Micro Syllabus

COURSE TITLE: FOREST ECOLOGY

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

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

OBJECTIVES

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

EXPECTED LEARNING OUTCOMES

Students completing the course should be able to:

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

UNIT 1: INTRODUCTION [5]

1.1 Concept and definition of forest ecology

- Define forest, ecology, and forest ecology (Barnes et al., 1998)

1.2 Concept of forest ecosystem (understanding of the functional relationship between soil, climate, flora and fauna in forest as ecosystems)

- Explain the concept of an ecosystem, emphasizing the intricate relationships between living (biotic e.g., flora, fauna and microorganisms) and non-living (abiotic e.g., soil, climate, and physiography) components of ecosystem
- Explain what makes forest an ecosystem (Franklin et al., 2018)

1.3 Attributes of forest ecosystem (biodiversity, function and structure)

- Explain three key attributes of forest ecosystem (Franklin et al., 2018):
  - its biological richness i.e., biodiversity
  - its multiple roles i.e., function
  - its complex structure i.e., structure

1.4 Forest Ecosystems of Nepal

- Introduce 118 ecosystems of Nepal reported by Biodiversity Profile Project (FRTC, 2021) while focusing on forest ecosystems
- Highlight ecological importance of forest ecosystems of Nepal
  - Biodiversity conservation
  - Climate regulation
  - Soil conservation

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- Hydrological services
- Cultural and economic significance

Pedagogy

- Lecture and presentation of photo essay

Assignment/Practical

- Prepare a photo essay showcasing ecological importance of forest ecosystems of Nepal

UNIT 2: FACTORS AFFECTING FOREST ECOSYSTEM [5]

2.1 Abiotic factors (climatic, physiographic, and edaphic factors)

- Define abiotic (non-living) factors (Barnes et al., 1998)
- Introduce three groups of abiotic factors and explain how they influence forest ecosystem

- Climatic factors
  - Light
  - Temperature
  - Precipitation
  - Water
  - Humidity
  - Wind
- Physiographic factors
  - Elevation
  - Slope
  - Aspect
- Edaphic factors
  - Physical properties of soil
  - Chemical properties of soil
  - Biological properties of soil

2.2 Biotic factors (microbes, animals, and humans)

- Define biotic (living) factors (Barnes et al., 1998)
- Introduce three groups of biotic factors and explain how they influence forest ecosystem

- Microbes
- Animals
- Humans

Pedagogy (2.1 & 2.2)

- Lecture and field visit

Assignment/Practical (2.1 & 2.2)

- Observation of abiotic and biotic factors and their interactions in forest ecosystem

2.3 Forest animal ecology and entomology and mycology

- Introduce the concepts of animal ecology, entomology, and mycology

Pedagogy

- Lecture

2.3 Concept of ecosystem productivity (gross and net primary productivity)

- Introduce the concept of ecosystem productivity with it two major types primary productivity and secondary productivity (McNaughton et al., 1991)
- Also introduce gross primary productivity (GPP) and net primary productivity (NPP)

Pedagogy

- Lecture and review of literature

Assignment/Practical

- Review literature to compare the amount & distribution of biomass among boreal, temperate, & tropical forest ecosystems

2.4 Liebig's law of minimum and Shelford's law of tolerance (Odum & Barrett, 2004)

- Explain Liebig's law of minimum with suitable examples
- Explain Shelford's law of tolerance with suitable examples

Pedagogy

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- Lecture and review of literature

Assignment/Practical

- Compile examples for Liebig's law of minimum & Shelford's law of tolerance from published literature

UNIT 3: AUTECOLOGY/POPULATION ECOLOGY [8] (Odum & Barrett, 2004)

3.1 Concept of population

- Define population, demography, census, and population ecology (autecology)

Pedagogy

- Lecture

3.2 Characteristics of population (population size, density, distribution, age structure, sex ratio)

- Explain the key characteristics of population
- Population size
- Density
- Distribution
- Age structure
- Sex ratio

Pedagogy

- Lecture and exercise

Assignment/Practical

- Estimate population size, population density, and sex ratio of megafauna in protected areas of Nepal based on census reports published by Department of National Parks and Wildlife Conservation (DNPWC), Nepal. Also make population pyramid and draw inference about the population growth pattern.

3.3 Major determinants of population size (fecundity, natality, mortality, immigration, and emigration)

- Explain key determinants of population size
- Fecundity
- Natality
- Mortality
- Immigration
- Emigration
- Explain population growth, carrying capacity, and population growth patterns
- Exponential growth
- Logistic growth

Pedagogy

- Lecture

Assignment/Practical

- What happens to population growth when population size (N) is small relative to carrying capacity (K) and when N is more or less equal to K?

3.4 Theories about natural regulation of population size (Density dependent and independent limiting factors, metapopulational theory)

- Define population regulation
- Define limiting factors and their types with suitable examples
- Density dependent limiting factors
- Density independent limiting factors
- Define metapopulation and metapopulation theory
- Briefly introduce four metapopulation models
- Classical/Levins' metapopulation model
- Patchy metapopulation model
- Mainland-island/Core-satellite/Source-sink metapopulation model
- Non-equilibrium metapopulation model

Pedagogy

- Lecture and review of literature

Assignment/Practical

- Compile the examples of density dependent and independent limiting factors from published literature

UNIT 4: SYNECOLOGY/COMMUNITY ECOLOGY [10] (Odum & Barrett, 2004)

4.1 Concept of community

- Define community and community ecology (synecology)

Pedagogy

- Lecture

4.2 Characteristics of community (trophic organization, dominance, interdependence, community structure, succession, stratification, ecotone)

- Explain the key characteristics of community
- Trophic organization
- Dominance
- Interdependence,
- Community structure
- Succession
- Stratification
- Ecotone and edge effect

Pedagogy

- Lecture

4.3 Community diversity (species richness and evenness)

- Define community diversity and its measure
- Species richness
- Species evenness
- Explain why using species richness alone can be misleading.

4.4 Quantitative analysis of community diversity (α, β and γ diversity, Importance value index, Simpson's diversity index, Shannon diversity index)

- Define α, β and γ diversity, importance value Index (IVI), Simpson's diversity index, Shannon diversity index and explain how they are calculated with their formulae

Pedagogy (4.3 & 4.4)

Lecture and group field work (divide class into groups of 5 – 8 students)

Assignment/Practical (4.3 & 4.4)

Collect tree species regeneration data from the nearby forest and analyze them to calculate species richness, species evenness, α, β and γ diversity, importance value Index (IVI), Simpson's diversity index, Shannon diversity index. Prepare a short report discussing your results.

4.5 Interactions between species in community (positive and negative interactions)

- Define biotic interaction and differentiate between positive and negative interactions
- Explain types of positive interactions with suitable examples
- Mutualism
- Commensalism
- Proto-cooperation
- Explain types of negative interactions with suitable examples
- Competition
- Antagonism
- Ammensalism
- Parasitism
- Predation

Pedagogy

- Lecture and field visit

Assignment

- Visit nearby forest, observe ongoing biotic interactions and take notes.

UNIT 5: VEGETATION ECOLOGY AND SUCCESSION [6]

5.1 Structure and function of forest vegetation and their spatial and temporal variation
- Introduce major vegetation types of Nepal (FRTC, 2021)
- Discuss about their structure and function and their spatial and temporal variation

Pedagogy
- Lecture and review of literature

5.2 Concept and stages of succession and retrogression (Odum & Barrett, 2004)
- Explain the concept of community dynamics
- Define succession and retrogression with their stages

5.3 Seral community and types of seres (Odum and Barret 2004)
- Define seral community and types of seres

5.4 Types of succession (Primary, Secondary and Cyclic) (Odum & Barrett, 2004)
- Explain the types of succession with suitable examples

- Primary
- Secondary
- Cyclic

Pedagogy (5.2, 5.3 and 5.4)
- Lecture and field visit

Assignment/Practical (5.2, 5.3 and 5.4)
- Visit nearby forest, observe ongoing succession/retrogression and prepare a short report based on your observation.

UNIT 6: RESTORATION ECOLOGY [6]

6.1 Concept of restoration and restoration ecology
- Define ecological restoration and restoration ecology (Falk et al., 2006; SER, 2004)
- Briefly introduce the UN Decade on Ecosystem Restoration 2021-2030

6.2 Ecological disturbances (especially fire and grazing) and their effects (Wohlgemuth et al., 2022)
- Define ecological disturbance and explain types of disturbances with suitable examples
- Explain ecological significance of disturbances

6.3 Traditional ecological knowledge and restoration ecology (Robinson et al., 2021)
- Introduce traditional ecological knowledge (TEK) and key characteristics of TEK
- Present suitable examples of TEK
- Explain the benefits of integrating TEK into restoration ecology

6.4 Applied ecological restoration (UNEP & FAO, 2024)
- Define applied ecological restoration
- Explain what sorts of projects come under applied ecological restoration

Pedagogy (6.2, 6.3 and 6.4)
- Lecture and field visit

Assignment/Practical (6.2, 6.3 and 6.4)
- Visit nearby restoration site, observe ongoing ecological restoration work, interact with the concerned akeholders, and prepare a short presentation based on your observation.

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PRACTICAL [20]

Content	Equipment/tools	Methodology/methods	Link to (s)
Visit nearby site for observing and erstanding factors affecting forest system	Observation	Excursion/field visit, 300-d report	2
Quantitative analysis of population pulation size, density, distribution)	Measuring tape, meter tape, Pegs	Plot survey, 300-word ort	3
Quantitative analysis of community rsity (α, β and γ diversity, Importance value index, Simpson's diversity index, Shannon diversity ex)	Measuring tape, meter tape, Pegs	Plot survey, 300-word ort	4
Succession observation in nearby	Observation	Excursion/field visit, 300-d report	5
Visit nearby restoration site for erving and understanding applied ogical restoration	Observation	Excursion/field visit, KII, minute presentation	6

- Practical will be covered by subunit wise assignments/practical as indicated above.

References:

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FRTC. (2021). *Vegetation types of Nepal: A report based on review of literature and expert knowledge)*. https://frtc.gov.np

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Odum, E. P., & Barrett, G. W. (2004). *Fundamentals of Ecology* (Fifth). CENGAGE Learning.

Robinson, J. M., Gellie, N., MacCarthy, D., Mills, J. G., O'Donnell, K., & Redvers, N. (2021). Traditional ecological knowledge in restoration ecology: A call to listen deeply, to engage with, and respect Indigenous voices. *Restoration Ecology*, *29*(4), 1–9. https://doi.org/10.1111/rec.13381

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