Diversity and Evolution of Living organisms

Course title: Diversity and Evolution of Living organisms
Course No: BEM 501, 502
Nature of the course: Theory and Practical
Year: M.Sc. BEM (I semester)

Total credit: 3 + 1
Full marks: 75 + 25
Pass marks: 37.5 + 12.5
Lecture: 48 + 16

OBJECTIVES

The overall objective of this course is to provide fundamental understanding of diversity, classification and evolution of living organisms.

Course Contents (Theory)

BEM: 501. Diversity and Evolution of Living Organisms

Unit 1. Introduction: taxonomy and systematics (concept of taxa) (2h); biological classification (history, recent classification) (2); biological nomenclature (concept, rules) (4); process of collection and preservation of specimens (2); biological identification (tools and techniques) (2). 2 +2 +4+2 +2 = 12h

Unit 2. Structure and evolution in different groups of living organisms:

a. **Monera**: ***Bacteria*:** (i) characteristic, diversity and distribution of Archebacteria and Eubacteria; (ii) concept of origin and evolution of bacteria. 1+1= 2h

b. **Protista**: (i) characteristic, diversity and distribution of Prostists; (ii) concept of origin and evolution. 1+1=2h

c. **Fungi**: (i) classification andstructural diversity of *Fungi* (Zygomycota: Zygomycetes, Eumycota: Ascomycetes, Basidiomycetes and Deuteromycetes); (ii) distribution, and present status of fungi with reference to Nepal. 3+1 = 4h

d. **Plantae**: ***Algae***: (i) classification andstructural diversity of Algae; (ii) distribution, and present status of algae with reference to Nepal (2h). ***Bryophytes*:** (i) classification andstructural diversity of bryophytes (Liverworts, hornworts, and mosses); (ii) distribution, and present status of bryophytes with reference to Nepal (2h). ***Pteridophytes***: (i) classification andstructural diversity of pteridophytes; (ii) distribution, and present status of pteridophytes with reference to Nepal (2 h). ***Gymnosperms***: (i) classification andstructural diversity of pteridophytes; (ii) distribution, and present status of pteridophytes with reference to Nepal (2 h). ***Angiosperms***: (i) overview of the origin and phylogeny of non-vascular and vascular plants; (ii) angiosperms evolution and diversity; (iii) classification of angiosperms; (iv) status of angiosperms in Nepal (5). 2+ 2 + 2 + 2 + 6= 14h

e. **Animalia:** (i) overview of animal phylogeny and diversity, criteria for classification of multicellular animals (symmetry, early development, body cavities and homology and analogy); overview of diversities of Mollusca and Insects in Nepal (6); (ii) vertebrates evolution and diversity: affinities of Hemichordates and Protochordates, evolutionary trends of vertebrates, classification of Fish, Aphibia, Reptilia, Aves and Mammal with their status and distribution in Nepal (6). 7+7=14h

Course Contents (Practical)

BEM 502. Diversity and Evolution of Living organisms

1. Study of the methods of survey and identification of insects, birds, amphibians, reptiles and mammals.
2. Tools and techniques for studying bacteria and fungi (inoculation, incubation and observation)
3. Identification of lichens through studying herbarium specimens
4. Study the method of collection, identification, herbarium preparation, and preservation techniques of algae, bryophytes, peridophytes, gymnosperms and angiosperms.
5. Visit herbarium (KATH, TUCH) and museum (natural history museum) to learn the method of management of preserved specimens.
6. Field trips for survey, collection, identification, of plants and animals.

References:

Ainsworth G.C., Sparrow F.K. and Sussman A.F. 1973. The Fungi: An Advanced Treatise I-IV. Academic Press, N.Y. and London.

Alexopoulos C.J. 1962. Introductory Mycology. John Wiley & Sons, NY, USA.

Bell, P.R. Hemsley, A.R. 2000. Green Plants: Their Origin and Diversity. Cambridge University Press, UK.

Hickmann, C. P., S.L. Keen, A. Larson, H. I'Anson, and D. J. 2008. Iisenhour. Integreted Principles of Zoology. McGraw-Hill

Jordan, E. L. and Verma, P.S. Chordate Zoology & Animal Physiology. S. Chand, New Delhi.

Kotpal, R. L. Modern Textbook of Zoology: Invertebrates. Rostogi Pub., Meerut India.

Kotpal, R. L. Modern Textbook of Zoology: Vertebrates. Rostogi Pub., Meerut India.

Mackie, T.J., McCartney, J.E. (2013). *Handbook of Practical Bacteriology*. Edward Arnold Publication.

Parihar N.S. 1965. An Introduction to Embryophyta vol. 1: Bryophyta. Central Book Depot, Allahabad, India.

Parihar N.S. 1992. *The Biology and Morphology of Pteridophytes*. Central Book Depot, Allahabad.

Parihar N.S. 1992. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

Parker, T. J. & Haswell, W. A. A text book of Zoology, Vol. 1. The McMillan Press Ltd. London, U.K

Parker, T. J. & Haswell, W. A. A text book of Zoology, Vol. 2. The McMillan Press Ltd. London, U.K.

Simpson, M.G. 2010. Plant Systematics. Elsevier Academy Press, USA.

Singh G.C. 2004. Plant Systematics: an Integrated Approach. Scientific Publishers, India.

Soltis DE, Soltis PE, Endress PK and Chase MW. 2005. Phylogeny and Evolution of Angiosperms. Sinauer Associates Inc. Publishers, MA, USA.

Sporne K.R. 1971. The morphology of Gymnosperm (revised edition). Hutchinson & Co., London, UK. Vashita P.C. 1990. Gymnosperms. S. Chand & Co. Ltd., India.

Takhtajan A.L. 1969. Flowering Plants: Origin and Dispersal. Oliver & Boyd, Edinburgh, UK.

Vashishta B.R. 1985. Botany for Degree Students. Bryophyta Part III. S. Chand and Co. Ltd., Ram Nagar, India.

Watson E.V. 1971. The Structure and Life of Bryophytes. Hutchinson University Library, London.

William B. Whiteman (2013). Bergey´s Manual of Systematic Bacteriology Second Edition.Volume Five, The Actinobacteria, Part A.

Young, J. Z.. The Life of Vertebrates. The Oxford University Press.

M.Sc. BEM FIRST SEMESTER

Population, Community and Ecosystem Ecology

Course title: Population, Community and Ecosystem Ecology
Course No: BEM 503, BEM 504
Nature of the course: Theory and Practical
Year: M.Sc. BEM (I semester)

Total credit: 3 + 1
Full marks: 75 + 25
Pass marks: 37.5 + 12.5
Lecture: 48 + 16

OBJECTIVES

The overall objective of this course is to provide fundamental understanding of the theory of population, community and ecosystem ecology.

COURSE CONTENTS

BEM 503. Population, Community and Ecosystem Ecology –Theory (Credit – 3, Lecture 45)

Unit 1. Population ecology (17 h):(i) Characteristics of populations: limits and boundaries, properties and composition; population genetic structure (3 h). (ii) Population structure and dynamics: demographic techniques, population parameters and their estimation, population structure, population growth models (8 h). (iii) Population regulation: variation and uncertainty, levels of variation, effect of environmental fluctuations and uncertainty, effect of crowding (4 h). (iv) Concept of metapopulation (1 h). (v) Application of demographic approaches in conservation (1 h).

Unit 2. Community ecology (16 h): (i) Community concept (1 h). (ii) Community pattern in space: gradients, problems of boundaries in community ecology (2 h); community pattern in time: primary and secondary succession, biological mechanisms underlying successions (3h). (iii) Keystone species (1 h). (iv) Describing communities (classification and ordination) (2 h). (v) Species richness patterns: simple model of species richness (2 h), factors affecting species richness (1 h), habitat area and remoteness (Island biogeography) (1 h), gradient of species richness (1 h), species richness and ecosystem functioning (1 h). (vi) Species interactions, facilitation theory (1 h).

Unit 3. Ecosystem ecology (15 h): (i) Abiotic and biotic components (1 h). (ii) Energy flow in ecosystem: measurement of primary productivity, concept of secondary productivity (1.5 h), patterns in primary productivity (1 h), factors affecting primary productivity in terrestrial and aquatic ecosystems (1.5 h), fate of energy in ecosystems (1 h). (iii) Flow of matter in ecosystem: nutrient budget in terrestrial and aquatic ecosystems (2 h), global biogeochemical cycles (hydrological, carbon, nitrogen, phosphorus and sulphur) (3 h). (iv) Key features of different ecosystems (aquatic, wetland, grassland and forest) (4 h).

BEM 504. Population, Community and Ecosystem Ecology – Practical(Credit – 1, Practical16)

- Qualitative and quantitative methods of biodiversity survey and analysis
- Observation of different successional stages in nature (primary and secondary)
- Exploration of vegetation of certain area using quadrat sampling method and analysis of community structure and composition: classification, gradient analysis
- Assessment of species diversity and distribution along spatial and temporal gradients
- Population survey and analysis of population parameters
- Population dynamics using secondary data
- Estimate carbon stock of some major tree species.
- Field report/Practical Book

TEXT AND REFERENCE BOOKS

Akçakaya H.R., Burgman M.A. and Ginzburg L.R. 1999. *Applied Population Ecology*. Sinauer Associates, Inc. Sunderland, MA, USA.

Begon M., Townsend C.R. and Harper J.L. 2006. *Ecology: From Individuals to Ecosystem*. Blackwell Publishing.

Krebs C.J. *Ecology: The Experimental Analysis of Distribution and Abundance*. Benjamin Cummings.

Singh J.S., Singh S.P. and Gupta S.R. 2008. *Ecology, Environment and Resource Conservation*. Anamaya Publishers, New Delhi, India.

SUGGESTED FURTHER READINGS

Barbour M.G., Burk J.H., Gilliam F.S. and Schwartz M.W. *Terrestrial Plant Ecology*. Benjamin Cummings.

Futuyma D. 1997. *Evolutionary Biology*. Sinauer Associates, MA, USA.

Primack R.B. 2006. *Essentials of Conservation Biology*. Fourth Edition. Sinauer Associates, MA, USA.

Silvertown J. and Charlesworth D. 2001. *Introduction to Plant Population Biology*. Fourth Edition. John Wiley & Sons.

Biodiversity and Biogeography

Course title: Biodiversity and Biogeography
Course No: BEM 505, BEM 506
Nature of the course: Theory and Practical
Year: M.Sc. BEM (I semester)

Total credit: 3 + 1
Full marks: 75 + 25
Pass marks: 37.5 + 12.5
Lecture: 48 + 16

OBJECTIVES

The overall aim of this course is to provide understanding of biodiversity and biogeography sciences.

COURSE CONTENTS

BEM 505. Biodiversity and Biogeography - Theory (Credit – 3, Lecture 45)

Unit 1: The science of biogeography (11 h)*:* (i)Introduction and scope of biogeography, overview of historical and ecological biogeography (2 h). (ii) History of earth and its biota (2 h). (iii) Fundamental biogeographic processes: dispersalist and vicariance biogeography, speciation and extinction, endemism, glaciations, provincialism (3 h). (iv) Biogeography and evolutionary processes: basic concept, fossil records and origin of life, macroevolutionary processes (4 h).

Unit 2. Patterns and processes of biodiversity distribution (16 h)*:* (i) Overview, components and levels of biodiversity (2 h). (ii) Species diversity: basic theory; equilibrium and non-equilibrium processes; ecological niche and adaptation; mechanisms regulating diversity in space and time, island biogeography theory and patterns of species distribution (5 h). (iii)Assessment of species diversity: diversity measures and indices, analytical methods and approaches (4 h). (iv) Diversity gradients and their determinants:altitudinal and latitudinal gradients; diversity in time – succession; factors causing diversity gradients (5 h).

Unit 3: Current biogeographic patterns and status of biodiversity (14 h)**:** (i) Concept and classification of biomes, introduction to biogeographic regions (phytogeographical and zoogeographical regions) of the world (4 h). (iii) Himalayan biogeography: introduction, major biogeographic divisions, major floristic and vegetation elements and their affinities, endemics and disjunction of Himalayan flora and fauna (with reference to Nepal) (6 h). (iv) Current status of global biodiversity, status of biodiversity (species diversity) in the Nepalese Himalaya, biodiversity hotspots, important plant and bird areas (IPA and IBA) (4 h).

Unit 4. Importance of biodiversity (7 h): (i) Valuesof biodiversity: direct and indirect economic values, option value, existence value; biodiversity and livelihood (2 h). (ii) Biodiversity and traditional knowledge, bioprospecting – introduction and significance (2 h). (iii) Methods and approaches of valuing biodiversity (3 h).

BEM 506. Biodiversity and Biogeography –Practical(Credit – 1, Practical16)

Objectives: The overall aim of this course is to provide practical and analytical knowledge related to biodiversity distribution in space and time. The specific objectives are to enable the students with the ability: (i) to document, manage and analyse biodiversity data at different spatial scale; (ii) to analysebiogeographic patterns of Himalayan flora and fauna; (iii) to monitor the change in biodiversity patterns.

Course Contents:

1 Basics

1.1 Overview of qualitative and quantitative methods of biodiversity survey and analysis including applications of data analysis tools

2 Biogeography

2.1 Biogeographic patterns of selected group of plants/animals of the Himalaya: chorology, endemism, disjunction

2.2 Assessment of historic collection of plant/animal specimens to compare changes in distribution patterns

3 Field Study: Biodiversity Survey

2.1 Analysis of community structure and composition: classification, gradient analysis

2.2 Assessment of species diversity and distribution pattern along environmental gradients

2.3 Participatory survey to document resource utilization patterns and estimation of economic value of resource use

2.4 Post field study: field data analysis and report writing

4 Term Paper and Seminar

5 Report/Mini Dissertation

TEXT AND REFERENCE BOOKS

Huston M.A. 1994. *Biological Diversity: The Coexistence of Species on Changing Landscapes*. Cambridge University Press, UK.

Lomolino M.V., Riddle B.R. and Brown J.H. 2006. *Biogeography*. Sinauer Associates, Inc., Sunderland, Massachusetts, USA (Third edition).

Primack R.B. 2006. *Essentials of Conservation Biology*. Fourth Edition. Sinauer Associates, Inc. Publishers, Sunderland, MA, USA.

SUGGESTED FURTHER READINGS

Campbell B.M. and M.K. Luckert. 2002. *Uncovering the Hidden Harvest: Valuation Methods for Woodland and Forest Resources*. Earthscan, London.

Chaudhary R.P. 1998. *Biodiversity in Nepal - Status and Conservation*. S. Devi, Saharanpur, India and Tecpress Books, Bangkok, Thailand.

Cox B.C. and Moore P.D. 2010. *Biogeography: An Ecological and Evolutionary Approach*. John Willey & Sons, Inc., USA. (8th edition)

Cunningham A.B., 2001. *Applied Ethnobotany:People, Wild Plant Use and Conservation*. Earthscan, London, UK.

GoN 2014. *Nepal National Biodiversity Strategy and Action Plan 2014-2020*. Government of Nepal Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

Good R. 1974. *The Geography of Flowering Plants*. Longman, London.

Hill D., Fasham M., Tucker G., Shewry M. and Shaw P. (eds.) 2005. *Handbook of Biodiversity Methods: Survey, Evaluation and Monitoring*. Cambridge University Press, Cambridge, UK.

Hubel S.P. 2001. *The Unified Neutral Theory of Biodiversity and Biogeography*. Princeton University Press, Princeton and Oxford.

Kent M. and Coker P. 1994. *Vegetation Description and Analysis: a Practical Approach*. John Wiley, Chichester.

Krebs C.J. 2001. *Ecology: the Experimental Analysis of Distribution and Abundance.* Fourth Edition. Addison-Wesley Educational Publishers, Inc., USA.(Fifth edition).

Laird S. (ed.), 2002. *Biodiversity and Traditional Knowledge: Equitable Partnerships in Practice*. Earthscan, London, UK.

Laszlo N. and Grabherr G. 2009. *The Biology of Alpine Habitats*. Oxford University Press.

Magurran, A.E. (1988). *Ecological diversity and its measurement*. Princeton university press, Princeton

Mani M.S. 1978. *Ecology and Phytogeography of High Altitude Plants of the Northwest Himalaya: Introduction to High Altitude Botany*. Oxford and IBH Publishing Co., New Delhi, India.

Myers A.A. and Giller P.S. (eds.). 1988. *Analytical Biogeography: an Integrated Approach to the Study of Animal and Plant Distributions*. Chapman & Hall, London, UK.

Partap, T. and Sthapit, B. (eds). 1998. *Managing Agrobiodiversity: Farmers Changing Perspectives and Institutional Responses in the HKH Region*. ICIMOD, Nepal.

Shrestha T.B. and Joshi R.M. 1996. *Rare, Endemic and Endangered Plants of Nepal*. WWF Nepal Program, Kathmandu, Nepal.

Soulé M.E. (ed.). 1986. *Conservation Biology*: *The Science of Scarcity and Diversity*. Sinauer Associates, USA.

Soulé M.E. and Wilcox B.A. (eds.). 1980. *Conservation Biology: an Evolutionary-Ecological Perspectives*. Sinauer Associates, USA.

Stainton J.D.A. 1972. *Forests of Nepal*. John Murray, London.

Takhtajan A. 1986. *Floristic Regions of the World*. University of California Press.

Tandon V., Bhattarai N.K. and Karki M. (eds.). 2001. *Conservation Assessment and Management Prioritization (CAMP) Report*. IDRC Canada/HMG Ministry of Forest and Soil Conservation, Kathmandu, Nepal.

WCMC (World Conservation Monitoring Centre). 1992. *Global Biodiversity: Status of the Earth's Living Resources*. Chapman & Hall, London.

Whittaker R.J., Araújo M.B., Jepson P., Ladle R.J., Watson J.E.M and Willis K.J. 2005. Conservation biogeography: assessment and prospect. *Diversity and Distributions* 11: 3-23.

Whittaker, R.J. and Fernández-Palacios, J.M. 2007. *Island Biogeography: Ecology, Evolution, and Conservation*, 2nd ed. Oxford University Press, Oxford.

Wilson E.O. 1988. *Biodiversity*. National Academic Press, Washington, D.C.

Wilson E.O. 1992. *The Diversity of Life*. Harvard Belknap, Cambridge.

Mountain Ecology

Course title: Mountain Ecology
Course No: BEM 507, BEM 508
Nature of the course: Theory and Practical
Year: M.Sc. BEM (I semester)

Total credit: 3 + 1
Full marks: 75 + 25
Pass marks: 37.5 + 12.5
Lecture: 48 + 16

OBJECTIVES

- To provide adequate knowledge on mountain environment and species adaptability
- To acquaint with resource status, issues, problems and conservation in mountain regions

COURSE CONTENTS

BEM 507. Mountain Ecology- Theory

Unit 1. Introduction (8 h):(i)Delimitation (boundary) of mountains, origin, type, global distribution (ii) Alti-system, altitude and latitude, climatic belts (iii) The highland-lowland interaction theory (iv) Mountain ecosystem in the global context; Himalayas and Hindu Kush-Himalaya (HKH); Chure-Bhabar region of Nepal **(2+2+1+3) = 8 h**

Unit 2. Mountain Biodiversity (9 h): (i) Key features and significance of mountain biodiversity, including endemism (ii) Verticality of mountain vegetation: forest and grasslands; treeline(iii) Elevational pattern of species richness;biodiversity of HKH(iv) Plant and animal adaptations: morphological, physiological and behavioral (v) Flagship species of the mountain regions: Yartsagumbu and Snow leopard **(1+3+2+2+2) = 10 h**

Unit 3. Mountain Environment (12 h): (i) Key environmental features: topography, mountain climate, vertical thermal layers of atmosphere, altitude and pressure, precipitation, wind, radiation, soil, microclimate; stability and instability (ii) Ecosystem services (iii) Mountain hazards: earthquake, GLOF, avalanche, landslide (iv) Bioengineering (v) Environmental pollution (vi) Climate change impacts (vii) Himalayan environmental degradation: myths and evidences; Altitude and human health (viii) deforestation and environmental degradation in Churia range of Nepal**(3+1+1+1+1+2+2+2) = 12 h**

Unit 4. Mountain Resources (16 h): (i) Forest and pasture; non-timber forest products; water resources (ii) Integrated watershed management (iii) Socio-economic dimension of natural resources management in mountain regions: ethnoecology/indigenous knowledge, community participation (iv) Land use and land cover: spatial and temporal patterns (v) Mountain agriculture;sustainable use of sloping lands (vi) Transhumance and pasture management (vii) Energy in the mountains(viii) Mountain tourism (ix) Conservation in mountains**(5+2+3+1+2+1+2+1+1)= 18**

BEM 508. Mountain Ecology – Practical

1. Analyze life zone and vegetation-climatic zone of mountains based on bio-temperature and warmth index
2. Exercise on plant adaptation in cold and arid environments
3. Exercise on exploration and documentation of indigenous knowledge of mountain communities
4. Sloping Agriculture Land Technology (SALT): demonstration and performance
5. Documentation of ecosystem services of specified areas
6. Term paper/Bibliographic review of the topics provided in the class/case study

TEXT AND REFERENCE BOOKS

Ives J.D. 2006. *Himalayan Perception: Environmental Changes and the Well-Being of the Mountain Peoples*. Himalayan Association for the Advancement of Sciences (HimAAS). Kathmandu, Nepal.

Korner C. 2003. *Alpine Plant Life: Functional Plant Ecology of High Mountain Ecosystem*. Springer.

Pandey R.K. 1995. *Himalayan Height: Altitude Geography*. RatnaPustakBhandar, Kathmandu.

Singh J.S. and Singh S.P. 1992. *Forest of Himalaya: Structure, Functioning and Impact of Man*. GyanodayaPrakashan, Nainital, India.

Valdia K.S. 1998. *Dynamic Himalaya*. University Press, Hyderabad, India.

Ya T. and Tulachan P.M. (eds.). 2003. *Mountain Agriculture in the Hindu Kush-Himalayan Region*. International Center for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal.

Poudel, K. C. (2003). *Watershed Management in the Himalayas: A Resource Analysis Approach.* Delhi: Adroit Publishers.

Pratap, T. &Waton, R.H. (1994). Sloping Agricultural Technology. ICIMOD Occasional paper NO.23, KTM.

Zuricket. al. (2005). Atlas of the Himalayas, ICIMOD.