Environment and Biodiversity

B. Sc. IVyr (4 yrs course)

Course title: Environment and Biodiversity **Full Marks**: 100

Course No: Bot401 **Pass Marks**: 35

Nature of the Course: Theory **Instruction Hours**: 150

Objectives (Bot 401& Bot 402)

To understand:

- Different aspects of environment
- Concept of nature conservation
- Different aspects of biodiversity
- Value of economic plants and livelihood development

Course Contents:

I. Environment 75 hr

1. Introduction: Basic components of environment (the atmosphere: structure, importance, meteorological conditions and air circulation; hydrosphere: importance, physico-chemical properties, global distribution; lithosphere: rocks, disintegration of rocks and soil formation, soil profile, importance of soil to the biosphere**3+3+3** = **9hr**
2. Biosphere and Biomes: (i) Structure and composition of biosphere: ecosystem, energy flow and biogeochemical cycles, system homeostasis(ii) Major biomes of the world: major terrestrial biomes (tropical rain forests, tropical seasonal forests, tropical woodlands and thornlands, tropical grassland and savannas, temperate rainforests, temperate deciduous forests, temperate woodland and shrublands, temperate grassland, hot deserts and cool deserts, alpine shrubland and grasslands); freshwater aquatic biomes: lentic (lakes and ponds), lotic (rivers), wetlands (swamps and marshes)**3+5=8hr**
3. Ecosystem Services: (i) Concept and categories (ii) Carbon sequestration and carbon trade, concept of REDD+ (iii) Watershed services (upstream-downstream linkages)**1+4+2=7hr**
4. Environmental Issues: (i) Human population (ii) Deforestation and land use(iii) Urbanization (iv) Pesticide use and abuse (v) Chemical fertilizers (vi) Global environmental change – weather and climate, invasive species, human health (heat stress and migration of disease vectors), food security, water security (vii) Environmental toxicants – toxins of biological and non-biological origin**2+3+1+1+1+9+3 =20hr**
5. Energy Issues: (i) Renewable energy resources (wind, solar and biofuel) (ii) Non-renewable energy resources (hydropower, coal, gas)**3+3 =6hr**
6. Natural Resource Management: (i) Concept, Participatory Technology Development (PTD) approach for NRM in context of Nepal with some case studies as examples (ii)

Environmental indicators – role of plants in environmental monitoring (iii) Bioengineering**4+2+2 = 8hr**

7. Environmental Impact Assessment (EIA):(i) Origin and development(ii) IEE and EIA process (iii)A case study of any developmental project in Nepal. **3+4+1 =8hr**
8. Environmental Affairs: (i) Environmental organizations (ii) Environmental legislations (iii) International conventions with special reference to various treaties and environmental laws in the context of Nepal (iv) Environmental education **2+2+3+2 =9hr**

II. Biodiversity 75hr

1. Introduction: (i) Concept and levels (ecosystem, species, genetic level) (ii) Biodiversity and systematics (ii) Important institutions/centers of biodiversity study (herbarium, museum, botanical gardens) (iv) Important literatures (Flora)

1+1+3+1 =6 hr

2. Biodiversity Overview: (i) Global distribution of plant biodiversity richness (ii) Biodiversity hotspots (iii) Status of biodiversity in Nepal (iv) Agrobiodiversity (v) Centre of origin of crop plants (vi) Plant gene pools (v) Forest types of Nepal **1+2+2+2+1+1+5 =14 hr**
3. Uses of Biodiversity: (i) Plant use (timber, firewood, food and oil yielding plants, fiber plants in context to Nepal) (ii) Medicinal and aromatic plants – status and distribution in different ecological zones of Nepal**7+5=10 hr**
4. Loss of Biodiversity: (i) Drivers of biodiversity loss (ii) Species extinction (iii) Threatened species (the IUCN Red List categories) **5+1+2 =8hr**
5. Conservation and Management of Biodiversity: (i) Fundamentals of wild life management (ii) Current practices in conservation (in situ, ex situ, sacred groves and cryopreservation) (iii) Protected areas network and connectivity (iv) Park-people conflict and case studies from protected areas of Nepal (v) Participatory community approach of biodiversity conservation **1+5+3+2+4 =15 hr**
6. Biodiversity and climate change: (i) The nature of climate change (ii) Biological consequences of climate change (phenological changes in plants, species range shift, ecosystem process changes) **1+3 = 4 hr**
7. Ethnobotany: (i) Introduction, history, Scope and future perspectives (ii) Methods of ethnobotanical study (iii) Data collection and hypothesis testing (iv) Bioprospecting and biopiracy of traditional knowledge, (v) Integrating ethnobotany in conservation and community development **1+1+2+2+2 =8 hr**
8. Biodiversity Policy, Legislation and Strategies: (i) Important policy and legislations (ii) Conservation ethics (iii) Major strategies of biodiversity conservation and salient features of CBD, CITES, Ramsar Convention (iv) Intellectual Property Rights (IPRs)**3+1+5+1 = 10 hr**

Suggested books

1. Asthana DK and Asthana M. 2005. *Environment: Problems and Solutions*. S. Chand & Co. Ltd. New Delhi
2. Chaudhary RP. 1998. *Biodiversity in Nepal – Status and Conservation*. S. Devi Saharanpur, India
3. Rana SVS. 2010. *Essentials of Ecology and Environmental Science*. PHI Learning Pvt. Ltd. New Delhi
4. Lekhak HD and Lekhak B. 2009. Natural Resource Conservation and Sustainable Development in Nepal. Kshitiz Publication, Kathmandu
5. Groombridge B (ed.). 1992. *Global Biodiversity – Status of Earth's Living Resources*. Chapman and Hall
6. Jha PK et al. 2008. *Medicinal Plants in Nepal*. Ecological Society (ECOS), Kathmandu, Nepal
7. Jha, P.K., F.P. Neupane, M.L. Shrestha and I.P. Khanal. 2013. *Environment and Natural Resources* (Nepalpedia series No 1). Publ. Nepal Academy of Science and Technology (NAST) Kathmandu.
8. Jha PK, Neupane FP, Shrestha ML and Khanal IP (eds.). 2013. *Biological Diversity and Conservation.*Nepalpedia Series No. 2. Publ. Nepal Academy of Science and Technology (NAST) Kathmandu.
9. Uprety B. 2003. *Environmental Impact Assessment: Process and Pactice*.Mrs. UttaraUprety, Koteshwor, Kathmandu.
10. Martin G. 1995. *Ethnobotany* – a Methods Manual. Chapman and Hall
11. Miller GT and Spoolman S. 2007. *Environmental Science: Problems, Connections and Solutions*. Thomson Brooks/Cole
12. Rajbhandary S. and Ranjitkar S. 2006. *Herbal Drugs and Pharmacognosy: Monographs on Commercially Important Medicinal Plants of Nepal*. Ethnobotanical Society of Nepal (ESON). Kathmandu.
13. Shrama PD. 2007. *Ecology and Environment*. BPR Publishers
14. Station JDA. 1972. *Forests of Nepal*. John Murray, London.
15. Stocking M, Helleman H and White R (eds.). 2005. Renewable Natural Resources Management for Mountain Communities. ICIMOD. Nepal
16. Primack Richard B. 2002. *Essentials of Conservation Biology*. Sinauer Associates Inc.

Environment and Biodiversity
PracticalB. Sc. IV yr

Course title: Environment and Biodiversity
Course No: Bot 402
Nature of the Course: Practical

Full Marks: 50
Pass Marks: 20
Instruction Hours: xx

I. Environment

1. To analyze abiotic and biotic components of an aquatic ecosystem.
2. To analyze vegetation quantitatively (density,relative density, frequency, relative frequency, coverage, relative coverage, importance value index).
3. To study soil profile of the given area.
4. To analyze soil samples (textures, water holding capacity, soil pH, porosity).
5. To analyze water samples and compare results with water quality standard ofWHO.
6. To study pollution effected plants and compare it with plants growing in undisturbed area.
7. To record climatic information (temperature, rainfall, relative humidity) and summarize it in graphs.
8. To determine carbon stock of major tree species in the area.
9. To assess environmental impact of a development project or industrial belt.

II. Biodiversity

1. To familiarize students with use of herbaria, slides, transparency, etc.
2. To study medicinal plants.
3. To study leaf anatomy to see oil glands in available plants (e.g. tea, lemon, camphor etc.).
4. To study food plants (staple food, beverages, spices and condiments etc.).
5. To study structure of oil storing tissues in sectioned seeds of mustard, groundnut and soybean, using microchemical tests.
6. To study timber andornamental plants.
7. To study wood anatomy (TS, TLS, RLS) of available timber yielding species.
8. To study rattan and fiber plants.
9. To study stem and leaf of fibre yielding plants to identify fibre tissues.
10. To explore plant diversity of a specified area (measurement of species richness, Shannon diversity index, similarity index etc.).
11. To perform practical assignment onEthnobotany.

12. To visit the nearest national park/protected areasto study biodiversity management practice and prepare a report.
13. To study the phenological changes in vegetation of local area.
14. To prepare a report on International Conventions related to biodiversity.

Note: A **three day** field visit should be arranged by the department/campus for both Environment and Biodiversity (combined) to study management measures and biodiversity of a national park/protected area. The students will be required to prepare a report for each to be submitted at practical examination for final evaluation.

Suggested books

1. Zobel DB, Jha PK, Behan MJ, and Yadav UKR. 1987. *A practical manual for Ecology*. Kathmandu. Ratna Book Distributors.
2. Pandey BP. 1985.*Modern Practical Botany*. Vol. I. S. Chand and Co. Ltd. New Delhi.
3. Sharma OP. 2012. *A Manual of Practical Botany*. Vol. I. Gyan Books Pvt. Ltd.
4. Shrama PD. 2007. *Ecology and Environment*. BPR Publishers

Plant Pathology and Protection

B. Sc. IV yr (4 yrs course)

Course title: Plant Pathology and Protection
Course No: Bot.403
Nature of the Course: Theory

Full Marks: 100
Pass Marks: 35
Instruction Hours: 150

Objectives:

- Concept of different aspects of plant diseases,
- To understand disease occurrence in different crop plants,
- To understand the different aspects of plant protection,
- To familiarize with the rules and regulation of plant protection,

Course Contents

Plant Pathology

(i) Concept of diseases in plants, history of plant pathology, classification and symptoms of plants diseases. **8**

(ii) Method of studying plant diseases (Field, laboratory: media, isolation, culture and purification, Kotch's Postulate), factor affecting plant disease development (physical, biological, economical and environmental) **12**

(iii) Principal of infection; concept of epidemiology and plant disease forecasting, severity and losses cause by plant diseases, Plant disease and food security, climate

change and plant disease occurrence. **20**

(iv) Symptoms, Etiology and Control of Crop Diseases: (a) **Cereals:** Rice: Blast of rice, Bacteria leaf blight of rice; **Wheat:** Black rust or stem of wheat, Loose smut of wheat; **Maize:** Loose smut of maize, Brown spot of maize (b) **Vegetables:** Leaf curl of tomato, Wilt of tomato, Late blight of potato, Powdery mildew of cucurbits (c) **Cash Crops:** Sugarcane: red rot of sugar cane (d) **Fruits:** Citrus: Citrus canker, Anthracnose of Mango, Apple scab (e) **Pulses:** Mosaic bean virus, Wilt of Arhar (Pigeon Pea), Rust of Peas. **38**

(v) Seed Pathology: Introduction and importance of seed pathology, detection of seed born fungi, control of seed born pathogen, seed certification, seed regulation of Nepal **12**

(vi) Forest Pathology: Introduction and significance; Pathogenic and non pathogenic disease. Host, causal agents, symptoms, and control of major forest diseases: Nursery Disease: Steam Diseases: Die back and Root Diseases: (iv) Major diseases at forests of Nepal. **15**

Plant Protection

(vii) Concept and significance of plant disease control; Principle of plant disease control, Defense mechanism in Plants, **Disease control methods:** Culture method; Chemical method; Biological method; Physical and Mechanical methods; Sanitation; Resistance varieties; Fungal antagonists; Plant disease management, Post harvest management; Concept and significance of IPM and its policies and practices in Nepal. **30**

(viii) Concept and significance of plant quarantine, regulation of plant quarantine in Nepal. 5

(ix) Crop certification, Plant disease clinic, Pesticides use and its impacts on health and environment, Status of plant protection activities in Nepal, Regulation of pesticide in Nepal. **10**

Text Books:

1. Vashista, B. R. and Sinha, A. K. (latest edition). Botany for Degree students Fungi. S. H hand Higher Academy.
2. Mahadevan, A and Rangaswami, G. 2008. Disease of crop plant in India. Prentice-Hall of India P. Ltd.
3. Pandey, B. P. 1992. Plant pathology: pathogen and Plant diseases. S. Chand and company Limited
4. Negi, S. S. 1996. *An Introduction to Forest Pathology*. International Books Distributers, Dehradun.

Reference Book:

Mehrotra, R. S. 2003. Plant Pathology. The MC-Graw-Hill Publishing Company Limited.

Plant Pathology and Protection

Practical

Course title: **Plant pathology and Plant Protection** **Full Marks**: 50
Course No: Bot 404 **Pass Marks**: 20
Nature of the Course: Practical **Class Hours**:
Year: Fourth Year

1. Study of basic functions of (Autoclave, Laminar flow, Incubator and Hot air oven, Growth chamber).
2. Preparation of basic solid media: Agar and PDA; both in Petridish and slant.
3. Preparation of liquid media (broth).
4. Method of isolation, pure-cultures of preservation of microorganisms.
5. Use of lacto phenol and cotton blue in the mounting of fungi.
6. Study of Plant disease symptoms of Cereals, Vegetables, Pulses, Cash crops and Fruits: (i) Collection and identification of infected plant specimens (ii) Isolation of plant diseases and culture, inoculation, incubation and identification by using identification key.
7. Herbarium preparation of plant diseases.
8. Isolation of soil and air bacteria and fungi (microorganism).
9. Study of different techniques of seed sterilization (Heat, radiation, chemicals and filtration)
10. Preparation of the slides of different fungi by cellophane tape technique (temporary and permanent slides).
11. Estimation of the number of fungal spores by using the counting chamber.
12. Study of seed-borne fungi by standard blotter method.
13. Control of pathogens by fungicides (thread methods and poison food technique).
14. Demonstration of biological control of plant pathogens by dual culture method.
15. Demonstration of compost making process with and without using EMO.
16. To list the quarantine posts in Nepal and review the existing regulation of plant quarantine in Nepal.

To list the band pesticides and review the pesticides regulat

Applied Botany

Course title: **Applied Botany** **Full Marks**: 100
Course No: Bot 405 **Pass Marks**: 35
Nature of the Course: Theory **Instruction Hours**: 150
Year: B.Sc. IV year

Objectives

1. To understand the concepts and technologies of Floriculture and mushroom cultivation
2. To learn the simple techniques for floriculture and mushroom cultivation.

Floriculture (Teaching periods 75)

1. **Introduction: Definition, scope, significance and classification of floriculture crops/plants** (Bedding and garden plants ; Cut foliage or greens; Cut flowers; Floriculture crops; Foliage plants; Greenhouse crops; Nursery crops). **Floriculture production, exports and imports in Nepal** (information to get from Floriculture Association of Nepal). **Establishment and management of floriculture enterprises** (nurseries, green houses, tissue culture). **Role botanical garden in plant conservation and development** (What is botanical garden?; Objectives of the Botanical Gardens; History of Botanical garden; Major Botanical Gardens of the world; Functions of Botanical garden). **Concept of garden landscaping/ designs** (Definition; Planning; Elements of Design (Line- straight line, curved lines, Vertical lines, Horizontal lines; Form - circular form, square form; Plant forms - tree forms, shrub forms, groundcover forms; Texture of plants - coarse texture, fine texture, medium texture; Principles of Design: Order - symmetrical balance, asymmetrical balance). **National policy and institutions for floriculture promotion** (Download available). 22

2. **Ornamental plants in garden and nature: Introduction of different types cultivated and natural ornamental plants** (examples of Lawn plant, pot plants, cut flower crops, bulbous plants, annuals and other bedding plants, rock garden plants, Bonsai, and aquatic plants). **Distribution of wild ornamental plants in different physiographical zones of Nepal** (need to develop by yourself). 15

3. **Plant propagation:** Asexual propagations - stem, leaves, roots, bulbils, and sexual propagations – seeds; and artificial vegetative propagation: cutting, layering, grafting, budding, micro-propagation, etc 8

4. **Garden implements and operations**: **Pinching, training and pruning practices**; **Soil** (Basic soil types: Stony soils, Clayey soils, Sandy soils, Limy soils, Peaty soils, Loamy soils); **Climate (**Definition, Types - general climate, local climate, and microclimate around growing plants, Important Weather Conditions: Temperature, Frost, Sunshine, Rain and wind) ; land preparation and planting, manuring, irrigation and other

intercultural operations, role of growth regulators, times and methods of propagation, management of weeds, diseases and pests. 15

5. **Production technology of commercial Flowers**: Rose, Carnations, Gladiolus, Gerbera, Orchids, Chrysanthemum, Jasmine, Dahlia, Bird of Paradise, Marigold and Gomphrena (Local name, English name, Botanical name, Family, Native of, Description, Species record, Distribution, Propagation & Cultivation for each flower) 10

6. **Post-harvest technology of ornamental plants:** Collection, storing, transportation and marketing of cut flowers, seeds, bulbs. 5

Mushroom Cultivation (Lecture Hr 75)

1. **Introduction:** General Introduction of Mushroom, Mushroom taxonomy, Collection, Preservation and Identification of mushroom. Biology of mushrooms, Bioconversion of Agro-waste using mushroom cultivation technology. Identification of poisonous and non-poisonous mushrooms, natural habitat of mushrooms, economic, edible and medicinal value of mushrooms. **18**

2. **Influence of Climatic factors:** Temperature, Relative Humidity, Rainfall, light, Wind, Carbon Dioxide. **4**

3. **Production technology:** Equipment required for mushroom cultivation, The principles of mushroom cultivation technology, Major phase in mushroom cultivation (selection of an acceptable mushroom, Requirement and selection of a fruiting culture, development of spawn, Preparation of compost, mycelia running and mushroom development) preparation of mushroom culture media, isolation of mushroom strains, and preparation of mushroom spawn, mushroom substrates (compost and non-compost), preservation and maintenance of mushroom cultures. **20**

4. **Cultivation Techniques:** Cultivation and harvesting of some valuable mushrooms such as Oyster mushroom (*Pleurotus* spp.), white button mushroom (*Agaricus* spp.), Shittake mushroom (*Lentinula edodes*,), paddy straw mushroom (*Volvariella volvacea*), *Grifola frondosa* (Maitake), *Flammulina velutipes* (golden pin mushroom), *Ganoderma lucidum*, fungal disease, bacterial disease, viral disease , (Management of pest and weed fungal attack) and their control measures. **25**

5. **Post-harvest management of mushrooms**: Short-term preservation: Washing, packaging, Conventional packaging, Storage of Fresh mushrooms, Transport of fresh mushrooms, Steeping preservation, Long term Preservation: Canning, Drying, Pickle Preparation, and marketing. **8**

References

Biswas, Subrata, M. Datta and S.V. Nagachan (2012). Mushrooms: A Manual for Cultivation. PHI Learning Private Limited, New Delhi, India.

Chanda, K.L. &Prateek, D.P. 1996. .*Advances in Horticulture,* vol. 3.Malhotra Pub.House,India.

Des Raj (2002). *Floriculture and Landscaping*.1st Edition, KalyaniPublishers, Ludhiana, India.

Hartmann, H. T., D. E. Kester, F. T. Davies Jr. and R. L. Geneve (2002) *Plant Propagation: Principles and Practices, 7th Edition.* Pearson Education, Inc. (Prentice-Hall), Upper Saddle River, New Jersey.

Ram, R.C. 2007.*Mushrooms and their cultivation Techniques.* Aviskar Prakashan. Jaipur, India.

Shrestha, G.K., Shakya, S.M. and Baral, D.R. and Gautam, D.M. 2001 .*Fundamentals of Agriculture.* IAAS, Rampur, Chitwan.

Tribhuvan University
Institute of Science and Technology
Four Years B. Sc. Zoology Course of Study

Course Title: Project Work **Full Marks : 100**
Course No. : BOT 406 **Pass Marks: 40**
Nature of Course: Research Work / Presentation **Year: IV**

Objective of the Course:

This course offers students to strengthen the knowledge in research based academic activities related with Botany.

Botany-Interdisciplinary

Plants and Society

B. Sc. IVyr (4 yrs course)

Course title: Plants and Society **Full Marks**: 50
Course No: Bot 407 **Pass Marks**: 17.5
Nature of the Course: Theory **Lectures**: 75

Objectives:

To understand:

- Different aspects of plant biodiversity

- Value of plants and livelihood development
- Overall plant and people relationship

Course Contents:

1. ***Plant diversity and its importance*** ***25 Lect. Hrs***

   Introduction of plant diversity (global and national context) **3 hr**

   Plants in traditional uses (baskets, cushion, mat, bags, agricultural tools, …..) **5 hr**

   Plants for medicine, food, fodder, ornaments (Orchid, Rose, Carnation, Ferns), timber, fiber (*Girardinia diversifolia*, *Cannabis sativa,Daphne bholua, Agave americana*)and religious use **10 hr**

   Plants and biofuel (biodiesel: *Aesandrabutyracea*, *Jatrophacurcas*, *Ricinuscommunis*), bioethanol, biofertilizers and biopesticides **5 hr**

   Concepts of sustainable use of biodiversity **2 hr**

2. ***Plants in Industry*** ***20 Hrs***

   Dye plants (*Juglansregia*, *Rubiamanjith*, *Mahonianapaulensis*, Lichens): availability, opportunities and livelihood promotion and challenges**4 hr**

   Algae in industry (nutrition, fertilizer, pollution control, energy sources): availability, opportunities and livelihood promotion and challenges **5 hr**

   Bamboo (decorations, building materials, fabrics and clothing, cooking, agriculture instruments, weapons, Briquett(ex. *Lantana camara, Ageratum conyzoides*): availability, opportunities and livelihood promotion and challenges **6 hr**

   Essential oils(ex.Tulsi, Cinnamomum, Eucalyptus, Jasmine): use and value; Waste water treatment: plants in waste water treatment; soil reclamation and bioremediation: plants in soil reclamation and bioremediation **5 hr**

3. ***Society and Plant Resources*** ***30 Hrs***

   Vegetation and society interactions: Trees and forest products, ecosystem services, fire **5 hr**

   Traditional ecological knowledgeand management system: forest and forest products, agriculture and agriculture products) **5 hr**

   Social institutions: Eco-clubs, Aamasamuha, CBOs, CFUGs **5 hr**

   Sacred groves and biodiversity conservation: concept, role in biodiversity conservation **2 hr**

   Transhumance practice and biodiversity conservation: concept, role in biodiversity conservation **2 hr**

Traditional farming system (conventional, conservational agriculture), climate change and agricultural production, genetically modified crops and their effects (ecosystem and human health) **10 hr**

Ethics in plant use **1hr**

Text Books

1. Cunningham, A.B. 2001. Applied Ethnobotany. Earthscam, London, UK.
2. GoN/MoFSC. 2014. Nepal Biodiversity Strategy and Action Plan 2014-2020. Government of Nepal, Ministry of Forests and Soil Conservation, Nepal.
3. Jha PK, Neupane FP, Shrestha ML, Khanal IP. 2013. Biological diversity and conservation (Nepal Pedia Series 2). NAST, Kathmandu.
4. Jha PK, Neupane FP, Shrestha ML, Khanal IP. 2013. Environment and Natural Resources (Nepal Pedia Series 1). NAST, Kathmandu.
5. Lekhak HD, Lekhak B. 2009. Natural resource conservation and sustainable development in Nepal. Kshitiz Publication, Kathmandu.
6. Primack, R.B. 2006. Essentials of conservation Biology. Fourth Edition, Sinauer Associates Inc. Publishers, Sunderland, MA, USA.
7. Rajbhandary S. and Ranjitkar S. 2006. *Herbal Drugs and Pharmacognosy: Monographs on Commercially Important Medicinal Plants of Nepal*. Ethnobotanical Society of Nepal (ESON). Kathmandu.
8. Singh, V., Pande, PC and Jain, DK. 2005.Economi Botany. Rastogi Publications, Meerut, India.

References Books

9. Jha PK, Karmacharya SB, Balla MK, Chetrri MK, Shrestha BB. 2010. Sustainable use of biological resources of Nepal. ECOS Nepal.
10. Chaudhary RP, Subedi BP, Veetas OR, Aase TH. 2002. Vegetation and Society-Their interaction in the Himalayas. TU, Nepal. UiB, Norway.
11. Joshi KK, Joshi SD. 2001. Genetic heritage and medicinal and aromatic plants of Nepal Himalaya. Budha Academics. Kathmandu.