of community forestry (changes over time)
- 1.3 Concept of user groups (primary and secondary users), process and criteria of user group selection and user group committee formation
- 1.4 CF legislations in Nepal (Acts, policies and guidelines)

UNIT 2. GUIDELINES FOR HANDING OVER NATIONAL FORESTS AS COMMUNITY FORESTS (7)

- 2.1 Phases of community forestry development
 - 2.1.1 Investigation – objectives, importance and what to investigate
 - 2.1.2 Negotiation – objectives, whom and what to negotiate
 - 2.1.3 Forest operational plan preparation
 - 2.1.4 Operational plan implementation
 - 2.1.5 Operational plan review and revision
- 2.2 Formation process of constitution
- 2.3 Formation process of operational plan (as per CF revised guideline and scientific forestry practices)
- 2.4 Content of constitution and operational plan

UNIT 3. USER GROUP APPROACH IN COMMUNITY FORESTRY (8)

- 3.1 Group dynamics in community forestry
- 3.2 Gender in forest management practices
 - 3.2.1 Gender equity
 - 3.2.2 Gender disparity
 - 3.2.3 Social inclusion
- 3.3 Decision- making in community forestry
 - 3.3.1 Election process
 - 3.3.2 General assembly
 - 3.3.3 Forest products pricing
 - 3.3.4 Products or benefits distribution system (within group, outside the group)

- 3.3.5 Cost- sharing mechanisms
- 3.3.6 CF fund mobilization (use)

UNIT 4. GOVERNANCE IN COMMUNITY FORESTRY (8)

- 4.1 Decision- making process in community forestry governance
- 4.2 Importance and process of social mobilization, communication and information flow in community forestry
- 4.3 Governance vs good governance
- 4.4 Elements of good governance (participation, transparency, accountability, responsiveness, predictability, rules of law, efficiency and effectiveness)
- 4.5 Tools for governance assessment - Public Hearing and Public Audit (PHPA), Participatory Well- Being Ranking (PWBR), equitable benefit sharing, Participatory governance assessment (PGA)
- 4.6 Actors of governance and their roles (government, NGO, civil society and private sectors)
- 4.7 Practice and process of access to resources and benefit sharing

UNIT 5. CONFLICT MANAGEMENT IN COMMUNITY FORESTRY (7)

- 5.1 Definition of conflicts
- 5.2 Types of conflicts/nature of conflicts
- 5.3 Principles of conflict resolutions
- 5.4 Methods of conflict management
- 5.5 Cases of conflict management in community forestry
 - 5.5.1 Mechanism for resolving conflicts

UNIT 6. ISSUES AND CHALLENGES IN COMMUNITY FORESTRY (6)

- 6.1 Threaten in traditional professions (fuelwood collector, blacksmith and pastoralism in high mountain area)
- 6.2 CF moving beyond original goal (not only fulfilling forest products but also contribute to national goal of poverty reduction)
- 6.3 Active vs. passive management
- 6.4 Forest management and benefit- sharing in community forestry (equity)
- 6.5 Sustainability of community forestry (equity, gender, participation, governance, subsistence vs market oriented management, change in governance system – federal system, effects of global issues – SDG, CC, carbon trading, PES)
- 6.6 Effects of changing national policy (landscape level conservation, water resources use, carbon trading and PES)

UNIT 7. COMMUNITY FORESTRY FOR RURAL DEVELOPMENT (6)

- 7.1 Impacts of CF
 - 7.1.1 Livelihood
 - 7.1.2 Landscapes
 - 7.1.3 Rural development
- 7.2 Different models of income generating activities in community forestry

- 7.3 Community forestry for development (enterprise and entrepreneurship development, scientific forestry, green economy, financing, value addition of NTFPs and MAPs commercialization)

PRACTICALS (12)

1. Visit to nearby community forests to study the following aspects:
 - a. Preparation of community forest operation plan and constitution (CF with scientific forest management)
 - b. Benefit-sharing mechanism, especially forest products in community forestry
 - c. Community forestry governance
 - d. Resolution of conflicts in community forestry
 - e. Income generating activities in community forestry
 - f. Enterprise development

TEXT AND REFERENCES

1. Belbase, Narayan and Regmi, Dhrubesh C. 2002. Potential for Conflicts: Community Forestry and Decentralization Legislation in Nepal. ICIMOD, Kathmandu.
2. Chhetri, Ram B. and Pandey, Tulsi R. 1992. User Group Forestry in the Far-Western Region of Nepal. ICIMOD, Kathmandu.
3. Gilmore, D.A. and Fisher, R.J. 1991. Villagers, Forests, and Foresters: The Philosophy, Process and Practice of Community Forestry in Nepal. Sahayogi Press, Kathmandu.
4. GoN. 2013. Persistence and Change: Review of 30 Years of CF in Nepal. MFSC, Kathmandu.
5. GoN. 2014. Nepal Fifth National Report to Convention on Biological Diversity. Environment Division, MFSC, Nepal.
6. HMG. 2058. Guidelines for Community Forestry Development Program. Ministry of Forests and Soil Conservation, Department of Forests, Kathmandu.
7. LFP. 2009. Community Forestry for Poverty Alleviation: How UK Aid Has Increased Household Incomes in Nepal's Middle Hills (LFP monitoring report series). LFP, Kathmandu.
8. MFSC. 2009. Nepal Fourth National Report to The Convention on Biological Diversity. Ministry of Forests and Soil Conservation, Singh Darbar, Kathmandu.
9. Nepal Swiss Community Forestry Project. 2011. Two Decades of Community Forestry in Nepal: What Have We Learned? Nepal Swiss Community Forestry Project, Kathmandu.
10. Pokharel, Ridish and Tiwari, Krishna. 2013. Good governance assessment in Nepal's community forestry. *Journal of Sustainable Forestry*, 32: 549 – 564.
11. Pokharel, Ridish K. 2008. Good forest governance: A key aspect in achieving the Nepal's community forestry vision. *Nepalese Journal of Development and Rural Studies*, 5 (2): 62 – 68.
12. Pokharel, Ridish K. 2008. Measuring good governance in community forestry in mid hill districts of Nepal.
http://www.indiana.edu/~workshop/seminars/papers/pokharel_mcpaper08.pdf
13. Pokharel, Ridish K. 2008. Nepal's community forestry funds: Do they benefit the poor? *Working Paper* No. 31-08, Kathmandu: South Asian Network for Development and Environmental Economics (SANDEE).

14. Pokharel, Ridish K. 2009. Pro-poor programs financed through Nepal's community forestry funds: Do income matter? *Mountain Research and Development*, 29 (1): 67 – 74.
15. Pokharel, Ridish K., Upadhyaya, Chirangibi P. and Singh, Abadhesh. 1997. Community Forestry: A Handing Over Process. Munal Offset Printers, Pokhara. pp.20.

Course Title: FIELD TRAINING
Course Code: SFM 605
Credit Hour: 2

Lecture Hour: 40
Full Mark: 50

A practical field-training exercise for two weeks will be conducted in Nepal to prepare a forest management plan / operational plan (forestry based plan). The concerned campuses will provide details of the program. The supervising faculty will evaluate the field training of the students.

Electives Courses

Course Title: BIO-CHEMISTRY (Elective)

Course Code: BSH 606

Credit Hour: 3

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

Lecture Hour: 60

Full Mark: 75

Course Objectives:

1. To impart to the students knowledge of fundamental concepts in biochemistry.
2. To enable them to enumerate the molecules of a living cell and understand the structural and functional hierarchy of bio-molecules.
3. To teach various aspects of metabolism and interrelationship of metabolic events.

UNIT 1. AMINO ACIDS AND PROTEINS (12)

- 1.1 Living cell-plant and animal cell, cell membrane-organelles-functions of major sub-cellular components--anabolism and catabolism and their relation to metabolism
- 1.2 Amino acids- classification-synthesis of α -amino acids and their identification
- 1.3 Peptide bond-stereochemistry, synthesis of peptides by solution and solid phase techniques
- 1.4 Proteins-classification-properties-3D structure-determination of amino acid sequence-denaturation and renaturation of protein molecules
- 1.5 Separation and purification of proteins -dialysis -gel filtration - electrophoresis
- 1.6 Catabolism of amino acids: Transamination, oxidative deamination, decarboxylation
- 1.7 The urea cycle and other possibilities of detoxification of ammonia.
- 1.8 Self study: Rare amino acids of proteins, tertiary structure of globular proteins, Plasma proteins

UNIT 2. ENZYMES (9)

- 2.1 Nomenclature, classification and properties-specificity
- 2.2 Factors influencing enzyme action
- 2.3 Mechanism of enzyme action-Lock and Key model and induced fit models
- 2.4 Co-enzymes- cofactors-prosthetic groups of enzymes (TPP, NAD, NADP, FAD, ATP)
- 2.5 Their importance in enzyme action
- 2.6 Mechanism of inhibition (competitive, non- and uncompetitive and allosteric)
- 2.7 Immobilization of enzymes
- 2.8 Enzyme specificity
- 2.9 Self study: Kinetics of mono and disubstrate enzyme catalyzed reactions
Serum enzymes and isoenzymes-their diagnostic value

UNIT 3. LIPIDS (8)

- 3.1 Classification- neutral lipids, phospho lipids (lecithins, cephalins, plasmalogens) and glycolipids-importance, synthesis and degradation
- 3.2 Fatty acids- saturated, unsaturated fatty acids, EFA.
- 3.3 Properties- hydrolysis-acid number, saponification number

- 3.4 Auto-oxidation (rancidity), addition reactions-Iodine value, Polenske number, Reichert-Meissl number, acetyl number
- 3.5 Hydrogenation
- 3.6 Cholesterol– biosynthesis. bile salts derived from cholesterol
- 3.7 Metabolism: oxidation of glycerol- β -oxidation of fatty acids
- 3.8 Biosynthesis of lipids-synthesis of fatty acids and synthesis of triglycerides.
- 3.9 Self study: reaction of lipases on triacylglycerols in aqueous and organic solvents.
- 3.10. Steroid hormones, vitamin-D, lipoproteins

UNIT 4. CARBOHYDRATES (8)

- 4.1 Classification-reducing and non-reducing sugars, Glucose: structure-conformation- stability
- 4.2 Carbohydrates of the cell membrane-starch, cellulose and glycogen (Structure and utility)
- 4.3 Metabolism: Glycolysis and its reversal; TCA cycle. Relation between glycolysis and respiration, Principles of bioenergetics, electron transport chain and oxidative phosphorylation.
- 4.4 Self study: Gluconeogenesis, pentose phosphate pathway

UNIT 5. NUCLEIC ACIDS (8)

- 5.1 Nucleosides and nucleotides-purine and pyrimidine bases, nucleic acids, difference between DNA and RNA, classification of RNA
- 5.2 Biosynthesis of DNA: replication, biosynthesis of mRNA: transcription
- 5.3 Genetic code-mutations and mutants. DNA repair. biosynthesis of proteins
- 5.4 DNA sequencing and PCR, recombinant DNA technology, DNA polymorphism
Self study: strategies for screening DNA libraries, blood composition. blood coagulation,hemoglobin - its role in chemistry of respiration

PRACTICALS (15)

- 1. Test of carbohydrate, protein.
- 2. Effect of water soluble nitrogenous compound on plants seedlings.
- 3. Visit different hospital and learn various test of blood test, pharmaceutical industries.

TEXT AND REFERENCES

- 1. Bohinski, Robert. 2010. Modern Concepts in Biochemistry. Allyn & Bacon Publishers, Boston.
- 2. Conn, E.P. Stumpf. 2009. Outlines of Biochemistry. Wiley India Pvt. Limited.
- 3. Jain, J.L. 1999. Biochemistry. Sultan Chand and Co., Delhi.
- 4. Jeremy, M. Berg, John L. Tymoczko and Lubert, Stryer. 2002. Biochemistry, Fifth ed. W.H. Freeman and Company, New York.
- 5. Kuchel, P.W. and G.B. Ralston, Shaum Series. 1988. Theory and Problems of Biochemistry. McGraw Hill Book Company, New York.
- 6. Malhotra, V.K. 2012. Biochemistry for Students. Jaypee Brothers Medical Publishers, New Delhi.
- 7. Mazur, A. and B. Harrow. 1971. Text Book of Biochemistry, Tenth edition. W.B. Saunders Co., Philadelphia.

8. Nelson, David L. and Michael M. Cox. 2005. Lehninger Principles of Biochemistry, Fourth edition. Worth Publishers, New York.
9. Paula, Yurkanis Bruice. 2002. Organic Chemistry, Third edition. Pearson Education, Inc. (Singapore), New Delhi.
10. Topping, J. 1993. Principles and Applications of Organic and Biological Chemistry. WBB publishers, USA.
11. Veerakumari, L. 2004. Biochemistry. MJP Publishers, Chennai.

Course Title: INTRODUCTION TO COMPUTER PROGRAMMING (Elective)
Course Code: FPE 607 **Lecture Hour: 60**
Credit Hour: 3 **Full Mark: 75**
(Final Theory: 45, Internal Assessment: 15, Practical:15)

GENERAL OBJECTIVE: After completion of this course, the students will be able to understand fundamentals of the programming using “C” language and apply in the field of forestry and natural resource management.

UNIT 1. INTRODUCTION TO C-PROGRAM (6)

- 1.1 History
- 1.2 ANSI standard
- 1.3 Importance of C-program
- 1.4 Basic Structure of C-program
- 1.5 Programming style
- 1.6 Executing a C-program

UNIT 2. ‘C’ FUNDAMENTALS (6)

- 2.1 Character set
- 2.2 C tokens
- 2.3 Keywords and identifiers
- 2.4 Constants, variables
- 2.5 Data types
- 2.6 Escape sequences
- 2.7 Preprocessors directives

UNIT 3. OPERATORS AND EXPRESSION (6)

- 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. DECISION- MAKING AND BRANCHING (4)

- 4.1 IF statement
- 4.2 The IF-ELSE statement
- 4.3 The Switch statement
- 4.4 The GOTO statement.

UNIT 5. DATA INPUT AND OUTPUT (4)

- 5.1 Reading and writing data
- 5.2 Formatted input
- 5.3 Formatted output.

UNIT 6. LOOPS (4)

- 6.1 The While statement
- 6.2 The DO statement
- 6.3 The FOR statement.

UNIT 7. ARRAYS (2)

- 7.1 Introduction
- 7.2 One -dimensional arrays

UNIT 8. FUNCTIONS (4)

- 8.1 Introduction
- 8.2 The form of C- function
- 8.3 Return values and their types
- 8.4 Calling a Function

UNIT 9. FILE MANAGEMENT IN C (4)

- 9.1 Introduction
- 9.2 Defining and opening a file
- 9.3 Closing a file
- 9.4 Input/ output operations on files.

PRACTICALS (20)

- 1. C- fundamentals
- 2. Operators and expression
- 3. Decision- making and branching
- 4. Data input and output
- 5. Loops
- 6. Arrays
- 7. Functions
- 8. File management in C

TEXT AND REFERENCES

- 1. Balguruswamy, E. 2008. Programming in ANSI C. Tata McGraw Hill Publishing, New Delhi.
- 2. Balguruswamy, E. 2008. Programming in "C#". Tata McGraw Hill Publishing, India.
- 3. Gottfried, Byron and, Jitender Chhabra. 2017. Programming with C (Schaum's Outline Series), Third ed. McGraw Hill Education.
- 4. Kanetkar, Yashvant. 2016. Let Us C. BPB Publications.

Course Title: WOOD SCIENCE AND TECHNOLOGY (Elective)

Course Code: FPE 608

Lecture Hour: 60

Credit Hour: 3

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

GENERAL OBJECTIVE: To provide knowledge and skills regarding the concept of the proper wood science and technology.

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

1. Identify wood through the anatomical structures, properties and protect from different pathogens.
2. Explain the wood and moisture relationship.
3. Explain the defects in wood and their prevention.
4. Explain the technological application of wood and other than wood.
5. Explain the importance and application of wood based panel products.
6. Explain the importance of nano-technology and certification of wood panel products.

UNIT 1. INTRODUCTION (4)

- 1.1. Historical background of wood science and technology
- 1.2. Status of wood utilization research and broadening horizons of research at various institutions in Nepal
- 1.3. Evolution of wood based industry (Global and Nepalese context)
- 1.4. Entrepreneurship development
- 1.5. Formulation schemes, productions, sales and marketing strategies. Overseas employment specialized training opportunities including research and development.

UNIT 2. WOOD ANATOMY (6)

- 2.1 Concept and importance of anatomical studies
- 2.2 Anatomical characteristics of 10 commercial timber tree species; bark, blaze, bole, crown, branching, flowers, fruits, etc.
- 2.3 Wood identification
 - 2.3.1 Using a hand lens; general feature, microscopic features of wood (soft/hard)
 - 2.3.2 Wood anatomy in relation to properties of wood
 - 2.3.3 Commercial timbers and its economic importance

UNIT 3. FOREST PRODUCT: CHEMISTRY AND INDUSTRY (6)

- 3.1 Wood as an industrial raw material
 - 3.1.1 Demand and supply of wood in national and international markets.
 - 3.1.2 Utilization of under used species
- 3.2. Chemical constituents of wood and their determination
 - 3.2.1 Occurrence of cellulose, hemi-cellulose and lignin in different morphological regions of cell wall
 - 3.2.2 Effects chemical constituents on physio-chemical properties of wood
- 3.3 Pulp and paper technology

- 3.3.1 Procedure of paper manufacturing
- 3.3.2 Types and categories of paper and paper boards
- 3.3.3 Properties of paper: bulk, curl, dimensional stability, moisture, smoothness
- 3.3.4 Optical properties: brightness, whiteness and color
- 3.3.5 Strength properties: bursting, strength, tensile strength, tearing resistance, wet strength
- 3.3.6 Recycling and reuse of waste paper
- 3.3.7 Mechanism of pollution control due to paper industry: water / air pollution control

UNIT 4. TIMBER MECHANICS AND GRADING (5)

- 4.1 Concept and importance of grading in wood utilization sectors
- 4.2 Defects and their manipulation in logs and sawn form
 - 4.2.1 Quantification of defects
 - 4.2.1.1 Softwood/hardwood logs and sawn timber
- 4.3 Visual grading
 - 4.3.1 Merits and demerits
 - 4.3.2 Stress grading and its relationship to non-destructive testing and their importance

UNIT 5. TIMBER ENTOMOLOGY AND WOOD MICROBIOLOGY (4)

- 5.1 General introduction of biological agent effect on woods
- 5.2 Classification of forest insects: wood borers
- 5.3 Principle and practices of insects and pests control
 - 5.3.1 Integrated pest management
- 5.4 Insect-fungi interaction, microbial control, insect behavior regulators and forest hygiene
- 5.5 Role of microbes in bio-degradation and bio-deterioration

UNIT 6. WOOD SEASONING AND PRESERVATION (5)

- 6.1 Concept and importance of wood seasoning
- 6.2 Forms of water and diffusion of bound water
- 6.3 Affecting components on seasoning: species, temperature, relative humidity, air circulation, species, initial moisture content, grain direction and wood thickness
 - 6.3.1 Classification of timbers: refractory / moderate / non refractory
 - 6.3.2 Log storage: water and on land.
 - 6.3.3 Wood stacking and their type
 - 6.3.4 Seasoning sheds
- 6.4 Type of wood seasoning: air /kiln
- 6.5 Wood chemistry:
 - 6.5.1 Agents responsible for wood deterioration
 - 6.5.2 Chemistry, biochemistry and biology of fungal decay
- 6.6 Micro-structural changes in wood due to fungal attack
- 6.7 Wood preservation
 - 6.7.1 Concept and importance of preservative chemicals
 - 6.7.2 Wood preservation techniques

UNIT 7. COMPOSITE WOOD AND ADHESIVES (6)

- 7.1 Theory of adhesion: inter-molecular, intra-molecular attraction, cohesion, adhesion and adherence
- 7.2 Application of adhesives: wood, plywood, laminated wood
- 7.3 Importance of colloidal state and rheological properties
- 7.4 Application techniques of glues in various products: cold setting, thermo-setting
- 7.5 Glue
 - 7.5.1 Natural glue: animal glue, casein glue, soya bean and starch, silicate of soda glues
 - 7.5.2 Synthetic glue: urea formaldehyde, phenol formaldehyde, melamine formaldehyde, epoxy and polyurethane adhesives, polyvinyl adhesives
- 7.6 Importance of viscosity, setting time of glues and adhesives

UNIT 8. WOOD LUMBER/PANEL PRODUCTS (7)

- 8.1 Concept and importance of plywood making
- 8.2 Veneering and its type
 - 8.2.1 Peeling of logs
 - 8.2.2 Equipment for peeling and stressing: spindle lathes and slicer
 - 8.2.3 Manufacturing process and testing
 - 8.2.3.1 Plywood, particle boards, fibre boards, and block board
 - 8.2.3.2 Preservative treatment of plywood and allied products
 - 8.2.3.3 Glue-line treatment and treatment of finished products
 - 8.2.3.4 Choice of glue compatible preservatives and fire retardant chemicals.
- 8.3 Introduction to lumber from bamboo-based raw materials and manufacturing process.
- 8.4 Wood plastic composite

UNIT 9. CERTIFICATION AND NANO TECHNOLOGY (5)

- 9.1 Concept and utility of nano-science in forest and forest products
- 9.2 Forest certification: Concept and importance
 - 9.2.1 Forest certification: background and importance
 - 9.2.2 Forest product certification and labeling
 - 9.2.3 Forest certification schemes

PRACTICALS (12)

1. Hand lens features and identification of wood, features of soft wood and hardwood, sapwood and heartwood specimens, microscopic features, slide inspection of twenty five characteristics species.
2. Identification and measurement of defects in wood and their evaluation.
3. Comparative studies on air and kiln dried woods.
4. Analysis of decayed wood for physical and chemical parameters.
5. Visit to wood-based industry to understand manufacturing procedures of wood products (pulp, paper, plywood, laminated wood and particle board, insulation board and fibre board, Treatment of wood with different types of preservatives).

6. Visit to laboratory to understand various tests carried out to know the strength of paper and pulp. Mechanical test on timber. Static bending, impact bending, compression parallel and perpendicular to grain, hardness, shear, torsion, nail and screw pulling test, brittleness test and calculation of properties.
7. Visit to laboratory to understand viscosity, jelling time, water tolerance, pH, solid contents and shear strength tests on adhesive, testing of plywood, including accelerated ageing tests, determination of moisture content and swelling coefficients of different woods.

TEXT AND REFERENCES

1. Bhattarai, T.N. and Kumud Shrestha. 2008. National Initiative in Forest Certification. Nepal Foresters' Association, Kathmandu, Nepal.
2. Brown, H.P. 2015. Manual of Indian Wood Technology. Palala Press Publisher.
3. Chauhan, Luxmi and Vijendra Rao. 2003. Wood Anatomy of Legumes of India. Bishen Singh Mahendrapal Singh. Dehradun. p. 220
4. Mehta, T. 2008. A Handbook of Forest Utilization. International Book Distributors, New Delhi.
5. Panshin, A.J. and C. de Zeeuw. 1980. Textbook of Wood Technology. McGraw Hill Book Company, New York.
6. Trotter, H. 1982. Manual of Indian Forest Utilization. FRI and College, Dehradun.
7. Troup, R.S. 1907. Indian Forest Utilization. Superintendent of Government Printing, Calcutta, India.
8. Wadoo, M.S. 1992. Utilization of Forest Resources. IDRIS Publ.
9. Zobel, B.J. and J.P. van Buijtenen. 1989. Wood Variation: Its Causes and Control. Springer-Verlag, New York.

Course Title: ALTERNATIVE ENERGY (Elective)

Course Code: FPE 609

Lecture Hour: 60

Credit Hour: 3

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

GENERAL OBJECTIVE: After completion of the course, the students will be able to work in the development and management of alternative energy (AE) and bio-energy resources.

SPECIFIC OBJECTIVES: After the completion of this course, students will enhance the following skills:

1. Plan for alternative and bio-energy resources.
2. Work on proper management of AE and bio-resources.
3. Work for conservation and improved utilization of AE and bio-energy.
4. Assess the demand and supply of important AE resources and bio-energy resources.
5. Identify appropriate AE and bio-energy sources.

UNIT 1. INTRODUCTION (10)

- 1.1 Energy types (renewable and non-renewable energy source)
- 1.2 National scenario of energy generation and consumption pattern (role and contribution of biomass resource in national energy)
- 1.3 Concept of renewable and non-renewable energy and the importance of AE and bio-energy in renewable energy

UNIT 2. CONCEPT OF ALTERNATIVE ENERGY (10)

- 2.1. Importance, scope and limitation of non- biomass based alternative energy (solar, wind, geo-thermal, tidal, nuclear etc.)
- 2.2. Bio-energy as AE (bio-briquettes, charcoal, bio-char, wood-fuel, bio-ethanol, bio-diesel, bio-gas and biomass power plant).

UNIT 3. BIO-ENERGY RESOURCES (8)

- 3.1. Prospects and potential of non/forest-based bio-energy and other AE development
- 3.2 Sustainable management of bio-energy resources (existing resource assessment, new resource development and management)

UNIT 4. CLASSIFICATION OF BIO-MASS ENERGY (8)

- 4.1. Solid biomass fuels (woody and non-woody: production sources i.e. forest, agriculture, livestock, industry, household and other sectors)
- 4.2. Solid biomass (charcoal, briquettes, dried residues of crops, dung and production methods)
- 4.3. Other biomass energy sources

UNIT 5. BIO-ENERGY TECHNOLOGY (8)

- 5.1. Direct combustion system (cooking-stoves, boilers, kilns, furnaces, etc.)
- 5.2. Thermo-chemical conversion system (charcoal kilns, retorts, gasifiers, etc.)
- 5.3 Bio-chemical conversion system (bio-methanation, fermentation)
- 5.4. Biomass power plants

UNIT 6. ENVIRONMENTAL CONCERNED OF BIO-ENERGY (8)

- 6.1. Green house gases (GHGs) emission and carbon sequestration
- 6.2. Clean development mechanism (CDM)
- 6.3. Green energy as an option of sustainable energy (substitution of fossil fuels)

UNIT 7. POLICY, STRATEGY, ACT AND PROGRAM (8)

- 7.1. Current sectoral specific policies, strategies, acts and programs in Nepal
- 7.2. Alternative energy and bio-energy related institutions and coordination in Nepal

Field Visit

- Visit to bio-energy related activities in surrounding potential site.

TEXT AND REFERENCES

- 1 APO. 2000. Renewable Energy Sources for Rural Areas in Asia and Pacific. Asian Productivity Organization, Tokyo.
- 2 Bhattarai, T.N. The Analysis of Sustainable Fuelwood and Charcoal Production Systems in Nepal: A Case Study. Available at: https://docmh.com/the-philosophy-of-money.html?utm_source=6-the-analysis-of-sustainable-fuelwood-and-charcoal-production-systems-in-nepal-a-case-study-pdf
- 3 Bhattarai, Tara N. and Kumud Shrestha. 2008. National Initiative in Forest Certification. Nepal Foresters' Association, Kathmandu, Nepal.
- 4 Jeremy Shere, 2013. Renewable: The World- Changing Power of Alternative Energy. Martin's Press, New York.
- 5 National Energy Council - Nepal publications
- 6 Sorensen, Bent. 2010. Renewable Energy: Physics, Engineering, Environmental Impacts, Fourth ed. Academic Press.
- 7 Taylor, R.H. 2001. Alternative Energy Sources. Adam Hilger Ltd., Bristol.
- 8 Wengenmayr, Ronald and Thomas Buhrke. 2012. Renewable Energy: Sustainable Energy Concepts. Wiley-VCH.

Course Title: REMOTE SENSING AND GIS APPLICATION IN NATURAL RESOURCE MANAGEMENT (Elective)

Course Code: WME 610

Lecture Hour: 60

Credit Hour: 3

Full Mark: 75

(Final Theory: 30, Internal Assessment: 15, Practical: 30)

GENERAL OBJECTIVE: At the end of the course, students will be able to understand and apply remote sensing and GIS tools to different sectors of natural resource management.

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

1. Understand the ways and means of acquiring/ capturing/creating spatial data from various sources and its organizations in GIS environment.
2. Perform digital/satellite image processing.
3. Understand the concept of geospatial analysis and its applications.
4. Know the different techniques of DEM preparation and its applications in terrain analysis.
5. Apply RS and GIS tools in assessment, management planning and monitoring of natural resources.

UNIT 1. OVERVIEW OF RS/GIS (4)

- 1.1 Review of remote sensing process
- 1.2 Review of GIS and geospatial data
- 1.3 Integration of RS/GPS/GIS
- 1.4 Recent trend in RS/GIS (participatory GIS in NRM , web GIS, open source tools)

UNIT 2. DATA CREATION AND MANAGEMENT (6)

- 2.1 Geospatial data creation (scanning, geo-referencing, digitization)
- 2.2 Spatial and non-spatial database management systems/models
- 2.3 Topology building
- 2.4 Data editing and thematic layer creation
- 2.5 Data quality and errors in GIS
- 2.6 Ground truthing/ field verification
- 2.7 Digital image processing (radiometric and geometric correction, image enhancement, image transformation and image classification)
- 2.8 Concept of map, coordinate system and projection

UNIT 3. IMAGE CLASSIFICATION AND CHANGE DETECTION (5)

- 3.1 Different approach of image classification
- 3.2 Concept of supervised, unsupervised, object based image classification systems
- 3.3 LULC/thematic map preparation
- 3.4 Forest mapping: type and density mapping
- 3.5 Feature extraction indices (NDVI, NDWI, NDSI, etc.)
- 3.6 Classification accuracy
- 3.7 Temporal mapping of land use/cover and change detection

UNIT 4. CONCEPTS GEO-SPATIAL ANALYSIS (5)

- 4.1 Introduction to geospatial data analysis
- 4.2 Integration and modelling of spatial data
- 4.3 Geospatial data analysis methods
 - 1. Data base query (spatial and non-spatial)
 - 2. Geospatial measurements
 - 3. Overlay operation
 - 4. Buffering operation
 - 5. Network analysis
 - 6. Surface analysis
 - 7. Geo-statistics
 - 8. Geo-visualization (classification and reclassification, map composition, chart, report, map layout, 3D visualization)

UNIT 5. DIGITAL ELEVATION MODEL (DEM) FOR LANDSCAPE ANALYSIS (4)

- 5.1 Digital elevation models (DEM) and its application
- 5.2 Techniques for DEM preparation
- 5.3 Terrain analysis
- 5.4 Watershed delineation and analysis

UNIT 6. APPLICATION OF RS/GIS IN VARIOUS SECTORS (6)

- 6.1 Forest resource inventory
- 6.2 Deforestation and forest degradation
- 6.3 Biodiversity characterization
- 6.4 Wildlife habitat analysis
- 6.5 Water resource assessment, planning and management
- 6.6 Disaster assessment and monitoring (forest fire, flood, earthquakes, landslide/erosion)
- 6.7 Environmental Impact Assessment (EIA)

PRACTICALS (30)

- 1. Familiarization with open source and commercial software and their tools used for image analysis and GIS.
- 2. Data download from internet (open source), extraction and layer stacking.
- 3. Georeferencing, rectification and projection of maps/image.
- 4. Generate NDVI, NDSI and NDWI maps and its interpretation.
- 5. Watershed delineation and morphometric analysis.
- 6. Case- based project work on
 - a. Change detection (using temporal satellite images)
 - b. Geo-spatial techniques used in forest management planning (scientific forest management)
 - c. Biomass estimation and carbon mapping
 - c. Forest fire risk assessment
 - d. Habitat suitability analysis (at least one species based on available data).

TEXT AND REFERENCES

1. Antenucci, J.C., K. Brown, P.L. Croswell, M.J. Kevany and H. Archer. 1992. *Geographic Information Systems: A Guide to the Technology*. Van Nostrand Reinhold, New York.
2. Bailey, Trevor C. and Anthony C. Gatrell. 1995. *Interactive Spatial Data Analysis*. Longman Scientific and Technical, published in US with John Wiley and Sons Inc., New York. ISBN 0-470-23502-0 USA, ISBN 0-582-24493-5.
3. Bonham Carter, G.F. 1994. *Geographic Information Systems for Geoscientists*. Love Printing Service Ltd., Ontario, Canada.
4. Burrough, P.A. 1994. *Principles of Geographic Information Systems for Land Resource Assessment*. Clarendon Press, Oxford, UK.
5. Burroughs P.A., McDonnell, R.A. and Lloyd, Christopher D. 2015. *Principles of Geographic Information Systems*. Oxford University Press, Oxford.
6. Chou, Yue Hong. 1997. *Exploring Spatial Analysis in Geographic Information System*. OnWord Press,
7. Chrisman, Nicholas. 2002. *Exploring Geographic Information System*. John Wiley and Sons.
8. Chung, Clang-jo F. and Fabbri, A.G. 1993. *The Representation of Geoscience Information for Data Integration, Nonrenewable Resources, Vol. 2, No. 2*. Oxford Univ. Press.
9. Douglas, William J. 1995. *Environmental GIS: Application to Industrial Facilities*. Environmental Resources Management, Inc. Lewis Publishers, CRC Press, Inc.
10. Eastman, Ron, Ford, Richard, Gibson, Anne and Toledano, James. 1990. *An Introduction to Geographic Information Systems for Resource Management*. SARSA, Worcester, MA,
11. Heywood, I., Cornelius, S. and Carver, S. 2002. *An Introduction to Geographical Information Systems*. Pearson Education Limited.
12. Huxhold, W.E. 1991. *An Introduction to Urban Geographic Information Systems*. Oxford University Press, New York.
13. Lo, C.P. and Albert K.W. Yeung. 2009. *Concept and Techniques on Geographic Information System*. PHI Learning Pvt. Ltd., New Delhi.
14. Longley, Paul A., Maguire, David J., Michael F. Goodchild and David W. Rhind (Eds.). 1999. *Geographical Information Systems: Principles, Techniques, Applications and Management*. Vol. I and Vol. II. John Wiley and Sons, Inc.
15. Peuquet, D.J. and D.F. Marble (Eds.). 1990. *Introductory Readings in Geographic Information Systems*. Taylor and Francis, Bristol, PA.
16. Ripple, William J. (Ed.). 1994. *The GIS Applications Book: Examples in Natural Resources: A Compendium*. American Society for Photogrammetry and Remote Sensing (ASPRS).
17. Star, J. and J. Estes. 1990. *Geographic Information Systems: An Introduction*. Prentice Hall, Englewood Cliffs, NJ.
18. Taylor, D.R.F. (Ed.). 1991. *Geographic Information Systems: The Microcomputer and Modern Cartography*. Pergamon Press, Riverside, NJ.
19. Tomlin, C.D. 2012. *Geographic Information Systems and Cartographic Modeling*. Esri Press.

Course Title: ENVIRONMENTAL CHEMISTRY (Elective)

Course Code: WME 611

Lecture Hour: 60

Credit Hour: 3

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

GENERAL OBJECTIVE: After completion of this course, students will gain knowledge about pollution (air, water and land), solid waste pollution, etc.

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

1. Understand the principles and practice of analytical chemistry.
2. Understand about pollution and its management.
3. Understand the solid waste pollution and its management.
4. Understand the practical process to detect the elements in organic compounds.

UNIT 1. INTRODUCTION (4)

- 1.1 Role of environmental chemistry in natural resources
- 1.2 Definition of pollution pollutants, types of pollution (air pollution, water pollution, solid waste pollution, radiation pollution, noise pollution, thermal pollution, etc.)
- 1.3 Role of plants as anti-pollutant in nature

UNIT 2. ANALYTICAL CHEMISTRY (10)

- 2.1 Common analytical techniques/methods used for determining various types of pollutants

UNIT 3. ATMOSPHERIC/AIR POLLUTION (10)

- 3.1 Stratification of atmosphere
- 3.2 Ozone layer and its importance
- 3.3 Green house effect, its cause and control
- 3.4 Major source of air pollution and major pollutants
- 3.5 Classification and sampling procedure
- 3.6 Analytical methods
- 3.7 Adverse effect of air pollution on plants and animals
- 3.8 Control measures

UNIT 4. WATER POLLUTION (8)

- 4.1 Introduction
- 4.2 Water standards for different uses
- 4.3 Water pollutants and major source of water (surface and ground) pollution
- 4.4 Analytical methods, water treatment (textile, paper, soap, leather, and chemical indicators)

UNIT 5. LAND POLLUTION (8)

- 5.1 Introduction
- 5.2 Source of land pollution and main pollutant
- 5.3 Adverse effect of land pollution on plants and animals
- 5.4 Control measures

UNIT 6. SOLID WASTE POLLUTION (5)

- 6.1 Introduction
- 6.2 Types of solid wastes
- 6.3 Effect of pollution
- 6.4 Control measures.

PRACTICALS (15)

1. Element detection present in organic compounds: N, S, Cl, Br and I
2. Determination of M.P. and B.P. of organic substance
3. Identification of organic compounds: alcohol, glycerine, acetone, oxalate, formate, acetate, etc.
4. Preparation of organic compounds: Nitrobenzene, Phenol, etc. (at least two)

TEXT AND REFERENCES

1. Bahl, Arun and B.S. Bahl. 2014. Advanced Organic Chemistry. S. Chand & Company Ltd.
2. Dey, A.K. 2010. Environmental Chemistry. New Age International Pvt. Ltd.
3. Kudesia, V.P. and U.K. Jetley. 2001. Environmental and Biochemistry. Pragati Prakashan, Pune.
4. Lal, J.B. 1987. Environmental Conservation. International Book Distributors, Dehradun.
5. Mishra, P.C. 2008. Fundamentals of Air and Water Pollution. APH Publishing Corporation.
6. Rao, M.N. and H.V. Rao. 1989. Air pollution. McGraw Hill Higher Education.
7. Tewari, K.S., K.S. Tiwari, S.N. Mehrotra and N.K. Vishnoi. 1978. A Textbook of Organic Chemistry. Advent Books Division, Stosius, Incorporated.

Course Title: ORNITHOLOGY AND MAMMALOLOGY (Elective)

Course Code: PWM 612

Lecture Hour: 60

Credit Hour: 3

Full Mark: 75

(Final Theory: 45, Internal Assessment: 15, Practical: 15)

GENERAL OBJECTIVE: To provide the knowledge about sensory organs, behavior, general classification of aves and mammals.

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

1. Develop basic knowledge of biology of birds and mammals common to Nepal.
2. Familiarize the students with the behavior and ecology of common birds and mammals of Nepal.
3. Develop skill to apply the techniques of research on birds and mammals.
4. Imply knowledge and skills for the conservation and management of birds and mammals.

GROUP A - ORNITHOLOGY

UNIT 1. INTRODUCTION (3)

- 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)

UNIT 2. CLASSIFICATION OF COMMON BIRDS OF NEPAL (4)

- 2.1 Terrestrial birds (forest birds, grassland birds)
- 2.2 Swimming and diving birds (ducks and geese, grebes)
- 2.3 Birds of prey (owls, osprey, eagles, vultures, falcons)
- 2.4 Shore and waders (cranes, storks, ibises and spoonbills; herons and bitterns)
- 2.5 Arboreal birds (parrots, pigeons and doves; woodpecker, bee eaters)
- 2.6 Aerial birds (swifts and swallows)

UNIT 3. SENSORY ORGANS (3)

- 3.1 Sense of smell
- 3.2 Hearing
- 3.3 Vocalisation
- 3.4 Homing and navigation
- 3.5 Orientation

UNIT 4. BEHAVIOUR (9)

- 4.1 Territory
 - 4.1.1 Classification (breeding territory, non breeding territory)
 - 4.1.2 Size and function of territory
- 4.2 Nesting
 - 4.2.1 Classification of nests (ground nest, cavity nest, platform nest, cupped nest)

- 4.2.2 Nest Building (site selection, participation of sexes, false nest)
- 4.2.3 Reuse and protection of nest
- 4.3 Mating
 - 4.3.1 Kinds of mating (monogamy, polygamy, promiscuity)
 - 4.3.2 Mating displays (pre-fertilization display, fertilization display, post fertilization display)
- 4.4 Egg laying and Incubation
 - 4.4.1 Size, shape and coloration of eggs
 - 4.4.2 Numbers of eggs in a clutch
 - 4.4.3 Incubation (participation of sexes and behavior, length and time involved with examples of some species)
 - 4.4.4 Brood parasitism
- 4.5 Parental care
 - 4.5.1 Brooding
 - 4.5.2 Feeding
 - 4.5.3 Nest sanitation
 - 4.5.4 Defense
- 4.6 Competition
- 4.7 Migration

UNIT 5. FLOCK (3)

- 5.1 Seasonal variation of food
- 5.2 Predation

GROUP B - MAMMALOLOGY

UNIT 1. DEFINITION AND GLOSSARY OF MAMMALOLOGICAL TERMS (2)

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

UNIT 2. GENERAL CHARACTERS AND CLASSIFICATION AND IMPORTANCE OF MAMMALS IN CONTEXT OF NEPAL (4)

UNIT 3. PHYSIOLOGY (8)

- 3.1 Digestive, circulation, respiration, nervous, excretion and reproduction.

UNIT 4. BEHAVIOR (8)

- 4.1 Territory
 - 4.1.1 Classification (breeding territory, non breeding territory)
 - 4.1.2 Size and function of territory
- 4.2 Mating
 - 4.2.1 Kinds of mating (monogamy, polygamy, promiscuity)
 - 4.2.2 Mating displays (courtship)
- 4.3 Parental care
 - 4.3.1 Feeding
 - 4.3.2 Habitat selection

- 4.3.3 Defense
- 4.4 Competition
- 4.5 Migration

UNIT 5. INTRODUCTION TO ENDOCRINOLOGY (4)

- 5.1 Thyroid, pituitary, gonads, pancreas and adrenal glands

PRACTICALS (12)

1. Dissection – general anatomy of pigeon.
2. Slide preparation – pecten of pigeon.
3. Field identification of common birds around the campus area.
4. Dissection of rat – general anatomy and skin preparation.
5. Identification of small mammals in the campus area.

TEXT AND REFERENCES

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 with Reference to Kashmir and Sikkim. Nature Himalayas, Kathmandu.
3. Gopal, Rajesh. 2011. Fundamentals of Wildlife Management. Natraj Publisher, Dehradun, India.
4. Kotpal, R.L. 2013. The Birds. Rastogi Publications, Meerut, UP.

Course Title: URBAN FORESTRY (Elective)
Course Code: SFM 613
Credit Hour: 3
(Final Theory: 60, Internal Assessment: 15)

Lecture Hour: 60
Full Mark: 75

OVERALL OBJECTIVE: Develop an understanding of the concepts, benefits (and negatives) and management of trees and forests in cities and towns (i.e. green/living infrastructure) using the i-Tree system as a basic learning tool (<http://www.itools.org/design.php>) with special emphasis on growing urbanization in Nepal.

SPECIFIC OBJECTIVES:

1. Become familiar with the concept of cities as social-ecological systems (SES's) and the roles of trees and urban forests.
2. Awareness and familiarity with urban governance systems (including both local and national issues) and their impact on the urban forest and how it is managed.
3. Awareness and familiarity with street tree biology and management.
4. Become familiar with and develop skills in street tree and urban forest inventory/analysis, and in particular, become competent in using i-Tree software.
5. An understanding of sustainability as it pertains to urban forests and urban forestry programs in modern cities, towns, communities and neighborhoods.
6. Conduct a case study of a campus/city "neighborhood".

UNIT 1. URBAN FOREST INTRODUCTION (6)

- 1.1 Urban Forest: understanding its scope and management
- 1.2 Urban socio-economic context
- 1.3 Historical perspectives of urban forestry and its practices
- 1.4 GON rules, regulation and priorities

UNIT 2. FORESTRY IN URBAN PLANNING (6)

- 2.1 Urban development and urban forestry
- 2.2 Land use trends, urbanization and expanding urban forests
- 2.3 Planning at the national and municipal level, storm preparedness and response
- 2.4 Review city, regional and national greening initiatives
- 2.5 Review neighborhood city and SAARC level greening initiatives

UNIT 3. INSTITUTIONAL ARRANGEMENTS AND GOVERNANCE (6)

- 3.1 Role and involvement of government, municipality, NGOs, other organizations, volunteers
- 3.2 Introduction to institutional arrangements/constraints and possibilities of urban forest in Nepal
- 3.3 Municipal governance, ordinances, city forest tree and urban forest inventories : the benefits and costs of trees and urban forests
- 3.4 Urban forestry in the context of environment friendly local governance

UNIT 4. URBAN FOREST INVENTORY AND MANAGEMENT(6)

- 4.1 Understanding urban tree growth and physiology

- 4.2 Inventory of street tree, green space, urban canopy cover
- 4.3 Green space management
- 4.4 Tools for assessing and managing urban and community forests Arboriculture
- 4.5 Street tree inventory and neighborhoods case study projects (teams)
- 4.6 Tree Inventory in the park and avenue
- 4.7 Tree inventory in river or canal site
- 4.8 Replacement mechanism of the 4D tree in the urban forestry
- 4.9 Thinning and pruning activities in the urban forestry

UNIT 5. GROWING URBAN TREES AND CONSERVATION (6)

- 5.1 Tree care and pest diagnostic basics
- 5.2 Tree planting and establishment
- 5.3 Suitable tree species (indigenous and exotics) for urban forestry Plantation

UNIT 6. URBAN FORESTRY ECOSYSTEM (6)

- 6.1 Urban forestry ecosystem management
- 6.2 Recreation and PES
- 6.3 Urban forestry sustainability
- 6.4 Urban resilience to climate change and disasters
- 6.5 Policy, rule and regulation for the management of urban forestry

UNIT 7. CASE STUDIES (8)

- 7.1 Case studies of urban forest in nearby sites in relation to sustainability, institutional arrangements, environment, PES and GESI

EXCURSION

- Participation in a volunteer event – Environment Day/Earth day/ Campus celebration day, neighborhood tree planting, etc.
- Field trips to urban forest in nearby cities

TEXT AND REFERENCES

1. Konijnendijk, C.C, Nilson, K., Randrup, T.B. and Schipperijn, J. (Eds.). 2005. Urban Forests and Trees: A Ference Book. Springer-Verlag, Berlin Heidelberg.
2. MOFALD. 2013. Environment Friendly Local Governance Guideline 2013. Ministry of Federal Affairs and Local Development, GoN, Kathmandu.

YEAR 4 SEMESTER II

Course Title: STUDENT RESEARCH /INTERNS PROPOSAL AND DEFENCE

Course Code: SFM 651

Credit Hour: 1

Lecture Hour: 20

Full Mark: 25

In the Fourth year Second semester, students must defend their internship or research proposal.

All students must submit proposals to their respective campuses for internship or research work based on their interest.

The respective campuses will allocate supervisors to supervise their work. Students will defend their proposal in the presence of faculty and evaluation committee. The evaluation committee formed by the Campus Chiefs of respective campuses will evaluate and grade their defence. Finding sites and experts for internship/project paper supervision and financing will be the responsibility of the students. Those who are planning to conduct research project will have to find funds for the research themselves.

Course Title: PROJECT PAPER/INTERNSHIP

Course Code: SFM 652

Credit Hour: 8

Lecture Hour: 160

Full Mark: 200

For the partial fulfillment of the requirements for B. Sc. Forestry degree, all students must work on their research project paper or internship. Students are encouraged to conduct original research work based on their interests. Project papers will be finalized in coordination with their respective campus administrations on recommendation of respective student's supervisor. The project paper will be evaluated both by the supervisor and an external evaluator.

Students should carry out the research project work or internship in the final (8th) semester which bears 8 credit Hour. During this project work period, students have to present the mid-term progress and submit interim (progress) reports to their advisors/supervisors along with a letter from institutions where they have carried out their field (project) work. If the students carry out project work in a national park or community forest or in any organization, they should have certification letter from the concerned park or community forest user committee testifying their presence doing field work. Students are required to submit this letter along with their final report.

Evaluation System

The project paper will be evaluated by the supervisor and an external evaluator. Fifty percent weightage is allocated for supervisor and remaining 50 percent for external evaluator.

The interns have to present their progress report to the supervisor. The weightage for the interim report presentation is 50 Mark. The remaining final internship report (for 150 Mark) will be evaluated by internal supervisor and external evaluator. The weightage for both its internal and external evaluators will be equal.

Course Title: STUDENT SEMINAR
Course Code: SFM 653
Credit Hour: 1

Lecture Hour: 20
Full Mark: 25

All students must present a seminar based on their project paper / internship. An evaluation team of three faculty members including seminar co-ordinator will be constituted by the campus administration. The grading of the seminar will be based on the methodology developed by the seminar evaluation team in their respective campuses.