

**SYLLABUS**  
**Masters of Science in**  
**Mountain Environment and**  
**Development Studies**  
**2024**



**Tribhuvan University**  
**Institute of Forestry**  
Kirtipur,  
Kathmandu



## **FOREWORD**

The Master of Science degree in Mountain Environment and Development Studies, conferred by Tribhuvan University, stands as an advanced educational milestone designed to cultivate adept professionals in the field of mountain studies. This academic journey has been shaped by a commitment to excellence, and the number of curriculum revisions ensures that the course is aligned with the changing context. The curriculum overhaul is an integral part of the Institute of Forestry's (IOF) comprehensive review process. This revision aims to fortify the student's proficiency in applying fundamental principles of mountain and development studies to address contemporary challenges in professional practice.

At the heart of this revision process lies a collaborative spirit, with experts and stakeholders engaged at both national and international levels. Leveraging their insights, the curriculum has been crafted aiming that equip students to confront the evolving issues within mountain environment science. The courses introduced are strategically designed to tackle the myriad challenges associated with the mountain environment, particularly in the face of escalating global changes. The envisioned outcome is to empower students with analytical skills, decision-making abilities, and the capacity to address the multifaceted nature of problems inherent in the field of mountain economy and development while balancing the trade-off between ecological and societal needs.

Embarking on this new academic journey, the subjects are identified considering these multiple roles of the mountain environment, where the subject committees and faculty board of the IOF took a leadership role in shaping it. Moreover, many individuals and institutions have contributed directly and indirectly to bring this curriculum to this shape. This is also an outcome of the consultative processes carried out at different levels. I express my sincere thanks to internal and external experts, subject committee chairs and members, and the Faculty Board for their kind cooperation and contributions. Special appreciation is extended to the ALIGN project WWF Nepal for their financial support in the preparation of the syllabus. Further, I would like to extend my special thanks to the Academic Council of Tribhuvan University for approving this curriculum. I appreciate the contribution of curriculum revision committee members Associate Prof. Dr. Sony Baral, Prof. Dr. Krishna Raj Tiwari, Prof. Dr. Rajesh Kumar Rai, Associate Prof. Dr. Narayan Prasad Gautam and Associate Prof. Dr. Menuka Maharjan, IOF for revising the M.Sc. syllabus with leaving no stone unturned.

I am confident that our students will serve as warriors for addressing the planetary crisis, that we are now facing, such as global climate change, biodiversity losses, and environmental issues. Moreover, they will serve in the sustainable management of the global commons. As we step into this renewed academic chapter, we remain committed to upholding the highest standards of education and fostering a learning environment that prepares our students to be leaders and innovators in their respective fields.

Prof. Bir Bahadur Khanal Chhetri, PhD  
Dean



## TABLE OF CONTENTS

INTRODUCTION .....	1
SEMESTER-WISE COURSE BREAKDOWN .....	5
SEMESTER I.....	6
COURSE TITLE: FORESTS AND ENVIRONMENT POLICY.....	6
COURSE TITLE: NATURE AND SOCIETY .....	10
COURSE TITLE: WATER-ENERGY-FOOD-ECOSYSTEM NEXUS.....	14
COURSE TITLE: LANDSCAPE MANAGEMENT AND BIODIVERSITY CONSERVATION .....	19
COURSE TITLE: NATURAL RESOURCE MANAGEMENT IN CHANGING ENVIRONMENT .....	23
SEMESTER II .....	27
COURSE TITLE: GEOINFORMATICS FOR NRM.....	27
COURSE TITLE: RESEARCH DESIGN AND SCIENTIFIC WRITING.....	31
COURSE TITLE: ADVANCED STATISTICS .....	35
COURSE TITLE: NATURAL RESOURCE ECONOMICS .....	38
COURSE TITLE: INDIGENOUS KNOWLEDGE IN MOUNTAIN PRODUCTION SYSTEM .....	42
SEMESTER III .....	47
COURSE TITLE: MOUNTAIN ENVIRONMENT.....	47
COURSE TITLE: MOUNTAIN ECONOMY AND DEVELOPMENT.....	51
COURSE TITLE: PASTORALISM AND RANGE MANAGEMENT .....	58
COURSE TITLE: MOUNTAIN HAZARD AND DISASTER MANAGEMENT.....	63
COURSE TITLE: ENVIRONMENTAL POLLUTION (OPTIONAL) .....	67
COURSE TITLE: NATURAL RESOURCE PROFESSIONAL ETHICS (OPTIONAL).....	71
SEMESTER IV .....	75



## **INTRODUCTION**

Mountain environment is currently grappling with a confluence of challenges, including climate change, biodiversity loss, and the need for sustainable production and development on a global scale. This has led to an escalating level of pressure and threats on forests, which serve as pivotal entities in addressing numerous national and international challenges. The role of the academics is pivotal in addressing these global challenges. In response to the evolving demands of the market, the Master's program in Mountain Environment and Development Studies has been revised to enhance the skills of students and preparing them to navigate the diverse aspects of technical, field, and policy dimensions within the sector. The program is designed not only to equip students with the knowledge necessary to address complex national and international forest challenges but also to empower them to seek, negotiate, and implement solutions in the face of a rapidly changing world.

The Institute of Forestry (IOF) aims to provide high quality education, developing critical thinking skills, and preparing students for their future careers in forestry and natural resources sectors. This is achieved through a multifaceted approach encompassing extensive field research, a dynamic forest lab, an on-campus museum, and impactful outreach programs. Established in 1947 AD, the IOF is the pioneer institute dedicated to imparting comprehensive knowledge and technical expertise in Forestry and allied sectors. As a hub for advanced education in forestry, the Institute of Forestry continues to play a pivotal role in developing skilled professionals and the sustainable management of Nepal's rich natural resources.

The IOF has been offering academic degrees, Bachelor's in forestry, Masters and PhD programs in various fields of Forest Science, including Forestry; Community Forestry; Wildlife Management and Biodiversity Conservation; Mountain Environment and Development Studies; Watershed Management; and Natural Resource Management and Rural Development. The IOF periodically revises the curriculum, engaging academicians, development practitioners, researchers, and policymakers to provide students with the current state of knowledge on forestry sciences and allied sectors and make them competent to address the emerging issues and challenges within it. The M.Sc. programs have been designed as per the increasing needs of the diverse areas and expanding context and career landscape at the national and international levels. Considering the forest is key to addressing many of these national and international challenges diverse Master programs have been introduced and revised as per the need.

The updated course streamlines the learning process by introducing a unified first-year curriculum, ensuring that students, regardless of their specialization (Forestry, Wildlife Management and Biodiversity Conservation, Natural Resources Management and Rural Development, Watershed Management, Mountain Environment and Development Studies, Community Forestry), develop a foundational understanding of crucial interdisciplinary concepts against the backdrop of pressing issues such as policy, forestry, climate change, biodiversity loss, and pollution. The primary objective of the program this is program is to impart essential skills to individuals, fostering sustainable practices and contributing to the well-being of mountain ecosystems and communities. The specific objectives of the program are:

- Build capacity to solve the unique problems associated with the mountain ecosystem based on the geographic needs of the area
- To prepare well-trained mountain professionals with a sound understanding of the mountain environment and development.

For this program adopts a pragmatic, field-based teaching approach, emphasizing applied learning structures. Our graduates will be equipped with a versatile skill set that positions them to ascend in government service, attain notable success in academic pursuits, establish themselves as successful entrepreneurs, and secure high-profile green jobs. The comprehensive academic journey will prepare them to thrive in various career paths and to contribute significantly to their chosen fields.

### **PROGRAM DURATION AND ACADEMIC SESSION**

The Mountain Environment and Development Studies program will span two academic years, comprising a total of four semesters. The First semester focuses on the theoretical aspects of forest and natural resource management. The second semester emphasized on tools and techniques required for data collection and analysis. The Third semester focuses on mountain economy and development, range management, and mountain hazards and disaster management. The Fourth semester is allocated for conducting research and sharing their findings.

### **COURSE CODE AND CODE NUMBERS**

The course code provided in this curriculum comprises a concise representation of the Subject Matter Committee, including a number and additional information enclosed in parentheses. The initial abbreviated text within the course code signifies the specific Subject Committee category to which the course belongs. The abbreviations corresponding to the course codes are outlined below:

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

Students have the option to take any of the courses as extra electives in addition to the required courses for their enrolled Master's degree program

## **ADMISSION, EVALUATION AND AWARD OF DEGREE**

The candidates should possess a 4-year undergraduate degree in either B.Sc. Forestry, Engineering/ Agriculture and Science degree from Tribhuvan University or any institution acknowledged by Tribhuvan University. All students must appear in the entrance examination administered by the Examination Section of the IOF and are selected for admission based on their merit score. Both academic achievements and performance in the entrance examination will play a crucial role in the admission process.

### ***Evaluation and Examination System***

Each semester, students undergo a comprehensive evaluation, encompassing both internal and external assessments. To pass the examination, students are required to secure a minimum of 50% marks in the final external (final exam) and internal (practical and assessments) examinations separately. The grading system allocates 40% of the marks to internal and 60% to the external (final) exams.

The administration of internal examination marks falls under the responsibility of the respective course coordinator, ensuring transparency and accuracy in the assessment process. However, the evaluation culminates in the final written examination, scheduled at the end of the semester. It is imperative to note that students must fulfill the prerequisite of passing the internal to be eligible to sit for the final examinations. In case of students failing to meet the passing criteria in the regular semester examination, they are provided with an opportunity to appear in a make-up examination. Nevertheless, students must adhere to the protocol of filling out the examination form for the respective semester.

The internal marks are given by the responsible course teacher based upon the assessment of attendance tracking, and various tasks such as fieldwork, laboratory exercises, term papers, class presentations, report writing, project work, and home assignments. The assessment process is undertaken by the faculty responsible for each course, who provide clear and detailed evaluation criteria to students well in advance. This proactive communication ensures students to understand and meet the expectations set forth in their courses effectively. Further, the Dean's office will form a committee to evaluate the completion of internal assessment and the marks given by the responsible course teacher. The committee will be responsible for reviewing the internal assignments and carried out while teaching the course and the evaluation criteria for the internal evaluation set by the course responsible teacher as per the nature and objective of the course. The committee will also be authorized to change or not to change the marks given by the internal evaluator if deemed necessary. Finally, the committee will submit report together with the marks of all subject of the semester to the Dean's Office stating whether or not the courses were taught and the evaluation were done in a scientific manner.

The student's thesis will undergo evaluation by the Research Assessment Committee (RAC), coordinated by the main supervisor alongside internal and external experts. The internal expert will be selected by the respective campus, while the external expert will be chosen by the exam control division, ensuring alignment with the subject area's relevance.

### ***Attendance Requirement***

A student must attend at least 80% of classes in each subject. Attendance carries 20% marks on the internal assessment. Failure to fulfill the attendance requirement by a student may result in his/her disqualification to appear in the final examination. But, in specific cases (seriously ill, out of control situation) student having 70% attendance are allowed to appear the final examination. In this case, student should submit medical certificate for seriously ill, and certificate of the concerned authority in other cases.

### ***Academic Transcript and Grading System***

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

Table 1: Grading System for M.Sc. Program

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

*In this system, a student has to receive a minimum of 2.7 GPA or letter "B-" grade to pass each course.*

In every semester, students will be given Semester Grade Point Average (SGPA) using the following calculation

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

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

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

## SEMESTER-WISE COURSE BREAKDOWN

<b>Semester I</b>	<b>Course</b>	<b>Credit</b>	<b>Page Number</b>
SFM 501	Forest and Environment Policy	3	6
SFM 502	Nature and Society	3	10
WME 503	Water- Energy-Food- Ecosystem Nexus	3	14
PWM 504	Landscape Management and Biodiversity Conservation	3	19
SFM 505	Natural Resource Management in Changing Environment	3	23
<b>Semester II</b>			
WME 551	Geoinformatics for NRM	3	27
BSH 552	Research Design and Scientific Writing	3	31
BSH 553	Advanced Statistics	3	35
SFM 554	Natural Resource Economics	3	38
SFM 557	Indigenous Knowledge in Mountain Production System	3	42
<b>Semester III</b>			
WME 625	Mountain Environment	3	47
SFM 626	Mountain Economy and Development	3	51
SFM 627	Pastoralism and Range Management	3	58
WME 628	Mountain Hazards and Disaster Management	3	63
WME 630	Environmental Pollution (Optional)	3	67
SFM 606	Natural Resource Professional Ethics (Optional)	3	71
<b>Semester IV</b>			
WME 651	Proposal	2	75
WME 652	Pre-defense	2	75
WME 699	Dissertation	9	75
WME 653	Manuscript of Research Work	2	75

## COURSE DESCRIPTIONS

### SEMESTER I

#### COURSE TITLE: FORESTS AND ENVIRONMENT POLICY

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 501	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** Forest and other environmental policies play an important role in sustainable resource management. This course is designed to introduce students to the contextual understanding of policies that have shaped the management of renewable resources (i.e., forest, wildlife, water, etc.) in Nepal and beyond. Throughout the course, students will learn ideas behind natural resource policies and try to understand their role in broader natural resource decision-making.

**OBJECTIVES:** The objectives of this course are to:

- To facilitate student learning in forest and environmental policymaking and be able to apply this understanding to case studies of environmental and natural resource policy issues.
- To familiarize students with the development of key national and international policies for natural resources and environmental sustainability.
- To familiarize students with the organizational and administrative structure and policy-making processes of the major federal natural resource management agencies in Nepal.
- To facilitate students in their ability to critique and evaluate policy processes and policy outcomes in the context of emerging market issues and changing natural resource conditions.

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

- Have a clear understanding of the evolution and administrative functionalities of major forest and environmental policies in Nepal.
- Understand the public policy formulation process in national and international contexts.
- Understand the evolution of environmentalism in national and international contexts.
- Be familiar with the various policies and regulations in Nepal pertaining to environment and natural resources.

## COURSE CONTENTS

### UNIT 1: INTRODUCTION TO FOREST AND ENVIRONMENTAL POLICY (6)

- 1.1 Natural Resource Management and Politics
- 1.2 Importance of Public Policy
- 1.3 Evolution of Environmental Policy (forest, watershed, wildlife)
- 1.4 Global Challenges in Natural Resource Management / Planetary Crisis
- 1.5 Tragedy of the Commons
- 1.6 Externalities and Market Failure

**UNIT 2: POLICY PROCESS MODELS (8)**

- 2.1 Economic, Political, and Ethical Perspectives on Environmental Policy
- 2.2 Natural Resource Policy as a Process
- 2.3 Public (forest/watershed/wildlife) Policy Formulation Process in Nepal
- 2.4 Environmental Sustainability and Natural Resource Policies
- 2.5 Criteria for Policy Analysis

**UNIT 3: ENVIRONMENTALISM AND ENVIRONMENTAL POLICIES (8)**

- 3.1 Environmentalism and its Impact on Policies
- 3.2 Theoretical Foundation: Ecocentrism, Anthropocentrism, and Deep Ecology
- 3.3 Emergence of Environmental Impact Assessment as a Policy Tool
- 3.4 Endangered Species Conservation and International Trade

**UNIT 4: INTERNATIONAL CONSERVATION POLICIES (4)**

- 4.1 International Convention Joining and Withdrawal Process
- 4.2 Earth Summit 1992 and its Outcome Conventions
- 4.3 International Climate Agreements and their Effectiveness

**UNIT 5: SECTORAL POLICIES IN NEPAL (6)**

- 5.1 Constitutional Provisions Related to Natural Resources
- 5.2 Sectoral Policies (Other) and Natural Resource Conservation
- 5.3 Synergies in Natural Resource Related Policies (Climate, Environmental, Forests, Watershed, Wildlife)
- 5.4 Natural Resource Revenue Sharing Mechanism

**PRACTICAL (16)**

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit(s)</b>
History of policies (Sectoral) in Nepal	Literature	Literature Review and Presentation	Unit 1, 4
Policy analysis of Nepal Forest/Environment/Watershed/climate policy (Outcomes)	Policy document	Group work / Report	Unit 2
Improving EIA in Nepal	Expert Consultation	Group work / Critiques and Suggestions	Unit 3
Status and Challenges of International Treaties in Nepal	Literature, Expert Consultation	Group work/ Report	Unit 5
Policies in Nepal	Literature	Review / Class Discussion	Unit 6

## KEY REFERENCES

### Unit 1

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### Unit 2

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#### **Unit 4**

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#### **Unit 5**

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2. Nepal Kanun Kitab Byabastha Samiti (Acts – Land, Infrastructure, Mine, Industry, Hydropower).
3. National Natural Resource and Fiscal Commission Act.
4. National Natural Resource and Fiscal Commission. (2017). Recommendation on the Distribution of Royalties from Natural Resources Mobilization.

## COURSE TITLE: NATURE AND SOCIETY

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 502	3	48 (32+16)	75 (45+30)

*Note: 1 Credit= 16 Lecture Hours*

**SCOPE:** This course covers key theoretical concepts and approaches in social sciences as they relate to understanding and describing the relationship between society and nature. It is intended to help students develop contemporary knowledge and practical skills in assessing and analyzing the causes and solutions of natural resource problems by integrating concepts and foundational theories in social science disciplines.

**OBJECTIVES:** The objectives of this course are to:

- Foster an understanding of the evolution of human-nature relationships
- Develop a deeper understanding of the complex dynamics of coupled human and natural systems
- Enhance knowledge regarding various social science theories in explaining and predicting human behavior in the context of natural resource management
- Develop a critical foundation for further research on human-nature interactions with using the concepts and skills of conservation social science

**LEARNING OUTCOMES:** Upon the completion of this course, the students are expected to be able to:

- Know a range of foundational theories in social science to explain and predict the interaction between humans and nature
- Understand the evolving complexity of human and natural systems, including disturbance and adaptation
- Identify and evaluate the importance of cultural and economic institutions in the sustainability of natural resources
- Become familiar with diverse ways human values, beliefs, and norms relate to their behavior toward nature and,
- Integrate ideas and practices from contemporary social science in planning, decision-making, and policy regarding sustainable management of natural resources.

### COURSE CONTENTS

#### UNIT 1: FOUNDATIONS OF NATURE AND SOCIETY (5)

- 1.1 Human History and Nature
- 1.2 Equilibrium and Non-Equilibrium Ecology
- 1.3 Philosophical Foundation of Nature-Human Relationship (Eco-centric, Anthropocentric)
- 1.4 The Social Construction of Nature
- 1.5 Nature and Culture

## **UNIT 2: CHANGES, CHALLENGES, AND PARADIGM SHIFT IN CONSERVATION**

**(6)**

- 2.1 Anthropocene Biosphere
- 2.2 Planetary Boundaries
- 2.3 Limits to Growth
- 2.4 Ecological Modernization
- 2.5 Bright Green Environmentalism
- 2.6 Eco-centric vs Anthropocentric

## **UNIT 3: HUMAN NATURE INTERACTION (8)**

- 3.1 Social-Ecological Systems
- 3.2 Common Property Regimes
- 3.3 The Community Capital Framework
- 3.4 Collective Actions and Impact
- 3.5 Intermediate Disturbance Hypothesis

## **UNIT 4: SOCIAL CONTEXT OF NATURE-BASED SERVICES (5)**

- 4.1 The Worth of Nature to Humans
- 4.2 Ecosystem Marketplace as a Solution
- 4.3 Climate Change and Social Cost of Carbon
- 4.4 Opportunity Cost Approach in Conservation Priorities
- 4.5 Environmental Consumerism

## **UNIT 5: CULTURE AND WORLDVIEWS (8)**

- 5.1 Drivers of Human Behaviors
  - 5.1.1 Theory of Behavior
  - 5.1.2 Value-Belief Norm Theory
- 5.2 Demographic Influences on Conservation Values
- 5.3 Nature-Culture/Indigenous People Relationship
- 5.4 Social Trust in Natural Resource Management

## **PRACTICAL (16)**

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit(s)</b>
Indigenous community (ethnic group) and nature relationship (Ethnicity/culture-wise group)	Literature review/ reading materials	Group discussion	Unit 1
Influence of human-nature Interaction on Nepal's Forest/environment/wildlife /Watershed Policy Development	Literature review	Group presentation	Unit 2
Social-ecological system	Field	A report on SES / Group	Unit 3

## KEY REFERENCES

### TEXT BOOK

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### Unit 1

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### Unit 4

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## Unit 5

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## COURSE TITLE: WATER-ENERGY-FOOD-ECOSYSTEM NEXUS

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
WME 503	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** Water, energy, land/food, and ecosystems (WEFE) are critical for nutrition and food security, healthy ecosystems, resilient economies, and sustainable development. Single disciplinary (or silo) approach has limitations to achieve the interconnected development goals (e.g., sustainable development goals) in inclusive manner whereas the nexus approach considers the interconnections among the sectors, quantifies synergies and trade-offs of an intervention, and also has the potential to serve as a climate change adaptation and human security solutions. However, governments, stakeholders, and investors are struggling to manage systems change in the WEFE nexus and ensure that the changes are robust under changing climate and evolving interactions among natural and human systems. In this context, this course starts with the context of natural resources under stress, introduces associated concepts, and then evolves into the system approach, nexus concept and principles, entry points for inclusion, system interactions, nexus assessment tools, nexus in practice and nexus future perspective. It includes theoretical sessions, assignments, practical/presentation sessions, and field studies. The course is divided into 5 chapters and 20 sub-chapters, with four sub-chapters in each chapter.

**OBJECTIVES:** This course aims for the following learning objectives

- To familiarize with the fundamentals of WEFE nexus in the context of natural resources management and climate change
- To enhance knowledge and skill in nexus assessment
- To provide exposure to practical cases and challenges for implementing WEFE nexus using context-specific and participatory approaches
- To deepen understanding of institutionalizing WEFE nexus
- To provide a future outlook of WEFE nexus as a sustainability agenda from people-centric lenses and Gender Equality, Disability and Social Inclusion (GEDSI) perspectives

**LEARNING OUTCOMES:** Upon the completion of this course, learners are expected to

- Internalize the nexus concept and apply as a solution in planning and designing natural resources development and management problems
- Develop interdisciplinary programs in a professional career with a focus on broader national goals rather than sector-specific goals
- Develop skills to engage with stakeholders to develop sustainable and participatory practices for WEFE nexus management
- Develop number of demonstrated cases of nexus solutions during professional practice and share in public domain

## **COURSE CONTENTS**

### **UNIT 1: UNDERSTANDING OF NEXUS (6)**

- 1.1 Stress in Natural Resources: Trends in Natural Resources Availability and Demand; Concept of Footprints (water, energy, and carbon footprints); Planetary Boundaries
- 1.2 System Approach: Understanding of a System and System Approach; Need of Integration Across Sectors; Evolution of the Nexus Thinking Approach (limits to growth, sustainability, and nexus)
- 1.3 WEF Nexus: Concept, Principles, and Added Benefits
- 1.4 Entry Points for Inclusion in Nexus Interventions

### **UNIT 2: SYSTEM INTERACTION (6)**

- 2.1 Water-Energy
- 2.2 Water-Food
- 2.3 Food-Energy
- 2.4 Interdependences and Inter-Linkages Across Multiple Systems (e.g., water, energy, food, ecosystem/biodiversity): Tradeoff and Synergies

### **UNIT 3: ASSESSMENT TOOLS (9)**

- 3.1 Assessment Process and Information Flow: Steps, Actors, Location, and Sectors
- 3.2 Various Types of Tools and Data
- 3.3 FAO Rapid Appraisal Tools and WEF Nexus Tool 2.0 (including demonstration of tool)
- 3.4 Scenario Analysis and Practical Challenges: Evaluating Impacts in the Changed Context (institutional changes, climate/environmental/socio-economic changes, policy changes, etc.)

### **UNIT 4: NEXUS IN PRACTICE (6)**

- 4.1 Dissecting Nexused Relationships on Existing Practices: Case Studies Highlighting Different Aspects of Nexus in Practice
- 4.2 Risks and Costs to Different Social Groups
- 4.3 Policy and Institutional Reforms
- 4.4 GEDSI and Indigenous Knowledge

### **UNIT 5: NEXUS FUTURE PERSPECTIVE (5)**

- 5.1 Nexus Governance: Fundamentals of Governance and Nexus Governance; Frameworks for Governance Analysis; Improving Sectoral Governance and for Nexus Gains
- 5.2 Streamlining WEF Nexus as a Common Agenda: Promoting Dialogue (between science, policy, practice/industry, private sector); Nexus Mainstreaming
- 5.3 Addressing Bottlenecks for Implementing Inclusive Solutions for WEF Nexus Gains: Technical/Engineering Solutions; Nature-Based Solutions; Governance Solutions
- 5.4 Monitoring, Evaluation, Accountability and Learning (MEAL) Framework for Maximizing Nexus Gains

## PRACTICAL (16)

- **Group assignment:** Divide the participants into different groups, each consisting of 3-5 persons. Ask the participants to identify one practical case that they are engaged with, characterize the WEFE nexus in that case, and then submit an assignment report as well as a presentation in class. There will be more discussions and inputs in the class from the instructor as well as other participants (beyond that particular group) to visualize the practical cases of the WEFE nexus. (4 hrs)
- **Assignment on application of FAO tool and WEFE nexus 2.0:** Based on data provided for a real or hypothetical case study for simulating WEFE nexus 2.0, and demonstration made in Chapter 3, students will prepare and submit a report on analysis of trade-offs and synergies and recommend potential solutions for minimizing tradeoffs and maximizing the synergies. (4 hrs)
- **Field study:** Students will join to 1-2 days field study in nearby areas to select 1-2 cases of different orientations (e.g., water, energy, food, ecosystem) but have nexuses relationships and dissect nexuses relationships in those cases, prepare a report and present in the class as post-field study report. (8 hrs)

Contents	Equipment/ tools	Methodology/methods	Link to Unit(s)
Dip dive nexuses relationship in existing approaches	Reference materials, Analytical thinking	Literature review to understand nexuses relationship Selected a couple of cases of different orientation Think critically to visualize interlinkages (trade-offs and synergies) Identify challenges and opportunities	Unit 1, 2, 4
Visualize nexus governance and explore the potential of WEFE nexus as a future security agenda	Field logistics, Reference materials, Analytical thinking	Field visits, Interaction with related stakeholders, Critical thinking to visualize interlinkages (trade-offs and synergies), and governance Identify the challenges faced and ways they are managed	Unit 5
Perspectives, cross-fertilization, and synthesis	Field data, Critical thinking	Analyses of field visit/data, Perspectives from different cases explored (e.g., management, policy, governance), Synthesis	Unit 1,2,3,4,5

## KEY REFERENCES

### Unit 1

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### Unit 2

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### Unit 3

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**COURSE TITLE: LANDSCAPE MANAGEMENT AND BIODIVERSITY  
CONSERVATION**

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
PWM 504	3	48 (32+16)	75 (45+30)

*Note: 1 Credit= 16 Lecture Hours*

**SCOPE:** This course is designed to develop an understanding of issues on conservation landscape (hereafter referred to as landscape), landscape ecology, and biodiversity conservation. To prepare for careers in landscape and biodiversity conservation, students must attain academic skills and knowledge (both theoretical and technical) related to landscape management and biodiversity conservation. This course will help enrich student's understanding of biodiversity conservation at the landscape level. It enhances students' capacity to identify the prospects and challenges of biodiversity conservation and management in multiple-use landscapes.

**OBJECTIVES:** The objective of this course are to:

- Familiarize students with key technical terms related to landscape ecology, and biodiversity conservation.
- Enrich students' knowledge on landscape principles, and best conservation practices at landscape levels.
- Increase students' understanding on the causes and consequences of biodiversity loss in human-dominated landscapes.
- Enrich student's knowledge and skill in landscape planning, management, and biodiversity conservation.

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

- To understand the basic landscape and biodiversity-related key terminologies
- To explore and understand landscape-level conservation values and challenges
- To learn the theories and principles related to landscape ecology
- In planning and implementation of landscape-level conservation initiatives
- To gain knowledge on biodiversity conservation and management in a human-dominated landscape

## **COURSE CONTENTS**

### **UNIT 1: INTRODUCTION (6)**

#### 1.1 Landscape

##### 1.1.1 Concept of Landscape and Landscape Ecology

##### 1.1.2 Review of the Key Terms: Habitat, Eco-region, Biomes, Biodiversity Hotspots, Biodiversity Cold Spots, Habitat Fragmentation, Edge Effect, Corridors and Connectivity, Upstream-downstream Linkages, Landscape Integrity and Functions

##### 1.1.3 Epistemology of the Landscape

##### 1.1.3.1 The Nature of Landscape (material and conceptual)

- 1.1.3.2 Role of Landscape (domain, system, Unit)
- 1.1.3.3 Description of Landscape (ecological and cognitive)
- 1.1.4 Landscape Functions and Dynamics: Linkages with Species and Human Culture (IT/TK)
- 1.2 Biodiversity
  - 1.2.1 Components of Biodiversity (genetic diversity, species diversity, ecosystem diversity, functional diversity)
  - 1.2.2 Species Richness Over Geological Time Scale (rates of species formation, rates of species extinction, current pattern of species richness)
  - 1.2.3 Values and Importance of Biodiversity (consumptive and non-consumptive use values, productive use values)
  - 1.2.4 Patterns of Diversity (variation along climate and environment, variation in topography, geological age, and habitat)
  - 1.2.5 Concept of Climate Change Refugia

## **UNIT 2: THEORIES AND MODELS IN LANDSCAPE ECOLOGY (6)**

- 2.1 Driving Forces for Landscape Approach (international dialogue, conservation debate, innovations)
- 2.2 Landscape Stability Principle and CBD Malawi Principle 1995
- 2.3 Theories Incorporated in Landscape Ecology: Complexity Theory, Information Theory, Cognition and Autopoiesis Theory, Hierarchy Theory, Percolation Theory, Resource Theory
- 2.4 Landscape Ecology Models
  - 2.4.1 Metapopulation Model
  - 2.4.2 Source-sink Model
  - 2.4.3 Island Biogeography Equilibrium

## **UNIT 3: PRINCIPLES FOR LANDSCAPE CONSERVATION, MANAGEMENT AND DESIGN (10)**

- 3.1 Landscape Evaluation (creating and quantifying landscape patterns)
- 3.2 The Cultural (human-dominated) Landscape (interaction between natural and cultural landscapes, fragility of the cultural landscapes, cultural keystone species, landscape indicators, predictive landscape models)
- 3.3 Principles for Landscape Management
- 3.4 Landscape Ecology (landscape principles for natural reserves, disturbance regime, and reserve design indications, inter-refuge corridor design)
- 3.5 Principles of Landscape Classification (structural patch, functional patch, resource patch, habitat patch, corridor patch)
- 3.6 Landscape Level Conservation
- 3.7 Ecosystem Processes on Landscapes
- 3.8 Hierarchical Structure of the System and Biodiversity Conservation
- 3.9 The Landscape-level Species Conservation Approach
- 3.10 Transborder Landscape Conservation Approaches

## **UNIT 4: BIODIVERSITY CONSERVATION IN HUMAN-DOMINATED LANDSCAPE**

**(4)**

- 4.1 Biodiversity Conservation (with examples: in-situ and ex-situ)
- 4.2 Issues of Biodiversity Conservation
- 4.3 Urban Biodiversity Conservation Challenges
- 4.4 Green Infrastructure: Linking Landscape and Community
- 4.5 Roles of Ecosystem Management in Landscape Integrity: Protected Area: Core and Buffer Zone, Habitats Outside PAs, MAB (Man and Biosphere Reserve), Other Effective Area-Based Conservation Measure (OECM)
- 4.6 Importance of Landscape-level Biodiversity for Promoting Ecosystem Services and Local Livelihood in Developing Countries

## **UNIT 5: LANDSCAPE MANAGEMENT FOR BIODIVERSITY CONSERVATION (6)**

- 5.1 Evolution and Practices of Landscape Management Models (global to national)
- 5.2 Conservation Landscapes of Nepal (TAL, CHAL, Kanchenjunga, SHL, and Kailash)
- 5.3 Prospects and Challenges of Landscape Management and Biodiversity Conservation
- 5.4 Land Use Planning and Conservation
- 5.5 Landscape Effects: in Individuals, Populations, and Organisms
- 5.6 Landscape Management Approaches and Strategies
  - 5.6.1 River Basin Approach
  - 5.6.2 North-South and East-West Landscape Approach
- 5.7 Case Studies
  - 5.7.1 Nepalese Model: Landscape (e.g., TAL, CHAL) and Corridor (e.g., Khata Corridor, Barandabhar Corridor)
  - 5.7.2 North American Model: (e.g., Yukon to Yellow stone)
  - 5.7.3 South African Model: (e.g., Great Limpopo Transfrontier Park)

## **PRACTICAL (16)**

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit (s)</b>
Measuring biodiversity	Silva compass, measuring tape, crown-densiometer, Abney level	3 days Field Diversity index (Simpson, Shannon Wiener) Observation, FGD,	Unit 1
Designing biodiversity conservation activities in the urban landscape	Reports, related literature	meetings with nearby community, KIS, Literature review, Report writing	Unit 1, 3
Study linkages with species and human culture	Checklist		Unit 1
Review of CBD Malawi Principle 1995	Related literature	Group presentation, report	Unit 2
Study on urban biodiversity challenges and threats ranking	Related literature	Excursion, Observation, Review of literature, Assessment by pairwise ranking, Report writing	Unit 4

## KEY REFERENCES

### Unit 1, 2, 3

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### Unit 3

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### Unit 5

1. Acharya, K. P., Tripathi, D. M., Joshi, J., & Gurung, U. M. (2011). Leveraging the Landscapes: Conservation beyond the Boundaries. *Kathmandu: Nepal Foresters Association*. (Unit 3, 4 too)

## **COURSE TITLE: NATURAL RESOURCE MANAGEMENT IN CHANGING ENVIRONMENT**

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 505	3	48 (32+16)	75 (45+30)

*Note: 1 Credit= 16 Lecture Hours*

**SCOPE:** Changing the environment has jeopardized human-nature interaction, which has created a lose-lose scenario. This course focuses on understanding the changing context, its impacts on natural resources, and their mitigation, adaptation, and management strategies.

**OBJECTIVES:** The objectives of the course are to:

- To understand the changing context
- To understand key environmental issues and their effects on nature and society
- To assess appropriate strategies for natural resource management in the changing contexts
- To understand the issues in changing contexts in NRM in Nepal

**LEARNING OUTCOMES:** On completion of this course, students should be able to:

- Understand the changing contexts and its effects on natural resources
- Analyze the natural resource management related issues in the changing contexts,
- Develop a conceptual and practical understanding of strategies for natural resource use and management in the changing environmental conditions
- Apply the learned concepts to a natural resource management problem of particular interest to them.

### **COURSE CONTENTS**

#### **UNIT 1: UNDERSTANDING THE CHANGING CONTEXT (5)**

- 1.1 Theoretical context – Change Theory
- 1.2 Global Environmental Changes: Climate Change, Land use and land cover change, Invasive Species
- 1.3 Social Changes- Demographic Shifts, Cultural Transformations, Technological Advancement, Urbanization, Gender Roles and Equality, Environmental Movement
- 1.4 Economic Changes – Technological Transformations, Globalization, Labor Market Change, Financial System, Environmental and Sustainable Practices, Income equality, Global Economic Shift

#### **UNIT 2: EFFECTS OF CHANGING ENVIRONMENT ON NATURAL RESOURCES (7)**

- 2.1 Effects on:
  - 2.1.1 Water Resources – Glacier’s Retreat, Precipitation Pattern, Sea Level, Spring, Rivers, Groundwater, Wetlands
  - 2.1.2 Agricultural Resources– Agro-Biodiversity, Cropping Pattern, Pest and Diseases

- 2.1.3 Forest and Biodiversity– Shift in Habitat Ranges, Increased Wildfire, Invasive Alien Species
- 2.1.4 Wildlife
- 2.1.5 Rangelands
- 2.1.6 Landscape
- 2.2 Alteration of Human-Nature Interactions Due to Changing Context

**UNIT 3: MITIGATION AND ADAPTATION STRATEGIES (5)**

- 3.1 Sustainable Land and Water Management
- 3.2 Biodiversity Conservation and Restoration
- 3.3 Climate Resilient Infrastructure
- 3.4 Traditional Knowledge, Practices, and Technologies
- 3.5 Renewable Energy Transition

**UNIT 4: ISSUES IN NRM IN CHANGING CONTEXT IN NEPAL (5)**

- 4.1 Shift in Demand for Natural Resources
- 4.2 Land Abandonment
- 4.3 Human-Wildlife Conflict
- 4.4 Governance Conflict
- 4.5 Level of Participation in Natural Resource Management

**UNIT 5: MANAGING NATURAL RESOURCES IN CHANGING ENVIRONMENT (10)**

- 5.1 Ecological Principles and their Application to Natural Resource Management
- 5.2 Adaptive Management
- 5.3 Forest-Landscape Restoration
- 5.4 Invasive Species Management
- 5.5 Nature Based Solutions
- 5.6 Disturbance-based Ecosystem Management

**PRACTICAL (16)**

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit(s)</b>
Drivers of changing context	Field /Checklist	Prepare a list of drivers and strategies to address them (Group work)	Unit 1, 2
Issues of NRM in Nepal and potential solutions	Literature review	Group / Class presentation	Unit 4
Enlisting mitigation/adaptation/management interventions in own locality	Interview (Telephone), Field observation	Individual - list of interventions	Unit 3, 4, 5

## KEY REFERENCES

### Unit 1

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1. Halofsky, J. E., Peterson, D. L., & Harvey, B. J. (2020). Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. *Fire Ecology*, 16(1), 1-26.
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### Unit 3

1. Dale, V. H., Brown, S., Haeuber, R. A., Hobbs, N. T., Huntly, N., Naiman, R. J., ... & Valone, T. J. (2014). Ecological Principles and Guidelines for Managing the use of the Land: Ecological Applications (2000). *The ecological design and planning reader*, 279-298.
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#### Unit 4

1. Laudari, H. K., Sapkota, L. M., Maraseni, T., Subedi, P., Pariyar, S., Kaini, T. R. & Volkova, L. (2024). Community forestry in a changing context: A perspective from Nepal's mid-hill. *Land Use Policy*, 138, 107018.
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7. Subedi, Y. R., Kristiansen, P., Cacho, O., & Ojha, R. B. (2021). Agricultural land abandonment in the hill agro-ecological region of Nepal: Analysis of extent, drivers and impact of change. *Environmental Management*, 67, 1100-1118.

#### Unit 5

1. Bolte, A., Ammer, C., Löf, M., Nabuurs, G. J., Schall, P., & Spathelf, P. (2009). Adaptive forest management: a prerequisite for sustainable forestry in the face of climate change. *Sustainable forest management in a changing world: a European perspective*, 115-139.
2. von Gadow, K. (2008). *Managing forest ecosystems: the challenge of climate change* (p. 338). F. Bravo, V. LeMay, & R. Jandl (Eds.). New York: Springer.
3. Napreenko, M. G., Antsiferova, O. A., Aldushin, A. V., Samerkhanova, A. K., Aldushina, Y. K., Baranovskiy, P. N. & Konshu, E. V. (2021). New approaches to sustainable management of wetland and forest ecosystems as a response to changing socio-economic development contexts. *Innovations and Traditions for Sustainable Development*, 395-416.
4. Thurman, L. L., Gross, J. E., Mengelt, C., Beaver, E. A., Thompson, L. M., Schuurman, G. W. & Olden, J. D. (2022). Applying assessments of adaptive capacity to inform natural-resource management in a changing climate. *Conservation Biology*, 36(2), e13838.
5. Kuuluvainen, T., Angelstam, P., Frelich, L., Jögiste, K., Koivula, M., Kubota, Y., ... & Macdonald, E. (2021). Natural disturbance-based forest management: Moving beyond retention and continuous-cover forestry. *Frontiers in Forests and Global Change*, 4, 629020.
6. Seddon, N., Chausson, A., Berry, P., Girardin, C. A., Smith, A., & Turner, B. (2020). Understanding the value and limits of nature-based solutions to climate change and other global challenges. *Philosophical Transactions of the Royal Society B*, 375(1794), 20190120.

**SEMESTER II**  
**COURSE TITLE: GEOINFORMATICS FOR NRM**

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
WME 551	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** This course is designed for the students having background on the foundation of GIS and Remote Sensing (RS). As the name says “Geoinformatics”, the course contents aim to provide broader understanding on the application of GIS and Remote Sensing in NRM, with particular focus on developing skills on geospatial data extraction, analysis, modelling, management and effective communication for sharing the research widely. The course is based on both the theoretical and lab-based teaching/learning approaches.

**OBJECTIVES:** The course aims to provide advanced knowledge on applying geospatial technologies and remote sensing in natural resources management with the particular focus on emerging technologies for data analysis and cloud computing. The specific objectives of this course are to make students:

- Understand recent advancements/trends in Geoinformatics including theoretical and practical knowledge on the advanced concepts of RS & GIS in NRM.
- Enhance knowledge and practical skills on geo computation including exploratory data analysis and advanced concepts on spatial statistics.
- Develop a theoretical foundation on geomodelling and practical hands-on modelling related to NRM used cases.
- Provide overview and hands-on on emerging geospatial technologies for NRM like Machine Learning (ML) cloud computing with Google Earth Engine (GEE).

**LEARNING OUTCOMES:** After the completion of the course, the learners are expected to be able to:

- Develop a project and use advanced GIS/RS techniques for data collection to address specific problems in NRM
- Use geo-computational and statistical knowledge for data cleaning, analysis and management
- Use geospatial techniques for predictive modelling - NRM used cases.
- Use Cloud computing platform for efficient data analysis and visualization

**COURSE CONTENTS**

**UNIT 1: OVERVIEW OF GEOINFORMATICS (6)**

- 1.1 Fundamentals of Remote Sensing and GIS
- 1.2 Data to Geoinformation in NRM (data sources and availability, acquisition, interpretation and data quality issues)

- 1.3 RS and GIS Software (open source and commercial)
- 1.4 Recent Advancements/Trends in Geoinformatics
  - 1.4.1 Mobile GIS, Drone-Based GIS, Citizen Science in GIS
  - 1.4.2 Overview of Google Earth Engine, AI, and ML in NRM

**UNIT 2: REMOTE SENSING SATELLITE AND SENSORS (8)**

- 2.1 Sensors and Satellites (including orbits)
- 2.2 Scanning Systems
- 2.3 Optical Remote Sensing
- 2.4 Hyperspectral Remote Sensing
- 2.5 Radio Detection and Ranging (RADAR) Remote Sensing
- 2.6 Light Detection and Ranging (LIDAR) Remote Sensing

**UNIT 3: GEOCOMPUTATION (6)**

- 3.1 Digital Image Processing and Classification
- 3.2 Review Geospatial Interpolation (Kriging, / IDW, etc.)
- 3.3 Geospatial Statistics
- 3.4 Map Algebra and Raster Models Analysis
- 3.5 Terrain and Visibility Analysis

**UNIT 4. GEOMODELLING (6)**

- 4.1 Database Queries and Geo-Processing
- 4.2 Model Building for Geo-Processing
- 4.3 AHP Modelling
- 4.4 Geo-Visualization (cartographic representation)

**UNIT 5. APPLICATION OF GEOSPATIAL TECHNOLOGIES (6)**

- 5.1 Resource Assessment and Management.
- 5.2 Risk Assessment (forest fire, landslide)
- 5.3 Suitability Analysis
- 5.4 Analyzing Multi-Temporal Earth Observation Data

## PRACTICAL (16)

Contents	Equipment/tools	Methodology/methods	Link to Unit (s)
Image acquisition and processing	QGIS, /ArcGIS	Practical: 4hrs Demo and case presentation Student Engagement: 10hrs	Unit 1
Data cleaning and/map algebra and raster models/ surface and visibility analysis	QGIS/ ArcGIS	Practical: 4hrs One demo and other can be case presentation Student Engagement: 6hrs	Unit 3
Data queries/ Analysis and geo-visualization.	QGIS/ArcGIS	Practical: 3hrs one demo and other case presentation Student Engagement: 12hrs	Unit 4
Forest resource inventory and mapping/ indices (e.g., NDVI, NDSI, NDWI calculation)/Suitability/Time-series analysis	Cloud computing/GEE/ QGIS/ ArcGIS	Practical: 5hrs one demo and other case presentation Student Engagement: 20hrs	Unit 5
Project report and presentation		Review and report	

## KEY REFERENCES

### Unit 1

1. Duckham, M., Goodchild, M. F., & Worboys, M. (2003). Foundations of geographic information science. CRC Press.
2. Liu, J. G., & Mason, P. J. (2016). Image processing and GIS for remote sensing: techniques and applications. John Wiley & Sons.
3. McInerney, D., & Kempeneers, P. (2014). Open source geospatial tools: applications in earth observations. Earth Systems Data and Models, Springer.
4. Ma, X., Mookerjee, M., Hsu, L., & Hills, D. (Eds.). (2023). *Recent Advancement in Geoinformatics and Data Science* (Vol. 558). Geological Society of America.
5. Chuvieco, E. (2020). *Fundamentals of satellite remote sensing: An environmental approach*. CRC press.
6. Bajracharya, B., Thapa, R. B., & Matin, M. A. (2021), Earth observation science and applications for risk reduction and enhanced resilience in Hindu Kush Himalayan Region, Springer Nature, free access

### Unit 2

1. Verbyla, D. L. (2022). *Satellite remote sensing of natural resources*. CRC Press.
2. Varshney, P. K., & Arora, M. K. (2004). *Advanced image processing techniques for remotely sensed hyperspectral data*. Springer Science & Business Media.
3. Richards, J. A. (2009). *Remote sensing with imaging radar* (Vol. 1, pp. 172-173).

Berlin/Heidelberg, Germany: Springer.

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5. Lu, B., Dao, P. D., Liu, J., He, Y., & Shang, J. (2020). Recent advances of hyperspectral imaging technology and applications in agriculture. *Remote Sensing*, 12(16), 2659.
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### **Unit 3**

1. Chun, Y., & Griffith, D. A. (2013). *Spatial statistics and geostatistics: theory and applications for geographic information science and technology*.
2. Getis, A., Anselin, L., Lea, A., Ferguson, M., & Miller, H. (2004). Spatial analysis and modeling in a GIS environment. In *A research agenda for geographic information science* (pp. 157-196). CRC Press. (Unit 4 too).

### **Unit 4 and 5**

1. McClain, B. P. (2022). *Python for Geospatial Data Analysis*. " O'Reilly Media, Inc."
2. Crooks, A., Malleon, N., Manley, E., & Heppenstall, A. (2015). Agent-based modeling and geographical information systems. *Geocomputation: A Practical Primer*. SAGE Publications Ltd, Thousand Oaks, CA, 63-77.
3. Pourghasemi, H. R., & Gokceoglu, C. (2019). *Spatial modeling in GIS and R for earth and environmental sciences*. Elsevier.
4. Wani, A. A., Bali, B. S., Ahmad, S., Nazir, U., & Meraj, G. (2022). Geospatial Modeling in Landslide Hazard Assessment: A Case Study along Bandipora-Srinagar Highway, NW Himalaya, J&K, India. In *Geospatial Modeling for Environmental Management* (pp. 113-125). CRC Press.
5. Wang, L., Yin, D. Z., & Caers, J. (2023). *Data science for the geosciences*. Cambridge University Press. (Unit 5 too).
6. Moseley, B., & Krischer, L. (2020). *Machine learning and artificial intelligence in geosciences*. Academic Press. (Unit 5 too).

## COURSE TITLE: RESEARCH DESIGN AND SCIENTIFIC WRITING

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
BSH 552	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** The scope of this course is designed to imbue M.Sc. students with a scientific perspective, bridging the gap between overarching methodological principles and the intricacies of systematic inquiry into literature. It equips students with the skills needed to adeptly select and employ a range of research methods and tools for data collection. Through this course, students are equipped with the proficiency to thoughtfully select and deploy a diverse array of research methods and tools, ensuring a holistic approach to data collection. Moreover, the course offers a guided journey through the entire research process. From the initial stages of data collection to the in-depth analysis, students receive hands-on guidance that facilitates a comprehensive comprehension of each step. Furthermore, the course guides them through the entire process, from analysis to effectively articulating and presenting their research findings in their M.Sc. thesis.

**OBJECTIVES:** The objectives of this course are to:

- Acquire a profound understanding of diverse research types, encompassing their distinctive characteristics and ethical considerations.
- Comprehend both quantitative and qualitative research designs, mastering the art of employing various data collection methods to ensure the generation of high-quality data.
- Cultivate the ability to conduct thorough literature reviews, organizing information systematically to build a solid foundation for research endeavors.
- Hone skills in crafting meticulous and comprehensive research proposals, coupled with the proficiency to eloquently defend them during presentations, showcasing a mastery of the subject matter.
- Develop the capacity to articulate research findings effectively through the composition of clear and concise research reports, thesis documents, and scientific articles.

**LEARNING OUTCOMES:** Upon course completion, students will adeptly handle the intricacies of research methodology, understanding the critical connection between research questions and theoretical frameworks.

- Gain the capability to independently formulate and develop robust research proposals aligned with overarching research objectives.
- Acquire practical skills in data generation and analysis, utilizing diverse research methods and analytical tools to produce high-quality data and insightful interpretations.
- Navigate the complexities of an M.Sc. thesis, demonstrating proficiency in structuring and integrating research findings within theoretical frameworks.
- Demonstrate adeptness in manuscript composition and effectively communicating research findings with clarity and impact.

## **COURSE CONTENTS**

### **UNIT 1: RESEARCH CONCEPTS (6)**

- 1.1 Definition and Purpose
- 1.2 Research Paradigm (Normative, Explorative, Critical)
- 1.3 Research Types (Qualitative, Quantitative and Mixed)
- 1.4 Conceptual Framework of Research
- 1.5 Research Ethics: Informed Consent, Data Use & Confidentiality, Research Interpretation, Authorship and Publication, Plagiarism)

### **UNIT 2: RESEARCH DESIGN (10)**

- 2.1 Meaning, Concept, Importance
- 2.2 Research Design: Components and Features
- 2.3 Characteristics
- 2.4 Types of Designs
  - 2.4.1 Descriptive
  - 2.4.2 Diagnostic
  - 2.4.3 Experimental and Quasi-experimental
  - 2.4.4 Exploratory Formulative
  - 2.4.5 Case Study
- 2.5 Quantitative Research Design
  - 2.5.1 Definition
  - 2.5.2 Purpose
  - 2.5.3 Analytical Framework
  - 2.5.4 Data Collection Methods (sampling design and methods, survey)
  - 2.5.5 Data Reliability and Validity
  - 2.5.6 Data Analysis Methods (descriptive, inferential and casual analysis)
- 2.6 Qualitative Research Design
  - 2.6.1 Definition
  - 2.6.2 Purpose
  - 2.6.3 Analytical Framework (use of theories)
  - 2.6.4 Data Reliability and Validity
  - 2.6.5 Data Collection Methods (observation, focus group discussion, semi-structured interview, content analysis)

### **UNIT 3: LITERATURE REVIEW AND ORGANIZATION (4)**

- 3.1 Purpose and Types of Review
- 3.2 Review Organization
- 3.3 Citation and Reference Management

### **UNIT 4: RESEARCH PROPOSAL WRITING (4)**

- 4.1 Research Proposal (purpose, components, and format)
- 4.2 Research Subject and Object
- 4.3 Formulating of Research Problem
- 4.4 Defining Research Objectives
- 4.5 Setting Research Hypothesis/Questions (meaning, definitions, nature, functions, importance, kinds, characteristics, formulation and testing)

- 4.6 Research Matrix
- 4.7 Research Site Selection
- 4.8 Respondent Selection
- 4.9 Data Collection Methods
- 4.10 Data Analysis
- 4.11 Work Plan
- 4.12 Budget Estimation

**UNIT 5: THESIS WRITING AND PRESENTATION (4)**

- 5.1 Purpose and Characteristics of the Good Thesis
- 5.2 Outline of the Thesis /Major Chapters or Sections
- 5.3 Data Analysis and Interpretation
- 5.4 Discussion on Findings (convergence and divergence analysis)
- 5.5 Establishing a Causal Link Between Objective, Findings, Conclusion and Recommendations
- 5.6 Thesis Presentation: Slide Preparation, Table Graph, etc.

**UNIT 6: SCIENTIFIC PAPER WRITING (4)**

- 6.1 Step-wise Procedure
- 6.2 Selecting a Journal for Publication/Predatory
- 6.3 Communicating with the Journal Editor/Editorial Board
- 6.4 Peer Review Processes and Responding to Reviewer

**PRACTICAL (16)**

Contents	Equipment/tools	Methodology/methods	Link to Unit(s)
Research Design	Classwork	Group discussion and panel discussion	Unit 1 & 2
Scientific paper writing	4-5 person in a team review and write paper	Review paper/research paper on the contemporary subjects related to their field of study (able to identify knowledge gap, analyses and interpreted study findings).	Unit 3, 6
Research proposal	Literature review	Each student will write, submit and present a research proposal in their area of interest.	Unit 4
Presentation	4-5 person in a team) will prepare and present their research findings	Prepare and present among students on their research findings and solicit comments and suggestions from students and faculties	Unit 3, 5, 6

**KEY REFERENCES**

**Unit 1**

1. Kumar, R. (2018). Research methodology: A step-by-step guide for beginners. *Research methodology*, 1-528.

2. Kerlinger, F. N. (1966). *Foundations of behavioral research*.
3. Mligo, E. S. (2016). *Introduction to research methods and report writing: A practical guide for students and researchers in social sciences and the humanities*. Wipf and Stock Publishers.

## Unit 2

1. Bryman, A. (2012). *Social Research Methods*. Oxford University Press, New Delhi.
2. Cohen, L., Lawrence, M., & Morrison, K. (2005). *Research Methods in Education*, 5<sup>th</sup> edition. Oxford University Press, Oxford.
3. Denscombes, M. (2010). *The Good Research Guide, For Small-Scale Social Research Projects*. Open University Press, Maidenhead, Berkshire, UK.
4. Gregory, J., Miller, S., & Miller S. (2000). *Science in Public: Communication, Culture and Credibility*, Reprint edition. Perseus Book Group, New York.

## Unit 3

1. Field, A. (2003). *How to Design and Report Experiments*. Sage Publications, Newbury Park, California.
2. Glass, D. (2006). *Experimental Design for Biologists*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
3. Holliman, R., Whitelegg, L., Scanlon, E., Smidt, S., & Thomas, J. (2009). *Investigating science communication in the information age: Implications for public engagement and popular media*. Oxford University Press.
4. Singh, Y.K. (2006). *Fundamental of Research Methodology and Statistics*. New International (P) Limited, Publishers, New Delhi.

## Unit 4

1. Soraya, M.C. & Cynthia, A.S. (2001). *Proposal Writing*. Sage Publications, Newbury Park, California.
2. Wallinman, N. (2006). *Your Research Project: A Step-by-Step Guide for the First Time Researcher*. Sage Publications, London.

## Unit 5

1. Adu, P & Miles D. A. (2024). *Dissertation Research Methods: A Step-by-Step Guide to Writing Up Your Research in the Social Sciences*. Routledge, New York.

## Unit 6

1. Thomas, C.G. (2021). *Research Methodology and Scientific Writing* (2<sup>nd</sup> eds). Springer. <https://link.springer.com/book/10.1007/978-3-030-64865-7>
2. Hoffmann, A.H. (2009). *Scientific Writing and Communication: Papers, Proposals, and Presentations*. Oxford, UK.
3. Mligo, E.S. (2016). *Introduction to Research Methods and Report Writing. A Practical Guide for Students and Researchers in Social Sciences and the Humanities*. Resource Publications, Eugene, Oregon.
4. Day, R. A., & Gastel, B. (2024). *How to write and publish a scientific paper*. Cambridge University Press.

## COURSE TITLE: ADVANCED STATISTICS

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
BSH 553	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** The course will increase understanding on general concepts, meaning & use of statistics, and develop basic skills for computing & interpreting social and bio-physical data, and their applications using computer software in applied research. More importantly, the course aims to help M.Sc. students in selecting and use of different regression models in forestry research.

**OBJECTIVES:** The objectives of this course are to:

- Demonstrate the concepts of descriptive statistical measures, probability distribution and their uses in forestry research.
- Demonstrate basic concepts of hypothesis testing and experimental designs.
- Learn different types of parametric and non-parametric tests and use them in forestry research.
- Understand correlation and regression analysis and apply different types of regression models in forestry research and interpretation of results.
- Understand the concept of factor and discriminant analysis and develop skills for computation.

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

- Demonstrate the ability to understand the different types of variables and data
- Understand the appropriate use of statistical analysis
- Develop basic skills for computing & interpreting the data and their applications using computer software in applied forestry research.

### COURSE CONTENTS

#### UNIT 1: INTRODUCTION (4)

Review: Data, Variables and Scale of Measurement, Population and Sample, Central Tendency and Dispersion, Sampling Techniques

#### UNIT 2: PROBABILITY DISTRIBUTIONS (4)

Review of Binomial, Poisson and Normal Probability Distribution, and their Applications

#### UNIT 3: ESTIMATION AND TESTING OF HYPOTHESIS (4)

Point estimation, Interval Estimation; t-test, z-test, Non-Parametric Tests: Chi-square Test, Median Test, Mann Whitney u-test, Kruskal Wallis test, Friedman ANOVA, Wilcoxon Sign Rank Tests

#### **UNIT 4: ANALYSIS OF VARIANCE AND EXPERIMENTAL DESIGNS (6)**

One-way and two-way ANOVA, Simple and Factorial Designs

#### **UNIT 5: CORRELATION AND REGRESSION ANALYSIS (10)**

Correlation Analysis, Ordinary Least Square Regression Models, Regression with Dummy Variables, Probit, Logit, Ordered Logit and Probit, MNL

#### **UNIT 6: MULTIVARIATE ANALYSIS (4)**

Principal Component Analysis (PCA), Factor Analysis, Cluster and Discriminant Function Analysis

#### **PRACTICAL (16)**

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit(s)</b>
Data entry, coding, and editing in statistical software	Computer	Use of the questionnaire/ data	Unit 1
Computation of frequency distribution, diagram, and graphs, descriptive measures and their interpretations	With appropriate software	Using student's own or the given data	Unit 1
Testing of different types of hypotheses: T-tests. F-test etc.	With appropriate software	Using student's own or the given data	Unit 2, 3
Use of different non-parametric tests and their interpretations	With appropriate software	Using student's own or the given data	Unit 3, 4
Linear regression models and testing assumptions: Normality, Multicollinearity	With appropriate software	Using student's own or the given data	Unit 5
heteroscedasticity and auto-correlation; analysis of residuals	With appropriate software	Using student's own or the given data	Unit 5
Fitting of the logit, Probit, ordered logit, multinomial logit regression models and their interpretations	With appropriate software	Using student's own or the given data	Unit 5
Principal component analysis	With appropriate software	Using student's own or the given data	Unit 6

## KEY REFERENCES

### Unit 1

1. Shrestha, S. & Silwal D.P. (2003). Statistical Methods in Management. Taleju Prakashan, Bhotahity Kathmandu.

### Unit 2

1. Gupta, S. C., & Kapoor, V.K. (1994). Fundamentals of Mathematical Statistics, 4th edition. Sultan Chand & Sons; 23, Daryagunj, Delhi.

### Unit 3

1. Levine, D. M., & Stephan, D. F. (2009). *Even you can learn statistics: A guide for everyone who has ever been afraid of statistics*. FT Press.
2. Shrestha, S. & Silwal, D.P. (2003). Statistical Methods in Management. Taleju Prakashan, Bhotahity Kathmandu.
3. Triola, M. F., Goodman, W. M., Law, R., & Labute, G. (2004). *Elementary statistics* (p. 794). Boston: Pearson/Addison-Wesley.

### Unit 4

1. FAO (1999). A Statistical Manual for Forestry Research. Forestry research support program, for Asia and the Pacific, Food and Agricultural Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok.
2. Nargundkar, R. (2008). Marketing Research: Text and Cases- Third edition. Tata McGraw-Hill Publishing Company Limited, NEW DELHI

### Unit 5

1. FAO (1999). A Statistical Manual for Forestry Research. Forestry research support program, for Asia and the Pacific, Food and Agricultural Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok.
2. Levine, D. M., & Stephan, D. F. (2009). *Even you can learn statistics: A guide for everyone who has ever been afraid of statistics*. FT Press
3. Snedecor, G.W., & Cochran, W.G. (1994). Statistical Methods, eighth edition. Iowa State University Press, Ames Iowa.

### Unit 6

1. FAO (1999). A Statistical Manual For Forestry Research. Forestry research support program, for Asia and the Pacific, Food and Agricultural Organization of the United Nations Regional Office for Asia and the Pacific, Bangkok.
2. Levine, D. M., & Stephan, D. F. (2009). *Even you can learn statistics: A guide for everyone who has ever been afraid of statistics*. FT Press
3. Nargundkar, R. (2008). Marketing Research: Text and Cases- Third edition. Tata McGraw-Hill Publishing Company Limited, NEW DELHI

## COURSE TITLE: NATURAL RESOURCE ECONOMICS

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 554	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** This course focuses on the concept of both theoretical and empirical evaluation of natural resources (forests, biodiversity, and water) pertaining to management. It includes subjects related to the time value of money, evaluation of a natural resource management project from an economic perspective, application of different valuation techniques to estimate the non-market benefits obtained from an ecosystem, practice of ecosystem service market, and green economy promotion for strong sustainability. Basically, it aims to capacitate students to analyze the problems and practices prevailing in the natural resource management sector from an economic perspective.

**OBJECTIVES:** The general objective of this course is to train students to promote economically viable natural resource management. Specific objectives are to:

- Enable students to understand and practice economic evaluation of natural resource management projects
- Enable students to estimate non-market benefits received from ecosystems
- Understand the importance of the ecosystem service market
- Prepare strategies for green economy promotion towards sustainable development

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

- Understand and analyze the existing problems associated to natural resource management from the economic perspective
- Apply different economic evaluation tools in natural resource management
- Estimate non market benefits of ecosystem services and provide policy feedback for its proper management
- Practice activities for green financing promotion and support for green accounting of natural resource

### COURSE CONTENTS

#### UNIT 1: INCORPORATING ENVIRONMENT INTO THE ECONOMIC SYSTEM (4)

- 1.1 Ecological Economics vs Environmental Economics
- 1.2 Economy-Environment Systems
- 1.3 Modelling Economy-Environment Interactions

#### UNIT 2: VALUATION OF ECOSYSTEM SERVICES (12)

- 2.1 Concept of Valuing the Ecosystem Services
- 2.2 Valuation Techniques
  - 2.2.1 Direct Market Approach
    - 2.2.1.1 Market Price Method

- 2.2.1.2 Production Function Approach
- 2.2.1.3 Cost-based Approach
- 2.2.2 Non-Market Based Valuation Techniques
  - 2.2.2.1 Contingent Valuation
  - 2.2.2.2 Travel Cost Method
  - 2.2.2.3 Hedonic Price Method

**UNIT 3: BENEFIT-COST ANALYSIS (8)**

- 3.1 The Foundations of Benefit-Cost Analysis
- 3.2 Steps of Benefit-Cost Analysis
- 3.3 Time Value of Money (Discounting and Compounding, One-time payment, Annual Payment and Perpetual, Periodic Payment and Perpetuity)
- 3.4 Decision Criteria (Net Present Value, Benefit-Cost Ratio, Internal Rate of Return)
- 3.5 Sensitivity Analysis

**UNIT 4: ECOSYSTEM SERVICES MARKET (4)**

- 4.1 Financing Green and Greening Financing
- 4.2 Payment for Ecosystem Services
- 4.3 Forest Carbon Offset and Market
- 4.4 Biodiversity Offsets

**UNIT 5: ENVIRONMENT AND SUSTAINABLE DEVELOPMENT (4)**

- 5.1 Concept of Weak and Strong Sustainability
- 5.2 Sustainable accounting (Green accounting): System of National Accounting (SNA) and System of Environmental Economics Accounting (SEEA)

**PRACTICAL (16)**

Contents	Equipment/tools	Methodology/methods	Link to Unit(s)
Natural Resources	Questionnaire, Excel, Data	Contingent Valuation Method	Unit 1, 2
Recreation areas such as protected areas/wetlands	Questionnaire, Excel, Data	Travel Cost Method	Unit 1,2
Evaluation of an environmental project/ Opportunity cost of carbon	Excel, Data	Benefit-cost analysis	Unit 3
Financing solutions	Peer-reviewed papers	Group presentation	Unit 4
SEEA of protected area/ CF	Peer-reviewed papers	Class Room discussion	Unit 5
Nature as an Input	Data, Excel	Production Function Approach	Unit 2

## KEY REFERENCES

### Unit 1

1. Adger, W. N. (2014). Environmental and ecological economics. In *Environmental science for environmental management* (pp. 93-118). Routledge.
2. Asafu-Adjaye, J. (2005). *Environmental economics for non-economists: techniques and policies for sustainable development*. World Scientific Publishing Company. (Chapter 2)
3. Venkatachalam, L. (2007). Environmental economics and ecological economics: Where they can converge? *Ecological economics*, 61(2-3), 550-558.
4. Shmelev, S. E., & Shmelev, S. E. (2012). The economic system and the environment. *Ecological Economics: Sustainability in Practice*, 3-18.

### Unit 2

1. Abdullah, S., Markandya, A., & Nunes, P. A. L. D. (2011). Introduction to economic valuation methods. *Research tools in natural resource and environmental economics*, 5, 143-187.
2. Asafu-Adjaye, J. (2005). *Environmental economics for non-economists: techniques and policies for sustainable development*. World Scientific Publishing Company. (Unit 5)
3. Chee, Y. E. (2004). An ecological perspective on the valuation of ecosystem services. *Biological conservation*, 120(4), 549-565.
4. Vincent, J. R. (2008). *Environment as a production input: a tutorial*. SANDEE, Kathmandu, NP.

### Unit 3

1. Asafu-Adjaye, J. (2005). *Environmental economics for non-economists: techniques and policies for sustainable development*. World Scientific Publishing Company. (Unit 6)
2. Hanley, N., Barbier, E. B., & Barbier, E. (2009). *Pricing nature: cost-benefit analysis and environmental policy*. Edward Elgar Publishing.
3. Sunstein, C. R. (2005). Cost-benefit analysis and the environment. *Ethics*, 115(2), 351-385.

### Unit 4

1. Brears, R. C. (2022). Financing Nature-Based Solutions. In *Financing Nature-Based Solutions: Exploring Public, Private, and Blended Finance Models and Case Studies* (pp. 29-50). Cham: Springer International Publishing.
2. Jack, B. K., Kousky, C., & Sims, K. R. (2008). Designing payments for ecosystem services: Lessons from previous experience with incentive-based mechanisms. *Proceedings of the national Academy of Sciences*, 105(28), 9465-9470.
3. Bull, J. W., Suttle, K. B., Gordon, A., Singh, N. J., & Milner-Gulland, E. J. (2013). Biodiversity offsets in theory and practice. *Oryx*, 47(3), 369-380.
4. Kinzig, A. P., Perrings, C., Chapin Iii, F. S., Polasky, S., Smith, V. K., Tilman, D., & Turner, B. L. (2011). Paying for ecosystem services—promise and peril. *Science*, 334(6056), 603-604.
5. van Kooten, G. C. (2017). Forest carbon offsets and carbon emissions trading: Problems of contracting. *Forest Policy and Economics*, 75, 83-88.

## Unit 5

1. Asafu-Adjaye, J. (2005). *Environmental economics for non-economists: techniques and policies for sustainable development*. World Scientific Publishing Company. (Unit 12)
2. Pelenc, J., Ballet, J., & Dedeurwaerdere, T. (2015). Weak sustainability versus strong sustainability. Brief for GSDR United Nations, 1-4.
3. Barua, A., & Khataniar, B. (2016). Strong or weak sustainability: A case study of emerging Asia. *Asia-Pacific Development Journal*, 22(1), 1-31.
4. Dietz, S., & Neumayer, E. (2007). Weak and strong sustainability in the SEEA: Concepts and measurement. *Ecological economics*, 61(4), 617-626.
5. United Nations (2021). System of Environmental-Economic Accounting— Ecosystem Accounting (SEEA EA). White cover publication, pre-edited text subject to official editing. Available at: <https://seea.un.org/ecosystem-accounting>.

## **COURSE TITLE: INDIGENOUS KNOWLEDGE IN MOUNTAIN PRODUCTION SYSTEM**

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 629	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** This course presents the indigenous knowledge and practices that have sustained mountain production systems for generations. Students will learn about traditional practices of natural resource management and agriculture system those rooted in the diverse mountain cultures. The course also emphasizes the importance of and international efforts for preserving and integrating Indigenous knowledge into the sustainability efforts in the context of changing environment.

**OBJECTIVES:** The general objective of this course is to improve the understanding of Indigenous and Traditional Knowledge and practices in mountain production systems while contributing to ecological sustainability, cultural significance, and productivity. The specific objectives are to:

- Explore the role of indigenous knowledge in conserving fragile mountain ecosystems
- Highlight the interconnected between cultural practices and sustainable mountain production system
- Explain the indigenous resource management techniques and practices specific to mountain regions

**LEARNING OUTCOMES:** After the completion of this course, each student will be able to

- Develop a deeper understanding of indigenous knowledge, practice, and technologies specific to sustainable mountain ecosystems
- Apply the appropriate indigenous practices to address the contemporary challenges in the mountain production system
- Develop critical thinking skills to incorporate indigenous knowledge, skills, practices, and technologies into modern development practices

### **COURSE CONTENTS**

#### **UNIT 1: INTRODUCTION TO INDIGENOUS AND TRADITIONAL KNOWLEDGE (8)**

- 1.1 Indigenous Knowledge, Traditional Knowledge, and Local Knowledge
- 1.2 Interconnection between Culture, Nature and Knowledge
- 1.3 Role of Knowledge in Traditional Society
- 1.4 Indigenous Worldviews and Cosmology
- 1.5 Traditional Ecological Landscape
- 1.6 Importance of Protecting Indigenous/Traditional Knowledge

- 1.7 Objections to Protecting Indigenous/Traditional Knowledge
- 1.8 Current and Traditional Knowledge and Their Contemporary Relevance

## **UNIT 2: MOUNTAIN PRODUCTION AND FOOD SYSTEM (4)**

- 2.1 Mountain Production System (Forests, Agriculture, Livestock)
- 2.2 Mountain Food Culture
- 2.3 Traditional Food Processing and Preservation
- 2.4 Local Markets and Trade
- 2.5 Food Processing Practical Session
- 2.6 Traditional Value Add of the Mountain Crops and Foods
- 2.7 Indigenous Methods of Conservation Plant Genetic Resources

## **UNIT 3: INDIGENOUS KNOWLEDGE IN PRODUCTION SYSTEM (8)**

- 3.1 Traditional Farming System
- 3.2 Grazing and Pasture Management
- 3.3 Traditional Animal Health Care
- 3.4 Traditional Soil Fertility Management
- 3.5 Terracing and Soil Conservation
- 3.6 Agroforestry in Mountain Ecosystems
- 3.7 Water Management and Irrigation Systems
- 3.8 Indigenous/Tribal Forest Management
- 3.9 Traditional Health Care Systems
- 3.10 Traditional Honey Production
- 3.11 Traditional Knowledge on Harvesting and Marketing NTFP/MAP

## **UNIT 4: CULTURAL AND SOCIAL ASPECTS (4)**

- 4.1 Ethical Considerations in Indigenous Resource Management
- 4.2 Indigenous Communities and Mountain Farming
- 4.3 Social Stratification of the Traditional Knowledge
- 4.4 Gender Relations and Traditional Knowledge
- 4.5 Cultural Importance of the Different Agricultural Products
- 4.6 Traditional Governance Systems (Mukhya, Nawa system in Nepal)
- 4.7 Retention and Integration of Traditional Knowledge
- 4.8 Community-Based Decision-Making
- 4.9 Gender and Youth Roles in Mountain Farming
- 4.10 Role of Language in Preserving Indigenous Knowledge
- 4.11 Traditional Trade and Exchange of Farm Products

## **UNIT 5: PRESERVING INDIGENOUS AND TRADITIONAL KNOWLEDGE (4)**

- 5.1 Challenges to Knowledge Preservation
- 5.2 Documenting and Revitalizing Indigenous Practices
- 5.3 Ethical and Legal Considerations
- 5.4 Approaches to Traditional Knowledge Protection
  - General Approach
  - Positive Protection

- Defensive Protection
- Practices of Protecting Traditional Knowledge and Resources in Nepal (such as Seed bank, Museum, Home-Stay)
- Conservation and Promotion of the Traditional Agriculture Heritage sites (e.g., home garden, terrace farming, wild honey hunting, fishing)
- Celebration of the Traditional and Cultural Festival (e.g., food, local products, dress)

#### **UNIT 6: TRADITIONAL KNOWLEDGE AND INTERNATIONAL DIPLOMACY (4)**

- 6.1 Retention of Traditional Knowledge: The Role of State Policy
- 6.2 The Convention of Biological Diversity
  - The Conference of the Parties, the Working Groups, and the International Regime
  - The Nagoya Protocol on Access to Benefit Sharing
- 6.3 The World Intellectual Property Organization
  - Provisions for the Protection of Traditional Knowledge
  - Provisions for the Protection of Traditional Cultural Expressions
- 6.4 The World Trade Organization
  - Traditional Knowledge, the TRIPS Council, and the Doha Development Agenda

#### **PRACTICAL (16)**

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit(s)</b>
Indigenous practice of agriculture or land management		Observation and interaction with communities Documentation and a 1,000-word essay or newspaper article	Unit 1 to 4
Integrate indigenous knowledge into a sustainable production system	Case studies	A case study analysis in group Powerpoint presentation	Unit 2,3,5
Indigenous Knowledge and Natural Resource Management	Case studies: Visit nearby local areas and prepare a report: Introduction methods and expected outcomes) – soil and water conservation; agro-biodiversity conservation; benefit-sharing	Literature review / Consultation Prepare project	Unit 4,5
Collaborative workshop with Indigenous community	Workshop	Students prepare and facilitate a workshop (half day) to exchange knowledge between students and the indigenous community on natural resource management	Unit 1 to 5

## KEY REFERENCES

### Text Books

1. Dutfield, G. (2006). *Protecting traditional knowledge: pathways to the future* (No. 16). International Centre for Trade and Sustainable Development (ICTSD).
2. Subramanian, S. M., & Pisupati, B. (2010). *Traditional knowledge in policy and practice: approaches to development and human well-being*. United Nations University Press.

### Unit 1

1. Agrawal, A. (1995). Dismantling the divide between indigenous and scientific knowledge. *Development and change*, 26(3), 413-439.
2. Onyanacha, O. B. (2024). Indigenous knowledge, traditional knowledge and local knowledge: what is the difference? An informetrics perspective. *Global Knowledge, Memory and Communication*, 73(3), 237-257.
3. Salas, M.A. Tillmann, H.J. Chiang Mai, C. (2004). *Basic Concepts of Indigenous Knowledge*. ICIMOD.

### Unit 2

1. FAO. (2019). *Mountain agriculture: Opportunities for harnessing Zero Hunger in Asia*. Bangkok.
2. Phillips, F. K. (2016). Intellectual property rights in traditional knowledge: enabler of sustainable development. *Utrecht J. Int'l & Eur. L.*, 32, 1.
3. Ramakrishnan, P. S. (2005). Mountain biodiversity, land use dynamics and traditional ecological knowledge. *Global change and mountain regions: An overview of current knowledge*, 551-561.

### Unit 3

1. Gartaula, H., Patel, K., Shukla, S., Devkota, R. (2020). Indigenous knowledge of traditional foods and food literacy among youth: Insights from rural Nepal, *Journal of Rural Studies*, Volume 73, Pages 77-86
2. Zehadul, A.H.M. (2014). Indigenous Food Production System and the Impact of Population Growth: Community-Based Examples with Anthropological Evidence. *Asian Social Science*; Vol. 10, No. 12.
3. FAO. (2003). *Understanding the Indigenous Knowledge and Information Systems of Pastoralists in Eritrea*.
4. Farooquee, N. A, B.S. Majila and C.P. Kala. (2004). Indigenous Knowledge Systems and Sustainable Management of Natural Resources in a High-Altitude Society in Kumaun Himalaya, India. *J. Hum. Ecol.*, 16(1): 33-42

#### Unit 4

1. Whyte, K. P. (2013). On the role of traditional ecological knowledge as a collaborative concept: A philosophical study. *Ecological processes*, 2, 1-12.
2. Sustainable Development. (2016). *Utrecht Journal of International and European Law* 1, DOI: <http://dx.doi.org/10.5334/ujiel.283>
3. Ingty, T. (2017). High Mountain communities and climate change: adaptation, traditional ecological knowledge, and institutions. *Climatic Change*, **145(1)**, 41–55.

#### Unit 5

1. Wright, E. (2020). *Protecting traditional knowledge: lessons from global case studies*. Edward Elgar Publishing.

#### Unit 6

1. IISD. (2007). *Traditional Knowledge and Sustainable Development*. International Institute for Sustainable Development (IISD) Canada.
2. Dutfield, G. (2006). *Protecting traditional knowledge: pathways to the future* (No. 16). International Centre for Trade and Sustainable Development (ICTSD).
3. Subramanian, S. M., & Pisupati, B. (2010). *Traditional knowledge in policy and practice: approaches to development and human well-being*. United Nations University Press.

**SEMESTER III**  
**COURSE TITLE: MOUNTAIN ENVIRONMENT**

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
WME 625	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** The mountain environment course is designed to deeply explore the principles, theories, and dynamics that shape mountain landforms and ecosystems. Students will gain the essential knowledge and skills to play an active role in regulating, managing, and mapping mountain resources, while also developing a nuanced understanding of the intricate environmental and socio-ecological implications linked to mountain landscapes.

**OBJECTIVES:** This course aims to achieve the following objectives:

- Students acquire a basic understanding of mountain ecosystems.
- Introduce students to the connection between social and ecological factors in mountains and the methods used to assess them.
- Familiarize students with the environmental consequences of human-caused stressors in mountains.
- Equip students with the knowledge necessary to create plans for managing and inventorying natural resources and biodiversity in mountain landscapes.
- Evaluate various criteria for decision-making tools related to mountain development and sustainability.

**LEARNING OUTCOMES:** Upon completing this course, students will gain the necessary skills to:

- Establish appropriate objectives for the sustainable development of mountain regions.
- Maximize the utilization of resources derived from mountain ecosystems
- Effectively regulate socio-ecological systems and human aspects in mountainous areas to ensure long-term sustainability
- Recognize the significance of mountains and propose practical management strategies.
- Develop a comprehensive plan for the conservation and management of mountain resources and biodiversity

## **COURSE CONTENTS**

### **UNIT 1: OVERVIEW OF THE MOUNTAINS (8)**

- 1.1 Introduction to Mountains, Mountains in the World, Distinctiveness of Mountains, Mountain Origin, Geomorphic and Geological Features
- 1.2 Mountain Weather and Climate
- 1.3 Atmosphere, Hydrosphere and Lithosphere: Interaction Between Spheres
- 1.4 Extent, Coverage of Hindu Kush Himalayas
- 1.5 Mountain Resources, Ecosystems, and Biodiversity

- 1.6 Ecosystem Services of Mountains
- 1.7 Mountain Tourism

**UNIT 2: MOUNTAIN GEO-MORPHOLOGY (4)**

- 2.1 Mountain Evolution (dynamic of earth and its internal structure, plate tectonics, mountain building process)
- 2.2 World Major Mountain Ranges
- 2.3 Mountain Hazards

**UNIT 3: SOCIO-ECOLOGICAL SYSTEMS IN MOUNTAINS (4)**

- 3.1 Socio-cultural Tradition, Culture, and Values of Mountains
- 3.2 Human-Mountain Interactions and Resources
- 3.3 Conventional Practices of Resource Management in Mountains
- 3.4 Assessing the Socio-Ecological Vulnerability of Mountain Communities

**UNIT 4: MOUNTAINS UNDER PRESSURE (8)**

- 4.1 Status of Mountain Resources (water towers, cryosphere, glaciers, glacial lakes, rivers, minerals, geo-thermal, wind, solar)
- 4.2 Mountain Pollution and Impacts
- 4.3 Climate Change and Indicators of Change
- 4.4 Land Use Land Cover Change and Consequences

**UNIT 5: MOUNTAIN DEVELOPMENT AND SUSTAINABILITY (8)**

- 5.1 Concept of Integrated Mountain Development
- 5.2 Highland-Lowland Interactive Systems
- 5.3 Mountain Development Initiatives
  - 5.3.1 Legal and Institutions Frameworks in Mountain Development
  - 5.3.2 Shifting Development Approach with Globalization
- 5.4 Sustainable Development Goals (SDGs) and Mountains

**PRACTICAL (16)**

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit (s)</b>
Field visit	Fieldwork	Observation (Individual report)	Unit 1 to 5
Critical analysis	Critical analysis of an article provided	Presentation (group)	Unit 1 to 5
Literature review on a critical mountain issue	Review	Report (individual)	Unit 1 to 5

## KEY REFERENCES

### Unit 1

1. Martin F. Price, Alton C. Byers, Donald A. Friend, Thomas Kohler, Larry W. Price. (2013). *Mountain geography: physical and human dimensions*. University of California Press, Ltd. USA. [Chapter 1, 3]
2. Wester, P., Mishra, A., Mukherji, A., & Shrestha, A. B. (2019). *The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people* (p. 627). Springer Nature. [Chapter 1, 3, 5]
3. Grêt-Regamey, A., & Weibel, B. (2020). Global assessment of mountain ecosystem services using earth observation data. *Ecosystem Services*, 46, 101213.
4. Kohler, T., & Maselli, D. (2009). *Mountains and climate change. From understanding to action*. Geographica Bernensia.

### Unit 2

1. Wester, P., Mishra, A., Mukherji, A., & Shrestha, A. B. (2019). *The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people* (p. 627). Springer Nature. [Chapter 11]
2. Romola, P. (2013). *Mountain environments*. Routledge Taylor and Francis Group, London. [Chapter 1]
3. Price, M. F. (2013). *Mountain geography: Physical and human dimensions*. Univ of California Press. [Chapter 2]

### Unit 3

1. Price, M. F. (2013). *Mountain geography: Physical and human dimensions*. Univ of California Press. [Chapter 10, 11].
2. Hasrat, A. (2023). *Mountain Ecosystems and Resources Management, Volume 1. The grassroot Institute, Canada*. [https://grassrootsinstitute.net/books-mountaina/Book-Mountains1\\_comp.pdf](https://grassrootsinstitute.net/books-mountaina/Book-Mountains1_comp.pdf) [Chapter 1, 5, 19]
3. Sarmiento, F. O. (Ed.). (2023). *Montology Palimpsest: A Primer of Mountain Geographies* (Vol. 1). Springer Nature. [Chapter 5,6,12]
4. Wester, P., Mishra, A., Mukherji, A., & Shrestha, A. B. (2019). *The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people* (p. 627). Springer Nature. [Chapter 12]
5. Liu, F., Dai, E., & Yin, J. (2023). A review of social–ecological system research and geographical applications. *Sustainability*, 15(8), 6930.

### Unit 4

1. Wester, P., Mishra, A., Mukherji, A., & Shrestha, A. B. (2019). *The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people* (p. 627). Springer Nature [Chapter 8, 9, 10]

2. Sarmiento, F. O. (Ed.). (2023). *Montology Palimpsest: A Primer of Mountain Geographies* (Vol. 1). Springer Nature. [Chapter 9]

## Unit 5

1. Martin F. Price, Alton C. Byers, Donald A. Friend, Thomas Kohler, Larry W. Price. (2013). *Mountain geography: physical and human dimensions*. University of California Press, Ltd. USA. [Chapter 12].
2. Hasrat, A. (2023). *Mountain Ecosystems and Resources Management*, volume 1. The grassroot Institute, Canada. [https://grassrootsinstitute.net/books-mountaina/Book-Mountains1\\_comp.pdf](https://grassrootsinstitute.net/books-mountaina/Book-Mountains1_comp.pdf) [Chapter 22]
3. Ives, J. D. (2022). *Sustainable mountain development: Getting the facts right*. Springer Nature. <https://doi.org/10.1007/978-3-030-96029-2>
4. Ariza, C., Maselli, D., & Kohler, T. (2013). *Mountains: Our Life, Our Future. Progress and Perspectives on Sustainable Mountain Development from Rio 1992 to Rio 2012 and Beyond. A global synthesis based on 10 regional reports*. Geographica Bernensia. [https://boris.unibe.ch/47827/1/Mountain\\_Synthesis\\_Report.pdf](https://boris.unibe.ch/47827/1/Mountain_Synthesis_Report.pdf) .

## COURSE TITLE: MOUNTAIN ECONOMY AND DEVELOPMENT

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 626	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 15 lecture hours*

**SCOPE:** The course covers fundamental concepts on economy and development in the context of the mountain environment. The geophysical characteristics of mountains with changing socioeconomic and its climatic features influence the culture, infrastructure and economy at a place. Also important is how economic and development policies, which are likely to change with regime shift and development approach impact the mountain communities. Therefore, course places high focus on applicability to the mountain environment and livelihood. Students will understand the broader context of the mountain and the heterogeneity in terms of development, socio-culture, and economy. Additionally, the course covers theoretical, empirical and practical knowledge and skills to explore about sustainable development and economic opportunities in the mountain of Nepal, in the Himalayas and in similar contexts in other regions.

**OBJECTIVES:** Students will briefly learn about the basic concept of development theories that enable them to think further on the economy and development of mountain communities. Students will understand the past, present, and future of mountain economy and development. Furthermore, students can critically evaluate the approaches and interventions adopted for mountain development over time. Students will develop the skill to evaluate policy/intervention on household/community welfare and be able to provide context-specific solutions to accelerate sustainable economic development in the mountain.

- Learn about the human geography of mountain communities
- Understand how mountain societies and individuals progress over time
- Learn about various perspectives of process and aspects of mountain development
- Develop skill to evaluate development intervention and its potential impact on mountain development
- Gain knowledge on developing contextual interventions for accelerating sustainable development and economic prosperity in the mountain region

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

- Understand and analyze different economic development theories and practices for sustainable mountain development.

### COURSE CONTENTS

#### UNIT 1. UNDERSTANDING THE MOUNTAIN COMMUNITIES AND DEVELOPMENT THEORIES (6)

- 1.1. How Mountain Communities and Individuals Progress Over Time
  - 1.1.1. How Mountains Evolved and Human Settlement Started
  - 1.1.2. The Population Living in the Mountains and their Broad Socio-Economic Status

- 1.2. Perspectives of Mountain Development
  - 1.2.1. Modernization Theory,
  - 1.2.2. Human Capital Theory
  - 1.2.3. Centre-Periphery Model and Mountain Communities
  - 1.2.4. Place Based Concept and the Mountain Economy
- 1.3 A Typical Household and Their Livelihood Strategies in the Hindu Kush Himalaya
  - Farm
  - Income Growth
  - Sustainable Resource Use
  - Employment
  - Livelihood
  - Resources
  - Basic Need
  - Quality of Life
  - Culture and Traditions

## **UNIT 2. ECONOMIC GEOGRAPHY OF THE MOUNTAIN COMMUNITIES (6)**

- 2.1. Dimensions of Remoteness in the Mountain
  - 2.1.1. Physical Distance from Market
  - 2.1.2. Digital Connectivity
  - 2.1.3. Social and Political Connection
  - 2.1.4. Economic Marginalization
  - 2.1.5. Cultural Isolation
- 2.2. Concept of Spatial Decay
- 2.3. Factors and Process of Heterogeneity in the Mountain
  - 2.3.1. Scattered Settlement
  - 2.3.2. Policies (for e.g., population-based resource allocation)
  - 2.3.3. Road and Connectivity
  - 2.3.4. Access to Energy
  - 2.3.5. Basic Services
  - 2.3.6. Economic Opportunities
  - 2.3.7. Education and Skill Development
- 2.4. Heterogeneity and its Influence on Mountain Development
  - 2.4.1. Development Interventions in the Mountain
  - 2.4.2. Value for Money
  - 2.4.3. Variation in Cost of Infrastructure
  - 2.4.4. Spatial Inequity
- 2.5. Synergies and Co-benefit
  - 2.5.1. Environment in Livelihood Practices
  - 2.5.2. Demand and Supply of Goods and Services (the social practices of self-sufficiency)
  - 2.5.3. Indigenous Knowledge and Economic Opportunities

## **UNIT 3. INTRICACIES OF ECONOMIC DEVELOPMENT IN THE MOUNTAINS (6)**

- 3.1. Trends in the Mountain Communities of Nepal
  - 3.1.1. Migration and Demographic Change
  - 3.1.2. Local Governance and Resource Allocation

- 3.1.3. Local Resource Mobilization
- 3.2. Costly Infrastructure and High Transaction Cost
  - 3.2.1. Geophysical Features and Extreme Climate
  - 3.2.2. Low Population and Scattered Settlement
- 3.3. Weak Economic Opportunities
  - 3.3.1. Income Poverty and Affordability
  - 3.3.2. Informal Sector
  - 3.3.3. Subsistence and Cultural Practices
- 3.4. Politics, Public Service and Facilities
  - 3.4.1. Weak Public Services like Health and Education
  - 3.4.2. Local Governance and Mountain Development
  - 3.4.3. Targeting Including Grant Allocation and Budgeting
- 3.5. Entrepreneurship, Investment and Commercialization of Goods and Services

#### **UNIT 4. CONTEMPORARY CHALLENGES AND OPPORTUNITIES OF THE MOUNTAIN DEVELOPMENT IN NEPAL (4)**

- 4.1. Challenges Transformation of Mountain Livelihoods
  - 4.1.1. Out Migration and Demographic Structure
  - 4.1.2. Un-enabling Policies
    - 4.1.2.1 Political Instability and Good Governance
    - 4.1.2.2 Weak Resource Allocation
    - 4.1.2.3 Access to Commercial Facilities and Market
  - 4.1.3. Policy Dilemma and Weak Targeting
    - 4.1.3.1 Spatially Inequitable Resource Allocation (budget, subsidy, and project)
- 4.2. Opportunities in the Mountain Development
  - 4.2.1. Adventure and Games
  - 4.2.2. Ecotourism
  - 4.2.3. Resources
  - 4.2.4. High Value Agricultural Product/Organic Farming
  - 4.2.5. Production of High Value Commercial Goods and Services
  - 4.2.6. Mountain Enterprises
  - 4.2.7. Others

#### **UNIT 5. INSTITUTION AND RESOURCE MANAGEMENT FOR ECONOMIC DEVELOPMENT (4)**

- 5.1. Role of Institutions in Economic Development
  - 5.1.1. Community-based Institutions and Economic Development in the Mountain Communities
  - 5.1.2. Role of Traditional Financial Institutions like Cooperatives
  - 5.1.3. Resources Management Institutions Including CFUG as a Social Change Agent
  - 5.1.4. Contribution of Cultural Institutions like, Guthi, Rodhi Ghar on Tourism and Income Generation
- 5.2. Sustainable Resource Management for Economic Development in the Mountain
  - 5.2.1. Harvesting Medical and Aromatic Plants
  - 5.2.2. Number of Permits and Ecological Threshold
  - 5.2.3. Conservation and Livelihood Opportunities

#### 5.2.4. Distribution of Benefits

### UNIT 6. SUSTAINABLE MOUNTAIN DEVELOPMENT (6)

- 6.1. Drivers of Change to Mountain Sustainability
  - 6.1.1. Environmental Drivers of Change to Mountain Sustainability (land use land cover change, overexploitation of natural resources, pollution, invasive alien species, mountain hazard, and climate change and vulnerability)
  - 6.1.2. Sociocultural Drivers of Change (demographic situation, sociocultural change, governance system and institutions, external knowledge, and technological innovation)
  - 6.1.3. Economic Drivers of Change to Mountain Development
    - 6.1.3.1 Economic Growth and Differentiation
    - 6.1.3.2 Infrastructure Development
    - 6.1.3.3 Urban and Peri-urban Development
- 6.2. Sustainable Mountain Development Initiatives
  - 6.2.1 Global, Regional, and National Initiatives
  - 6.2.2 Principles for Sustainable Mountain Development
- 6.3. Unlocking the Economic Potential of Mountain Economy
  - 6.3.1. Emerging Opportunities
    - 6.3.1.1 Carbon Off-Sets Credits
    - 6.3.1.2 Zero Emission Mountain Economy
    - 6.3.1.3 Improving Existing Services
    - 6.3.1.4 Ecotourism and Trekking (including homestay)
- 6.4 Role of Context Specific Interventions

### PRACTICAL (16)

#### Case studies

1. Evaluation of the impact of policy/development intervention on mountain communities
2. Mountain product and comparative advantage
3. Youth migration and rural economy

**Objective:** Gain quantitative skills to understand the impact of development intervention on household economy.

**Requirement:** Individual data set with village/Local Level information and socio-economic variable like employment and education.

#### Step by step guidelines:

- a) Identifying development intervention: Students will select a development intervention. The intervention could be a physical program such as MHP or conservation areas or irrigation program or ecotourism. Alternatively, it can be other policies such as subsidies or training or programs. While identifying the project student will also collect information on:
  - a. What is it about?
  - b. Where is it located?
  - c. When did it start and end?
  - d. Who were the beneficiaries?

- e. Adjacent village/local level that was not impacted by the program.
- b) Conceptualize: Student will write a brief background of 200 word describing
  - a. The project/policy
  - b. Why was it implemented?
  - c. Progress so far
  - d. What is expected direct output (say light from MHP)
  - e. What possible economic outcome (Education or income)
  - f. Who are more likely to be benefited?
  - g. Research question.
- c) Students will be given the individual and household level data set for that district; it could be panel data set.
- d) Data analysis: Student will do data analysis
  - a. Identify the found impacted household by geography (if the household is not known)
  - b. Prepare descriptive statistics of treated and control household
  - c. Mean test of the impacted and other household both on immediate output and outcome variables
  - d. Other advanced analyses including heterogeneous impact
- e) Write results and discuss
- f) Presentation

Alternative data set can be used for analysis. For example, MacKinnon, D., & Cumbers, A. (2018) provide several practical datasets. Or Students can use datasets used in the evaluation of mountain development intervention.

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## COURSE TITLE: PASTORALISM AND RANGE MANAGEMENT

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 627	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** This course delves into the principles, practices and challenges associated with pastoralism and range management in the mountains. Topics generally include rangeland management, rangeland ecology, drivers of change, rangeland management strategy, and building resilience in pastoral community. Students explore strategies to maintain pastoralism and sustainable range management.

**OBJECTIVES:** This course provides students with a comprehensive understanding of the management and sustainable development of rangelands, focusing on the positive relationships between pastoralism and biodiversity, traditional knowledge, as well as the social, economic, and ecological aspects of pastoral systems. After the completion of the course, the students will be able to:

- Explore rangelands as social-ecological system
- Promoting interdisciplinary approaches that integrate ecological, social, and economic perspectives in rangeland management
- Analyse the drivers of rangeland change
- Cultivate critical thinking and problem-solving abilities to address complex challenges facing pastoralism and rangeland ecosystems
- Develop skill in sustainable range management

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

- Understand the concept of rangelands and pastoralism and their socio-ecological significance.
- Understand the dynamics of pastoralism and its cultural, economic, and ecological dimensions.
- Get insights on the positive linkages between pastoralism and biodiversity and the role of traditional knowledge in rangeland management.
- Gain knowledge in optimizing livestock production in pastoral settings, covering breeding, nutrition, health, market strategies and rangeland management to improve the livelihoods of pastoralist communities.
- Understand the socio-economic and ecological factors influencing pastoral development and pastoralist communities.

### COURSE CONTENTS

#### UNIT 1: INTRODUCTION TO RANGELANDS AND PASTORALISM (8)

- 1.1 Significance of Rangelands (multiple benefits of rangelands)
- 1.2 Overview of Pastoralism and its Types

- 1.3 Historical Context of Pastoralism
- 1.4 Livelihood Strategies in Pastoral Communities
- 1.5 Current and Historical Debates on Rangeland and Pastoralism
- 1.6 Relationship Between Rangeland, Pastoralism and Developments
- 1.7 Rangeland as Social-Ecological Systems

## **UNIT 2: RANGELAND ECOLOGY (6)**

- 2.1 Rangeland Ecology in Changing World
- 2.2 Biotic and Abiotic Factors Influencing Rangeland Ecology (theories on rangelands at equilibrium and non-Equilibrium)
- 2.3 Plant-Animal Interactions in Rangeland Ecosystems
- 2.4 Domestic-Wildlife Animals Interactions in Rangeland
- 2.5 Rangeland Fire Ecology and Management

## **UNIT 3: DRIVERS OF RANGELAND CHANGE (6)**

- 3.1 Climate Change and its Effects on Rangeland Ecosystems
- 3.2 Land Use and Disturbances in Rangelands
- 3.3 Overgrazing and Over-Exploitation (e.g., herb medicine collection)
- 3.4 Human Wildlife Conflict and Protected Areas
- 3.5 Invasive Species and Pollution
- 3.6 Globalization and Market Forces
- 3.7 Demographic and Socio-Cultural Changes
- 3.8 Technological Advancements
- 3.9 Sectoral Policies

## **UNIT 4: RANGELAND MANAGEMENT STRATEGIES (6)**

- 4.1 Traditional Knowledge and Indigenous Practices
  - 4.1.1 The Role of Traditional Knowledge in Rangeland Management
  - 4.1.2 Indigenous Practices for Sustainable Rangeland Use
- 4.2. Grazing Systems and Stocking Rates
  - 4.2.1 Principles of Rotational Grazing Systems and its Application
  - 4.2.2 Determination of Stocking Rates for Optimal Forage Utilization
  - 4.2.3 Monitoring and Assessing the Health of Rangeland Ecosystem
- 4.3. Biodiversity and Pastoralism
  - 4.3.1 Understanding the Positive Relationships Between Pastoralism and Biodiversity
  - 4.3.2 Balancing the Needs of Wildlife and Livestock in Pastoral Systems

## **UNIT 5: BUILDING RESILIENCE IN PASTORALIST COMMUNITIES (6)**

- 5.1 Conflict Resolution
  - 5.1.1 Understanding Conflicts in Rangeland Management
  - 5.1.2 Conflict-Sensitive Rangeland Management Approaches
- 5.2 Participatory Approaches and Community Engagement
  - 5.2.1 Promoting Community Involvement in Decision-Making Processes
  - 5.2.2 Participatory Resource Management and Co-Management
  - 5.2.3 Stakeholder Collaboration for Managing Rangeland for Multiple Benefits
- 5.3 Adaptive Management for Resilience
  - 5.3.1 Principles of Adaptive Management
  - 5.3.2 Implementing Adaptive Strategies for Pastoral Communities

## PRACTICAL (16)

Contents	Equipment/tools	Methodology/methods	Link to Unit (s)
Practices of herding practices	Protocol / Checklist	Focus group/interaction with local herders	Unit 1 to 4
Issues in Rangeland / Pastoralism	Protocol / Checklist	Focus group/ interaction with local herders and stakeholders	Unit 1 to 4
Improving rangeland and pastoralism (specific topic)	Information from field	Report (Individual)	Unit 1 to 4

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## COURSE TITLE: MOUNTAIN HAZARD AND DISASTER MANAGEMENT

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
WME 628	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** The course on Mountain Hazards and Disaster Management typically covers a range of topics related to the specific challenges and risks associated with mountainous regions. The scope of this course includes the understanding of mountain geography, identification of mountain hazards, risk assessment and management, disaster preparedness and response, environmental sustainability and conservation, case studies and best practices, policy and governance as major key areas of study. By studying these aspects, students can gain comprehensive knowledge and skills to effectively assess, manage, and mitigate the risks posed by various hazards in mountainous regions, contributing to the overall goal of promoting sustainable development and resilience in these vulnerable areas.

**OBJECTIVES:** The objectives of the course are to:

- Understand the unique geological and geomorphological processes and natural hazards prevalent in mountainous regions.
- Analyze the socio-economic impacts of mountain hazards and their repercussions on local communities.
- Evaluate different strategies for disaster risk management and risk reduction specific to mountain environments.
- Apply advanced/understanding techniques and technologies for predicting, monitoring, and mitigating mountain-related disasters.

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

- Understand the fundamentals of mountain hazards and disaster risk management processes in mountain areas
- Assess the vulnerability of the community
- Understand the disaster risk management process
- In-depth knowledge about disaster management through case study

### COURSE CONTENTS

#### UNIT 1: INTRODUCTION TO MOUNTAIN HAZARDS (4)

- 1.1 Overview of Mountain Systems and their Ecological Significance
- 1.2 Types of Natural Hazards in Mountainous Regions: Landslides, Snow Avalanches, Glacial Lake Outbursts, Floods, Drought
- 1.3 Fragility of Mountain and Hazard

## **UNIT 2: CLIMATE-RELATED RISKS IN MOUNTAINOUS REGIONS (7)**

- 2.1 Climate Change Impacts on Mountain Ecosystems
- 2.2 Extreme Weather Events (e.g., snowstorms, rainfall events, drought) and their Implications
- 2.3 Hydrological Hazards: Floods, Flash Floods, and Debris Flows
- 2.4 Geological Hazards: Landslide, Rockfall, and Rock Avalanche
- 2.5 Water, Ice, Society, and Ecosystems
- 2.6 Food, Water, and Energy Security

## **UNIT 3: MOUNTAIN HAZARDS AND COMMUNITY RESILIENCE (10)**

- 3.1 Multi-Hazard and Cascading Effects in Mountain
- 3.2 Vulnerability/risk Assessment of Mountain Communities towards Different Mountain Hazards
- 3.3 Case Studies of Successful Community-Based Risk Reduction and Disaster Management Initiatives in Mountain

## **UNIT 4: POLICY AND GOVERNANCE IN MOUNTAIN HAZARD MITIGATION (5)**

- 4.1 International Policies and Risk Governance Frameworks for Mountain Hazard Management e.g., Sendai Framework
- 4.2 Mountains in the 2030 Agenda for Sustainable Development
- 4.3 Local Governance in Disaster Risk Reduction

## **UNIT 5: DISASTER RISK MANAGEMENT TECHNIQUES FOR MOUNTAIN HAZARDS (6)**

- 5.1 Disaster Risk Reduction and Sustainable Development in Mountainous Regions
- 5.2 Early Warning Systems for Mountain-Related Disasters
- 5.3 Emergency Response Planning and Coordination in Remote Mountain Areas
- 5.4 Risk-Sensitive Land-Use Management for Disaster Risk Reduction
- 5.5 NBS for Disaster Risk Reduction and Adaptation in Mountains
- 5.6 Indigenous Approach to Disaster Risk Reduction in Mountain Areas

## **PRACTICAL (16)**

Learning Objectives: The objective of the practical is to provide practical tools and techniques to understanding mountain hazards and disaster management.

**Fieldwork:** Field study on hazard events (nearby) in the Nepal Himalaya

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit (s)</b>
Risk assessment of mountain hazard: Landslide/flood/avalanches/drought/rock fall (any one of the hazards)	Field, GIS, and remote sensing	Analysis	Unit 3

Case study of mountain hazards Analysis of community resilience and adaptation strategies in the face of recurring mountain hazards.	Literature review and field visit	Analysis	Unit 5
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## Unit 4

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## Unit 5

1. Alcántara-Ayala, I., Cui, P., & Pasuto, A. (2022). Disaster risk reduction in mountain areas: a research overview. *Journal of mountain science*, 19(6), 1487-1494.
2. Veith, C., & Shaw, J. (2011). Why invest in sustainable mountain development?
3. Banba, M., & Shaw, R. (2017). *Land use management in disaster risk reduction*. Springer Verlag, Japan.
4. Cook, A. D., Shrestha, M., & Htet, Z. B. (2018). An assessment of international emergency disaster response to the 2015 Nepal earthquakes. *International journal of disaster risk reduction*, 31, 535-547.
5. Parmesan, C., Morecroft, M. D., & Trisurat, Y. (2022). *Climate change 2022: Impacts, adaptation and vulnerability* (Doctoral dissertation, GIEC).
6. CHANGE, O. C. (2007). Intergovernmental panel on climate change. *World Meteorological Organization*, 52, 1-43.

## COURSE TITLE: ENVIRONMENTAL POLLUTION (OPTIONAL)

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
WME 630	3	48 (32+16)	75 (45+30)

*Note: 1 credit= 16 lecture hours*

**SCOPE:** This course deals with the origin, and fundamental principles of the different environmental pollutions, namely; water pollution, air pollution, solid waste management, and land pollution. The scientific principles described are useful to be applied to local, regional, and global aspects of the subject. The hands-on laboratory experiments and field visits will help to evaluate the status of environmental pollution in the context of local and global perspectives. The course will also suggest mitigation measures to control environmental pollution.

**OBJECTIVES:** The general objective of this course is to infer the students about concepts, causes, effects and control of pollution of water, air, noise pollution and solid waste management. The specific objectives are:

- Impart the knowledge about water pollution; sources and types, its impact, different important parameters of water quality and their significances, standards, purification, and treatment of wastewater
- Convey the problems of air pollution, outdoor and indoor air pollution, different air pollutants, their sources, relation of meteorology with air pollution, standards for air pollution and the concept of air pollution control
- Describe the cause and effect of noise pollution, its sources, effects, measurement, standards, and control techniques
- Acquire knowledge about solid waste generation, types of solid waste, functional units and principles of solid waste management
- Impart the knowledge about land pollution and different methods of land restoration

**LEARNING OUTCOMES:** After studying this course you will be able to

- Categories the different forms of environmental pollution, describe their causes and consequences to natural, economic, and social systems.
- Understand the fundamental principles governing the interactions between those systems (i.e. transport of pollutants in the environment)
- Give examples of good practices of pollution control technologies and their options
- Analyze, synthesize, and evaluate evidence to understand problems in order to select control measures and techniques concerning atmospheric, water, or terrestrial challenges

### COURSE CONTENTS

#### UNIT 1: INTRODUCTION (6)

##### 1.1 Water Pollution

###### 1.1.1 Concept of Water Pollution: Groundwater and Surface Water Pollution

###### 1.1.2 Sources of Water Pollution: Point and Non-Point Sources

- 1.1.3 Types and Sources of Water Pollutants
- 1.1.4 Impact and Consequences of Water Pollution
- 1.2 Water Quality
  - 1.2.1 Concept and Characteristics of Water Physical, Chemical, and Biological Parameters of Water Quality
  - 1.2.2 Water Quality Standards: Water Quality Index, Drinking Water Quality Standards- National Drinking Water Quality Standards (NDWQS, Nepal), Guidelines for Drinking Water Quality (WHO), Wastewater Effluent Standards

## **UNIT 2: WATER PURIFICATION AND TREATMENT (6)**

- 2.1 Physical, Chemical, and Biochemical Processes
  - 2.1.1 Natural Purification of Water, Multiple Barrier Approach of Water Safety, Principles of Physical, Chemical, and Biochemical Processes of Water Treatment,
  - 2.1.2 Units and Processes of Water Treatment: Aeration, Solid Separation, Settling Operations, Precipitation and Coagulation, Softening, Filtration, Disinfection and Advanced Water Treatment Processes
  - 2.1.3 Alternative Treatment Processes: Biologically Active Filtration, Membrane Filtration, Ion exchange, Adsorption, Reverse Osmosis.
- 2.2 Wastewater Treatment and Disposal
  - 2.2.1 Composition and Characteristics of Municipal Sewage and Industrial Wastewater, Emerging Pollutants of Severe Environmental Concern in Wastewater, Potential Source of Emerging Pollutants: Plastics, Personal Care Products, Nutraceutical, Pharmaceuticals, Pesticides
  - 2.2.2 Basic Principles of Physical Chemical and Biological Processes of Wastewater Treatment, Units of Wastewater Treatment Processes: Primary, Secondary, and Tertiary Treatments; Sludge Treatment and Disposal; Reclamation of Wastewater
  - 2.2.3 Bioremediation of Water Pollutants: In situ and Ex situ Bioremediation, Phytoremediation

## **UNIT 3: AIR POLLUTION (9)**

- 3.1 Air Quality: Definitions, Characteristics and Perspectives
  - 3.1.1 Historical Overview and Global implications of Air Pollution, Units of Measurement
  - 3.1.2 Sources and Classification of Air Pollutants: Particulates, Hydrocarbons, Carbon Monoxide, Oxides of Sulphur, Oxides of Nitrogen, Photochemical Oxidants; Indoor Air Pollution
- 3.2 Meteorology and Natural Purification Processes
  - 3.2.1 Elemental Properties of the Atmosphere: Scales of Motion, Heat, Pressure, Wind, Moisture and Relative Humidity
  - 3.2.2 The Meteorological Bases of Atmospheric Pollution; Ventilation, Stagnation; Affects of Pollution on Atmosphere: Precipitation, Fogs, Solar Radiation
  - 3.2.3 Influence of Meteorological Phenomena on Air Quality: Laps Rates and Dispersion, Pressure Systems and Dispersion, Winds and Dispersion, Moisture and Dispersion, Modelling Used for Air Quality
  - 3.2.4 Transport and Dispersion of Air Pollutants
    - 3.2.4.1 Wind velocity

- 3.2.4.2 Turbulence
- 3.2.4.3 Dispersion Instrumentations: Measurement Near the Surface, Measurement Above the Surface; Atmospheric Tracers
- 3.3 Air Pollution Control
  - 3.3.1 Atmospheric Cleansing Processes: Wet and Dry Deposition, Reactions/Transformations
  - 3.3.2 Control Devices for Air Contaminants: Different Control Devices for Particulates and Gaseous Contaminants

**UNIT 4: SOLID WASTE (8)**

- 4.1 Solid Waste: Definitions, Characteristics, and Perspectives
  - 4.1.1 Types of Solid Wastes: Municipal, Industrial, Agricultural, and Hazardous Wastes
  - 4.1.2 Sources of Solid Wastes: Municipal Wastes and Hazardous Wastes
  - 4.1.3 Properties of Solid Wastes: Physical and Chemical Compositions and Changes in Composition
- 4.2 Solid Waste Management
  - 4.2.1 Solid Waste Management Overview: Materials Flow in Society and Principles of Solid Waste Management- 3R principal
  - 4.2.2 Solid Waste Management Systems: Functional Elements, Solid Waste Generation, On-Site Handling, Storage and Processing, Collection, Transfer and Transport, Processing techniques and Ultimate Disposal
- 4.3 Resources and Energy Recovery Systems

**UNIT 5: LAND POLLUTION (3)**

- 5.1 Causes and Consequence of Land Pollution
- 5.2 Management of Land Pollution

**PRACTICAL (16):** The objective of the practical is to provide practical tools and techniques to understand the various aspects of air, water, solid waste, and land pollution.

**Fieldwork:** Field work for collection of data for air/water/land/solid waste research

Contents	Equipment/tools	Methodology/methods	Link to Unit(s)
Water/air/solid waste/land pollution (any one of pollution)	Fieldwork Report	Laboratory analysis	Unit 1 to 5
Case study of pollution	Literature review	Analysis	Unit 3, 5

## KEY REFERENCES

### Unit 1 and 2

1. Apha Awwa, W. P. C. F. (2005). Standard methods for the examination of water and wastewater. *APHA WEF AWWA*.

### Unit 3

- 1 APTI. (2005). Basic air pollution meteorology: self -self-instrumental manual. Air Pollution Training Institute, United States Environmental Protection Agency.  
[www.epa.gov/apti](http://www.epa.gov/apti)
- 2 MoEST/GoN. (2009). National indoor air quality standards and implementation guidelines. Ministry of Environment, Science and Technology, Government of Nepal, Kathmandu.
- 3 MoEST/GoN. (2012). National ambient air quality standards. Ministry of Environment, Science and Technology, Government of Nepal, Kathmandu.

### Unit 4

- 1 SWMRMC. (2008). Solid waste management technical guideline for municipalities of Nepal. Solid Waste Management and Resource Mobilization Center, Government of Nepal and UN-Habitat, Kathmandu.
- 2 Worrel, W.A. (2016). Solid Waste Engineering- A Global Perspective. Third Edition. Cengage Learning. 1-800-423-0563. USA.

### Unit 5

1. Galatositsch, S.M. (2012). Ecological restoration. Sinauer Associates Inc., USA.  
ISRIC. 2002. Procedures for soil analysis. International Soil Reference and Information Centre, Wageningen.
2. Lamb, D. & Gilmour, D.A. (2003). Rehabilitation and restoration of degraded forests. IUCN, Gland, Switzerland, Cambridge, UK and WWF. Gland, Switzerland.
3. Peavy, S.H. (1985). Environmental Engineering. Mc-Graw-Hill Book Company, ISBN 0-07-100231-6. New York
4. Sawyer, C.N. (2000). Chemistry for Environmental Engineering. TATA Mc-Graw-Hill Book Company, ISBN 0-07-043560-X. New York

## COURSE TITLE: NATURAL RESOURCE PROFESSIONAL ETHICS (OPTIONAL)

Course Code	Credit	Lecture Hours (Theory +Practical)	Total Marks (External/final +Internal)
SFM 555	3	48 (32+16)	75 (45+30)

*Note: 1 Credit= 16 Lecture Hours*

**SCOPE:** This course focuses on the ethical aspects of the delivery of professional services in the field of natural resource management. It emphasizes the importance of conducting one's work in a just, fair, and ethically responsible manner, especially when balancing the demands of resource conservation and the fulfillment of legitimate human needs. The course offers valuable guidance on how to navigate these complex ethical dilemmas and make decisions that align with a strong moral and environmental compass. Students will gain the knowledge and skills necessary to address these issues in a professional and responsible manner, ensuring sustainable management of natural resources for the benefit of current and future generations.

**OBJECTIVES:** Upon completion of the course, students will have acquired a deep understanding of professional ethics in natural resource management and developed the ability to apply ethical principles to real-world challenges in this field, leading to responsible and sustainable resource management practices. The specific objectives are:

- Students will demonstrate a comprehensive knowledge of historical and contemporary ethical frameworks in the management of natural resources, allowing them to recognize ethical dilemmas and principles in this context.
- Students will develop problem-solving skills to address practical ethical challenges through case analysis, discussions, and group work within a professional setting.
- Students will cultivate a personal commitment to ethical conduct and develop a code of professional behavior consistent with the principles of professional ethics in the management of natural resources.

### LEARNING OUTCOMES

- **Ethical competence:** Graduates will have a strong ethical foundation and deep understanding of professional ethics in natural resource management, enabling them to navigate complex ethical challenges in their careers.
- **Problem-solving:** Graduates will demonstrate the ability to effectively address practical ethical dilemmas within the field of natural resource management, employing analytical skills and critical thinking to develop sound ethical solutions.
- **Personal ethical commitment:** Graduates will cultivate a personal code of professional conduct consistent with the principles of professional ethics in natural resource management, reflecting a commitment to ethical behavior in their careers.

## **COURSE CONTENTS**

### **UNIT 1: INTRODUCTION (4)**

- 1.1 Define Ethics, Areas of Ethics (meta, normative, and applied), Norms and Values.
- 1.2 Applied Ethics Approaches (utilitarianism, deontological, virtue) and Major Subfields.
- 1.3 Profession, Professionalism, Professional Ethics, and Professional Practice.
- 1.4 Developing Professional Ethical Reflections on Natural Resource Management.

### **UNIT 2: NATURE AND ETHICS (8)**

- 2.1 Rights of Trees and Nature, Animal Rights and Welfare.
- 2.2 Definition, Types, Principles and Importance of Environmental Ethics in Nature Conservation and Protection.
- 2.3 Anthropocentrism vs. Ecocentrism Views on Nature.
- 2.4 Environmental Justice: Concept of Justice and Fairness, Distributional Inequality and Environmental Injustice, Interlinkage Between Environmental Ethics, Social Justice and Sustainable Resource Management.

### **UNIT 3: PROFESSIONAL ETHICS (8)**

- 3.1 Loyalty to Employer, Responsibility and Duty, Confidentiality and Proprietary Information, Occupational Safety and Ethics, Digital and Cyber Ethics Including the Use of Robotics and Artificial Intelligence (AI)
- 3.2 Public Duties: Moral Obligations of Government Servants, NGOs, INGOs and Other Public Institutions, Professional Consulting and Advertising
- 3.3 Conflicts of Interest in Decision Making: Recognizing and Resolving Conflicts of Interest in Professional Judgments in Natural Resources Management
- 3.4 Program Operation and Activities: Institutional Ethical Board/Committee, Code of Conduct, Program Activity Plans and Inclusiveness, Prior Informed Consent, Request for Permission

### **UNIT 4: ETHICAL DECISION-MAKING METHODS AND TOOLS (6)**

- 4.1 Methods: Situation Analysis, Moral Reasoning, Practical Reasoning, Precautionary Principle
- 4.2 Tools: Ethics Codes and Professional Standards; Compliance with Laws, Regulations and Standards; Code of Conduct; and Ethical Checklists
- 4.3 Audits: Social Audit, Social Media Audit

### **UNIT 5: ETHICAL ISSUES AND DILEMMAS (6)**

- 5.1 Ethical Issues: Corruption, Lack of Transparency, Prioritizing Private Interests Over Public Good, and Influence of Special Interests and Politics on Policies
- 5.2 Ethical Dilemmas: Balance Economic Interests with Conservation, Managing Competing Demands on Land Resources, Weighing Single vs. Multiple Values in Forests, and Conflicts between Short-term and Long-term Goals

### **PRACTICAL (16)**

At least two practical tasks (1 individual and 1 group work) must be performed, and the instructor of the course should organize a workshop in which students present their individual assignments.

- **Ethical reflection paper (Individual):** This assignment encourages students to engage in individual ethical reflection on a specific interest, aligning their personal ethical values with the course's ethical principles.
- **Role-play scenario (Group):** Through this group assignment, students will investigate ethical dilemmas within various environmental philosophies, allowing them to apply ethical principles in a practical context.
- **Conflict resolution (Individual):** By providing students with a real case of conflict of interest in resource management, this assignment assesses their ability to recognize and manage conflicts of interest in a professional context.
- **Situation analysis (Group):** Student groups engage in situation analysis by examining real-world case studies with ethical dilemmas. This promotes their practical skills in ethical decision-making.
- **Professional ethics workshop (Individual/Group):** Student groups organize and conduct a workshop on professional ethics in natural resource management, providing an opportunity for them to demonstrate and share their understanding of the course's ethical principles and their practical application by presenting their ethical reflection paper.

<b>Contents</b>	<b>Equipment/tools</b>	<b>Methodology/methods</b>	<b>Link to Unit(s)</b>
Ethical reflection paper (individual)	A case for a student	Review of the literature	Unit 1, 2, 3, 4, 5
Role-play scenario (group)	Ethical dilemmas and environmental philosophy	Assign student groups a role-play scenario on an ethical dilemma using environmental philosophy	Unit 2
Conflict resolution (individual)	Cases of conflict of interest, one per student	Provide real cases of conflict of interest in resource management and guide students in solving it	Unit 3
Situation Analysis (Group)	Ethical dilemmas in decision-making in resource conservation	Provide student groups with real-world case studies that involve ethical dilemmas in decision-making	Unit 4
Professional ethics workshop	Space for workshops, audiovisual aids	The teacher/students organize an in-house presentation workshop on professional ethics in natural resource management, and students present their individual assignment	Unit 1, 2, 3, 4, 5

## KEY REFERENCES

### Unit 1

1. Irland, L.C. (2007). Professional Ethics for Natural Resource and Environmental Managers: A Primer. Yale School of Forestry & Environmental Studies, Forestry & Environmental Studies Publications Series. 7. [Chapter 1, 2]
2. Jamieson, D. (2008). Ethics and the environment: an introduction. Cambridge University Press. United Kingdom. [www.cambridge.org/9780521864213](http://www.cambridge.org/9780521864213). [Chapter 1]
3. Kelly, T.M. (2018). Professional ethics: a trust-based approach. Lexington Books, London. [Chapter 1]
4. T. Airaksinen. (2012). Professional Ethics: Ruth Chadwick, Encyclopedia of Applied Ethics (Second Edition), Academic Press, Pages 616-623. ISBN 9780123739322. <https://doi.org/10.1016/B978-0-12-373932-2.00080-6>.

### Unit 2

1. Jamieson, D. (2008). Ethics and the environment: an introduction. Cambridge University Press. United Kingdom. [www.cambridge.org/9780521864213](http://www.cambridge.org/9780521864213) [Chapter 1, 6]
2. Lee, W. N. (2022). This is environmental ethics: an introduction. John Wiley and Sons Ltd. United Kingdom. [Chapter 1, 6]
3. Mohai, P., Pellow, D. & Roberts, J.T. (2009). Environmental justice. *Annual Review of Environment and Resources*, 34, pp.405-430. <https://doi.org/10.1146/annurev-environ-082508-094348>
4. Hale, B., Light, A., & Lawhon L. A. (2023). The Routledge Companion to Environmental Ethics. Taylor and Francis, New York and London. [Chapter 1, 5, 63]

### Unit 3

1. Irland, L.C. (2007). Professional Ethics for Natural Resource and Environmental Managers: A Primer. Yale School of Forestry & Environmental Studies, Forestry & Environmental Studies Publications Series. 7 [Chapter 6 to 10]
2. Kelly, T.M. (2018). Professional ethics: a trust-based approach. Lexington Books, London. [Chapter 3, 6]
3. Meyers, C. (2018). The professional ethics toolkit. John Wiley and Sons Ltd. United Kingdom. [Chapter 6-8]
4. T. Airaksinen. (2012). Professional Ethics: Ruth Chadwick, Encyclopedia of Applied Ethics (Second Edition), Academic Press, Pages 616-623. ISBN 9780123739322

### Unit 4

1. Meyers, C. (2018). The professional ethics toolkit. John Wiley and Sons Ltd. United Kingdom. [Chapter 2, 9]
2. Lee, W. N. (2022). This is environmental ethics: an introduction. John Wiley and Sons Ltd. United Kingdom. [Chapter 1]
3. Hale, B., Light, A., & Lawhon L. A. (2023). The Routledge Companion to Environmental Ethics. Taylor and Francis, New York and London. [Chapter 58]

### Unit 5

1. Jamieson, D. (2008). Ethics and the environment: an introduction. Cambridge University Press. United Kingdom. [www.cambridge.org/9780521864213](http://www.cambridge.org/9780521864213) [Chapter 6]
2. Meyers, C. (2018). The professional ethics toolkit. John Wiley and Sons Ltd. United Kingdom. [Chapter 9]
3. Hale, B., Light, A., & Lawhon L. A. (2023). The Routledge Companion to Environmental Ethics. Taylor and Francis, New York and London. [Chapter 54-56]

## SEMESTER IV

Proposal
Pre-defense
Dissertation
Manuscript of Research Work

