

**Institute of Science and Technology**

**Master of Science in Botany**

*M.Sc. Botany*

**Curriculum**

1999



**Curriculum Development Centre**

***Tribhuvan University***

*Kirtipur, Kathmandu*

**Nepal**

TEXT BOOK

**Master of Science in Botany**  
*M.Sc. Botany*

*Effective from 1999*

*Office of the Dean*  
**Institute of Science and Technology**  
**Tribhuvan University**  
**Kathmandu, Nepal**

**Introduction:**

Quality education is the right of every student, parent, employer, and, in fact, every citizen of the country and the quality of education imparted by an educational institution is mostly reflected in its curriculum.

Attempts were made for updating the M. Sc. curriculum in 1990 by organizing a seminar on "Teaching in Botany" by the Central Dept. of Botany. At that time, the curricula for I. Sc., B.Sc. and M. Sc. were reconstructed. The time and efforts thus put into the task by concerned experts went in vain because these curricula were never implemented at any level.

Recently Tribhuvan University has introduced three years' Bachelor degree program. In line with this policy, the IOST/TU has also made the newly changed Bachelor's program system operational by implementing the three-year curriculum. In this context therefore, redesigning and restructuring the M.Sc. curriculum has become a matter of necessity. Moreover, because three-year Bachelor's degree is now required to be eligible to get admission to the M.Sc. course, a bridge course of the honor's degree level has to be thrashed out to enable the students with only two-years' B.Sc. degree to qualify for enrolment.

**Objectives:**

The present M. Sc. Botany course has been designed with the objectives:

- To provide advanced knowledge through fundamental and applied research;
- To train the students in a wide range of academic and professional skills needed to fulfil personal, societal and national needs;
- To explore new areas of teaching and research; and
- To make the science programme more relevant to the developmental needs of the country.

**Eligibility for Admission:**

The candidates who have passed B.Sc. degree with major in Botany from Tribhuvan University or equivalent degree with the same major from Tribhuvan University or a university recognized by Tribhuvan University shall be considered eligible to apply for admission to M.Sc. Botany degree course.

**Admission Criteria:**

An applicant seeking admission to M.Sc. Botany must appear in an Entrance Examination of two hours' duration conducted by the Central Department of Botany / Campus. The applicant who fails to appear in the Entrance Examination or to obtain a minimum qualifying score will not be given admission. A merit list of the qualified applicants will be prepared by adding the percentage of marks in their B. Sc. Examination with the marks obtained by them in the Entrance Examination. Admission of the students will be based strictly on the merit list and on the enrollment capacity of the Central Department of Botany / Campus.

**Course Structure:**

The proposed new curriculum has been designed for 2 years i.e. M.Sc. I and M.Sc. II. M.Sc. I year course has 4 papers of theory, each carrying 100 marks and 2 papers of practical, each carrying 100 marks.

M.Sc. II year course has 2 special theory papers (from 5 subjects), each carrying 100 marks and 1 paper of practical carrying 100 marks. Finally, 100 marks are allotted to either dissertation or an elective course. At present 3 elective courses (Plant Biotechnology, Biodiversity and its management, and Economic Botany, Ethnobotany and Community Management) have been proposed. However, it does not limit the number of elective courses. Other elective courses can be proposed later when the department has the facilities to run the courses.

**Special courses:** i) Genetics and Plant Breeding, ii) Ecology, iii) Plant Pathology, iv) Plant Biochemistry and Plant Biotechnology, v) Plant Systematics and Phytogeography

**Elective courses:** i) Biotechnology\*, ii) Cell and Molecular Biology, iii) Environment and Biostatistics, iv) Biodiversity and its Management\*, v) Mycology and Microbiology, vi) Economic Botany, Ethnobotany and Community Development\*, vii) Research Methodology and Biostatistics.

**Bot. 513: Cytology & Genetics, Anatomy, Embryology and Economic Botany**

(Approximate weightage of marks)

Paper	Cytology & Genetics	Anatomy	Embryology	Economic Botany	Total
Marks	50	15	10	25	100

**Bot. 514: Physiology, Morphogenesis, Ecology and Evolution**

(Approximate weightage of marks)

Paper	Physiology	Morphogenesis	Ecology	Evolution	Total
Marks	40	10	40	10	100

**Bot. 515 & 516: Practical Papers:**

Course no.	Paper	Marks
Bot. 515	Based on Bot. 511 and Bot. 512	100
Bot. 516	Based on Bot. 513 and Bot. 514	100

<b>Total Full Marks (Theory)</b>	<b>400</b>
<b>Total Full Marks (Practical)</b>	<b>200</b>
<b>Grand Total = 400 + 200</b>	<b>600</b>

**M. Sc. IInd Year**

**Special Courses:**

**a) Plant Systematics and Phytogeography**

Course no.	Course Title	Full Marks	Pass Marks
Bot. 611	Plant Systematics and Evolution	100	40
Bot. 612	Phytogeography and Biosystematics	100	40
Bot. 613	Plant Systematics and Evolution, Pract.	50	20
Bot. 614	Phytogeography and Biosystematics Pract.	50	20
Total		300	

**b) Genetics and Plant Breeding**

Course no.	Course Title	Full Marks	Pass Marks
Bot. 621	Genetics I	100	40
Bot. 622	Genetics II	100	40
Bot. 623	Genetics I Practical	50	20
Bot. 624	Genetics II Practical	50	20
Total		300	

**c) Ecology**

Course no.	Course Title	Full Marks	Pass Marks
Bot. 631	Advanced Ecology	100	40
Bot. 632	Applied Ecology	100	40
Bot. 633	Advanced Ecology Practical	50	20

Bot. 634	Applied Ecology Practical	50	20
Total		300	

**d) Plant Pathology**

Course no.	Course Title	Full Marks	Pass Marks
Bot. 641	Plant Pathology	100	40
Bot. 642	Principles of Plant Pathology	100	40
Bot. 643	Plant Pathology Practical	50	20
Bot. 644	Principles of Plant Pathology Practical	50	20
Total		300	

**e) Plant Biochemistry and Plant Biotechnology**

Course no.	Course Title	Full Marks	Pass Marks
Bot. 651	Plant Biochemistry	100	40
Bot. 652	Plant Biotechnology	100	40
Bot. 653	Plant Biochemistry, Practical	50	20
Bot. 654	Plant Biotechnology, Practical	50	20
Total		300	

**Elective Courses and Dissertation:**

Course no.	Course Title	Full Marks	Pass Marks
<i>Select one combination course from (a) or (b) group of the following course numbers or opt for the dissertation course mentioned at the bottom.</i>			
Bot. 671a	Biotechnology	75	30
Bot. 672a	Biodiversity and their Management	75	30
Bot. 673a	Economic Botany, Ethnobotany and Community Development	75	30
Bot. 671b	Biotechnology Practical	25	10
Bot. 672b	Biodiversity and their Management Pract.	25	10
Bot. 673b	Economic Botany, Ethnobotany and Community Development Practical	25	10
Bot. 678	Dissertation in lieu of Elective Course	100	40
Total		100	

<b>Total Special paper Theory</b>	<b>200</b>
<b>Total Special Paper Practical</b>	<b>100</b>
<b>Total Special Paper Practical</b>	<b>100</b>
<b>Grand Total</b>	<b>400</b>

**Grand Total of M. Sc. I<sup>st</sup> and M. Sc. II<sup>nd</sup> year = 600 + 400 = 1000**

**Course Duration:**

The entire course is spread over two academic years. There will be a separate yearly examination after the end of each academic year.

**Hours of Instruction:**

- a) Working days : 150 days in an academic year.
- b) Class hour :
- i) Theory: One theory paper of 100 marks and one of 75 marks will have 4 hours' lecture per week.
  - ii) Practical: One practical paper of 100 marks will have 16 hours of practical per week and that of 50 marks will have 8 hours and that of 25 marks 4 hours of practical per week.
- c) Attendance: 70 percent attendance in the class is compulsory.

**Examination:**

All the students must appear in four hours' examination for theoretical courses carrying 100 marks and 75 marks and in 12 hours' practical examination for 100 marks, 6 hours' practical examination for 50 marks and 3 hours' practical examination for 25 marks.

**Evaluation :**

Institute of Science and Technology, Tribhuvan University will conduct the annual examinations. The students will have to pass each level and each course numbers separately. The minimum pass marks is 40 percent, both for theory and practical.

A student having passed his / her two years of study will be graded on the basis of the two years average marks as follows:

75 percent and above	Distinction
60 percent and above	First Division
50 percent and above	Second Division
40 percent and above	Third Division

**Master of Science Course of Study in Botany**  
**2056**  
**First Year**

Course Title: Non-Vascular Plants  
Course No: Bot 511  
Nature of the Course: Theory

Full Marks: 100  
Pass Marks: 40  
Year: I

**Course Description : Non-Vascular Plants**

**General Objective:** To give the students a thorough knowledge on diverse groups of non-vascular plants.

**Specific Objectives:**

- To impart knowledge on the habit and habitat of non-vascular plants in general in the context of Nepal;
- To give detailed information on the classification and economic importance of various non-vascular plants;
- To give ideas on the cell structure, reproduction and interrelationship of these non-vascular plants.

**Course Contents:**

**Algae:** History of Algae, General distribution, characteristics, classification and economic importance of Algae Distribution and systematic studies of the range of thallus, cell structure, reproduction, classification, interrelationship and economic importance of the following groups: Cyanophyceae, Chlorophyceae, Phaeophyceae, Xanthophyceae, Rhodophyceae, Bacillariophyceae Algal researches in Nepal., Algal biofertilizer and Nitrogen fixation. **30 Hrs**

**Fungi:** History of Fungi, Introduction of Fungi., Classification and economic importance of Fungi. Systematic studies of the structure and reproduction and economic importance of the following groups:  $\alpha$  Magistomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina, Mycorrhiza – Symbiotic relationships of fungi. **2 Hrs**

**Bacteria:** History, Classification, External and Internal cell structure, Reproduction, Genetic transformation (Transformation, Transduction and Conjugation), Nutrition, Economic importance with reference to Food, Medicine, Industry, Agriculture, Solid waste recycling, Immunology. **6 Hrs.**

**Virus:** History, Classification, Structure and Chemical composition, structure and Function of RNA and DNA Viruses (TMV & Bacteriophage), Multiplication, Mode of transmission with special reference to Insect Vector, Immunology, Recent discovery in Virology. **6 Hrs.**

**Lichen:** History, Classification, Life-form, External and Internal structure, Vegetative diaspores, Reproduction, Economic importance with reference to Food, Medicine, Lichenometry, Biomonitors, Heavy metal uptake, Radionucleide accumulation, Exploration of Lichens in Nepal, Status of diversity. **6 Hrs.**

**Bryophyta:**

1. General characters, classification and systematic position of Bryophytes
2. Comparative study of the structure, life history, phylogeny and interrelationship of the following groups.
  - A. Hepaticopsida: a) Sphaerocarpaceae, b) Marchantiales, c) Metzgeriales, d) Calobryales, e) Takakiales
  - B. Anthoceroopsida
  - C. Bryopsida: a) Sphagnales, b) Andreales, c) Bryales
3. Vegetative propagation in Bryophytes
4. Conducting system in Bryophytes
5. Fossil Bryophytes
6. Role of Bryophytes in Ecological Succession
7. Distribution of Bryophytes in Nepal. 30 Hrs.

**Text and Reference Books****Algae:**

1. Baral, S. R. 1995. *Algae of Nepal*. Report of Biodiversity Profile Project
2. Bold, C. and M. J. Wynne. 1978. *Introduction to the Algae: Structure and Reproduction*. Prentice hall.
3. Chapman, V. J. and Chapman D. J. 1975. *The Algae*. McMillan & Co. Ltd. N. Y., London.
4. Desikachary, T. V. 1969. *Cyanophyta*. I.C.A.R. New Delhi Englewood Cliffs, New Jersey.
5. Fritsch, F. E. 1979. *Structure and Reproduction of Algae*, Vols. I & II. Cambridge University Press, London.
6. Gangulee, H. C. and Kar, A. K. 1994. *College Botany*. New Central Book Agency, Calcutta.
7. Kumar, H. D. and Singh, H. N. 1982. *A Text book of Algae*. Affiliated East West Press, New Delhi.
8. Lee, R. E. 1980. *Phycology*. Cambridge University Press, London.
9. Round, F. E., 1969. *The Biology of the Algae*. Edward Arnold Ltd.
10. Smith, G. M., 1955. *Cryptogamic Botany* Vol. I & II. McGraw Hill Book Co., N.Y.
11. Venkataraman, G. S. 1973. *Algal Biofertilizers and Rice Cultivation*. I.C.A.R. New Delhi.

**Fungi:**

1. Ainsworth, G. C., Sparrow, F. K. and A. F. Sussman. 1973. *The Fungi: An Advanced Treatise I-IV*. Academic Press, N. Y. and London.
2. Alexopoulos, C. J., 1962. *Introductory Mycology*. John Wiley & Sons, New York.
3. Alexopoulos, C. J. and C. W. Mims, 1993. *Introductory Mycology*. Wiley Eastern Limited.
4. Bessey, E. A., 1950. *Morphology and taxonomy of the Fungi*. Blakiston Co., Philadelphia
5. Deacon, J. W. 1996. *Introduction to Modern Mycology* I & II. Blackwell Scientific Publication, London.

6. Dickson, J. G. 1956. Diseases of Field Crops. McGraw Hill Book Co., N.Y.
7. Gangulee, H. C. and Kar, A. K. 1994. College Botany. New Central Book Agency, Calcutta.
8. Smith, G. M. 1955. Cryptogamic botany Vol. 1. McGraw Hill Book Co., N.Y.
9. Talbot, P. H. 1971. Principles of fungal taxonomy. MacMillan Publishing Co. Inc., New York.
10. Webster, J., 1989. Introduction to Fungi. Cambridge University Press, London.

#### **Bacteria:**

1. Elifton, C. E. 1958. Introduction to the Bacteria. Tata McGraw Hill, NY.
2. Frobiacher, N. 1957 Fundamental of microbiology. Co & Saunder Co., Philadelphia, USA
3. Lehninger, A. L., L. N. David, and M. M. Cox. 1993. Principles of Biochemistry, CBS Publishers and Distributors, New Delhi
4. Pyatkin, K. 1976. Microbiology. Mir Publication.
5. Stewart, F. S. 1962. Bigger's Handbook of Bacteriology. Willoame & Wilkiesali, Beltimore.
6. World Journal of Microbiology and Biotechnology. The Official Journal of the Mircen Network in Association with UNESCO.

#### **Virus:**

1. Bawden, F. C. 1904. Plant Viruses and Virus diseases. Ronald Press.
2. Burnet, F.M. and W. M. Stanley. 1959. The Viruses (Biochemical, Biological and Biophysical Properties). Academic Press, London.
3. Luria, S.E. and E.J. Darnell 1967. Genral Virology. A Wiley International Edition.
4. Smith, K. M. 1996. A Text Book of Plant Virus Diseases. J. & A. Chuachall, London.

#### **Lichen:**

1. Brown, D. H., Hawksworth, D. L. and R. H. Bailey. 1976. Lichenology Progress and Problems. Proceedings of an International Symposium held at the University of Bristol. Academic Press Inc. (London).
2. Hale, ME. 1974. The biology of Lichen. Edward Arnold Publication.
3. Hawksworth, D.L. and Seaward, M. R. D. 1977. Lichen Ecology. Edward Arnold Publication.
4. Seaward, M. R. D. 1977. Lichen Ecology. Academic Press. Inc. (London) Ltd
5. Sharma, L.R. 1995. Enumeration of Lichens of Nepal. Biodiversity Profile Project.
6. The Lichenologist. Academic Press. ISSN: 0024-2829.

#### **Bryophytes**

1. Cavers, F. 1917. The interrelationship of bryophytes. New Phytol Inc.
2. Parihar, N.S. 1997. Introduction to the embryophyta vol 1. Bryophyta. Central Book Depot, Allahabad.
3. Smith, G.M. 1955. Cryptogamic Botany Vol II Bryophytes and Pteridophytes. McGraw-Hill Book Company, Inc., New York.

4. Vasistha, B.R. 1996. Bryophyta. S.Chand & Co., New Delhi.
5. Watson, E.V. 1967. Structure and life of bryophytes. Hutchinson University Library, London.

## Vascular Plants

Course Title: Vascular Plants  
Course No: Bot 512  
Nature of the Course: Theory

Full Marks: 100  
Pass Marks: 40  
Year: I

**Course Description:** Pteridophytes, Gymnosperms and Taxonomy of Angiosperms

**General Objective:** To provide information on the diversity of vascular plants viz. pteridophytes, gymnosperms and angiosperms, their origin and evolutionary trends.

**Specific objectives:**

- To impart knowledge on the habit and habitat of vascular plants in general in the context of Nepal
- To impart knowledge about the principle, history, nomenclature of plant taxonomy
- To discuss the origin and evolutionary trends in vascular plants
- To study and use contemporary tools of plant taxonomy
- To study the systematics of different taxa
- To study the history and recent development in flora of Nepal
- To understand the role of taxonomy in conservation.

**Course Contents:**

**Pteridophyta:**

Introduction, Origin and Evolution of pteridophytes, classification, General topic, Distribution of ferns in Nepal, Gamatophyte– Sporophyte relationship, Alternation of generation, Apogamy, Apospory and Regeneration, Evolution of sori ferns, Heterogeny its significance, seed habit nature in pteridophytes, Experimental studies: on growth and differentiation of sporophyte and gametophyte, Gametophyte morphogenesis:- Germination of spores, development and differentiation of protonima, morphogenesis *in vit*, Telome theory. Study of the groups: Psilophytopsida, Psilopsida, Lycopsida, Sphenopsida

**30 Hrs.**

**Gymnosperms and Paleobotany:** Introduction, general characters and classification of gymnosperm, General distribution of fossil and living gymnosperms in the world; distribution and status of gymnosperms in Nepal; economic importance of gymnosperms, Progymnospermales and the origin of gymnosperms. Morphological and anatomical characters, evolutionary tendencies and affinities of the following orders of fossil gymnosperms: Pteridospermales, Cycadeoidales or Bennettitales, Pentoxylales, Cordaitales, Life histories, morphological and anatomical characters, evolutionary tendencies and affinities of the following orders and families of living gymnosperms: Cycadales (Cycadaceae), Ginkgoales (Ginkgoaceae), Coniferales (Pinaceae, Taxodiaceae, Cupressaceae, Podocarpaceae, Araucariaceae, Cephalotaxaceae), Taxales (Taxaceae), Gnetales (Ephedraceae, Gnetaceae, Welwitschiaceae). Palaeobotany: Introduction; nature and

mechanisms of fossil formation; types of fossils, the sequence of the plant world in geological times; techniques used in the study of fossils **30 Hrs.**

#### **Taxonomy of Angiosperms:**

1. History of Plant Taxonomy : Principles of plant taxonomy , History of plant classification (Pre-Darwinian, Post Darwinian and Recent systems of classification)
- ② Origin and Evolution of Angiosperms: Different theories of Origin of Angiosperms, General Evolutionary trends in flowering plants. ✓
3. Contemporary Plant Taxonomy (Phytochemistry, Cytology and Cytogenetics, Palynology, Anatomy, Embryology)
4. Plant Nomenclature: History, Important Articles of ICBN (International Code of Botanical Nomenclature)
5. Plant collection and Herbarium Techniques
- ⑥ Systematic studies and evolutionary trends in following taxa: Magnoliidae, Ranunculidae, Hamamelidae, Caryophyllidae, Lamiidae, Alismatidae. ✓
7. Flora of Nepal: History of botanical exploration in Nepal, Institutions and activities., Characteristics and status
8. Role of Taxonomy in Plant Conservation. **60 Hrs.**

#### **Text and Reference Books**

##### **Pteridophytes**

1. Andrews, H.N. 1961. Studies in paleobotany. John Wiley & Sons, New York.
2. Arnold, C.A. 1947. An introduction to paleobotany. McGraw-Hill Book Company, Inc., New York.
3. Bower, F.O. 1935. Primitive land plants. London.
4. Eames, A.J. 1936. Morphology of vascular plants: lower groups (Psilophytales to Filicales). McGraw-Hill Book Company, Inc., New York.
5. Parihar, N.S. 1992. The biology and morphology of pteridophytes. Central Book Depot, New Delhi.
- ✓ 6. Rashid, 1977. An introduction to pteridophyta. ✓
7. Smith, G.M. 1955. Cryptogamic Botany Vol II Bryophytes and Pteridophytes. McGraw-Hill Book Company, Inc., New York.
8. Sporne, K.R. 1970. The morphology of pteridophytes. (3<sup>rd</sup> edition). Hutchinsonson & Co., London
9. Surange, K.R. 1966. Indian fossil pteridophytes. CSIR, New Delhi.
10. Vasista, B.R. 1993. Pteridophytes. S.Chand & Co., New Delhi.

##### **Gymnosperms and Paleobotany**

1. Andrews, H.N. 1961. Studies in paleobotany. John Wiley & Sons, New York.
2. Arnold, C.A. 1947. An introduction to paleobotany. McGraw-Hill Book Company, Inc., New York.
3. Bhatnagar, S.P. and A. Mitra. 1996. Gymnosperms. New Age International Limited, New Delhi.
4. Coulter, J.M. and C.J. Chamberlain. 1917. Morphology of Gymnosperms.

- Chicago Univ. Press, Chicago.
5. Chamberlain, C. J. 1935. *Gymnosperms: structure and evolution*. Chicago Univ. Press, Chicago.
  6. Foster, A.S. and E.M. Gifford. 1959. *Comparative morphology of vascular plants*. San Francisco.
  7. Raizada, M.B. and K.C. Sahni. 1960. Living Indian Gymnosperms. Pt I (Cycadales, Ginkgoales and Coniferales). *Ind. For. Rec.*, 5: 73-150.
  8. Shrestha, T.B. 1984. Indigenous Gymnosperms. In: Majupuria, T.C. (ed.), *Nepal nature's paradise*, Craftsman Press, Bangkok, pp. 252-260.
  9. Shrestha, T.B. and Dobremez, J.F. Gymnosperms of Nepal. *Cahiers Nepalais Doc. No 3*, CNRS, France, 23 p.
  10. Sporne, K.R. 1974. *The Morphology of Gymnosperms*. Hutchinsonson & Co., London.
  11. Vashishta, P.C. 1997. *Botany for degree students*. Vol. 5: Gymnosperms. S. Chand & Co., New Delhi.

#### **Taxonomy of Angiosperms**

1. Bania, A. M. S. and Sakya, S. R. 1999. *Vegetation and Floara of Southwest Kathmandu Valley* (Chandragiri). L. S. Shakya, 485-Naghal, Kathmandu.
2. Bhatt, D. D. 1977. *Natural History and Economic Botany of Nepal*. Orient Longman
3. Davis, P.H. and Heywood, V.H. 1963. *Principles of Angiosperm Taxonomy*. Oliver and Boyd, Edinburgh & London.
4. Faegri, K. and Iversen, J. 1989. *Textbook of Pollen Analysis*. John Wiley & Sons.
5. Naik, V. N. 1984. *Taxonomy of Angiosperms*. Tata McGraw Hill Publishers, N. Delhi.
6. Sivarjan, V. V. 1991. *Introduction to the Principles of Plant Taxonomy*. Oxford and IBH Publishing Co. New Delhi
7. Stace, C.A. 1980. *Plant Taxonomy and Biosystematics*. Edward Arnold, London.
8. Takhtajan, A. L. 1980. Outline of the classification of flowering plants and Magnoliophytes. *The Botanical Review*, 46 (3): 225-359.
9. Takhtajan, A.L. 1991. *Evolutionary Trends in Flowering Plants*. Colombia University Press, N. York.

## **Cytology & Genetics, Anatomy, Embryology and Economic Botany**

Course Title: Cytology & Genetics, Anatomy,

Embryology and Economic Botany

Full Marks: 100

Course No: Bot 513

Pass Marks: 40

Nature of the Course: Theory

Year: I

**Course Description:** Cytology & Genetics, Anatomy, Embryology and Economic Botany

**General Objective:** to make the students familiar with the cytology, anatomy, embryology and economic importance of plants.

**Specific Objectives:**

- To provide advanced knowledge of the basic principles and concepts applied at different levels of organization and to help understand the structural and functional work of cytogenetical and genetical materials.
- To give the knowledge on the techniques and methods used for the study of anatomy and to familiarize with the tools for the identification of wood anatomy.
- To impart knowledge on the various types of tissues, and anomalous structure found in the stem, root.
- To give knowledge on nodal, seedling and floral anatomy.
- To give a broad spectrum on microsporogenesis, megasporogenesis, embryogenesis in dicot and monocots, embryo type, polyembryony along with pollination, fertilization and apomixis.
- To familiarize the students with advanced and experimental embryology and development of endosperms in angiosperms.
- To provide an understanding of the origin, distribution, cultivation, production and uses of important plant species of Nepal.

**Course Contents:**

**Cytology and Genetics:**

History of Cytology and Genetics, The Nucleus and the Chromosome, General Features of Karyotype, Chromosomal Behavior during Meiosis, Mutation and Evolution, Allelism and Pleiotropism, The Chromosomal Mechanism of Sex Determination in plants, Transduction and Transformation, Molecular

**Genetics :** Genetic Material - Nucleic Acid: Chemistry, Structure, Denaturation – renaturation, Types of DNA, Replication and synthesis Structural, Organisation of Genome, Genetic Code **60 Hrs.**

**Anatomy:** General Introduction, Techniques used in the study of anatomy and histology, Meristems: Structure, classification and theories of differentiation of shoot and root apices, Nodal anatomy: Anatomy of various types of stems and their evolutionary significance, Cambium and its activities, Periderm and abscission, Anomalous types of dicot and monocot stems and roots and their significance, Anatomy of floral organs and its relation to taxonomy, seedling anatomy, and ecological, anatomy, Anatomy as tools to wood identification

**18 Hrs.**

**Embryology:** Recent Advances Angiosperm Embryology, Microsporogenesis, Megasporogenesis, Embryosac type, Embryogenesis in dicot & monocots, Polyembryony, pollination, fertilization and Apomixis, Development and types of endosperms in Angiosperms, Experimental Embryology. **12 Hrs.**

**Economic Botany:** People and Plant: Dependence of man on plants and plant products, Centers of origin of cultivated plants.

History, origin, distribution, botany, methods of cultivation and utilization of the following plants:

- A. Cereals : Rice, Wheat, Maize, Finger Millet.
- B. Pulses : Blackgram, Pigeon pea, Lentil
- C. Vegetable oil : Sunflower, Linseed, Soybean.
- D. Fiber crops : Cotton, Jute, Nettle.
- E. Fruit crops : Apple, Mango, and Citrus
- F. Cash crops : Sugarcane, Tea, and Tobacco.

General account of the spices and aromatic plants., Important Vegetables of Nepal., Important medicinal plants of Nepal, Forest products of Nepal. **30 Hrs.**

### **Text and Reference books**

#### **Cytology and Genetics**

1. Briggs, D and Walter, S.M. 1984. Plant Variation and Evolution. Cambridge University Press, Cambridge, U. K.
2. De Robertis, EDP and Nowinski, WW and FA Saez (1970, 5ed). Cell Biology. WB Saunders Co. Philadelphia, London, Toronto.
3. De Robertis EDP and De Robertis (Jr.) EMF 1995. Cell and Molecular Biology. Waverly P. Ltd. New Delhi, India.
4. Sarin, C. 1985. Genetics. Tata McGraw-Hill Publishing Company Limited, New Delhi.
5. Sharma A.K. and Sharma A. 1990. Chromosome Techniques: Theory and Practice. Butterworth & Co. Ltd.
6. Sinha, U. and S. Sinha (1976). Cytogenetics, Plant Breeding and Evolution. Pub. Vikas Publishing House Pvt. Ltd., New Delhi.
7. Winchester, A.M. 1979. Genetics: A Survey of the Principles of Heredity. Oxford & IBH Publishing Co., New Delhi.
8. Swanson, CP 1972. Cytology and Cytogenetics. Pub. The Mac Millan Co. of India Ltd. Delhi, India.

#### **Anatomy**

1. Chandurkar. P. J. 1971. Plant Anatomy. Oxford and IBH Publishers, N. Delhi.
2. Cutter, E. G. 1978. Plant Anatomy. Edward Arnold, London.
3. Eames, A. J. and L. H. McDaniels. 1947. An Introduction to Plant Anatomy. McGraw-Hill Publishers, N. Y., USA.
4. Esau, K. 1988. Plant Anatomy, Wiley Publishers, N. Y., USA.
5. Pandey, B. P. 1998. Plant Anatomy. S. Chand and Company. Ramnagar, India.
6. Metcalf, C. R. and L. Chalk. 1979. Anatomy of Dicotyledons. Oxford

University Press.

7. Tayal, M. S. 1996. *Plant Anatomy*. Rastogi Publications, Meerut, India.
8. Vashishtha, P. C. 1998. *Plant Anatomy*. S. Chand Company, N. Delhi.

#### **Embryology**

1. Bhojwani, S. S. and S. P. Bhatnagar, 1998. *The embryology of Angiosperms*. Vikash Publishing House, New Delhi.
2. Davis, G. L. 1966. *Systematic embryology of Angiosperms*, Wiley publishers, N. Y., USA
3. Johri, B. M. 1994. *Embryology of Angiosperms*. Springer-Verlag, Berlin
4. Maheshwari, P. 1998. *An Introduction to the embryology of Angiosperms*. Tata-McGraw Hill Publishing, New Delhi.
5. Pandey, A. K. 1997. *Introduction for Embryology of Angiosperms*. CBS Publishers, N. Delhi.
6. Sporne, K. R. 1991. *The morphology of angiosperms: the Structure and Evolution of Flowering Plants*. B. I. Publications, N. Delhi.

#### **Economic Botany**

1. Bhatta, D. D. 1977. *Natural History and Economic Botany of Nepal*. Orient Longman Ltd.
2. Cobley, L.S.. 1998. *An introduction to the Botany of Tropical crops*. Longman, Green London.
3. Hill, A.F. 1952. *Economic Botany*. Tata McGraw Hill Pub. Comp. Ltd. New Delhi
4. Kochhar, S.L. 1998. *Economic Botany in the Tropics*. MacMillan India Ltd. Madras, Delhi, Bombay, Patna.
5. Majapuria, T.C. 1999. *Nepal Nature's Paradise*. M. Devi, Gwalior.
6. Sen, S. 1998. *Economic Botany*. New Central Book Agency, Calcutta.
7. *The Wealth of India* – A Dictionary of Raw materials and Industrial Products. CSIR, New Delhi.

## Physiology, Morphogenesis, Ecology and Evolution

Course Title: Physiology, Morphogenesis,  
Ecology and Evolution

Full Marks: 100

Course No: Bot 514

Pass Marks: 40

Nature of the Course: Theory

Year: I

**Course Description:** Physiology, Morphogenesis, Ecology and Evolution

**General Objective:** To make students aware about the various physiological phenomena and morphogenetic changes in the growth and development of the plant life and to impart to them fundamental knowledge about the structural and functional aspects of ecology.

**Specific Objectives:**

- To help the students know about the structure and function of various cell organelles.
- To lay emphasis on metabolic processes such as photosynthesis, respiration and synthesis of fats and proteins.
- To discuss and explain morphogenesis on the basis of cell, its growth and differentiation and correlation.
- To give an introduction to the basic ecological principles including the ecosystem structure and function.
- To make students understand the problems, issues and challenges pertaining to environment

**Course Contents:**

**Plant Physiology:**

**Cell Biology:** Structure of biological membrane, membrane transport, molecular structure of chloroplast and Mitochondria, Mechanism of ATP synthesis in chloroplast and mitochondria.

**Photosynthesis:** CAM, Bacterial photosynthesis, and chemosynthesis, translocation of photosynthate.

**Respiration:** Photorespiration and its mechanism, its effect on net productivity in C<sub>3</sub> and C<sub>4</sub> plants, Pentose phosphate pathway.

**Fat Metabolism:** Mechanism of synthesis of saturated and unsaturated fat, oxidation of fat and fatty acid, conversion of fat into carbohydrate.

**Protein synthesis:** Structure, and Function of protein, Mechanism of Protein synthesis, comparative account in Prokaryotic and eukaryotic cells, Regulation of protein synthesis.

**Growth and Development**

Growth regulating substances, their biosynthesis, Bioassay and Mechanism of action, Role of Phytochrome, Physiology of senescence and Abscission, Concept of Allelopathy and Phytoalexin.

**Stress Physiology:** Physiology of drought, cold, salt stress and disease resistance in plant

**48 Hrs.**

**Morphogenesis:** Introduction about the process of morphogenesis, Growth: Growth and differentiation of plant cell., Physiological and genetic Correlation,

Polarity and development with suitable examples of plants, Role of Symmetry in plant development (radial, bilateral and dorsiventral). **12 Hrs.**

### Ecology:

**Introduction:** Definition, history and scope of ecology, Ecological levels in biological organization, Patterns and Scale in Ecology

**Methods in vegetation analysis:** Sampling techniques, Introduction to modern methods (remote sensing and GIS), Statistical approaches to data analysis (Variance, X<sup>2</sup>-test and Correlation), Ecological factors in relation to different ecological levels, Climatic, Physiographic, Edaphic, and Biotic factors

**Population ecology:** Concept, population density and age structure, Growth patterns of plant populations

**Plant Communities:** Structure and Dynamics, Concept and nature of plant communities, Structure of plant communities (analytical characters), Classifications of Forests of Himalayas, Phytogeography of Nepal, Community Dynamics: Concept and models of succession, Climax

**Ecosystems:** Structure and Functions, Components and trophic dynamics, Energy flow and nutrient cycling, The cybernetic nature and stability, Productivity in different ecosystems (Grassland, Forest, Aquatic and Wetland) from Nepal Evolutionary adaptations in plants in different ecological settings, Environmental pollution and its impact on plants

**Natural resources and their conservation:** , Nature of natural resources in Nepal, Biodiversity: Concept and its status in Nepal, Depletion of natural resources and their ecological implications Approaches to natural resource conservation in ecological perspectives **48 Hrs.**

**Evolution:** Origin of life: Historical and Modern Concepts, Heredity and Environment in relation to evolution., Species concept. **12 Hrs.**

### Text and Reference books:

#### Physiology

1. Bidwell, R.G.S. 1979. *Plant Physiology*. Macmillan Pub. Co., Inc. N.Y.
2. Devlin, RM and F.H Withman, 1990. *Plant Physiology*. CBS Publications & Distribution, Delhi, India.
3. Noggle, GR and GJ. Frits. 1992. *Introductory Plant Physiology*. Prentice-Hall of India Pvt. Ltd. New Delhi, India.
4. Salisbury, F.B. and Ross. CW. 1985. *Plant Physiology*. Wordsworth publishing Co., London.
5. Wilkins, M.B. (ed.). 1987. *Advance plant physiology*. ELBS Longman, England.
6. *Annual Review of Plant Physiology (1950 onwards) Annual Review Inc.*, 4139 EL Camino Way Palo Alto, California, U.S.A.
7. *Encyclopedia of Plant Physiology (Vol 1 to recent volumes)*, Springer - Verlag, Berlin , Germany.
8. Hall, D.O. and K.K. Rao. 1987. *Photosynthesis*. Edward Arnold, London.
9. Holdt, H.W. 1996. *Plant biochemistry*. Cambridge, UK
10. Jacobs, W.P. 1979. *Plant hormones and plant development*. Cambridge, UK.

11. Leopold, AC and Kriedemaun, PE. 1975. Plant Growth and Development. Tata McGraw Hill Pub., New Delhi.
12. Pandey, SN and BK Sinha. 1998. Plant Physiology (3<sup>rd</sup> Revised Edition). Vikas Pub. House Pvt. Ltd., New Delhi.
13. Shrivastava, H.S. 1998. Plant physiology. Rastogi Publication

#### **Morphogenesis**

1. Wardlaw, CW. 1968. Morphogenesis in Plants. Methuen & Co. London.
2. Sinnott, Edmund, W. 1960. Plant Morphogenesis, MacGraw Hill Publication, New York USA.

#### **Ecology**

1. Kormondy, E. J. 1996. Concept of Ecology. Prentice Hall of India P. Ltd. New Delhi, India
2. Odum, E. P. 1996. Fundamentals of Ecology, 3<sup>rd</sup> Ed. Natraj Publishing, Dehradun India.
3. Kershaw, K. A. 1973. Quantitative & Dynamic Plant Ecology, English Language Book Society, London
4. Krebs, C. J. 1985. Ecology: The Experimental Analysis of Distribution & Abundance, Harper & Row, New York.
5. Sharma, P. D. 1997. Ecology and Environment, Rastogi Publications, India
6. Miller, G. I. Jr. 1995, Living in the Environment, Worldsworth Publishing Co. California.
7. Kumar, H. D. 1997. General Ecology. Vikash Publishing House, New Delhi.
8. Anomymous. 1998. Status of Environment of Nepal. Ministry of Environment, HMG, Nepal.

#### **Evolution**

1. Stebbin (Jr.), G. L. (1968). Variation and Evolution in Plants., Oxford & IBH Publishing Co., Delhi, India.
2. Darlington, C. D. (1964). Chromosome Botany and the Origins of Cultivated plants., George Allen & Unwin Ltd. The University Press Aberdeen, Great Britain.
3. Briggs, D. and Walters, S. M. Plant variation and Evolution., McGraw Hill
4. Clausen, J. Stage in the Evolution of Plants species, Cornell university press Ithala, New York
5. Darlington, C. D. The Evolution of Genetic Systems., Cambridge University press New York II<sup>nd</sup> edition
6. Sakya, SR (1999). Cytogenetical studies in the Genus Primula L. and its allies of Nepal Himalayas, A Research Report , LK Shakya, Nepal.
7. Stebbins, G. L. Process of Organic Evolution, prentice Hall international Inc. Eagle wood cliffs.

## Non-Vascular Plants

Course Title : Non-Vascular Plants  
Course No : Bot 515  
Nature of the Course: Practical

Full Marks : 100  
Pass Marks: 40  
Year: I

**Course Description:** Non-Vascular Plants/ vascular plants

**General Objective:** to make the students familiar with the morphological character and practical knowledge on different techniques used to identify the non-vascular and vascular plants.

**Specific Objectives:**

- To impart to the students knowledge on different techniques of permanent slide and herbarium preparation of non-vascular and vascular plants.
- To help them know the process of collection and preservation of these plants.
- To make them aware of the keys and techniques to identify the non-vascular and vascular plants.
- To give them information on the equipment used for the culture of some of these non-vascular plants.

**Course Contents:**

**Algae:** Study of methods of collection, preservation, culture and permanent preparation of slides of algal specimens. Monographic studies of algae belonging to the classes: Cyanophyceae, Chlorophyceae, Phaeophyceae, Xanthophyceae, Rhodophyceae, Bacillariophyceae, Study of frequency and density of algae present in some aquatic habitats., Cultivation and identification of algae. Study of permanent slides of algae belonging to the classes: Cyanophyceae, Chlorophyceae, Phaeophyceae, Xanthophyceae, Rhodophyceae, Bacillariophyceae

**Fungi:** Culturing the aquatic fungi using different baits. e.g. tomato, hempseeds, houseflies, rice seeds in pond and tap water. Isolation, Identification and study of the different types of aquatic fungi from culture discs. Study of the following apparatus: Hot air oven, Autoclave, Incubator, Laminar flow, U.V. Chamber, Inoculation, Preparation of media (PDA, Czepack and Liquid media)., Preparation of Stain (Lactophenol, Cotton blue)., Isolation of soil fungi by soil dilution plate method. Monographic studies of the fungal organism belonging to the classes: Phycomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes, General survey of fleshy fungi.

Local trip (Collection, identification of fungal infected plant parts and mushrooms).

**Bacteria:** Preparation of Gram Stain., Identification of Bacteria by using Gram Stain., Study of Motility of Bacteria by Hanging Drop Method., Preparation of Media (Nutrient Agar) to culture Bacteria. Culture and Isolation of Bacteria., Spore tests of Bacteria., Study of Symptoms and etiology of some Bacterial Diseases.

**Virus:** Study of different Viral Diseases, Symptoms and etiology in crops and

ornamental plants., Transmission of Virus diseases in plants.

**Lichens:** General Survey of Lichens of Nepal (At Least 10 spp.), Study of Internal Structure of Lichen Thallus and Reproductive Structures., Study of Vegetative Diaspores found in Lichen., Estimation of chlorophyll present in lichen thallus., Study of Lichens as Bioindicators of pollution and Heavy Metals. Study of Lichens as Dyeing agents.

**Bryophytes:** General survey of some bryophytes of Nepal., Study of methods of collection, preservation and identification of bryophytes. Monographic study of Bryophytes belonging to: Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Bryales, Experiments to study, spore germination, formation of protonema and bud development.

**Pteridophytes:** General survey of indigenous pteridophytes of Nepal with particular reference to their morphology, distribution, economic importance, habit and habitat based on herbarium deposited at the CDB., Study variation and evolution of stellar structures among pteridophytes., Study the variation in soral structures among ferns.

Monographic study of the followings:

- Lycopsida: *Lycopodium*, *Selaginella*
- Sphenopsida: *Equisetum*
- Pteropsida: *Ophioglossum*, *Botryopteris*, *Helminthostachys*, *Adiantum*, *Pyrrossia*, *Diplazium*, *Pteris*, *Marsilea*, *Azolla*.

Study the fossil pteridophytes through permanent slides., Excursion to representative areas of the country to study the distribution and ecology of pteridophytes.

#### **Gymnosperms and Paleobotany**

General survey of indigenous gymnosperms of Nepal with particular reference to their morphology, distribution, status, economic importance, habit and habitat based on herbarium deposited at the CDB.

Study the variation in male and female fructifications among living gymnosperms.

Anatomical study of the followings:

- Cycadales: *Cycas*
- Ginkgoales: *Ginkgo biloba*
- Coniferales: *Pinus*, *Cedrus*, *Tsuga*, *Abies*, *Podocarpus*, *Cupressus*, *Juniperus*, *Araucaria*
- Taxales: *Taxus*
- Gnetales: *Gnetum*, *Ephedra*

Study different types of fossils., Study the extinct gymnosperms through permanent slides and intact fossils., Excursion to representative areas of the country to study the distribution and ecology of gymnosperms.

#### **Taxonomy of Angiosperms**

Description of plants by using semi-technical taxonomic terminology representing 2-3 families from each subclass., Identification of plants up to species using keys, literatures, and punch cards., Study of different types of pollen grains, stomata and trichomes., Field trips., Demonstration of Database in plant identification and management.

## **Cytology & Genetics, Anatomy, Embryology, Economic Botany, Physiology and Ecology**

Course Title: Cytology & Genetics, Anatomy, Embryology,  
Economic Botany, Physiology and Ecology      Full Marks: 100  
Course No: Bot 516      Pass Marks: 40  
Nature of the Course: Practical      Year: I

**Course Description:** Cytology & Genetics, Anatomy, Embryology and Economic Botany

**General Objective:** To strengthen the theoretical knowledge acquired through experimentation.

**Specific objectives:**

- To give the students an idea on the cytological techniques used for the study of genetic material;
- To give them a clear concept on various stages of meiosis and mitosis;
- To make them understand the microtechnique used in the study of anatomy;
- To teach various techniques used in the study of embryology;
- To help them make a study of the plants of economic importance;
- To have them perform experiments related to physiological processes;
- To help them learn to analyze plant community;
- To help them learn about the physical and chemical nature of soil and water;
- To enable them to learn how to analyse the field data.

**Course Contents:**

**Cytology and Genetics**

1. Cytological techniques for study of cell organelles.
2. Study of chromosomal behaviors at different phases of mitosis in somatic cells.
3. Study of chromosomal configurations at various stages of meiosis.
4. Study of chromosome number of different species (Chromosome count).
5. Preparation of the unusual giant chromosomes from the larvae of fruit flies (*Drosophila* sp.).
6. Determination of the apparent pollen fertility of the different species (staining with Muntzing solution).
7. Study of the abnormal chromosomal behavior in dividing cells.
8. Experiment on isolation of DNA.
- \* Other practical will be based on theory portion subject to the availability of facilities.

**Anatomy**

1. Use of paraffin method of microtechnique (Microtomy)
2. Preparation of temporary and permanent slides of different types of roots, stems, and leaves.
3. Use of photomicrography in anatomical studies

4. Study of wood anatomy and preparation of identification keys
5. Study of anomalous structures in roots and stems
6. Study of floral anatomy using microtomy technique
7. Preparation of whole mount of meristematic tissues

#### **Embryology**

1. Study of permanent slides of structure and development of anthers, pollens, ovules, megasporogenesis, embryo sac, endosperm and embryo.
2. Preparation of dissected whole mount of endothecium, tapetum, ovule, endosperm and embryo.

#### **Economic Botany**

1. Study of specimens of medicinal plants
2. Study of specimens of fiber crops
3. Study of specimens of cash crop
4. Study of specimens of spices and aromatic plants
5. Study of the specimens of forest products of Nepal.

#### **Physiology**

1. Isolation of cell, protoplasm and cell organelles (4 practical)
2. Preparation of artificial lipoprotein (2 practical)
3. Separation of photosynthetic pigments by paper and thin layer chromatography and measurement of their absorption spectrum (4 practical)
4. Separation and quantitative estimation of photosynthetic pigments (2 practical)
5. Fluorescence of chlorophyll (1 practical)
6. Demonstration of Hill Reaction (1 practical)
7. Demonstration of CO<sub>2</sub> uptake during photosynthesis (1 practical)
8. Measurement of O<sub>2</sub> produced during photosynthesis (1 practical)
9. Measurement of light induced proton pump in isolated chloroplast (2 practical)
10. Measurement of diurnal acid cycle in CAM plants (2 practical)
11. Measurement of respiratory quotient (1 practical)
12. Estimation of fat by Soxhlet's extraction method (1 practical)
13. Change of fat into carbohydrates during germination (3 practical)
14. Determination of gibberellic acid by half seed (cereal) methods (1 practical)
15. Straight coleoptile growth test for IAA, NAA and 2,4-D using wheat/maize seedlings (4 practicals)
16. Split pea stem test for IAA (2 practical)
17. Demonstration of the effects of auxin on abscission and rooting (2 practicals)
18. Demonstration of the effects of gibberellic acid on growth and development of rice seedlings (1 practical)
19. Demonstration of the effects of Cytokinin on growth and development of pea seedlings (1 practical)
20. Demonstration of the inhibitory effects of abscisic acid (2 practicals)
21. Experiments on senescence and effects of hormone on senescence (2 practicals)

22. Experiment to demonstrate allelopathy (2 practical)
23. Effect of red and far red light on germination (2 practical)
24. Separation and identification of amino acids (4 practical)
25. Preparation of buffers and measurement of pH (2 practical)

### **Ecology**

1. To determine the requisite size of quadrats for vegetation study.
2. To determine the requisite number of quadrats for vegetation study.
3. To determine the frequency and relative frequency of plants in botanical garden, CDB.
4. To determine the density and relative density of plants in botanical garden, CDB.
5. To determine coverage and relative coverage of plants in botanical garden, CDB.
6. Determination of the Importance Value Index (IVI) of plants in botanical garden, CDB.
7. To determine the soil texture of different soil samples by sieve plate method.
8. To estimate soil moisture content in different soil samples.
9. To determine the water holding capacity of different soil samples.
10. To determine the sticky point of different soil samples.
11. To determine the water percolation rate in different soil samples.
12. To determine the water rising capacity rate in different soil samples.
13. Estimation of humus content in different soil samples.
14. To estimate the amount of salt present in different salt samples.
15. Measurement of pH of soil samples.
16. Statistical analysis (variance,  $X^2$ -test, correlation) of soil data from various sources.
17. Summarization and analysis of climatic data from Kathmandu Valley.
18. Estimation of water acidity by titration.
19. To determine the dissolved oxygen (DO) in different water samples.
20. To summarize the population data from Nepal and to determine the age structure from population data.

**M.Sc. Course of Study in Botany  
2056  
Second Year**

**Special Paper: Plant Systematics and Phytogeography**

Course Title : Plant Systematics and Evolution

Course No : Bot 611

Nature of the Course: Theory

Full Marks : 100

Pass Marks: 40

Year: II

**Course Description:** Plant systematics and Evolution

**General objectives:** To provide information about basic and applied aspects of plant systematics for better understanding of the status and conservation of plant diversity

**Specific objectives:**

- To make the students able to understand the concept of different taxa in the light of recent principles.
- To enable them to trace the general evolutionary trend of flowering plants, and to construct and analyze phlogenetic trees.
- To enable them to understand the applied aspects of systematics.

**Course Contents**

The Nature of Systematics

**5 Hrs.**

**Concept of taxa:** Species concept, Concept of infra-specific and supra-specific taxa

**5 Hrs.**

Evolutionary trends of flowering plants (vegetative and floral parts)

**10 Hrs.**

**Applied Systematics:** Palynology, Molecular systematics, Ecology

**10 Hrs.**

**Cladistics:** Cladistic hypotheses and evolutionary processes, Cladistic analysis: Sympleiomorphy, synapomorphy and homology, Evaluation of cladistic hypotheses

**30 Hrs.**

**Modes of speciation and analysis of phylogenetic trees:** Systematics and the evolutionary process, Phylogenetic trees, Patterns of speciation, Construction of phylogenetic trees

**30 Hrs.**

Principles of biological classification (in relevance to flowering plants)

**10 Hrs.**

**Methods of identifying flowering plants:** Herbaria (preparation and management), Libraries, Botanical Gardens, Major Herbaria of the World

**20 Hrs.**

## Phytogeography and Biosystematics

Course Title : Phytogeography and Biosystematics  
Course No : Bot 612  
Nature of the Course: Theory

Full Marks : 100  
Pass Marks: 40  
Year: II

### Course Description: Phytogeography and Biosystematics

**General objectives:** To provide information on distribution of plant diversity in global, regional and national perspectives for management of taxonomic data.

#### Specific objectives:

- To enable the students to explain the role of phytogeography in the evolution of plants.
- To familiarize them with the elements of different floristic regions.
- To familiarize them with the overall vegetation pattern of Nepal.
- To enable them to manage and document taxonomic data.

#### Course Contents:

**Phytogeography and the evolutionary process:** The ecological evolution of flowering plants and the origin of the temperate flora, The differentiation of floras and the development of the major phytochoria, The basic steps in the evolution of the tertiary flora of the extra-tropical region. **20 Hrs.**

#### Floristic regions of the World.

Holarctic Kingdom: Boreal sub-kingdom (Circum boreal region, Eastern Asiatic Region, Northern American Atlantic Region and Rocky Mountain Region), Thethyan sub-kingdom, Palaeotropical Kingdom: African subkingdom, Madagascan subregion, Indo-Malesian subregion, Polynesian subkingdom, Neo-Caledonian subkingdom, Neo-tropical kingdom, Cape Kingdom, Australian Kingdom, Holantarctic Kingdom **40 Hrs.**

Phytogeography of Nepal (including vegetation Map of Nepal) **10 Hrs.**

The origin and dispersal of crop plants **10 Hrs.**

**Biosystematics** :Sources of information, Sources of variation, Population concept :Steps, methods and categories, Natural selection, Random events, Variability in populations and racial differentiation, Isolation and the origin of species **30 Hrs.**

Management and documentation of taxonomic data **10 Hrs.**

#### Text and Reference Books:

1. Faegri, K. and Iversen, J. 1989. *Text book of Pollen Analysis*. John Wiley & Sons.
2. Takhtajan, A. L. 1980. Outline of the classification of flowering plants and Magnoliophytes. *The Botanical Review*, 46 (3):225-359.
3. Takhtajan, A.L. 1991. *Evolutionary Trends in Flowering Plants*. Colombia University Press, N. York.
4. Takhtajan, A.L. 1986. *Floristic Regions of the World*. University of

- California Press.
5. ✓ Eldredge, N. and Cracraft, J. 1980. Phylogenetic Patterns and the Evolutionary Process. Columbia University Press, N. York.
  6. Cook, C.D.K. 1996. Aquatic and Wetland Plant of India. Oxford University Press, Oxford, New York, Delhi.
  7. Akerele, O. Heywood, V. and Sygne, H. 1991. (Eds.). The conservation of Medicinal Plants. Cambridge University Press.
  8. Takhtajan, A. 1997. Diversity and classification of Flowering Plants. Columbia University Press, New York.
  9. Hawksworth, D.H. (Eds) 1988. Prospects in Systematics. Clarendon Press, Oxford.
  10. Davis, P.H. and Heywood, V.H. (1963 or new edition). Principles of Angiosperm Taxonomy. Oliver and Boyd, Edinburgh & London ( our Library's copy is destroyed).
  11. ✓ Stace, C.A. 1980 (or new edition). Plant Taxonomy and Biosystematics. Edward Arnold, London.
  12. Naik, V. N. 1984. Taxonomy of Angiosperms. Tata McGraw Hill Publishers, N. Delhi.\
  13. Sivarjan, V. V. 1991. Introduction to the Principles of Plant Taxonomy. Oxford and IBH Publishing Co. New Delhi
  14. Bhatt, D. D. 1977. Natural History and Economic Botany of Nepal. Orient Longman

## Genetics I

### Special Paper: Genetics and Plant Breeding

Course Title : Genetics I

Course No : Bot 621

Nature of the Course: Theory

Full Marks : 100

Pass Marks: 40

Year: II

### Course description: Genetics and Plant Breeding

**General objective:** To make the M. Sc. program more relevant to the professional and academic needs of the country with the introduction of the specialised study on genetics

#### Specific objective:

- To provide advanced knowledge of the basic principles and concepts in applied cytogenetical field along with its applications.

#### Course Contents:

**Mendelian Genetics:** The Chromosome Theory of Inheritance, Lethality and interaction of genes, Probability and Heredity **30 Hrs.**

**Cytogenetics:** Karyotype Analysis, Meiosis and Species Interrelationship, Linkage, Crossing Over and Gene Mapping, Polyploidy **30 Hrs.**

**Quantitative Genetics:** Quantitative Inheritance, Outbreeding, Inbreeding and Heterosis **15 Hrs.**

**Heredity and Environment** **10 Hrs.**

**Population Genetics:** Gene Frequencies and Equilibrium, Genetic Mechanism of Evolution **20 Hrs.**

**Genecology:** Genetic Diversity, General Concept, Measurements and Analysis, Techniques and Principles of Provenance: Variation and its Analysis **15 Hrs.**

#### Text and Reference Books:

1. De Robertis, E. D. P. and De Robertis (Jr.), E. M. F. (1995). *Cell and Molecular Biology*. Waverly Pvt. Ltd. New Delhi, India.
2. Gupta, P. K. (1998). *Genetics*. Rastogi Publications, Shivaji Road, Meerut-250002.
3. Gardner, E. J., Simmons, M. J. and Snustad, D. P. (1991). *Principles of Genetics*, John Wiley & Sons. INC., New York, Singapore.
4. Strickbesrger, M. W. (1996). *Genetics*. Prentice-Hall of India Pvt. Ltd. New Delhi-110001, India.
5. Darlington, C. D. and La Cour, L. F. (1976). *The Handling of Chromosomes*. George Allen and Unwin Ltd. London.
6. Sharma, AK and Sharma, A (1990). *Chromosome Techniques: Theory and Practice*, Butterworth & Co. Ltd.
7. Sarin, C. (1993). *Genetics*. Tata McGraw Hill.
8. Hartman, P. E. and Suskind, S. R. (1972). *Gene Action*. Prentice-Hall of India Pvt. Ltd. New Delhi.
9. Cherayil, JD. (1971). *Gene and the Genetic code (The chemical basis of*

- life*). Tata McGraw-Hill Publishing Co., New Delhi.
10. Briggs, D and Walter, S.M. 1984. *Plant Variation and Evolution*. Cambridge University Press, Cambridge, U. K.

## Genetics II

Course Title: Genetics II  
Course No: Bot 622  
Nature of the Course: Theory

Full Marks: 100  
Pass Marks: 40  
Year: II

### Course Description: Genetics II

**General objective:** - To make the M. Sc. program more relevant to the professional and academic needs of the country from a specialised study of the area on genetics

**Specific objective:** -

- To provide advanced knowledge of the basic principles and concepts in the applied field as well as for applying appropriate techniques in the genetic field.

### Course Contents:

**Extranuclear Inheritance**

**20 Hrs.**

**Biochemical and Molecular Genetics:** Gene Action: Garrod's Discovery, One Gene One Enzyme and One Gene One Polypeptide Hypothesis, gene regulation, genetic code

**25 Hrs.**

**Microbial Genetics:** Linkage and Recombination in Neurospora, Recombination in Bacteria and Bacteriophage

**20 Hrs.**

**Human Genetics:** Human Chromosomes, Sex-linked inheritance, Chromosome aberrations and syndromes, Blood Group Inheritance and its Legal Application, Inborn Error of Metabolism, Human Genome

**25 Hrs.**

### Applied Genetics:

**Genetic Counseling:** Handling Genetic Disorders, Diagnosis of Genetic Disorders, Positive and Negative Eugenics

**Genetic Engineering:** Techniques, Practical applications, Restraints on genetic, Engineering Research

**Crop Improvement:** Techniques and Principles of Plant Breeding, Pollen Culture, Protoplast Fusion, DNA Hybridization

**30 Hrs.**

### Text and Reference Books:

1. Sharma, J. R. (1994). *Principles and Practice of Plant breeding*. Tata Mc Graw-Hill Publishing Co. Ltd. New Delhi
2. Chandrasckharan, S. N. and Parthasarathy, S. V. (1975). *Cytogenetics and Plant Breeding*. P. Varadacharya & Co. Madras, India.
3. Chaudhari, HK (1971). *Elementary principles of Plant Breeding*. Oxford and IBH Publishing Co, New Delhi.
4. Hayes, H. K., Immer, I. R. and Smith, D. C. (1955). *Methods of Plant Breeding*. McGraw-Hill Book Co. INC.
5. Poehlman, J. M. and Borthakur, D. (1972). *Breeding Asian field Crops*. Oxford & IBH Publishing Co.
6. Sharma, P. C. and Sharma, R. (1972). *Cytogenetics, Plant breeding and*

Evolution. Shashidar Malaviya Prakashan.

7. Singh, B. D. 1996. Fundamental of genetics, Kallyani Publication Delhi
8. Darlington, C. D. (1964). Chromosome Botany and the Origins of Cultivated plants. George Allen & Unwin Ltd. The University Press Aberdeen, Great Britain.
9. Sinha, U. and Sinha, S. (1976, 1997). Cytogenetics, Plant Breeding and Evolution. Vikas Pvt. Ltd., India.

## Advanced Ecology

### Special Paper: Ecology

Course Title: Advanced Ecology

Course No: Bot 631

Nature of the Course: Theory

Full Marks: 100

Pass Marks: 40

Year: II

### Course description: Advanced Ecology

**General objective:** To make the M. Sc. program more relevant to the professional and academic needs of the country with the introduction of this course study.

### Specific objective:

- To provide advanced knowledge of the basic principles and concepts applied at different levels of organization and to help understand the structure and functioning of Biosphere.

### Course Contents:

**Introduction:** Ecology & Environment, Ecology: Relation to other Sciences and its Relevance to human civilization, subdivisions of Ecology, Ecosystem, homeostatis and stability, ecology vs. economy, ecosystem manipulation, system ecology, cognitive ecology, remote sensing and geographic information system, environmental priorities for sustainable development in Nepal . **6 Hrs.**

**Ecosystem dynamics:** The strategy of ecosystem development, types of succession (primary and secondary, autogenic vs allogenic, progressive vs retrogressive, cyclic vs. directional, chronosequence vs. toposequence), driving forces of succession, methods of documenting succession. **5 Hrs.**

**Production ecology:** Introduction, methods of measuring primary production, world distribution of primary production and biomass, environmental factors and productivity, comparison of primary productivity. **20 Hrs.**

**Biogeochemistry:** Plant nutrients and patterns of basic types of biogeochemical cycles, quantitative study of biogeochemical cycles, the sedimentary cycle, cycling of non-essential elements, cycling of organic nutrients, nutrient cycling in temperate regions & tropics, recycle pathway, litter removal and deforestation. **20 Hrs.**

**Population ecology:** Definitions, the study of populations (basic equation, age structure, life tables, population pyramids, survivorship curves, evolutionary V- and K- strategies), population regulation, (exponential growth, simple population regulation the logistic growth curve), character displacement – sympatry and allopatry, natural selection - allopatric and sympatric speciation. **10 Hrs.**

**Species interactions:** Types of interactions among species, Negative interactions (predation, parasitism, antibiosis) positive interactions (commensalism, cooperation, mutualism), allelopathy, coexistence, coevolution. **4 Hrs.**

**Forest ecology:** Himalayan phytogeography (botanical regions, discontinuous distribution of some tree species, forest formations), species composition and

profile structure of major forests, phenology of forest layers, population structure and regeneration of trees, recovery of damaged forest ecosystem, man and forest (commercial exploitation of forest, shifting agriculture, structure and functioning of agro-ecosystem in Nepal Himalaya. Community and farm forestry). **8 Hrs.**

**Nutrient budget:** Nutrient dynamics in grassland, natural forest, forest floors and converted ecosystems: standing state of nutrients; leaf nutrient dynamics (deciduous Vs evergreen, evergreen with leaf span for several years); hydrologic response to forest with particular reference to nutrients; nitrogen relations in plantation of certain tree species. **8 Hrs.**

**Plant ecophysiology:** The environment of plants (atmosphere, hydrosphere, lithosphere, radiation & climate), plant water relationship; the utilization of mineral elements (mineral nutrients in soil and uptake of mineral nutrients, habitat related aspects of mineral metabolism,); environmental influences on growth and development (germination to vegetative, reproductive and senescence phases), winter dormancy. **8 Hrs.**

**Wetland ecology:** Types of wetland with special reference to freshwater wetland ecosystem, floodland, swamp and marsh ecosystems, bog ecosystems and aquatic ecosystems; plant responses to flooding or partial submergence (aerenchyme development, root extension, reorientation of leaves and stem, hypertrophy and adventitious rooting, underwater shoot extension, root to shoot communication in flooded plants), biochemical and molecular changes induced by oxygen deprivation caused by flooding. **6 Hrs.**

**Landscape ecology:** Landscape diversity, Land use pattern, Causes of habitat alterations. **4 Hrs.**

**Mountain ecology:** Mountain evolution, structure, stability and instability crisis, land use pattern; competing demand of land; soil erosion, landslides, grazing and deforestation; watershed management; reclamation of degraded, mined and other types of wastelands. Integrated rural development in mountain ecosystems with special reference to natural resource base, input base, infra-structural base, human resource base and need base. **8 Hrs.**

**Biometry:** Mean, standard error, confidence, limits, students t-test and analysis of variances, correlation, regressions, chi-square contingency analysis. **8 Hrs.**

#### **Text and Reference Books:**

1. Barbour, M.G., J.B. Burk and W.D. Pitts. 1980. *Terrestrial plant ecology*. Benjamin/Cummings Publishing Co., Inc., California/London/Sydney.
2. Bormann, F.H. and G.E. Likens. 1979. *Pattern and process in a forested ecosystem*. Springer, New York.
3. Chapman, J. L. and M. J. Reiss. 1995. *Ecology*. Cambridge Low Price Edition. Cambridge University Press, Cambridge, U.K.
4. Chaudhari, R. P. 1998. *Biodiversity in Nepal*, Craftsman Press, Bangkok.
5. Crawford, R. M. M. 1989. *Studies in plant survival. Ecological case histories of plant adaptation to adversity*. Blackwell, Oxford, U.K.
6. Gupta, S. C. and V. K. Kapoor. 1984. *Fundamentals of applied statistics*. Sultan & Sons, New Delhi.
7. Hillary, E. (ed.). 1984. *Ecology 2000: the changing face of earth*.

- Multimedia Publications, U.K.
8. Jha, P. K. (Ed.) *Environment & Biodiversity proceedings* 1996 ECOS publication.
  9. Jha, Sasinath. 1990. *Conservation for development in Nepal*. National Book Organisation, New Delhi.
  10. Larcher, W. 1995. *Physiological plant ecology*. Third edition, Springer Verlag, Berlin / Heidelberg / New York.
  11. Odum, E. P. 1996. *Fundamentals of ecology*, 1st Indian ed, Natraj Publishers, Dehra Dun.
  12. Prasad, M.N.V. (Ed.). 1997. *Plant ecophysiology*. John Wiley & Sons, Inc., New York.
  13. Sah, J. P. 1997. *Koshi Tappu Wetlands Nepal's Ramsar site*. IUCN- The World Conservation Union, Bangkok.
  14. Singh, J. S. and S. P. Singh. 1992. *Forests of Himalaya*. Gyanodaya Prakashan, Nainital.

## Applied Ecology

Course Title : Applied Ecology  
Course No : Bot 632  
Nature of the Course: Theory

Full Marks : 100  
Pass Marks: 40  
Year: II

**Course description:** Applied Ecology

**General objective:** to provide an understanding of the multiple uses of natural resources and their management.

**Specific objectives :**

- To make the students familiar with comprehensive resource planning, resource management and conservation and environmental and socio-economic impacts of natural resources
- To develop among the students an ability to evaluate the environmental effects.

**Course Contents:**

**The earth and its mineral resources:** Origin, structure and composition of earth, The earth and its riches, Mineral resources and society, Environmental impacts of mineral exploitation, The sustainable path of mineral need, Natural hazards **8 Hrs.**

**Soil resource and management:** History of land abuse, Factors controlling soil formation, Soil horizons, Soil structure, classification and distribution, Nature of soil nutrients, Nature of soil erosion, Soil conservation **12 Hrs.**

**Water resources:** Unique properties of water, Global supply, demand and uses, Water resource issues, Water resource management **8 Hrs.**

**Food resources:** Plant based food resources (Global and National), World food situation and food security, Agricultural policy, Factors affecting food production, Sustainable agriculture **6 Hrs.**

**Energy resources:** Energy form and use, Laws of thermodynamics, Fossil fuels (oil, natural gas, coal), Nuclear energy, Hydro-energy, Solar energy, Biomass energy, Geothermal energy, Alternative energy resources, Energy efficiency, Energy conservation **8 Hrs.**

**Biodiversity resources:** Status of biodiversity, Sustainable use of biodiversity, Loss of biodiversity, Ecosystem function of biodiversity, Biodiversity related treaties and conventions, Strategy and Action Plans for biodiversity conservation, Rare and endangered plants and animals of Nepal. **12 Hrs.**

**Protected areas:** History of protected areas, Category of protected areas, Protected areas of Nepal, Protected area management: issues and strategies, Protected areas and people **10 Hrs.**

**Human Ecology:** Human environment interaction, Factors affecting human population, The population trend, Population distribution, The status of population control and strategies, Human evolution **8 Hrs.**

**Impact studies:** Impacts of natural and anthropogenic disturbances on environment **8 Hrs.**

**Ecotourism:** History of Tourism and ecotourism, Principles of ecotourism,

Impact of ecotourism, Strategies for ecotourism.	<b>8 Hrs.</b>
<b>Environmental policies and organisations:</b> Environmental policies, Environmental conventions, Environmental legislation, Environmental organizations	<b>10 Hrs.</b>
<b>Application of remote sensing and GIS in ecology</b>	<b>8 Hrs.</b>
<b>Environmental impact assessment (EIA):</b> EIA Principles, EIA requirements and administrative procedures, Approaches and methodologies, EIA procedures, Mitigation measures, Monitoring, EIA guidelines for Nepal, Drafting EIA reports	<b>14 Hrs.</b>

**Text and Reference Books:**

1. Canter, L.W. 1977. Environmental Impact Assessment. McGraw Hill Book Co., New York.
2. CBS, 1998. Environment Statistics, Central Bureau of Statistics, HMG, Nepal.
3. Chaudhary, R. P. 1998. Biodiversity in Nepal. Tecpress, Bangkok.
4. Chiras, D. D. 1994. Environmental Science. The Benjamin Cumming Publishing Co., New York.  
Environment and Biodiversity, ECOS
5. IUCN, 1996. EIA Training Manual, IUCN, Nepal.
6. Jha, P. K. 1992. Environment and Man in Nepal. Craftsman Press. Bangkok.
7. Jha, P. K., Ghimire, G. P. S., Karmacharya, S. B., Baral, S. R. and Lacoul, P. 1996.
8. Jha, S. 1990. Conservation for development in Nepal, National Book Organization, New Delhi.
9. Miller, G. T. Jr. 1995 Living in the Environment, Wadsworth Publishing Co., California
10. Sah, J. P. 1997. Koshi Tappu Wetlands: Nepal's Ramsar Site. IUCN-The World Conservation Union, Bangkok.
11. Schulze, E.D. and Moonen, H.A. 1994. Biodiversity and Ecosystem Function. Springer Verlag.
12. Singh, T. V. and Kaur, J. 1985. Integrated Mountain Development. Himalayan Books, New Delhi.

## Plant Pathology

### Special Paper: Plant Pathology

Course Title: Plant Pathology

Course No: Bot 641

Nature of the Course: Theory

Full Marks : 100

Pass Marks: 40

Year: II

### Course Description: Plant Pathology

**General objective:** To make the M. Sc. program more relevant to the agricultural and academic needs of the country with the introduction of this course study.

#### Specific objectives:

- To provide knowledge on pathogens of plant diseases;
- To develop suitable methods of controlling the disease with the objective of reducing loss in the yield of crops.

#### Course Contents:

Importance of plant pathology. Classification of plant diseases on the basis of causative organisms and symptoms, Mode of Infection and disease development., Koch's postulates. **27 Hrs.**

**Diseases of field crops:** Symptomatology, principle of infection, etiology, dissemination and control of economically important major crops of Nepal Caused by Fungi, Bacteria and Viruses – Cereal crops (Rice, Wheat, Maize and Millet), Cash crops (Sugarcane, Cotton, Jute and Tobacco), Vegetable crops (Potato, Tomato, Cucurbits, Crucifers and Chilly), Pulse crops (Soyabean, Pea and Gram), Oil seed crops (Mustard, Groundnut and Linseed), Fruit crops (Apple, Citrus and Peach) **64 Hrs.**

**Mycoplasma disease:** Citrus-greening. **3 Hrs.**

**Seed pathology:** Introduction and signification of seed born pathogens, Methods of detection of seed-born pathogens, Control of seed-borne pathogens, Role of microorganisms in storage of seed. **12 Hrs.**

**Forest pathology:** Diseases of forest plants. Wood decay and their management. **14 Hrs.**

## Principles of Plant Pathology

Course Title: Principles of Plant Pathology  
Course No : Bot 642  
Nature of the Course: Theory

Full Marks : 100  
Pass Marks: 40  
Year: II

### Course Description: Principles of Plant Pathology

**General objective:** To provide detailed knowledge of the principles of plant pathology.

#### Specific objectives:

- To impart knowledge on epidemics of crops.
- To give insights into the role of environment, host and pathogen to develop diseases.

### Course Contents

History and present status of plant pathology. Production and dissemination of inoculum. Inoculum potential. Host parasite interaction. **20 Hrs.**

Mechanism of disease resistant in plant., Role of Toxins and Enzymes in plant diseases., Wilt diseases: Theories and mechanism., Effect of environment on disease development., Epidemiology of plant diseases and plant disease forecasting., Assessment of disease incidence and crop loss. **46 Hrs.**

Effect of infection on physiology morphology and anatomy of host. , Genetics of Host-parasite interaction., Physiological specialization of plant pathogens., Soil-borne and air-borne plant pathogens., Rhizosphere and root diseases. **38 Hrs.**

Control of plant-diseases: Cultural methods - Host eradication, crop rotation, Sanitation and Tissueculture. Physical methods - Heat treatment, refrigeration's and Radiation. Major classes of fungicides and antibiotics. Resistant varieties. Biological control. Plant Quarantines. **16 Hrs.**

### Text and Reference Books:

1. Bilgrami, K.S. & H.C. Dube (1979), A Text Book of Modern Plant pathology. Vikash Pub. House Pvt. Ltd. New Delhi.
2. Bilgrami, K.S. & R.S. Verma, Physiology of Fungi.
3. Butter, E.J. and S.C. Jones (1948), Plant Pathology. MacMillan & Co. Ltd. London.
4. Manners, J.G. (1982), Principles of Plant Pathology. Cambridge University Press.
5. Mehrotra, R.S., Plant Pathology. Tata McGraw-Hill Publishing Company Ltd. New Delhi.
6. Rangaswami, . (1988), Diseases of crop. Plants In India. Prentice Hall of India.
7. Rangaswami, G. & A. Mahadevan, (1999), Diseases of crop plants in India.
8. Rangaswami, G. (1988), Principles of Plant Pathology. Prentice-Hall of India.

9. Singh, R.N. (1968), Plant Diseases. Oxford University Press.
10. Singh, R.S. (1978), Introduction to Principles of Plant Pathology. Oxford & IBH pub. Co. Pvt. Ltd., New Delhi.
- ✓11. Tarr, S. A. J. (1972), The principles of Plant Pathology. McMillan Press.
12. Walker, J.C. (1969), Pathology. McGraw Hill.
13. Wheeler, B.E.G. (1976), Diseases of crops
- ⑭14. Butler, E.J. (1948), Fungi and Diseases In Plants. Thacker, sprink & Co. Calcutta.
15. Heald, F.D. (1933), Mannual of Plant Diseqases. Mc Graw Hill Book Co. Inc. New York.
16. Horsfall, J.G.& A.E. Diamond (1957), Plant Pathology Vol. I-III Acad. Press.
17. Lilly, V.G. & H.L. Barnett (1957), Physiology of the Fungi. McGraw-Hill Book Company-Inc. New York.
18. Neergard. P. (1977), Seed Pathology.
19. Stakman, F.C. & J.G. Harrar (1957), Principles of Plant Pathology. The Ronald Press, New York.
20. Wood, R.K.S. (1963) Physiological Plant Pathology. Black well Scientific Publication Oxford
21. Phytopathology – American Society of plant pathology.
22. Plant Diseases - American Society of plant pathology

## Plant Biochemistry

### Special Paper: Plant Biochemistry and Plant Biotechnology

Course Title: Plant Biochemistry

Full Marks : 100

Course No: Bot 651

Pass Marks: 40

Nature of the Course: Theory

Year: II

### Course Description: Plant Biochemistry

**General Objectives:** In this course the knowledge on various aspects of Plant Biochemistry have been included so that the students will know the basics of biochemical processes, reactions and their products. Biochemistry is a very essential subject in which enzymes, coenzymes, pigments, proteins, carbohydrates, fats, nucleic acids have been included with their structure, function and their importance.

### Specific Objectives:

- In view of its relevance to Biotechnology, this course is designed to provide to the students adequate knowledge on the various biochemical processes and biochemical pathways.

### Course Contents:

**Carbohydrate:** Different types of monosaccharides, oligosaccharides, and polysaccharides and their biosynthesis. **10 Hrs.**

✓ **Assimilation of nitrogen:** Biological nitrogen fixation and its biochemistry, its significance, Development Of nitrogen fixing root nodule. **6 Hrs.**

**Amino acid :** Structure, type and biosynthesis **10 Hrs.**

**Nucleic acid:** Structure, chemistry, function, biosynthesis of nitrogen base and nucleotides, Replication of DNA, mutation, DNA damage and repair.

**10 Hrs.**

**Organization of nuclear DNA:** The nucleus and chromatin organization, Organisation of DNA sequences, Satellite DNAs, repeated DNA sequence, Genome coding for protein in Prokaryotic and Eukaryotic cells, Transposable elements. **10 Hrs.**

**Structure and expression of nuclear genes:** Transcription and processing of RNA, Ribosomes, Translation, operon concept and control of gene expression, Gene amplification. **10 Hrs.**

**Enzyme:** Chemical nature of enzyme, nomenclature and classification, mechanism of Enzyme action, enzyme kinetics, factor affecting enzyme action, Allosteric enzyme, Inhibition of enzyme action, feedback inhibition and its significance. **6 Hrs.**

**Co-enzyme:** Coenzyme and prosthetic group, structures and functions of coenzymes **8 Hrs.**

**Pigments:** Structure, function and synthesis of chlorophyll, carotenoid, xanthophyll. **5 Hrs.**

**Chloroplast:** Chloroplast organization and function, chloroplast genetics, protein synthesis, Protein transport, ATP production. **5 Hrs.**

**Mitochondria:** Mitochondrial DNA, Protein synthesis, male sterility,

- membrane transport, respiration and ATP synthesis **5 Hrs.**
- Recombinant DNA Technology:** DNA cloning, Enzymes, cloning vectors, Amplification of cloned DNA Sequence, Restriction mapping Chimaeric DNA. **5 Hrs.**
- Differential gene expression during plant development** **8 Hrs.**
- Basic methods of Molecular Biology:** Separation methods, Nucleic acid extraction and purification, Nucleic acid reassociation technique: DNA melting and reassociation, RNA-DNA hybridization, C-DNA, nick translation., Blotting technique, DNA-recombination: Enzymes, DNA vectors, DNA splicing, ligation, transformation, cosmid packing, amplification, C-DNA library, security problem., Gene sequencing, PCR technique **22 Hrs.**

**Text and Reference Books:**

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Robert and J. D. Watson. 1983. *Molecular Biology of cells*. Garland, USA.
2. Annual Review of Plant Physiology (1950 onwards) *Annual Review Inc.*, 4139 EL Camino Way Palo Alto, California, U.S.A.
3. Bonner, J. and Varner, J. E. 1976. *Plant Biochemistry*. Academic Press, N.Y., USA.
4. Conn, E.E. and P. K. Stumpf. 1976. *Outlines of biochemistry*. Wiley Eastern.
5. Darnell, J., H. Lodivh, D. Baltimor. 1990 *Molecular cellbiology*. Free Man.
6. DeRobertis, E. D. and E. M. F. DeRobertis. 1980. *Cell and molecular biology*. Holtsaunden.
7. *Encyclopedia of Plant Physiology* (Vol 1 to recent volumes), Springer Verlag, Berlin, Germany.
8. Srivastava, H.S., 1998 *Essential of Plant Biochemistry*. Rastogi Publication
9. Goodwin, T. W. and E. I. Mercer, 1983. *Introduction to Plant Biochemistry*. Pergamon Press, NY.
10. Griersen, D. (ed.). 1981. *Plant genetic engineering*. Blackie, UK.
11. Griersen, D. and Covey. 1988. *Plant Molecular Biology*. Blackie, UK.
12. Holdt, H. W. 1996. *Plant biochemistry*. Cambridge, UK
13. Jain, 1993. *Fundamentals of biochemistry*, S. Chand and Company.
14. Lehninger, A. H. 1992. *Principles of Biochemistry*. CBS Publication, New Delhi.
15. Lewis, O. A. M. 1986. *Plant and nitrogen*. Adward Arnold, UK.
16. Rastogi, S. C. 1993. *Biochemistry*. Tata McGraw Hill, India.
17. Stryer, L. 1981. *Biochemistry*. WH Freeman.
18. Watson, J. D. 1979. *Molecular Biology of the gene*. Cambridge, UK.
19. Watson, J. D.; Hopkins, NH; Robertis, HJW; Stitz, JK; Weiner, AM; 1987. *Moleclular Biology of the gene*. The Benzamin/cummings Pub. Co./nc. USA / UK/Singapore.
20. White, E. H. 1970. *Chemical Background for the Biological Sciences*. Prentice-Hall, Englewood Cliffs.
21. Wilkins, M. B. (ed.). 1987. *Advance plant physiology*. ELBS Longman, England.

## Plant Biotechnology

Course Title: Plant Biotechnology  
Course No: Bot 652  
Nature of the Course: Theory

Full Marks: 100  
Pass Marks: 40  
Year: II

### Course Description: Plant Biotechnology

**General Objectives:** Plant Biotechnology is the integrated discipline of relevant fields of Plant Sciences such as Plant Physiology, Plant Biochemistry, Plant-Microbe Interaction, Molecular Genetics, Biosafety Measures, etc. This is an integrated course with basic and applied aspects of Plant Science with a knowledge of recent tools of Biotechnology such as PCR, RFLP and other relevant tools in which theoretical and practical aspects have been included.

#### Specific Objectives:

- Included in this course are studies on Micro Propagation, tissue culture, genetic manipulation of plants, Biological Nitrogen Fixation, Algal Biotechnology, Role of Biotechnology in Agriculture and Forestry, Environmental Biotechnology with safety measures.

#### Course Contents

**Micropropagation techniques** : Cellular totipotency, nutrient media, sterilization and contamination, stages of Micropropagation, Types of plant tissue culture Somaclonal and gametoclonal variation. **14 Hrs.**

**Tissue culture for clonal propagation:** Embryo culture, Propagation through axillary

bud, Meristem culture, Callus induction , Suspension culture and single cell culture, somatic embryogenesis, Protoplast culture. **10Hrs.**

**Biosynthesis for secondary plant product:** Suspension culture in bioreactor, Secondary plant product in suspension culture Secondary metabolites in immobilized plant cell. **10 Hrs.**

**Tissue culture for crop improvement:** Somaclonal variation, anther culture invitro fertilization, Somatic hybridization and hybridization, embryo rescue, artificial seed, cryopresevation. **10Hrs.**

**Genetic manipulation of plant:** Basic topics: Transformation, transduction, plasmid, cosmid, restriction endonuclease, Techniques of genetic manipulation of prokaryotic and eukaryotic cells, Vectors, Agrobacterium and Ti-plasmid, Plasmid and phase as vector, direct gene transfer, southern blotting, Nick translation, oligo labeling, biotine marking, digoxigonin marking, RFLP. Gene transformation in plant: Methods of genetic manipulation in economic important plants. Genetic transformation of plants by Agrobacterium: Ti-plasmid, transformation process, Regeneration of transformed plant. Tissue specific expression of promotor and its role. Gene tagging and gene isolation: Transposable element and its role in gene tagging and gene isolation, methods of gene tagging. **48 Hrs.**

**Biological nitrogen fixation:** Mechanism of nitrogen fixation, different prokaryotes as natural nitrogen fixer, Symbiosis of legumes and Rhizobium,

Other symbiosis, N-fixer in association with different economic important crops. **8 Hrs.**

**Algal Biotechnology:** Economic importance of algae, Culture of macro and microalgae (Small scale and Large scale), Cyanobacteria (blue green algae) as biofertilizer, chemicals from algae, Algae in industry. **8 Hrs.**

**Role of Biotechnology in Agriculture and Forestry.** **4 Hrs.**

**Environmental Biotechnology** **4 Hrs.**

**Safety Measures in Biotechnology** **4 Hrs.**

#### **Text and Reference Books:**

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Robert and J.D. Watson. 1983. *Molecular Biology of cells*. Garland, USA.
2. Borowitzka, M. A. and L.J. Borowitzka (eds). 1988. *Micro algal Biotechnology*. Cambridge, UK.
3. Burgess, J. 1985 *An introduction to plant cell developmet*. Cambridge, UK.
4. Chaleff, R. 1981. *Genetics of higher plants application of cell culture*, Cambridge, UK.
5. Cresswell, R. C., T.A.V. Ress and N. Shah (eds). 1989. *Algal and cynobacterial biotechnology*. Longman, UK.
6. Darnell, J., H. Lodivh, D. Baltimor, 1990, *Molecular cell biology*. Free Man.
7. DeRobertis, E. D. and E. M. F. DeRobertis. 1980. *Cell and molecular biology*. Holtsaunden.
8. Dixon, R. (ed.). 1981. *Plant cell-culture a practical approach*. Holtsaunden.
9. Green, C. E., D. A. Somera, W. P. Mackett and D. P. Biesboer. 1987. *Plant tissue and cell culture*. E.I. Brill, Leiden
10. Griersen, D. (ed.). 1981. *Plant genetic engineering*. Blackie, UK.
11. Griersen, D. and Covey. 1988. *Plant Molecular Biology*. Blackie, UK.
12. Gupta, PK. 1997. *Elements of Biotechnology*. Rastogi Publication Delhi.
13. Ignacimuthes, S.J. 1998. *Basic Biotechnology*. Tata McGraw Hill
14. Jacobs, W.P. 1979, *Plant hormones and plant development*. Cambridge, UK.
15. Kumar, H.D. 1996. *Molecular Biology and Biotechnology* Vikash Publishing House Pvt. Ltd. New Delhi.
16. Leopold, AC and Kriedemaun, PE. 1975. *Plant Growth and Development*. Tata McGraw Hill Pub., New Delhi.
17. Lewis, O. A. M. 1986. *Plant and nitrogen*. Adward Arnold, UK.
18. Pierik, R. 1987. *In vitro culture of higher plants*. Martinus Nijhoff.
19. Prasad, B. N. (Ed.) 1999. *Biotechnology and Biodiversity in Agriculture/Forestry*. Science Publishers, Oxford and IBH, New Delhi, India.
20. Razdan, M. K. 1996. *An introduction to plant tissue culture*. Oxford IBH, New Delhi.
21. Reinert, J. and Bajaj, Y. P. S. 1977. *Plant cell and organ culture*. Springer-Verlag, Berlin.
22. Reinert, J. and Yeoman, M. M. 1982. *Plant cell and tissue culture*. A laboratory manual. Harosa publishing house, New Delhi.
23. Smith, J. E. 1996. *Biotechnology*. Cambridge, UK.

## Special Paper Practical

### Special Paper: Plant Systematics and Phytogeography

Course Title: Plant Systematics and Evolution

Full Marks: 50

Course No: Bot 613

Pass Marks: 20

Nature of the Course: Practical

Year: II

### Course description: Plant Systematics

**General objectives:** To provide necessary expertise to the students to collect, preserve and identify the plants for better understanding of the status and the conservation of plant diversity.

### Specific objectives:

- To make the students able to understand the concept of different taxa in the light of recent principles.
- To enable them to make herbaria and to identify the plants.
- To enable them to understand the applied aspects of systematics.

### Course contents:

1. Study of members of a family (morphology, anatomy, palynology, molecular Systmatics etc.)
2. Preparation of Identification keys.
3. Preparation and analysis of phylogenetic trees
4. Field trip and visit to herbaria
5. Mini dissertation.

## Phytogeography and Biosystematics

Course Title: Phytogeography and Biosystematics

Full Marks: 50

Course No: Bot 614

Pass Marks: 20

Nature of the Course: Practical

Year: II

**Course description:** Phytogeography

**General objectives:** To provide information on distribution of plant diversity in global, regional and national perspectives for management of taxonomic data.

**Specific objectives:**

- To familiarize the students with the elements of different floristic regions.
- To familiarize them with the overall vegetation pattern of Nepal.
- to enable them to manage and document taxonomic data.

**Course contents:**

1. Study of local flora of specified area and collective exercise
2. Herbarium management
3. Field trip
4. Preparation and management of biological database.

## Genetics I

### Special Paper: Genetics and Plant Breeding

Course Title: Genetics I

Course No: Bot 623

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 20

Year: II

### Course description: Genetics and Plant Breeding

**General objective:** To make the M. Sc. program more relevant to the professional and academic needs of the country by helping the students have practical experience on genetics.

#### Specific objective:

- To provide advanced knowledge of the basic principles and concepts in the applied cytogenetical field along with its application.

#### Course contents:

1. Cytogenetical techniques to observe physical nature of chromosomes (Material collection, pre-treatment and hypotonic treatment, fixation, mordant staining, squashing, dehydration, mounting).
2. Handling of micrometer for the measurement of cell and its organelles.
3. Handling of Camera Lucida and its drawing.
4. Mitotic phase, Mitotic index and phase indices, polytene chromosome (*Drosophila* larvae).
5. Karyotype- determination of chromosome number, method of chromosome analysis (Centromeric Index), presentation of karyotype and idiogram to understanding evolutionary pattern from different plant species.
6. Study of meiotic stages, meiotic abnormality. Preparation and comment on cytological slide and photographs of (a) Pollen mitosis, (b) B-chromosomes, (c) Inversion bridge, (d) Univalent and multivalent, (e) Cytomixis, (f) Human chromosomes, (g) Observation of Bar-body in human.
7. To find out the Chiasma frequency of the different species.
8. Apparent pollen fertility and genetical segregation during meiosis.
9. Mutation and pollen sterility.
10. Detection of mutagenic effects of chemicals by cytological technique (or effluents, or plant extract).
11. Induction of polyploidy by Colchicine in the root meristem (bulb or seed).
12. Photomicrography techniques for working document.
13. Field visit.
14. Chromosomal banding and genetical analysis.
15. Experiment in *Neurospora*.

## Genetics and Plant Breeding

Course Title: Genetics and Plant Breeding  
Course No: Bot 624  
Nature of the Course: Practical

Full Marks: 50  
Pass Marks: 20  
Year: II

### Course Description: Genetics II

**General objective:** - To make the M. Sc. program more relevant to the professional and academic needs of the country by having the students get practical experience on genetics and plant breeding.

**Specific objective:** -

- To provide advanced knowledge of the basic principles and concepts in the applied field as well as to conduct appropriate techniques in the genetical field.

### Course contents:

1. Cytogenetical techniques to observe physical nature of chromosomes (Material collection, pre-treatment and hypotonic treatment, fixation, mordant staining, squashing, dehydration, mounting).
2. Study of meiotic stages, meiotic abnormality. Preparation and comment on cytological slide and photographs of (a) Pollen mitosis, (b) B-chromosomes, (c) Inversion bridge, (d) Univalent and multivalent, (e) Cytomixis, (f) Human chromosomes, (g) Observation of Bar-body in human.
3. Apparent pollen fertility and genetical segregation during meiosis.
4. Mutation and pollen sterility.
5. Induction of polyploidy by Colchicine in the root meristem (bulb or seed).
6. \*Audio-Visual: Emerging Virus and Bacteria.
7. Photomicrography techniques for working document.
8. Field visit.
9. Experiment on microbial genetic for detection of mutation. (Bacteria as genetical tool)
10. Different methods of plant breeding techniques.
11. \*Experiment on isolation of DNA.
12. \*Agarose gel electrophoresis of DNA fragments.
13. Chromosomal banding and genetical analysis.
14. \*Experiments on genetic code, gene regulation, genetic engineering (recombinant-DNA techniques, etc)
15. Electrophoresis and analysis of genetical material and its product.
16. Experiment in *Neurospora*.
17. \*Analysis of DNAs by Southern Blot Hybridizations.
18. \*Analysis of DNAs by Northern Blot Hybridizations.
19. \*Analysis of Proteins by Western Blot Techniques.
20. \*Detection of genetic variability by gel electrophoresis. (population genetics)
21. Study of Blood groups in human. (multiple alleles effects)

22. Regeneration of plants from Protoplasts and Callus tissue and their chromosomal stability.
23. \*Visualization of DNA in electron microscope.

\*The listed and other practical will be based on theory portion subject to the availability of facilities.

## Advanced Ecology

### Special Paper: Ecology

Course Title: Advanced Ecology

Course No: Bot 633

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 20

Year: II

### Course description: Advanced Ecology

**General Objective:** To impart practical knowledge of various investigation techniques of ecological parameters.

#### Specific Objectives:

- To develop skill and ability of using various kinds of equipment connected with ecological studies.
- To make the students able to collect, summarize and analyse various types of ecological data.

#### Course contents:

1. Summarize the climatic data from Nepal.
2. Summarize the population data from Nepal:  
Population data of Nepal (1951-54, 1961, 1971, 1981, 1991), Population growth rate, Mortality and Natality rate, life, expectancy, Sex Ratio, Age structure, Life Table (use table 3.1, page 37)
3. Enumeration of flora of Hatiban forest (HF).
4. Determination of life form/spectrum of HF.
5. Determination of vegetation similarity and dissimilarity of HF.
6. Quantitative estimation of HF by point center quarter method.
7. Determination of tree trunk BA, Height etc. of different tree species.
8. Determination of IVI of vegetation in the Botany Department.
9. Determination of productivity of an aquatic system by light and dark bottle method.
10. Estimation of tree volume.
11. Measurement of relative growth rate of plant species.
12. To determine the plant-plant interaction (competition among plants) inter and intra species.
13. Effect on pollutant on seed germination.
14. Effect of plant leaf leachates used for ecological study.
15. Details of following equipments used in ecology: Max. and Min. thermometer, Hydrometer, Rain gauge, Lightmeter / Lux meter, Anemometer, Bomb calorimeter, pH meter etc.
16. Vegetation mapping of coronation garden, recently afforested area.

## Applied Ecology

### Special Paper: Ecology

Course Title: Applied Ecology

Course No: Bot 634

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 20

Year: II

**Course description:** Applied Ecology

**General Objective:** To provide practical knowledge on the current techniques of water and soil analysis.

#### **Specific Objectives:**

- To develop skill and ability to analyze soil and water samples and to learn their physical and chemical properties.
- To inculcate practical knowledge about the conservation and management of natural resources through field visits.

#### **Course Contents:**

1. Determination of porosity of different soil samples.
2. Determination of percolation capacity of different soil samples.
3. Determination of water rising capacity of different soil samples.
4. Determination of CO<sub>2</sub> released from soil microbial activity.
5. Determination of soil carbonates and bicarbonates.
6. Determination of humus content by desigmond method.
7. Rapid tests of nitrates, carbonates etc. in the different soil samples.
8. Determination of free CO<sub>2</sub> present in different water samples.
9. Determination of acidity of different water samples.
10. Determination of alkalinity of different water samples.
11. Determination of caloric content of tissue by Bomb Calorimeter.
12. Details of following equipments used in ecology,
  - Max. and Min. thermometer, Hydrometer, Rainguage, Lightmeter/Lux meter, Anemometer, Bomb calorimter, pH meter etc.
13. Field visit report - Industry/Forest.
14. Mini dissertation work.
15. Talk Program.

## *L* Plant Pathology

### **Special Paper: Plant Pathology**

Course Title: Plant Pathology

Course no: Bot 643

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 20

Year: II

### **Course description: Plant Pathology**

**General Objective:** To make the students familiar with the methods of collection, preservation and identification of infected plants.

#### **Specific Objectives:**

- To make the students able to identify the plant diseases.

#### **Course contents:**

1. Study of symptoms caused by parasites.
2. Study of local plant diseases. Those prescribed in the course.
3. Study of seed-borne fungi by standard blotter method.
4. Control of seed-borne pathogens by fungicides.
5. Study of forest plant diseases of Nepal.
6. Study of wood decaying fungi.
7. Collection, identification and preservation of infected specimens.

4

## Principles of Plant Pathology

Course Title: Principles of Plant Pathology

Course no: Bot 644

Nature of the Course: Practicals

Full Marks: 50

Pass Marks: 20

Year: II

**Course description:** Principle of Plant Pathology

**General Objective:** To make the students familiar with the principles of plant diseases.

**Specific Objectives:**

- To develop among the students the skill and ability of using various equipment concerned with pathological studies.
- To make them able to isolate the pathogens from diseased plant, seed, soil and air.

**Course Contents:**

1. Isolation of fungi from soil and air.
2. Isolation and culture of causal organism from diseased plants.
3. Measurement of fungal spores by the use of an ocular micrometer.
4. Germination of fungal spores under different conditions by hanging drop method.
5. Effect of nutrition on spore germination by hanging drop method.
6. Demonstration of cell wall degrading on potato tuber disease.
7. Demonstration of Koch's postulates for fungal pathogen.
8. Demonstration of fusarial wilting on tomato or potato plant.
9. Demonstration of damping off of seedling.
10. Isolation of fungi from rhizosphere and root surface by soil dilution method.

## Plant Biochemistry

### Special Paper: Plant Biochemistry and Biotechnology

Course Title: Plant Biochemistry

Course no: Bot 653

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 20

Year: II

### Course Description: Plant Biochemistry

**General Objectives:** This course is designed to cover biochemical parameters in which relevant biochemical processes are included. Plant biochemistry is the backbone of plant biotechnology so that it includes carbohydrate, protein, fats, pigments, their structure and functions. The students will have to be familiar with the recent trends in biochemistry theoretically and practically.

#### Specific objectives:

- In this course students will have theoretical and relevant practical approaches and students will perform most relevant experiments.

#### Course contents:

1. Separation techniques in biochemistry (5 practicals)
2. Preparation of buffer of different pH and measurement of pH (2 practicals)
3. Extraction and quantitative tests of carbohydrates, proteins, lipids and nucleic acids (12 practicals)
4. Chromatography: column, paper and thin layer (6 practicals)
5. Electrophoresis: Separation of amino acids, polyacrylamide gel electrophoresis and separation of protein, SDS-gel electrophoresis (10 practicals)
6. Spectrophotometry and fluorescence spectroscopy (4 practicals)
7. Separation of pigments from flower and leaf (4 practicals)
8. Quantitative estimation of amino acids (4 practicals)
9. Isolation, separation and estimation of RNA and DNA (8 practicals)
10. Experiments to show the effect of temperature, pH, substrate concentration and enzyme concentration on enzyme activity, e.g. amylase, catalase, phosphorylase (5 practicals)
11. Separation of isoenzyme (4 practicals)
12. Induction and repression of B-galactosidase synthesis (3 practicals)
13. Extraction of chloroplast, mitochondria and other cell organelles (4 practicals)
14. PCR technique (2 practicals)
15. Extraction of essential oil by clavenger extraction (4 practicals)
16. Separation and identification of sugars by paper chromatography (2 practicals)
17. Determination of iso-electric point of proteins (2 practicals)
18. Determination of  $K_m$  and  $V_{max}$  for phosphorylase and amylase (4 practicals)
19. Estimation of total nitrogen by Kjeldal method (4 practicals)

20. Determination of chlorophyll a/b ratio in  $C_3$ ,  $C_4$  and CAM plants (3 practicals)
21. Estimation of  $\alpha$ -amylase activity in wheat seeds as affected by  $GA_3$  (3 practicals)

**Note:** Students are required to perform at least 50% of the practicals mentioned above.

## Plant Biotechnology

### Plant Biotechnology

Course Title: Plant Biotechnology

Course no: Bot 654

Nature of the Course: Practical

Full Marks: 50

Pass Marks: 20

Year: II

### Course Description: Plant Biotechnology

**General objectives:** To provide information on distribution of plant diversity in global, regional and national perspectives for management of taxonomic data.

#### Specific objectives:

- To explain the role of phytogeography in evolution of plants.
- To familiarize them with the elements of different floristic regions.
- To familiarize them with the overall vegetation pattern of Nepal.
- To enable them to manage and document taxonomic data.

#### Course contents:

##### A. *In vitro* culture of plants

1. Introduction of laboratory equipment (4 practical)
2. Sterilization techniques: dry and wet sterilization and surface sterilization (5 practical)
3. Preparation of media (5 practical): Micro propagation technique: axillary bud proliferation, adventitious shoot proliferation, callus culture, organogenesis, somatic embryogenesis, meristem culture, embryo culture, anther culture, suspension culture (60 practical)

##### B. Genetic manipulation technique

1. Extraction and purification of plasmid DNA and plant DNA (5 practical)
2. Restriction enzyme and digestion of DNA (2 practical)
3. Agarose gel electrophoresis (2 practical)
4. Preparation and transformation of competent *E. coli* (5 practical)
5. Construction of chimeric plasmid (5 practical)
6. Isolation of protoplast (2 practical)
7. Technique of protoplast fusion and protoplast culture (4 practical)
8. Isolation of nucleus from protoplast (2 practical)

##### C. Biological nitrogen fixation

Formation of root nodule (5 practical), Rhizobium/Legume symbiosis (5 practical), Measurement of nitrogenase activity (3 practical)

##### D. Algal biotechnology-

Culture of algae (4 practical), Azolla/Anabaena symbiosis (4 practical)

## Biotechnology Electives

Course Title: Biotechnology  
Course No: Bot 671a  
Nature of the Course: Theory

Full Marks: 75  
Pass Marks: 30  
Year: II

**Course Description:** This course is meant an alternative or an option to be offered in lieu of dissertation by the students who are interested in having an elementary knowledge on Biotechnology.

**Objectives:** This course has been designed to cover the applied aspect of Biotechnology.

**Specific Objectives:** This course covers some important but most relevant aspects of Biotechnology in which the contents include:

- Tissue culture, Anther Culture, Micro Propagation, conservation of Genetic resources, Biofertilizers (Rhizobium, Cyanobacteria, Azospirillum), Some biochemical processes have also been included with the structure, function and their significance.

### Course Contents:

#### A. Tissue Culture

**Introduction:** Historical Background of tissue culture , Tissue culture technique , Anther culture and induction of haploids **6 Hrs.**

Application of tissue culture in Agriculture, horticulture, morphogenesis, pathology, Genetics and plant breeding. **20 Hrs.**

Induction of genetic variations through tissue culture technique. **15 Hrs.**

Micropropagation, Somatic hybridization and protoplast fusion., Conservation of genetic resources and tissue culture technique. **12 Hrs.**

**Biofertilizer:** Role of Biological fertilizers: Symbiotic with legumes (Rhizobium-legume symbiosis), Actinorhizal symbiosis (Frankia and nonlegum), Role of cyanobacteria, (free living nitrogen fixing), Azospirillum and Azatobactor for the crop productivity in cereals (rice, wheat and maize) in Nepal. **8 Hrs.**

**B. Plant Biochemistry:** Proteins: Biological significance of proteins, protein synthesis, Carbohydrates: Monosaccharides, oligo-saccharides, Polysaccharides and significance of carbohydrates. Enzymes and coenzymes: Physico Chemical nature, The mechanism of enzyme action, (active site & Regulation), Pigments: Plants pigments and their role. Plant hormones: Mechanism of synthesis and mode of action of IAA, GA<sub>3</sub>, cytokinin and ABA.

**26 Hrs.**

## Biotechnology

Course Title: Biotechnology  
Course No: Bot 671b  
Nature of the Course: Practical

Full Marks: 25  
Pass Marks: 10  
Year: II

**Course Description:** This course, which is offered in lieu of the dissertation, covers various biotechnological processes and methods which has basic and applied significant objective:

**Objective:** In this course the students will be given basic and applied aspects of plant biotechnology on the basis of available equipment and facilities to perform some relevant experiments.

**Specific Objectives:**

- To perform experiments on micropropagation anther culture, tissue culture, symbiotic and free living nitrogen fixing bacteria ;
- To make estimation and measurement of enzymes and, pigments and role of plant hormones.

**Course contents:**

1. The use of various tools and equipments such as spectrophotometer, Gel-Electrophoresis, Poly acrylamide gel, Gas chromatography technique, PCR technique ( 6 part )
2. Preparation of solutions for various media – ( 3 pract. )
3. Experiment on micropropagation technique from axillary bud and leaf, meristem culture, embryo culture, anther culture, - (8 pract.)
4. Nodulation in legumes such as soyabean, Pea, non-legumes, Alnus, cansuarina estimation of nitrogen content in the nodules of the above plants and measurement of nitrogenase activities using gas chromatography, culture of algal sample such as Anabaena, Nostoc, meqasurement of nitrogenase and total nitrogen content in the cultured samples. – (15 practs).
5. Estimation of starch, Carbohydrates, and total nitrogen, protein content, pigments such as chlorophyll, carotenoids pigments, experiments on enzymes such as measurement of amalyase, catalyase nitrate reductase, role of plant hormones in germination of cereal seeds, rice, wheat and maize using IAA, GA<sub>3</sub>, ABA and cytokinin (20 pract.)

**Text and Reference Books: Plant Biochemistry and Plant Biotechnology**

1. Alberts, B., D. Bray, J. Lewis, M. Raff, K. Robert and J.D. Watson. 1983. *Molecular biology of cells*. Garland, USA.
2. Borowitzka, M.A. and L.J. Borowitzka (eds). 1988. *Micro algal Biotechnology*. Cambridge, UK.
3. Burgess, J. 1985. *An introduction to plant cell developmet*. Cambridge, UK.
4. Chaleff, R. 1981. *Genetics of higher plants application of cell culture*, Cambridge, UK.

5. Cresswell, R.C., T.A.V. Ress and N. Shah (eds). 1989. Algal and cyanobacterial biotechnology. Longman, UK.
6. Darnell, J., H. Lodivh, D. Baltimor. 1990. Molecular cell biology. Free Man.
7. DeRobertis, E.D. and E.M.F. DeRobertis. 1980. Cell and molecular biology. Holtsaunden.
8. Dixon, R. (ed.). 1981. Plant cell culture a practical approach. Holtsaunden.
9. Green, C.E., D.A. Somera, W.P. Mackett and D.P. Biesboer. 1987. Plant tissue and cell culture. E.I. Brill, Leiden
10. Griersen, D. (ed.). 1981. Plant genetic engineering. Blackie, UK.
11. Griersen, D. and Covey. 1988. Plant molecular biology. Blackie, UK.
12. Gupta, PK. 1997. Elements of Biotechnology. Rastogi Publication Delhi.
13. Ignacimuthes, S.J. 1998. Basic Biotechnology. Tata McGraw Hill
14. , Jacobs, W.P. 1979. Plant hormones and plant development. Cambridge, UK.
15. Kumar, H.D. 1996. Molecular Biology and Biotechnology Vikash Publishing House Pvt. Ltd. New Delhi.
16. Leopold, AC and Kriedemaun, PE. 1975. Plant Growth and Development. Tata McGraw Hill Pub., New Delhi.
17. Lewis, O.A.M. 1986. Plant and nitrogen. Adward Arnold, UK.
18. Pierik, R. 1987. In vitro culture of higher plants. Martinus Nijhoff.
19. Prasad, B.N. (Ed.) 1999. Biotechnology and Biodiversity in Agriculture/Forestry. Science Publishers, Inc. USA, New Hampshire, USA.
20. Razdan, M.K. 1996. An introduction to plant tissue culture. Oxford IBH. New Delhi.
21. Reinert, J. and Bajaj, Y.P.S. 1977. Plant cell and organ culture. Springer-Verlag, Berlin.
22. Reinert, J. and Yeoman, M.M. 1982. Plant cell and tissue culture. A laboratory manual. Harosa publishing house, New Delhi.
23. Smith, J.E. 1996. Biotechnology. Cambridge, UK.

## Biodiversity and Their Management

Course Title: Biodiversity and Their Management  
Course No: Bot 672a  
Nature of the Course: Theory

Full Marks: 75  
Pass Marks: 30  
Year: II

### Course description: Biodiversity and their Management

**General Objectives:** The overall aim of the course is to make the students knowledgeable about, capable of, and responsible for the management of biodiversity

#### Specific Objectives:

To familiarise the students with:

- Concept, value, assessment, monitoring of biodiversity
- Causes of loss of biodiversity
- Management constraints of biodiversity
- Indigenous knowledge and biodiversity conservation
- Biodiversity prospecting and its legal mechanism
- Convention, treaties and institutions on biodiversity conservation
- National act and regulations.

#### Course Contents:

**Biological diversity:** Concept, value, types (genetic and subcellular, taxonomic, ecological), Status (National, regional, global), Importance, The road to Rio and Post Rio development **5 Hrs.**

**Plant diversity:** Inventory of Planet earth, measuring biodiversity, islands, hotspots, biodiversity and Global climate change. **5 Hrs.**

**Center of species diversity:** Species-Area relationship, evolution of biodiversity, speciation, keystone species. **5 Hrs.**

**Extinction:** Loss of biodiversity, endemic, threatened plant diversity. **5 Hrs.**

**Guide to the convention on biological diversity:** Important articles on the convention on biological diversity, role of NGOs and other international mechanism in implementing the convention (BioNet, GEF). **10 Hrs.**

**Conservation, constraints and opportunities:** Biodiversity conservation in Asia-Pacific Region, social dimensions of biodiversity conservation, approaches by IUCN, ADB, World Bank; Conservation approach in Nepal – Inside and outside Protected areas, Traditional agro-ecosystems, agroforestry, landscape diversity, Expanding human capacity to conservation, Economics of Biodiversity **13 Hrs.**

**Indigenous Knowledge and biodiversity conservation.** Creating incentives and conditions for local biodiversity conservation, Principles to guide indigenous peoples and sustainability, Communities (Peoples) participation. **5 Hrs.**

**Biodiversity and Environment Impact Assessment (EIA).** Objectives and criteria of EIA, law and mechanism, biosafety, EIA in agriculture and forestry. **5 Hrs.**

- Biodiversity prospecting.** Concept, issues, contracts, management policies. **5 Hrs.**
- Intellectual Property Rights (IPRS).** Concept, survey, practice and political challenges, IPRs of indigenous peoples, Farmers right and plant genetic resources, various options for *sui generis* systems. **8 Hrs.**
- Conservation of plant genes.** The utilization of DNA, recent advances in DNA, fingerprinting and DNA chips, DNA Bank-Net. **5 Hrs.**
- Preservation of Germplasm.** Objectives and needs, germplasm resources, techniques. Information system, ownership, management and utilization. **5 Hrs.**
- Core collection of Plant Genetic Resources.** Analysis of genetic diversity, sampling strategies, genetic markers, testing and use of core collection. **5 Hrs.**
- Biodiversity Management.** Diversity and Development, policies, legal and institutional issues, international conventions and treaties (CGIAR, GATT, TRIPS), national Acts. **5 Hrs.**
- Panel Discussion** **4 Hrs.**

## Biodiversity and their Management

Course Title: Biodiversity and their Management  
Course no: Bot 672b  
Nature of the Course: Practical

Full Marks: 25  
Pass Marks: 10  
Year: II

### Course Description: Biodiversity and their Management

**General objectives:** To help the students make a study of biodiversity at different levels and to make them familiar with concerning management techniques.

**Specific objectives:**

- To enable the students to make an assessment of plant diversity at different levels
- To help them explore and be familiar with the indigenous knowledge of biodiversity management
- To make them able to conduct Environmental Impact Assessment and Biodiversity Monitoring

**Course Contents:**

1. Study plant diversity at the levels of :
  - a. Ecosystem
  - b. Species
  - c. Gene
1. Study biodiversity under different gradients.
2. Exploration of indigenous knowledge for biodiversity management.
3. Environment Impact Assessment for biodiversity assessment.
4. Monitoring biodiversity as indicator species.
5. Database preparation
6. Mini Project (Field or Laboratory base)
7. Panel discussion.

**Text and Reference Books:**

1. Adams, R.P. and Adams, J. (Eds.). 1998. Conservation and Utilization of African Plants. Missouri Botanical Garden Press, USA.
2. Adams, R.P., Miller, J.S., Golenberg, E.M. and Adams, J.E. (Eds.) 1994. Conservation of Plant Genes II: Utilization of Ancient and Modern DNA. Missouri Botanical Garden, USA.
3. Anonymous, 1994. Biodiversity Conservation in the Asia and Pasific Region. Asian Development Bank & IUCN.
4. Applied Anthropology, Oklahoma city, USA.
5. Bania, A. M. S. and S. R. Shakya. 1999. Vegetation and Flora of South-west Kathmandu Valley (Chandragiri). L. S. Shakya, Kathmandu.
6. Bryant, P.J. (1998 ) Biodiversity and Conservation /University of california, Irvine.
7. Chaudhary, R. P. 1998. Biodiversity in Nepal. Status and Conservation. Tec Press, Bangkok, Thailand.

8. Courrier, K.(Ed.) 1992. *Global Biodiversity Strategy*, WRI/IUCN.UNEP.
9. Davis, P.H. and Heywood, V.H. 1963. *Principles of Angiosperm Taxonomy*. Oliver and Boyd, Edinburgh & London
10. Glowka, L., Burhenne-Guilmin, F. and Sygne, H. 1994. *A guide to the convention on Biological Diversity*. IUCN-The World Conservation Union.
11. Greaves, T. 1994. *Intellectual Property Rights for Indigenous Peoples*. Society for
12. Groombridge, B. 1992. *Global Biodiversity*. Chapman & Hall.
13. Hodgkin, T., Brown, A.H.D., Van Hintum, Th. J.L. and Morales, E.A.V. (Eds.) 1995. *Core collections of Plant Genetic Resources*. John Wiley & Sons.
14. IUCN 1997. *Indigenous peoples and sustainability*.IUCN.
15. Jeffries, M.J. 1997. *Biodiversity and Conservation*. Routledge, London & New York.
16. Knutson, L. and Stoner, A. (1989). *Biotic Diversity and Germplasm presentation*, Global Imperatives. Kluwer Academic Publishers.
17. Krattiger, A.F. 1994. *Widening Perspectives on Biodiversity*/Natraj Publishers, Dehra Dun.
18. Martin, G.J. 1995. *Ethnobotany-a methods manual* Chapman & Hall.
19. Reid, W.V., S. A. Laird, C. A. Meyer, R. Gamez, A. Sittenfeld, D. H. Janzen, M. A. Gollin and C. Juma. 1993. *Biodiversity Prospecting: Using Genetic Resources for sustainable Development*. WRI/IUCN/UNEP Global Biodiversity strategy.
20. S. R. Shakya. 1999. *Cytogenetical Studies in the Genus Primula L. and Its allies of Nepal Himalaya: A Research Report*. L. S. Shakya, Kathmandu.
21. Stace, C.A. 1980. *Plant Taxonomy and Biosystematics*. Edward Arnold, London.
22. Wilson, E.D. (Editor) 1988. *Biodiversity*. National Academy Press, Washington D.C.
23. Bhatt, D. D. 1977. *Natural History and Economic Botany of Nepal*. Orient Longman Ltd.

## Economic Botany, Ethnobotany and Community Development

Course Title: Economic Botany, Ethnobotany and  
Community Development

Course No: Bot 673a

Nature of the Course: Theory

Full Marks: 75

Pass Marks: 30

Year: II

**Course Description:** Economic Botany, Ethnobotany and Community Development

**General objectives:** To motivate the students to pursue their areas of special interest through a choice of an elective subject and help them develop professional competence in the related fields.

**Specific objectives:**

- To give the students an exposure to the application of the knowledge of plant science to the welfare of mankind and to provide knowledge about the conservation and management of economically important plants.
- To acquaint them with the knowledge about the origin, distribution, culture, cultivation, processing and economic uses of various plants and plant products and to provide knowledge about the plant use of different communities
- To give them an understanding of the socio-economic impact of plant products in community development.

**Course Contents:**

### A. Economic Botany

Impact of plant resources on human civilization and national economy., Chemical constituents of plant products and their classification and utilization.

**14 Hrs.**

Food value of plants.:General account of the important cereals, legumes, vegetables and fruits. Lower plants as a supplementary of food., Plants used as spices, condiments and other flavoring stuffs.

**14 Hrs.**

Industrial and agricultural values of plants.: Definition, classification, characteristics of plant fibers and fiber based industry. Starch and cellulose products: Paper and sugar industry. Tannins and dyestuff; Rubber and latex; Gums and Resins; Drugs and medicines; Tea and coffee; Essential oils; Vegetable oils (Fatty oils and waxes); Alkaloids; Antibiotics; Insecticides and herbicides; Wood industry; Lower plants in the industry and agriculture

**22 Hrs.**

### B. Ethnobotany and community development.

Definition, Scope and Perspective., Fields of ethnobotany, Status of ethnobotany, Methods and Approaches for ethnobotanical study., Ethnoecology.

**20 Hrs.**

Application of ethnobotany for sustainable management of plant resources.

**10 Hrs.**

Application of ethnobotany for conservation and community development.

**10 Hrs.**

## Economic Botany, Ethnobotany and Community Development

Course Title: Economic Botany, Ethnobotany and  
Community Development

Course No: Bot 673b

Nature of the Course: Practical

Full Marks: 25

Pass Marks: 10

Year: II

**Course Description:** Economic Botany, Ethnobotany and Community Development

**General objectives:** To make the students familiar with the diverse types of plant resources of significant economic importance.

**Specific objectives:**

- To make the students capable of making collection, preservation and identification of useful plants.
- To make them able to document and analyze information about the plants used by different communities for various purposes.

**Course Contents:**

1. Study of various chemical constituents of plant products of economic value.
2. Study of following with living / preserved materials: Plants of food value and products, Plants of industrial value and products
3. Collection, preservation, identification and record keeping of useful plants, Inventory of useful plants.
4. Rapid ethnobotanical Appraisal PRA for ethnobotanical research.
5. Mini-dissertation work.

**Text and Reference Books**

1. A.F. Hill, 1952. *Economic Botany*. Tata McGraw Hill Pub. Comp. Ltd. New Delhi
2. S.L. Kochhar, 1998. *Economic Botany in the Tropics*. MacMillan India
3. S.Sen, 1998. *Economic Botany*. New Central Book Agency, Calcutta.
4. T.C. Majapuria, 1999. *Nepal Nature's Paradise*. Craftmas Press, Bangkok.
5. R.P. Chaudhary, 1998. *Biodiversity in Nepal* Tec Press, Bangkok.
6. K.K. Shrestha, P.K.Jha, Pei Shengji, A. Rastogi, S. Rajbhandary, M. Joshi, 1998. *Ethnobotany for Conservation and Community Development*, Ethnobotanical Society of Nepal.
7. L.S. Copley, *An introduction to the Botany of Tropical crops*. Longman, Green London.
8. *The Wealth of India* – A Dictionary of Raw materials and Industrial Products. CSIR, New Delhi.
9. Grary J. Martin, 1995. *Ethnobotany: A Methods Manual*. Chapman & Hall.
10. Bhatt, D. D. 1977. *Natural History and Economic Botany of Nepal*. Orient Longman

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