Tribhuvan University

Institute of Science and Technology

Central Department of Botany

M.Sc. Botany Syllabus

Second Semester

2074

Course Outline

SEMESTER II: Theory + Practical (Lab/Fieldwork)

Credit: 18; Full mark: 450

Course No	Title	Credit	FM
BOT 551	Ecology (theory)	3	75
BOT 552	Ecology (practical)	1	25
BOT 553	Cytology and Genetics (theory)	3	75
BOT 554	Cytology and Genetics (practical)	1	25
BOT 555	Plant Physiology (theory)	3	75
BOT 556	Plant Physiology (practical)	1	25
BOT 557	Plant Systematics (theory)	3	75
BOT 558	Plant Systematics (practical)	1	25
BOT 559	**Field work** (techniques of ecological sampling, vegetation and floristic study – 1 time of at least 15 days duration) and **seminar**	2	50
Total		**18**	**450**

Ecology

Course title: Ecology	**Full marks:** 75
Course No.: BOT 551	**Pass marks:** 37.5
Nature of course: Theory	**Credits:** 3
Level: MSc, II Semester	**Credit hours:** 48

Objectives

The general aim of this course is to impart fundamental knowledge about the structural and functional aspects of ecology. The specific objectives are to:

- Give an introduction to the basic ecological principles on population, community and ecosystem levels
- Make the students understand the problems, issues and challenges pertaining to environment

Course content

Unit 1. Population ecology: (i) Concept and characteristics. (ii) Population growth models and regulation; life history strategies; meta-population concept. (iii) Measurement and experimental design for population study. (iv) Factors controlling distribution pattern. (v) Major theories of geographical distribution patterns: Lotka-Voltiera, vicariance, isolation, and nunatak. [**12 h** (1+4+3+2+2)].

Unit 2. Community ecology: (i) Introduction and history. (ii) Hierarchical concept: species and speciation. (iii) Community pattern: community composition, species richness, and productivity. (iv) Methods in vegetation study; gradient analysis: regression, ordination, and classification (hierarchical, k-means and fuzzy clustering). (v) Major biological and environmental determinants of community pattern (scales, area, adaptations). (vi) Community dynamics: boundary concept; ecotone, conservatism and resilience, biological mechanism of ecological succession, changes in ecosystem properties during succession. (vii) Methods of measuring succession: lichenometry, dendrochronology, palaeoecology, radio carbon dating, long term ecological research (LTER). [**15 h** (1+1+2+4+2+3+2)].

Unit 3. Ecosystem ecology: (i) Forest ecology: introduction, forest biomes of the world, forest types and phytogeography in the Himalayas, community attributes (composition, profile structure, regeneration, phenology), ecosystem services, carbon dynamics, REDD (reducing emission from deforestation and degradation). (ii) Wetland ecology: introduction, global distribution of wetlands, types of wetlands with special reference to freshwater wetland ecosystem, service and function of wetlands, threats to wetlands, conservation and management, Ramsar sites of Nepal. (iii) Grassland ecology: introduction, types and global distribution, factors determining grassland development and distribution, productivity, grassland and climate change, grassland management. [**15 h** (5+5+5)].

Unit 4. Contemporary environmental issues: (i) Biodiversity loss. (ii) Pollution. (iii) Climate change. (iv) Biological invasion. [**6 h** (2+1+2+1)].

Course title: Ecology	**Full marks: 2**5
Course No.: BOT 552	**Pass marks:** 12.5
Nature of course: Practical	**Credits:** 1
Level: MSc, II Semester	**Credit hours:** 16×4

Course content

1. To determine the Importance Value Index (IVI) of plants in a community.
2. To measure species diversity (Simpson, and Shannon-Weiner indices) of a plant community.
3. To determine sticky point and water holding capacity of different soil samples.
4. To determine the water rising and percolation rate of different soil samples.
5. To estimate humus content in different soil samples.
6. To measure pH of soil samples.
7. To determine soil texture of different soil samples.
8. To summarize and analyze climatic data from different parts of Nepal.
9. To determine the age structure from population data of Nepal.
10. To determine dissolved oxygen (DO) in different water samples.
11. To estimate acidity of given water samples by titration.

Text and reference books

Begon M., Townsend C.R and Harper J. L. 2006. *Ecology: Individuals, Populations and Communities*. 4th edition. Blackwell Publishing Ltd.

Grime J.P. 2001. *Plant Strategies, Vegetation Processes, and Ecosystem Properties*. 2nd edition. Chichester (United Kingdom) and New York: John Wiley & Sons..

Krebs C.J. 1994. *Ecology: the Experimental Analysis of Distribution and Abundance*. 4th edition. Addison-Wesley Educational Publoishers, Inc., USA.

Odum E.P. 1996. *Fundamentals of Ecology*. Natraj Publishing, Dehradun, Inida.

Singh J.S., Singh S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation*. Anamaya Publishers, New Delhi.

Suggested further readings

Barbour M.G., Burk J.H., Pitts W.D., Gilliam F.S. and Schwartz M.W. 1999. *Terrestrial Plant Ecology*. 3rd edition, Benjamin/Cummings.

Callaway R.M. 2007. *Positive Interactions and Interdependence in Plant Communities*. Springer.

Chase J.M. and Leibold M.A. 2003. *Ecological Niches: Linking Classical and Contemporary Approaches*. The University of Chicago Press.

Gaugh H.G. 1982. *Multivariate Analysis in Community Ecology*. Cambridge University Press, Cambridge.

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.

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

Jonathan C. 2007. *Climate Change*. Cambridge University Press, Cambridge.

Korner C. 2003. *Alpine Plant Life: Functional Plant Ecology of High Mountain Ecosystems*. 2nd edition. Springer.

Kreshaw K.A. 1973. *Quantitative and Dynamic Plant Ecology*. English Language Book Society, London.

Larcher W. 1995. *Physiological Plant Ecology*. Springer

Myers J. H. and Bazely D. 2003. *Ecology and Control of Introduced Plants*. Cambridge University Press. Cambridge.

Nagy L. and Grabherr G. 2009. *The Biology of Alpine Habitats* . Oxford University Press, USA.

Perlman D.L. and Adelson G. 1997. *Biodiversity: Exploring Values and Priorities in Conservation.* Blackwell Science, Massachusetts, USA.

Silvertown J. 1987. *Introduction to Plant Population Ecology* . Longman Scientific & Technical, UK.

Singh J.S. and Singh S.P. 1992. *Forests of Himalaya: Structure, Functioning and Impact of Man*. Gyanodaya Prakashan, Nainital, India.

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

Waltner-Toews D. 2004. *Ecosystem Sustainability and Health.* Cambridge University Press,

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

Wiens John A., Moss Michael R., eds. 2005. *Issues and Perspectives in Landscape Ecology*. Cambridge University Press, Cambridge.

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

Woodward F.I. 1996. *Climate and Plant Distribution.* Cambridge University Press, UK.

References for practical

Gupta, P.K. 2000. *Methods in Environmental Analysis: Water, Soil and Air.* Agrobios (India), Jodhpur, India.

Kreshaw K.A. 1973. *Quantitative and Dynamic Plant Ecology.* English Language Book Society, London.

Zobel, D.B., Behan M.J., Jha, P.K. and Yadav, U.K.R. 1987. *A Practical Manual for Ecology*. Ratna Book Distributors, Kathmandu, Nepal

Cytology and Genetics

Course title: Cytology and Genetics	**Full marks:** 75
Course No.: BOT 553	**Pass marks:** 37.5
Nature of course: Theory	**Credits:** 3
Level: MSc, II Semester	**Credit hours:** 48

Objectives

The general aim of this course is to impart theoretical and practical knowledge about cytology, genetics and evolution. The specific objectives are to:

- Give the students fundamental knowledge about cell, cell organelles and principles of cell signaling
- Impart knowledge about the nature of gene and genome, and mechanism of gene expression
- Impart understanding of the theory of inheritance and evolution
- Make the students understand the recent aspects of plant breeding, genetic manipulations and their impact on human life

Course content

Unit 1. Cell: Structure and reproduction: (i) Major intracellular compartments of eukaryotic cells, endosymbiont hypothesis on the evolution of mitochondria and chloroplast. (ii) Biological membranes (chemical composition, structure and function of membrane). (iii) Cyto-skeleton: structure, assembly, disassembly and regulation of microfilaments, microtubules and intermediate filaments. (iv) Cell communication and cell signaling (general principles, signaling molecules and their receptors). (v) Cell cycle and regulation of cell division, chromosomal behavior during meiosis. [**8 h** (1+1+1+3+2)].

Unit 2. Structural organization of genome: (i) Genome organization in virus, prokaryotic genome (folded chromosome of *E. coli*), eukaryotic genome (organization of nuclear and organellar genomes). (ii) Chromosome structure: eukaryotic chromatin and chromosomes; histones and non-histone proteins, nucleosomal organization of chromatin, higher levels of chromatin structure, chromosomal packing and structure of metaphase chromosome, structure and function of centromere and telomere, special chromosomes. (iii) Chromosome banding patterns and their use in cytogenetics. [**8 h** (3+4+1)].

Unit 3. Structure, expression and regulation of gene: (i) Nucleic acids: structure, chemistry and types, replication of DNA in prokaryotes and eukaryotes. (ii) Concept of gene: molecular structure of prokaryotic and eukaryotic genes, genetic code. (iii) Changes in gene structure and correction mechanism. (iv) Gene expression and its regulation. [**10 h** (3+2+2+3)].

Unit IV. Genetics and plant breeding: (i) Theory of inheritance: overview of Mendel's laws, interaction of genes (allelic and non-allelic); linkage and chromosome mapping; cytoplasmic inheritance, sex determination in plants, influence of environment on heredity. (ii) Population genetics: introduction to population genetics, the Hardy-Weinberg Equilibrium and its significance; describing genetic variation and diversity, relationship between species traits and population genetic diversity. (iii) Genetics and evolution: sources of genetic variation (mutation, gene flow, selection and drift); migration, speciation and genetic variation, inbreeding and heterosis; macro- versus micro-evolution. (iv) Human genetics: blood group inheritance, human chromosomes and sex-linked diseases, in-born error of metabolism,

cancer genetics, genetic counseling. (v) Genetics and human affairs: introduction to genetic engineering, transgenic plants (problems and solutions). (vi) Plant breeding: overview of plant breeding methods; conventional and mutation breeding. [**22 h** (7+5+4+3+1+2)].

Course title: Cytology and Genetics	**Full marks:** 25
Course No.: BOT 554	**Pass marks:** 12.5
Nature of course: Practical	**Credits:** 1
Level: MSc, II Semester	**Credit hours:** 16×4

Course content

1. Preparation of different types of solutions for cytological study:
   a. 8-Hydroxyquinoline and Colchicine
   b. Carnoy's Solutions
   c. Aceto-Carmine
2. Study of cytological techniques:
   a. Collection of roots
   b. Pretreatment of roots
   c. Fixation and
   d. Staining of chromosomes
3. Study of chromosomal behavior of different phases of mitosis cell division of *Allium cepa/Triticum aestivum/Lens culinaris*.
4. Determination of mitotic index of *Allium cepa/Triticumaestivum/ Lens culinaris*root meristem
5. Determination of mitotic phase index in root meristem of *Allium cepa/Triticum aestivum/Lens culinaris*.
6. Preparation of permanent slide of mitotic cell division of *Allium cepa/ Triticumaestivum/ Lens culinaris*.root meristem.
7. Study of chromosomal behavior of different phases of meiosis cell division of *Allium cepa/Triticum aestivum/Lens culinaris*.
8. Study of giant chromosome.
9. Study of pollen fertility.
10. Study of plant breeding techniques.
11. Extraction of DNA from plant material.

Text and reference books

Briggs D. and Walter S.M. 1997. *Plant Variation and Evolution*. Cambridge University Press.

De Robertis E.D.P. and De Robertis E.M.F. (Jr.). 1995. *Cell and Molecular Biology*. Waverly Pvt. Ltd. New Delhi, India.

Sarin C. 1993. *Genetics*. Tata McGraw-Hill Publishing Co. Ltd., New Delhi, India.

Snustad, D.P. and Simmons, M.J. 1999. *Principles of Genetics*. 2nd edition. John Wiley & Sons.Inc.

Stebbin G.L. 1979. *Process of Organic Evolution*. Prentice-Hall of India Pvt. Ltd., New Delhi, India.

Strickberger M.W. 1996. *Genetics*. Prentice-Hall of India Pvt. Ltd. New Delhi, India.

Suggested further readings

Cherayil J.D. 1971.*Gene and the Genetic code* (The chemical basis of life). Tata McGraw-Hill Publishing Co., New Delhi.

Czepulkowski B. 2001. *Analyzing Chromosomes* (Basics). BIOS Scientific Publishers, Oxford, UK.

Darlington C.D. 1964. *Chromosome Botany and the Origins of Cultivated Plants*. George Allen Unwin Ltd., the University Press, Aberdeen, UK

Darlington C.D. and Cour La L.F. 1976. *The Handling of Chromosomes*. George Allen and Unwin Ltd., London.

de Jong Tom and Klinkhamer P. 2005. *Evolutionary Ecology of Plant Reproductive Strategies.* Cambridge University Press. Cambridge, UK.

Frankham R., Ballou J. and Briscoe D. 2009.*Introduction to Conservation Genetics*. Cambridge University Press, Cambridge, UK.

Freifelder D. 1986. *Molecular Biology*. Jones &Barriet Publishing Inc., Boston, Portola Valley.

Futuyma D.J. 1998. *Evolutionary Biology*. 3rd ed. Sinauer Associates, Sunderland, Massachusetts.

Gomperts B.D. 1976. *The Plasma Membrane: Models for its Structure and Function*. Academic Press.

Gunning B.E.S. and Steer M.W. 1975. *Ultrastructure and the Biology of Cells*. Edward Arnold.

Gupta P.K. 1998. *Genetics*. Rastogi Publications, Shivaji Road, Meerut.

Gustafson J.P. 1984. *Gene Manipulation in Plant Improvement*. Plenum Press, NY, USA.

Hartman P.E. and Suskind S.R. 1972.*Gene Action*. Prentice-Hall of India Pvt. Ltd., New Delhi, India.

Levin B. 1974. *Gene Expression: Vol. I Bacterial Genomes, Vol .II Eucaryotic Chromosomes*. Wiley Inter Science. London.

Levin B. 1998. *Genes VI* .Oxford University Press, London.

Niklas Karl J. 1997. *The Evolutionary Biology of Plants*. The University of Chicago Press, Chicago, USA.

Packer L. 1976.*Mitochondria: Bioenergetics, Biogenesis and Membrane Structure*. Academic Press, NY, USA.

Pigliucci M. and Kaplan J. 2006. *Making Sense of Evolution: The Conceptual Foundations of Evolutionary Biology*. The University of Chicago Press, Chicago, USA.

Risley M.S. 1986. *Chromosome Structure and Function*. Van Nostrand, Reinholt.

Roger B., Bridle J. and Schluter D. 2009. *Speciation and Patterns of Diversity*. Cambridge University Press, Cambridge, UK.

Rost T.L. Gifford, Jr. and Ernest M. 1977. *Mechanism and Control of Cell Division*. Academic Press, NY, USA.

Rothwell N.V. 1983. *Genetics*. Oxford University Press, UK.

Sharma A.K. and Sharma A. 1985. *Advances in Chromosome and Cell Genetics*. Oxford & IBH Publishing Co., India.

Sharma AK and Sharma A. 1990. *Chromosome Techniques: Theory and Practice*. Butterworth & Co. Ltd., New Delhi, India.

Singh R.J. 2002.*Plant Cytogenetics*. 2nd edition. CRC Press, Florida, USA.

Sinha U. and Sinha S. 1997. *Cytogenetics, Plant Breeding and Evolution*. Vikas Pvt. Ltd., India.

Sinnot E.W., Dunn L.E. and Dobshansky T. 1973. *Principles of Genetics*. TMH Edn.

Stebbin (Jr.) G.L. 1968.*Variation and Evolution in Plants*. Oxford & IBH Publishing Co., Delhi, India.

Willis K. J. and McElwain J.C. 2002.*The Evolution of Plants*. Oxford University Press, USA.

Winchester A.M. 1979.*Genetics*: *A Survey of the Principles of Heredity*. Oxford & IBH Publishing Co., New Delhi, India.

Plant Physiology

Course title: Plant Physiology	**Full marks:** 75
Course No.: BOT 555	**Pass marks:** 37.5
Nature of course: Theory	**Credits:** 3
Level: MSc, II Semester	**Credit hours:** 48

Objectives

The general aim of this course is to impart theoretical and practical knowledge about various physiological phenomena occurring in plant life in relation to changing environment. The specific objectives are to:

- Advance the knowledge of students on various metabolic processes
- Impart understanding of physiological processes in relation to plant growth and development
- Make the students understand the physiological processes in relation to environment change

Course content

Unit 1. Mineral nutrition and solute transport in plants: Mineral nutrition of plants an overview; acquisition and transport of mineral ions by plants; factors affecting availability and absorption of mineral ions. [**3 h**].

Unit 2. Nitrogen assimilation: Uptake and utilization of nitrogen in plants, biological nitrogen fixation (symbiotic and asymbiotic). [**3 h**].

Unit 3. Bioenergetics and ATP synthesis: Laws of thermodynamics and energy transformation in living systems, energy transformation and coupling, energy transduction and chemiosmotic synthesis of ATP in chloroplast and mitochondria. [**4 h**].

Unit 4. Photosynthesis: An overview of photosynthesis (photosynthetic apparatus, photosynthetic electron transport system, photosynthetic carbon assimilation – comparative account of C_3, C_4 and CAM pathways); allocation, partitioning and translocation of photosynthate; photorespiration and its effect on plant productivity; law of limiting factors with reference to climate change. [**5 h**].

Unit 5. Respiration: Overview of plant respiration, structural organization of mitochondria, electron transport and terminal oxidation, oxidative pentose phosphate pathway. [**4 h**].

Unit 6. Lipid metabolism: Properties and function of lipids, mechanism of synthesis of saturated and unsaturated fatty acids, oxidation of fat and fatty acid, gluconeogenesis. [**5 h**].

Unit 7. Secondary metabolites: Introduction, secondary metabolites and plant defense (metabolism and significance of terpenes, phenolic compounds and nitrogen-containing compounds). [**5 h**].

Unit 8. Environmental physiology: Functional adaptation of plants in terrestrial and aquatic environments, plant water relations; physiological responses to biotic and abiotic (water, minerals, temperature, oxygen) stresses; mechanism of stress injury and resistance; concept of allelopathy and phytoalexin; stress induced gene expression. [**8 h**].

Unit 9. Developmental physiology: Plant growth and development; the analysis of plant growth; phytochrome and light control of plant development; hormonal control of growth, plant growth regulators (biosynthesis, translocation, bioassay, physiological effects, and cellular and molecular mechanisms of action: hormone receptors and signal transduction); seed physiology; physiology of senescence and ageing; physiology of fruit ripening. [**11 h**].

Course title: Plant Physiology	**Full marks:** 25
Course No.: BOT 556	**Pass marks:** 12.5
Nature of course: Practical	**Credits:** 1
Level: MSc, II Semester	**Credit hours:** 16×4

Course content

1. Visit to the nearby field to study the deficiency syndromes of different minerals
2. Determination of absorption spectrum of chlorophyll pigments
3. Demonstration of Hill reaction
4. Document the C_3 and C_4 plants from nearby locality on anatomical basis
5. Study the diurnal fluctuation in acidity of cell sap in succulent plants
6. Isolation and separation of different photosynthetic pigments
7. Localization of fats in germinating mustard/soybean cotyledons
8. Extraction and qualitative test of secondary metabolites present in plants
9. Determination of water potential of plant tissues
10. Effect of different plant hormones on seed germination and seedling growth
11. Effect of different hormones on plant senescence (chlorophyll retention)
12. Effect of different hormones in breaking seed dormancy
13. Bioassay of phytohormones (auxins, cytokinins, Gibberellins)

Text books

Bhattarai, T. 2005. *Plant Physiology*. Bhundipuran Prakashan, Kathmandu.

Hopkins, W.G. and Huner, N.P.A. 2010. *Introduction to Plant Physiology*. 4th edition. John Wiley and Sons Inc.

Mukerjee, S. and Ghosh, S.K. 2012. *Plant Physiology*. New Central Book Agency, New Delhi, India

Taiz Lincoln, and Eduardo Zeiger 2010. *Plant Physiology*. 5th edition. Sinauer Associates, Inc., Sunderland, MA, USA.

Reference Books

Bajracharya, D. 1999. *Experiments in Plant Physiology*. Narosa Publishing House, New Delhi.

Bard J. 1990. *Morphogenesis*. Cambridge University Press, London.

Baskin C.C. and Baskin J.M., 1998. *Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination*. Academic Press, San Diego, USA.

Bieleski R.L., A.R. Ferguson and Creswell M.M., eds. 1974. *Mechanisms of Regulation of Plant Growth*. The Royal Society of New Zealand, Wellington.

Buchanan B., Wilhelm G. and Russell J., eds. 2000. *Biochemistry and Molecular Biology of Plants*. American Society of Plant Biologists, Rockville, USA.

Fenner M. and Thompson K. 2005. *The Ecology of Seeds*. Cambridge University Press. Cambridge, UK.

Hall D.O. and Rao K.K.. 1981. *Photosynthesis* (3rd edition). Study in Biology no. 37. Edward Arnold, London.

Helgi Ã–pik, Stephen A. Rolfe 2005. *The Physiology of Flowering Plants* (4th Edition). Cambridge University Press. Cambridge, UK.

Hess D. 1975. *Plant Physiology: Molecular, Biochemical, and Physiological Fundamentals of Metabolism and Development*. Springer-Verlag.

Korner C. 2003. *Alpine Plant Life: Functional Plant Ecology of High Mountain Ecosystems* (2nd edition). Springer.

Kramer P.J. 1983. *Water Relations of Plants*. Academic Press, NY and london.

Larcher W. 1995. *Physiological Plant Ecology*. Springer-Verlag.

Leopold A.C. and Kriedemaun P.E. 1975. *Plant Growth and Development*. Tata Mcgraw Hill Publishing Co., Ltd., New Delhi, India.

Levitt J. 1980. *Responses of Plants to Environmental Stresses* (Vols. I & II). Academic Press, Inc., NY and London.

Mayer A.M. and Poljakoff-Mayber A. 1989. *The Germination of Seeds*. Pergamon Press, Oxford.

Murphy T.M. and Thompson W.F. 1988. *Molecular Plant Development*. Prentice Hall, New Jersey.

Mussell H. and Staples R. 1979. *Stress Physiology in Crop Plants*. Wiley-Interscience, NY, USA.

Nobel P.S. 1974. *Introduction to Biophysical Plant Physiology*. W.H. Freeman and Company, San Francisco, USA.

Noggle G.R. and Frits G.J. 1992. *Introductory Plant Physiology*. CBS Publications & Distributors, New Delhi, India.

Purohit S.S., ed. 1983. *Aspects of Physiology and Biochemistry of Plant Hormones*. Kalyani Publishers, New Delhi, India.

Reiss, C. 1993. *Experiments in Plant Physiology*. Benjamin Cummings.

Salisbury F.B. and Ross C.W. 1986. *Plant Physiology*. Wordsworth Publishing Co., London

Salisbury, F.B. 1996. *Units, Symbols and Terminology for Plant Physiology*. Oxford University Press, USA.

Sinnot, E.W. 1960. *Plant Morphogenesis*. McGraw Hill Publication, NY, USA.

Srivastav, L.M. 2001. *Plant Development: Effect of Hormones and Environment*. John Wiley and Sons

Steward F.C. 1971. *Plant growth and Development*. Academic Press, NY, USA.

Turner N.C. and Kramer P.J. 1980. *Adaptation of Plants to Water and High Temperature Stress*. John Wiley and Sons, NY, USA.

Wardlaw C.W. 1968. *Morphogenesis in Plants*. Metheum & Co., London.

Plant Systematics

Course title: Plant Systematics	**Full marks:** 75
Course No.: BOT 557	**Pass marks:** 37.5
Nature of course: Theory	**Credits:** 3
Level: MSc, II Semester	**Credit hours:** 48

Objectives

The general aim of this course is to impart theoretical and practical knowledge on taxonomy of angiosperms. The specific objectives are to:

- Advance the knowledge of students on principles of angiosperm taxonomy, nomenclature and classification systems
- Impart understanding of the systematics and evolutionary trends in different taxa
- Impart understanding of the history and recent developments in Flora of Nepal
- Make the students understand the role of taxonomy in plant conservation.

Course content

Unit 1. Nature and concept of taxa: (i) Basic terminologies, taxonomic characters. (ii) Taxonomic hierarchy and concepts of categories: concept of species, types of species, intraspecific categories (subspecies, variety and forms), genus and higher categories. [**6 h** (2+4)].

Unit 2. Principles and approaches of classification: (i) Introduction: brief overview of the principles and background of biological classification. (ii) Pre-Darwinian systems: overview of Theophrastus, Linnaean, and Bentham and Hooker systems. (iii) Post-Darwinian and phyletic systems: overview of Engler and Prantl, Bessey, Hutchinson, Takhatajan and Cronquist systems. (iv) Phenetic (numerical taxonomy) and cladistic approaches: introduction to phylogeny and phylogenetic systematics, introduction to phenetic and cladistic approaches, nature and sources of information, assumptions, methodological steps, dendrograpm and cladogram construction and analysis. (v) Angiosperm Phylogeny Group (APG) classification: principles and ranks with major angiosperm clades, with updated version. [**15 h** (1+2+3+6+3)].

Unit 3. Botanical nomenclature: International Code of Botanic Nomenclature (history, principles, rules, important articles); typification; rules of effective and valid publications; retention, rejection, and choice of names. [**4 h**].

Unit 4. Systematic studies and evolutionary trends of major Angiospermic clades: basal order (Nymphaeales), Magnoliids (Magnoliales), Monocotyledones (Liliales), Commelinoides (Poales), Eudicots (Ranunculales), Core Eudicots (Caryophyllales), Rosids (Geraniales), Euroides- I (Rosales), Euroids –II (Sapindales), Asterids (Ericales), Euasterids –I (Lamiales), Euasterids-II (Asterales). [**12 h**].

Unit 5. Herbarium taxonomy, and taxonomic tools: surveys and monitoring, plant collection and herbarium technique, curation of living material, herbaria and taxonomic libraries, plant identification techniques. [**3 h**].

Unit 6. Botanical exploration and Flora of Nepal: History of botanical exploration in Nepal, Flora of Nepal. [**2 h**].

Unit 7. Taxonomy and plant conservation: Taxonomy and species conservation – introduction; taxonomy and the implementation of conventions and global strategies – Convention on Biological Diversity (CBD), Global Strategy for Plant Conservation (GSPC), Global Taxonomy Initiative (GTI), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); IUCN Red List categories and threatened species conservation. [**6 h**].

Course title: Plant Systematics	**Full marks:** 25
Course No.: BOT 558	**Pass marks:** 12.5
Nature of course: Practical	**Credits:** 1
Level: MSc, II Semester	**Credit hours:** 16×4

Objectives

The general aim of this course is to impart practical knowledge on taxonomy of angiosperms. The specific objectives are

- to impart basic techniques on collection, herbarium preparation, identification, preservation and documentation of specimens of angiosperms.
- to impart basic knowledge on using keys for plant identification.

Course content

1. Plant description and identification

- Identification of selected groups of angiosperms up to species level using keys and literature.
- Description of plants by using semi-technical taxonomic terminology representing the families (minimum 10 families) mentioned in unit 4, based on macro- and micro-morphological studies.

2. Interrelationships and phylogeny

- *Phenetic approach*: data correlation, data coding, analysis (cluster analysis, PCA), construction of dendrogram/phenogram
- *Cladistic approach*: data correlation, data coding, construction of cladogram, and tracing phylogenetic relationships

3. Field work

- Field trips to learn collection of specimens and herbarium techniques (refer to Course Bot. 559).

Text and reference books

Judd W.S., Campbell C.S., Kellogg E.A., Stevens P.F., Donoghue M.J. 2015. *Plant Systematics: A Phylogenetic Approach*. Fourth edition. Sinauer Associates, Inc.

Simpson M.G. 2010. *Plant Systematics*. Second edition. Academic Press, USA.

Stuessy T.F. 2009. *Plant Taxonomy: The Systematic Evaluation of Comparative Data*, 2nd edition. Columbia University Press, NY, USA.

Woodland D.W. 2009. *Contemporary Plant Systematics*. Fourth edition. Andrews University Press, Berrien Springs, MI, USA.

References for practical

Bridson D. and Forman L 1999. *The Herbarium Handbook*. Third edition. Royal Botanic Gardens, Kew, UK.

Davis P.H. and Cullen J. 1965. *The Identification of Flowering Plant Families*. Oliver & Boyd, Edinburgh & London, UK.

Long D.J. 1999. *Flora of Bhutan*. Volumes 1, 2, 3 parts 1, 2, 3. Royal Botanic Gardens, Edinburgh, UK.

Malla S.B., Rajbhandary S.B., Shrestha T.B., Adhikari P.M., Adhikari S.R. and Shakya P.R. (eds). 1986. *Flora of Kathmandu Valley*. Department of Medicinal Plants, Thapathali, Kathmandu.

Watson M.F., Akiyama S., Ikeda H., Pendry C.A., Rajbhandari K.R. and Shrestha K.K. 2011. *Flora of Nepal. Volume 3*. Royal Botanic Garden Edinburgh.

Suggested further readings

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

Cronquist A. 1988. *The Evolution and Classification of Flowering Plants*. Nelson, NY, USA.

Cullen J. 2004. *The Identification of Flowering Plant Families*. Oliver & Boyd, UK.

Dahlgren R. 1984. *The Families of Monocotyledons: Structure, Evolution and Taxonomy*. Springer Verlag.

Davis P.H. and Cullen J. 1965. *The Identification of Flowering Plant Families*. Oliver & Boyd, Edinburgh & London, UK.

Davis P.H. and Heywood V.H. 1963. *Principles of Angiosperm Taxonomy*. Oliver & Boyd, Edinburgh & London, UK.

Faegri K and Iverson J. 1989. *Textbook of Pollen Analysis*. John Wiley & Sons.

Greuter W. et.al., eds., 1988. *International Code of Botanical Nomenclature*. Intl. Ass. Plant Tax. Leiden.

Herzberg F.O., Brown A.H.D., Burdon J.J. 1995. *The Conservation of Plant Biodiversity*. Cambridge University Press. Cambridge, UK.

Heywood V.H., ed. 1968. *Modern Methods in Plant Taxonomy*. Academic Press, NY, USA.

Jones S.B. and Luchsinger A.E. 1979. *Plant Systematics*. McGraw-Hill Book Company, NY, USA.

Lawrence G.H.M. 1951. *Taxonomy of Vascular Plants*. Oxford & IBH, New Delhi, India.

Leadlay E. and Jury S. 2006. *Taxonomy and Plant Conservation*. Cambridge University Press.

Naik V.N. 1984. *Taxonomy of Angiosperms*. Tata McGraw hill Publishers, New Delhi, India.

Perlman, D.L. and Adelson, G. 1997. *Biodiversity: Exploring Values and Priorities in Conservation*. Blackwell Science, Massachusetts, USA.

Roger B., Bridle J. and Schluter D.. 2009. *Speciation and Patterns of Diversity*. Cambridge University Press, Cambridge, UK.

Shivarajan V.V. 1991. *Introduction to the Principles of Plant Taxonomy*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, India.

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

Siwakoti M. and Rajbhandary S., eds. 2015. Taxonomic Tools and Flora Writing. Department of Plant Resources, Ministry of Forests and Soil Conservation and Central Department of Botany, Tribhuvan University, Kathmandu, Nepal.

Sporne K.R. 1974. *The Morphology of Angiosperms*. Hutchinson and Co. Ltd., London.

Stace C.A. 1980. *Plant Taxonomy and Biosystematics*. Edward Arnold, London.

Takhtajan A.L. 1980. Outline classification of flowering plants and Magnoliophytes. *The Botanical Review*, 46(3): 225-359.

Takhtajan A.L. 1991. *Evolutionary Trends in Flowering Plants*. Colombia University Press, NY, USA.

UNEP 2002. Global Strategy for Plant Conservation. Decision V1/9, UNEP/CBD/COP/6/20. Secretariat of the Convention on Biological Diversity, Montreal, Quebec, Canada.

UNEP 2002. Global Taxonomy Initiative (GTI). Decision V1/8, UNEP/CBD/COP/6/20. Secretariat of the Convention on Biological Diversity, Montreal, Quebec, Canada. www.bidiv.org/programmes/cross-cutting/taxonomy/default.asp.

Willis K.J. and McElwain J.C. 2002. *The Evolution of Plants.* Oxford University Press, USA.

Important Journals

- *Annals of the Missouri Botanical Garden*
- *Australian Systematic Botany*
- *Blumea*
- *Botanical Journal of the Linnean Society*
- *Curtis's Botanical Magazine*
- *Edinburgh Journal of Botany*
- *European Journal of Taxonomy*
- *Harvard Papers in Botany*
- *Journal of Japanese Botany*
- *Journal of Systematics and Evolution*
- *Nordic Journal of Botany*
- *Novon*
- *Phytokeys*
- *Phytotaxa*
- *Plant Systematics and Evolution*
- *Systematic Botany*

Fieldwork and Seminar

Course title: Fieldwork and Seminar	**Full marks:** 50
Course No.: BOT 559	**Pass marks:** 25
Nature of course: Fieldwork and seminar (**Practical**)	**Credits:** 2
Level: MSc, II Semester	**Credit hours:** 32×4

Objectives

- Familiarize student with techniques of ecological sampling, vegetation and floristic study (1 time of at least 15 days duration).
- Enable students to prepare report based on field work and present their finding
- Develop skill to review scientific literatures, their synthesis, critical analysis, and presentation