INDEX

DEPARTMENT OF BOTANY
SEMESTER – II

COURSES OFFERED BY DEPARTMENT OF BOTANY

Category-I

Botany (H) Courses for Undergraduate Programme of study with Botany as a Single Core Discipline

DISCIPLINE SPECIFIC CORE COURSE – 4: Microbiology and Plant-Microbe Interactions

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Microbiology and Plant-Microbe Interactions	**DSC-4**	**2**	0	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biology/ Biotechnology**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

To impart basic understanding about microbial world and their interactions with plants.

Learning outcomes

The Learning Outcomes of this course are as follows:

- Understanding microbes and their roles and applications.
- Understanding about modes of reproduction of Viruses, Archaebacteria, Eubacteria.
- Understand plant-microbe interaction

SYLLABUS OF DSC-4

Unit 1: Introduction 01 Week

Microbial world, Growth and nutrition of microbes with reference to nutritional media.

Unit 2: Viruses 3.5 Weeks

Discovery; Physicochemical and biological characteristics; Classification (Baltimore); General structure with special reference to viroids and prions, DNA and RNA viruses; General account and mechanism of replication, lytic and lysogenic cycle; General account of viral diseases of plants (mosaic and vein clearing disease).

Unit 3: Bacteria 4.5 Weeks

Discovery, General characteristics; Types - Archaebacteria, Eubacteria, Wall less forms (Mycoplasma, Phytoplasma and Spheroplasts); Cell structure; Nutritional types; Reproduction - vegetative, asexual and recombination (conjugation, transformation and transduction); General account of bacterial diseases of plants (Citrus canker, Angular leaf spots of cotton).

Unit 4: Applied Microbiology 02 Weeks

Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics and agriculture. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Unit 5: Plant-Microbe interactions 04 Weeks

General account of Plant-microbe interactions; Plant growth promoting rhizobacteria (PGPR); Mechanism of nitrogen fixation by Cyanobacteria and Rhizobia; Types of mycorrhizal association with plants; Ectomycorrhiza and Endomycorrhiza and their effects on plant growth.

Practicals:

1. Study of Viruses: Electron micrographs / Model - T-Bacteriophage and TMV; specimens/digital resources/ Line drawings of Lytic and Lysogenic Cycle. 02 Weeks
2. Study of Bacteria: Electron micrographs of bacteria; Types of Bacteria from temporary/permanent slides. Endospore, Binary fission, Conjugation, Root nodule

through specimens/digital resources. 02 Weeks

3. Study of Plant Growth Promoting Rhizobacteria (PGPR) through specimens/digital resources (at least three). 01 Week
4. Gram staining to differentiate between Gram-positive and Gram-negative bacteria. 02 Weeks
5. Study of *Rhizobium* from root nodules of a leguminous plant. 02 Weeks
6. Isolation of *Anabaena* from *Azolla* leaves. 02 Weeks
7. Histochemical staining to observe Arbuscular Mycorrhizal Fungi (AMF) colonization in roots. 02 Weeks
8. Study of Bacterial diseases (Citrus canker, Angular leaf spots of cotton) and viral diseases of plants (mosaic and vein clearing disease) through specimens/digital resources.

02 Weeks

Suggested Readings:

1. Pelczar, M.J. (2001) Microbiology, 5th edition. New Delhi, Delhi: Tata Mc-Graw- Hill Co.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2016) Microbiology: An Introduction, Indian edition, Pearson India Education Services Pvt. Limited, Noida, India
3. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, 6th edition: McGraw Hill, New Delhi.
4. Gupta, R., Chugh, G. (2022) Plants, Microbes and Diseases 1st Edition, I.K. International Pvt. Ltd., Delhi.
5. Subba Rao, N.S. (2000) Soil Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

Additional Resources:

1. Talaro, K.P., Talaro, A. (2006). Foundations in Microbiology. Mc-Graw Hill, New Delhi

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 5: Plant Resources and Economic Botany

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Resources and Economic Botany	DSC-5	**2**	0	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biology/ Biotechnology**	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize students with the economic importance of diverse plant species and train them in identifying plants of economic importance through field visit/s, live plant specimens, herbarium specimens and digital resources.
- To make students understand the importance of various plant parts and derived products used as food, fibers, medicines, oils and other economically important products.
- To acquaint students with the processing of various economically important plant resources and train them to identify and analyses nutrients using simple microchemical tests.

Learning outcomes

The Learning Outcomes of this course are as follows:

- This course would provide students with information about the economic importance and products derived from plants and their roles in our daily lives.
- Students will learn to perform micro-chemical tests to study presence of various components.
- Students will explore the regional diversity in food crops and other plants and their

ethnobotanical importance.

SYLLABUS OF DSC-5

Unit 1: Introduction and Origin of Cultivated Plants 01 Week

Importance of Plant Resources; Vavilov's concept for the Origin of cultivated plants; Centres of Origin (Primary and Secondary); Centres of diversity, Harlan's concept of gene pools. Plant Genetic Resources and their conservation.

Unit 2: Cereals 02 Weeks

Wheats (Origin, Evolution of Wheats (tetra- & hexaploid), Morphology, Production, and Economic Importance of Hexaploid Wheat); Rice (Origin-Monophyletic and Polyphyletic, Production, Morphology, Comparison between *indica* and *japonica* Rice, Parboiling, Economic Importance); Other cereals: Maize, Barley, Oats, Millets (jowar, bajra, ragi) and Pseudocereals.

Unit 3: Legumes 1.5 Weeks

General account (Nutritive Value of Pulses, Protein Malnutrition, Lathyrism,
Favism, Ecological Importance); chick pea and pigeon pea (Production, Morphology and Economic Importance). Other Legumes: Lentil, Cluster Bean, Lathyrus, Beans, Pea, Cowpea, Fodder legumes and Green manure crops.

Unit 4: Sugars and Starches 1.5 Weeks

Sugarcane (Morphology, Ratooning, Nobilization, Products and By- products); Potato (Morphology, Tuber Anatomy, Seed Tubers vs True Potato Seeds and Economic uses).

Unit 5: Spices, Condiments & Flavourings 1.5 Weeks

General Account (Spices, Condiments, Culinary Herbs and Essences, with examples), Importance of Spices, Clove (Morphology, Anatomy of part used and Economic Importance) and Black Pepper (Morphology, Anatomy of part used and Economic Importance). Other examples: Ginger, Turmeric, Cinnamon, Saffron, Cardamom, Chillies & Pepper, Fennel, Coriander, Cumin, Vanilla, Nutmeg.

Unit 6: Beverages 01 Week

Types of Beverages (Alcoholic and Non-Alcoholic) with examples, Tea and coffee (Morphology, Chemistry, Processing and Economic Importance)

Unit 7: Fibres and Fibre-yielding plants 1.5 Weeks

Classification of Fibres based upon their Origin (surface fibres, bast fibres, and leaf fibres, with examples); Jute (morphology, extraction and economic importance), Cotton (*Gossypium* species, morphology, processing and economic importance) Comparison between Jute and Cotton fibers. Other examples: Flax, Hemp and Coconut.

Unit 8: Oil-Yielding Plants 1.5 Weeks

Fatty Oils and Essential Oils, Comparison between Fatty Oils and Essential Oils; Fatty Oils (Classification with examples, keeping quality), Groundnut (Morphology and Economic Importance); Essential Oils (General characteristics, Methods of Extraction and Economic Importance, with examples). Other examples: Rapeseed & Mustard (canola), Coconut, Olive, Castor, Cottonseed, Sesame, Soybean, Linseed.

Unit 9: Medicinal and Drug-Yielding Plants 01 Weeks

Brief Account of Therapeutic Drugs with Examples; Morphology, Chemical Constituents, Economic Importance of *Cinchona, Rauwolfia, Digitalis.*

Unit 10: Fumigatory & Masticatory 01 Week

Tobacco **(**Morphology, species - *Nicotiana tabacum* & *N. rustica*), Processing, Products, Economic Importance and Health Hazards), *Cannabis*, *Papaver* (Morphology, Chemical Constituents, Economic Importance)

Unit 11: Rubber 0.5 Week

Para Rubber - *Hevea brasiliensis* (Morphology, Tapping of latex, Processing, Products and Economic Importance)

Unit 12: Fruits & Nuts 0.5 Week

Tropical & Temperate; *Citrus*, Mango, Banana, Apple, Pineapple, Papaya; Nuts: Cashew, Walnut, Almond & Pistachio.

Unit 13: Vegetables 0.5 Week

Common examples of root crops, leafy vegetables (herbag), fruit seed vegetables;

Practicals:

1. **Cereals**: Wheat (Habit Sketch, L.S/T.S. grain, W.M. starch grains, Micro-chemical tests), Rice (Habit Sketch, study of paddy and grain, W.M. starch grains, Micro- chemical tests). Millets - Pearl Millet, Finger Millet and Pseudocereals - Amaranth Grain, Quinoa (specimens/digital resources and grains) 02 Weeks
2. **Legumes**: Chickpea, pigeonpea (Habit, fruit, seed structure, Micro-chemical tests). 01 Weeks
3. **Sugars and Starches**: Sugarcane (Habit Sketch, Products and By-products, Cane Juice- Micro - chemical tests); Potato (Habit Sketch, Tuber morphology, T.S. tuber to show localization of starch grains, W.M. starch grains, Micro-chemical tests). 02 Weeks
4. **Spices**: Clove, Blackpepper (Habit and sections L.S./T.S.), Saffron, fennel (specimen/digital resources) 01 Week
5. **Beverages**: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans) 01 Week
6. **Fibres**: Jute (specimens/digital resources of *Corchorus capsularis* and *C. olitorious*, T.S. stem, test for cellulose and lignin on section of stem and fibre). Cotton (specimen, W.M. seed to show lint and fuzz; W.M. fibre and test for cellulose) 02 Week
7. **Oil-Yielding Plants**: Fatty Oils: Groundnut (Habit-specimen, Fruit, seeds, Microchemical Tests) Coconut-Habit (photograph), Fruit, T.S. nut, Mustard - (Habit-specimen, Fruit, seeds); Essential Oils: Habit Sketch of Rose, Jasmine, Vetiver, Sandalwood and *Eucalyptus* (specimens/photographs) 02 Weeks
8. **Drug-Yielding plants:** Habit - Fever Bark Tree, Poppy, Foxglove and Cannabis (Specimens/ Photographs) 02 Weeks
9. **Tobacco:** *Nicotiana tabacum* and *N. rustica* (specimens/photographs), Tobacco Products
10. **Rubber:** Para Rubber-Habit, Tapping of latex (Specimen/photograph), Rubber Products 01 Week
11. **Petro-crops:** *Saccharum officinarum* , *Jatropha* sp. 01 Week

Suggested Readings:

1. Kochhar,S.L. (2012). Economic Botany in Tropics. New Delhi, India: MacMillan & Co.

2. Kochhar, S.L. (2016). Economic Botany – A Comprehensive Study, 5th Edition. New Delhi, India: Cambridge University Press.
3. Wickens, G.E. (2001). Economic Botany: Principles & Practices. The Netherlands: Kluwer Academic Publishers.
4. Chrispeels, M.J., Sadava, D.E. (1994). Plants. Genes and Agriculture. Jones & Bartlett-Publishers.
5. Berg L, (2008). Introductory Botany: Plants, People, And The Environment, Thomson Brooks/Cole.
6. Cook F.E.M. (1995). Economic Botany: Data Collection Standard Royal Botanic Garden, Kew, Richmond.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 6: Plant Systematics

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Plant Systematics	**DSC-6**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biology/ Biotechnology**	**Nil**

Learning Objectives

The course will help students gain knowledge about:

- The basics of plant systematics and its inter-relationships with allied subject areas

Learning outcomes

On completion of the course the students will be able to:

- understand technical terminology used in plant taxonomy
- apply the terminologies to describe, identify and classify flowering plants
- search and analyse taxonomic information from internet-based scientific databases and other resources
- interpret and evaluate the concept of species and evolutionary processes in angiosperms
- comprehend and compare various systems of classifications
- recognise diversity in local/regional flora
- appreciate the significance and application of systematics in science and welfare of society

SYLLABUS OF DSC-6

Unit 1: Introduction 01 Week

Identification, Classification (types) and Nomenclature, Phylogeny; Major contributions - Parasara, Charaka, Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan, Bremer, MW Chase

Unit 2: Resources in Plant Identification 01 Week

Literature (Floras, Manuals, *Icones*, Monographs, Revisions, Journals, e-resources); Herbaria and Botanical gardens (in brief)

Unit 3: Systematics - An Interdisciplinary Science 02 Weeks

Relevance of palynology, cytology, phytochemistry and molecular data (cite at least

(streak, spread & pour), replica plating, serial dilution.

three examples from each with emphasis on application in resolving taxonomic problems - details of techniques to be excluded)

Unit 4: Botanical Nomenclature 2.5 Weeks

Principles and rules (ICN); Ranks and names; Principle of priority and its limitations; Concept of 'Type', Author citation, Valid publication, Rejection of names; Nomenclature of hybrids

Unit 5: Systems of Classification 03 Weeks

Taxonomic hierarchy; Concept of species (morphological, biological and evolutionary); Classifications - Bentham and Hooker's (up to series), Engler and Prantl's (upto sub-class) and Angiosperm Phylogeny Group (APG) classification (major clades).

Unit 6: Approaches in Systematics 03 Weeks

Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly, clades and grades).

Phenetics - Principles, Methodology, Characters; Selection of OTUs, Character weighing and Coding; Cluster analysis; Phenogram.

Cladistics - Principles, Methodology, Characters; Selection of EUs, Character weighing and Coding; Cluster analysis; Cladogram

Unit 7: Evolution of Angiosperms 2.5 Weeks

Concept of a primitive flower (Euanthial theory and Pseudanthial theory); Basal Living Angiosperms; Herbaceous origin; Co-evolution of angiosperms with animals.

Practicals:

1. Field trip/ Visit to any herbaria/ Botanical Garden. 01 Week
2. To prepare at least five herbarium specimens and identify them using available resources (Literature, herbaria, e-resources, taxonomic keys) and classify up to family level (according to Bentham and Hooker's classification and comapare it with APG IV System in the field note book). 02 Weeks
3. Description of taxa using semi-technical terms and identification of the families according to Bentham and Hooker's classification and compare the placement of family with APG IV System (Only placement of family according to APG IV system to be mentioned)

12 Weeks

Note: Any **twelve** families from the following list to be studied with **at least two** specimens (**or one** where limitations exist).

List of Suggested Families (*mandatory)
Acanthaceae, Amaranthaceae, *Apiaceae, Apocynaceae, *Asteraceae, *Brassicaceae, *Euphorbiaceae, *Fabaceae, *Lamiaceae, Liliaceae, *Malvaceae, Moraceae, *Poaceae, *Ranunculaceae, *Solanaceae

Suggested Readings:

1. Simpson, M. G. (2019). Plant systematics. 3rd Edition, Academic press.
2. Singh, G. (2019). Plant Systematics- An Integrated Approach. 4th edition. CRC Press, Taylor and Francis Group.
3. Stuessy, T.F. (2009). Plant Taxonomy: The Systematic Evaluation of Comparative Data, 2nd edition, Columbia University Press.
4. Taylor, D.V., Hickey, L.J. (1997) Flowering Plants: Origin, Evolution and Phylogeny.

CBS Publishers & Distributers, New Delhi.

5. Pandey, A. K., Kasana, S. (2021). *Plant Systematics*. 2nd Edition. CRC Press Taylor and Francis Group
6. http://www.mobot.org/MOBOT/research/APweb/
7. Maheshwari, J. K. (1963). The flora of Delhi. Council of Scientific & Industrial Research.
8. Maheshwari, J. K. (1966). Illustrations to the Flora of Delhi. Council of Scientific & Industrial Research.
9. Harris, J. G., Harris, M. W. (2001). Plant Identification Terminology: An Illustrated Glossary. Spring Lake, Utah: Spring Lake Pub. Spring Lake, Utah.
10. Radford, A. E. (1974). Vascular plant systematics. Harper & Row Publishers, New York, London.
11. Judd, W.S., Campbell, L.S., Kellogg, E.A., Stevens, P.F., Donoghue, M.J. (2016) Plant Systematics: A Phylogenetic Approach. 4th edition. Sunderland, MA: Sinauer Associates

Additional Resources:

1. The Angiosperm Phylogeny Group, Chase, M. W., Christenhusz, M. J.M., Fay, M. F., Byng, J. W., Judd, W. S., Soltis, D.E. Mabberley, D. J., Sennikov, A. N., Soltis, P. S., Stevens, P. F. (2016). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants*:* APG IV. Botanical journal of the Linnean Society 181 (1): 1–20.
2. Soltis, D. E., Bell, C. D., Kim, S., Soltis, P. S. (2008). Origin and early evolution of angiosperms. Annals of the New York Academy of Sciences 1133: 3-25.
3. Scutt, C. P. (2021). The origin of angiosperms. In Evolutionary developmental biology: a reference guide. Cham: Springer International Publishing.
4. https://www.mobot.org/MOBOT/research/APweb/treeapweb2s.gif
5. https://www.digitalatlasofancientlife.org
6. http://apps.kew.org/herbcat/navigator.do
7. https://efloraofindia.com/
8. https://powo.science.kew.org/
9. Page, R.D.M., Holmes, E.C. (1998). Molecular Evolution: A phylogenetic approach. Blackwell Publishing Ltd.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

Category II

Botany Courses for Undergraduate Programme of study with Botany as one of the Core Disciplines

(B.Sc. Programmes with Botany as Major discipline)

DISCIPLINE SPECIFIC CORE COURSE – 2: Genetics and Molecular Biology

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Genetics and Molecular Biology	**DSC-6**	**2**	**0**	**2**	10+2 from any recognized Board with Biology & Candidates must appear in CUET in the following subject combination: **Physics+ Chemistry+ Biology/ Biotechnology**	**Nil**

Learning Objective

To apprise students with the basic principles of Genetics and Molecular Biology and its applications in living systems

Learning Outcome:

Students would be able to

- understand the fundamentals of Mendelian inheritance and non-Mendelian inheritance.
- describe the concepts of linkage and crossing over and their usage in constructing genetic maps.
- gain knowledge about chromosomal aberrations and mutations.
- become familiar with structure and function of nucleic acids with reference to replication, transcription and translation.
- understand the mechanisms of gene regulation

SYLLABUS OF DSC-02

Unit 1: Mendelian genetics and extrachromosomal inheritance 03 Weeks

Mendel's principles of inheritance; chromosomal theory of inheritance; incomplete dominance and co-dominance; multiple allelism; lethal alleles (dominant and recessive lethals); deviations of Mendelian dihybrid ratio (Epistatic interactions-Dominant, Recessive, Duplicate Dominant, Duplicate Recessive, Duplicate Gene Interaction, Dominant - Recessive); polygenic inheritance; numericals based on above; extrachromosomal inheritance (Chloroplast Inheritance: Variegation in Four O` clock plant; Mitochondrial inheritance: petite mutants in yeast); Maternal effect (shell coiling in snails).

Unit 2: Structure & Function of the gene 01 Week

Classical and molecular concept of gene - Benzer's cis-trans complementation analyses & fine map of rII locus in phage. Central Dogma.

Unit 3: Linkage, crossing over and chromosome mapping 1.5 Weeks

Discovery; linkage and crossing over; recombination frequency: two factor crosses; sex linkage (eye color in *Drosophila*; colour blindness and haemophilia in humans).

Unit 4: Variation in chromosome number and structure 1.5 Weeks

Haploidy, polyploidy, autopolyploidy (examples: banana, watermelon), allopolyploidy (ancestry of wheat) and aneuploidy (Down's, Turner's and Klinefelter's syndromes); Deletion; Duplication (Bar eye in *Drosophila*); Inversion (paracentric and pericentric); Translocation (*Rhoeo, Oenothera;* Robertsonian translocation, Familial Down Syndrome and cancer).

Unit 5: DNA structure and replication 1.5 Weeks

Discovery of DNA; Watson and Crick model of DNA structure; semiconservative replication (Meselson & Stahl's experiment); DNA replication mechanism in *E. coli* (semi-discontinuous mode and Y-fork).

Unit 6: Mutations 1.5 Weeks

History; mutation types with examples [spontaneous and induced; somatic and germinal; biochemical mutations; point mutations (base substitutions): transition and transversion; deletion and frameshift mutations), missense and nonsense mutations]; Molecular basis of mutation; Mutagens - physical (UV and X-rays), chemical mutagens [Base analogues, deaminating, alkylating and intercalating agents] and Transposons.

Unit 7: Gene expression 03 Weeks

Genetic code; Structure and types of RNA; Transcription and Translation in Prokaryotes; Transcription, RNA processing and Translation in Eukaryotes.

Unit 8: Regulation of gene expression: Prokaryotes 02 Weeks

Inducible and repressible systems, negative and positive control of lactose operon and tryptophan operon. **Eukaryotes -** Transcriptional gene silencing - Role of chromatin, DNA methylation, histone modifications; cis-acting elements (promoters & enhancers/silencers), trans-acting factors; Post-transcriptional gene regulation (RNA interference/ PTGS), role of small RNAs, Epigenetics.

Practicals:

1. To study mitosis in *Allium cepa* through squash preparation of root tips. 01 Week
2. To study meiosis in *Allium cepa* through smear preparation of anthers. 02 Weeks
3. To study incomplete dominance and deviations of Mendelian dihybrid ratio (12:3:1, 9:3:4, 9:7, 15:1, 13:3) through seed samples. 02 Weeks

a) Human Genetics b) Study of autosomal & sex-linked dominant & recessive inheritance through pedigree analyses. c) n ABO blood group testing using kits, d) To study the syndromes (Down's, Klinefelter's, and Turner's) through karyotypes 02 Weeks

4. To study chromosomal aberrations: reciprocal translocation through squash preparations of *Rhoeo* anthers. Complex translocation ring, quadrivalents, lagging chromosomes, dicentric/inversion bridge through permanent slides.

02 Weeks

5. To prepare LB medium, inoculate and maintain (spread plate, streak plate, pour plate & serial dilution methods) *E. coli* cultures. 02 Weeks
6. To isolate genomic DNA from cauliflower and *E.coli*. Visualise using agarose gel electrophoresis. 02 Week
7. To estimate DNA by diphenylamine method. 01 Week

Suggested Readings:

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, 8th edition. New Delhi, Delhi: John Wiley & sons.

2. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2020). Introduction to Genetic Analysis, 12th edition. New York, NY: W.H. Freeman and Co.

3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2020). Concepts of Genetics, 12th edition. San Francisco, California: Benjamin Cummings.

Additional Resources:

1. Russell, P. J. (2010). Genetics- A Molecular Approach. 3rd Edition. Benjamin Cummings

2. Snustad, D.P., Simmons, M.J. (2016). Principles of Genetics, 7th Edition. New Delhi, Delhi: John Wiley & sons

3. Pierce, B. A. (2020). Genetics: A Conceptual Approach Seventh Edition, Macmillan

COMMON POOL OF GENERIC ELECTIVES (GE) COURSES OFFERED BY THE DEPARTMENTS

GENERIC ELECTIVES (GE-6)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Ethnobotany	GE-06	4	2	2	NIL	NIL

Learning Objectives

- To have the knowledge of the plants used by the local communities, tribals, ethenic groups, their nutritive and medicinal value.

Learning outcomes

After studying this course the student will gain knowledge about:

- Students would have an understanding of the treasure, value and usefulness of the natural products and their efficient use by the local communities as food and medicine and their conservation practices.

SYLLABUS OF GE-6

Unit 1: Introduction to Ethnobotany and Basic Taxonomy 03 Weeks

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science, databases and knowledge resource (Traditional Knowledge Digital Library), The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, and their life styles,Plants used by the indigenous societies: a) Food plants b) Medicinal plants c) intoxicants and beverages d) Resins and oils and miscellaneous uses.

Unit 2: Applied Ethnobotany 3.5 Weeks

Role of ethnobotany in modern Medicine, Medico-ethnobotanical sources in India; Significance of the following plants in ethnobotanical practices (along with their habitat and morphology): a) *Azadiractha indica,* b) Ocimum sanctum, c) *Vitex negundo,* d) *Gloriosa superba*, e) *Tribulus terrestris,* f) *Pongamia pinnata,* g) *Cassia auriculata,* h) *Indigofera tinctoria*.

Unit 3: The Ecology of Ethnobotany 3.5 Weeks

Ethnobotany—Spirits, Lore, Material Cultures, Folk Magic, Narcotics, Stimulants; Nutritional Ethnobotany – Agriculture, foraging and wild foods; Linguistic Ethnobotany—Botanical Classification and Ethics; Medicinal Ethnobotany and Ethnopharmacology; Ethnoveterinary knowledge

Unit 4: Research Methods in Ethnobotany 03 Weeks

Etic and Emic Perspectives: a) Field work; b) Herbarium; c) Ancient Literature and oral traditions; d) Archaeological finding inferences; e) Religious and sacred places.

Unit 5: Protecting Knowledge 02 Weeks

Ethnobotany and legal aspects, Ethnobotany as a tool to protect interests of ethnic groups, Sharing of wealth concept with few examples from India, Biopiracy, Intellectual Property Rights and Traditional Knowledge; Case studies of traditional medicines leading to development of modern pharmaceutical products (use of *Trichopus zeylanicus* by kanhi tribe and Artemesia sp. for malaria cure)

Practicals:

- Collection, identification and preparation of herbarium of three ethno-botanically important plants with appropriate references
- Preparation of crude extract of ethno-botanically important plants with appropriate references (any method to be used)
- Project work-documentation, literature survey, and collection of information on ethno-botanically useful plants from traditional healers)

Suggested Readings:

- Jain, S.K. (2010). Manual of Ethnobotany. Rajasthan: Scientific Publishers.
- Martin, G.J. (1995). Ethnobotany: A Methods Manual. Chapman Hall
- Cunningham, A.B. (2001). Applied Ethnobotany: People, Wild Plant Use and Conservation. Earthscan, London.
- Young, K.J. (2007). Ethnobotany. Infobase Publishing, New York.
- Schmidt, B.M., Cheng, D.M.K. (Eds.) (2017). Ethnobotany: A Phytochemical Perspective. John Wiley & Sons Ltd. Chichester, UK.
- Research papers from various Scientific Journals for case studies.

GENERIC ELECTIVES (GE-7)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Exploring Nature through Lens	GE-07	4	2	2	0	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- To provide students a comprehensive introduction to photography, including both aesthetic and technique.
- To get students to rethink the environment in which they live through the medium of pictures.
- To become thoroughly familiar with digital camera and smartphone photography technology.
- To develop a working knowledge of digital image modification,
- To understand the importance and use Nature photography in your business and career prospects.
- To enhance appreciation for the tremendous beauty inherent in plants and gardens.

Learning outcomes

On successful completion of this course, a student will be able to:

- understand the digital camera or smartphone camera functions.
- use different photographic equipment to enhance their photographic skills.
- know about the photographic variables with weather and season.
- exploit their photographic work in various professions and for entrepreneurship development.

SYLLABUS OF GE-7

Unit 1: Basics of Photography and Videography **05 Weeks**

History and development of digital photography, Introduction to lenses and camera, Definitions (Megapixel, Magnification, Resolving Power, Zoom feature, contrast and brightness of image), Types of lenses, analog camera, Digital camera, SLR camera, imaging system in camera. Role of lighting, depth of field, focal length, colour and contrast in photography, types of photography and techniques, working of camera: exposure, shutter speed and aperture.

Understanding Image: Types of shots: distance, angle and movement; digital image basics: image format, resolution, aspect ratio, Pixels, DPI and PPI, composition and aesthetics: rules and guidelines.

Unit 2: Diversity of Nature: Colours and Landscape **05 Weeks**

Importance of plants as natural products, General characteristic features of various plant life forms (Single celled, colonial forms, filamentous forms and multicellular and complex forms). General account of diverse landscaping patterns based on different geographical locations, plant adaptations and ecological interactions, role of plant pigments (diverse forms of alga, leaf coloration, floral pigments) in aesthetic appeal.

Unit 3: Diversity around us - A magnified view **2.5 Weeks**

Principles of Microscopy: Dissection and compound microscope, scanning electron microscope. importance of sample preparation for microscopy, staining techniques.

Unit 4: Photographic visualisation of Nature **2.5 Weeks**

Sensitization of Biodiversity conservation; Thematic depiction of nature in Art galleries; Eco-tourism: a general account; role of photography in Eco-tourism and ecological discourse.

Practicals:

1. To study the parts of a digital camera.
2. To study the principle and working of digital camera/ smartphone camera.
3. Working and handling of light microscopes (Dissection and Compound).
4. Study of plant forms through microscopic lens (Single celled, colonial forms, filamentous forms, multicellular and complex forms).
5. To study techniques of capturing shots (using light and lenses effectively, macro and micro photography, wide angle and close-ups).
6. Study of plant adaptations through photographs (Aquatic and desert plants).
7. To capture and understand the Ecological Interactions.
8. Identification of different plant life forms through online available tools/ search engines.
9. Outdoor/ Campus Photography: Plants, Environment, Landscapes and cityscape, Mushrooms.
10. Project Work: To make a portfolio of diverse landscaping patterns/ selected theme through outdoor visits.

Suggested Readings:

1. Ang., T. (2008). Fundamentals of modern Photography. London, Mitchell.
2. Patterson, F. (1999). The Art of Seeing. Key Porter Books.
3. Fitzharris, T. (2011). Landscape Photography. Firefly Books.
4. Kelby, S. (2012). The digital photography book. Peachpit Press.
5. Langford, M., Fox, A., Smith, R.S. (2013). Langford basic photography: the guide for serious photographers. Amsterdam: Focal Press/Elsevier.
6. Peterson, B. (2016). Understanding exposure: how to shoot great photographs with any camera. AmPhoto Books.
7. Karp, G. (2010). Cell Biology, 6th edition. New Jersey, U.S.A.: John Wiley & Sons.

Additional Resources:

1. Sharma, P.D. (2010.) Ecology and Environment. Meerut, UP. Rastogi Publications.
2. Wilson, K., Walker, J. (2018). Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press

GENERIC ELECTIVES (GE-8)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Agricultural Botany and Weed Science	GE-08	4	2	2	NIL	**Nil**

Objectives: To gain the knowledge on

- Requirement of the conditions for seed germination
- Growth hormones, plant development and flowering conditions
- Weeds and the methods to control weeds

Learning Outcomes:

After completion of this course the students would be able to understand:

- how is the quality of seeds judged and how are the suitable conditions for the seed germination created?
- how are the growth, flowering and fruiting in plants managed through the applications of hormones?
- how are weeds managed in commercial crops?

Unit 1: Seed Physiology **02 Weeks**

Seed dormancy types, factors, mechanism and methods for breaking dormancy, seed viability, seed vigour and seed germination.

Unit 2: Physiology of Crop Growth and Yield **2.5 Weeks**

Growth, methods of growth analysis, factors affecting growth, concept of phytotronics and Fertilizers (Nitrogen, Phosphorus, biofertilizers).

Unit 3: Regulation of Growth and Development **02 Weeks**

Role of hormones in plant growth and development, growth retardant.

Unit 4: Reproductive Physiology and Senescence **03 Weeks**

Physiology of flowering, Photoperiodism, vernalization, physiology of fruit ripening, senescence and regulation of senescence.

Unit 5: Biology of Weeds **02 Weeks**

Ecology of weeds, competition, reproduction of weeds. Allelopathy and Invasive Plants.

Unit 6: Crop Management Practices **3.5 Weeks**

Mechanical, Cultural, Biological and Chemical Weed control. Some abnoxious weeds and their management, Integrated pest management (IPM).

Practicals:

1. To study the effect of ethylene on shelf life of cut flowers./ To study the effect of cytokinin on leaf senescence.
2. To test the viability of weed seeds.
3. To study the allelopathic effects of weeds on germination of crop seeds.
4. To study the effect of herbicides on seed germination and seedling growth of weeds.
5. Determination of pH and analysis of a soil sample for carbonates, chlorides, sulphates, organic matter and base deficiency by rapid field tests.
6. To perform the qualitative test for Nitrogen (NH^{4+}, NO^{3-}, urea) in a fertilizer and the soil sample.
7. Demonstration / photographs for the mechanisms used in herbicide application.
8. Field trip to a crop land to study weeds.
9. Submission of any two properly dried and mounted weed specimens with the herbarium label.

Suggested Readings:

1. Ashton, F. M., Monaco, T. J. (2002). Weed Science: Principles and Practices. New Jersey, U.S.: John Wiley and Sons. Inc.
2. Hopkins, W. G., Huner, N. P. A. (2009). Introduction to Plant Physiology, 4th edition. New Delhi, Delhi: Wiley India Pvt. Ltd.
3. Taiz, L., Zeiger, E., Moller, I. M., Murphy, A. (2018). Plant Physiology and Development International 6th edition. New York, NY: Oxford University Press, Sinauer Associates.
4. Mandal, R.C. (1990). Weeds, weedicides and weed control: Principle and Practice. New Delhi, Delhi: Agro Botanical Publishers.
5. Rao, V. S. (1999). Principles of Weed Science. Oxford and IBH Publishers, New Delhi.
6. Subramanian, S. (2017). All about weed control. New Delhi, Delhi: Kalayani publishers.

GENERIC ELECTIVES (GE-9)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Intelligent Systems in Plants	GE-09	4	2	2	0	**Nil**

Learning Objectives

- The course aims to lay the foundations on plant intelligence and develops understanding of the intelligent adaptively variable behaviour of plants.

Learning outcomes

The Learning Outcomes of this course are as follows:

- The students will be learning the concepts of intelligence, distinction between development and intelligent behaviour and morphological /adaptive strategies employed by plants to survive.

SYLLABUS OF GE-09

Unit 1: Introduction **02 Weeks**

An Introduction to Plant Structure (Morphological and Anatomical details), compartmentalization

Unit 2: Plants and Intelligence **1.5 Weeks**

Introduction to Plant Intelligence and Memory - Historical Perspective

Unit 3: Sensory Biology **02 Weeks**

Cell to cell communication, Self-recognition, Recognition of Neighbours and Relatives.

Unit 4: Learning in Plants **03 Weeks**

Habituation learning, Learning by association (Rhizosphere and Mycorrhizae), Adaptive Intelligence (Hydrophytes, Xerophytes, Parasites, Carnivorous plants, Thermogenic plants),

Response to water, heat, salt, cold stress. Mechanical and chemical defence against predators with special reference to secondary metabolites.

Unit 5: Intelligent Behaviour of Plants 6.5 Weeks

A Guided tour to Plant Movements (Tropic Movements, Movement towards gravity, light, tracking sun movements, prey driven movements, liberation movements), Intelligent response to minerals and light (Seed germination, root cap, response of shoot, leaf morphology and anatomy), Unique pollination and seed dispersal mechanisms, Osmosis, Short and long-distance transport of water and food, Metabolic redundancy, Life Cycle Signaling in response to external stimuli (Reactive Oxygen Species, peptides, receptors, hormones).

Practicals:

1. Study the structure of plant cell using temporary mount
2. Study of the cell as an osmotic system (Plasmolysis and Deplasmolysis).
3. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
4. Extraction and qualitative analysis of alkaloids, flavonoids, tannins and phenols.
5. To study the phenomenon of seed germination (effect of light).
6. To study light sensitivity and etiolation vs. de-etiolation.
7. Morphology and orientation of chloroplasts in leaves growing in light and dark, plasmodesmata connections and plasma membrane receptors. (through photographs or other digital resources)
8. Estimation of total photosynthetic pigments.
9. Study of (a) Root cap (b) Trichomes: non-glandular and glandular (c) Leaf Morphology and Anatomy. (d) pulvinus anatomy in *Mimosa pudica.* (e) Specialised motor tissue at the base of monocot leaves
10. (a) Study of morphological and anatomical adaptations of hydrophytes, xerophytes. (b). Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants).
11. Pollination types (selected) and associated seed dispersal mechanisms

Suggested Readings:

1. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
2. Evert, RF., Eichhorn, S.E. (2012). Raven Biology of Plants, 8th edition, New York, NY: W.H. Freeman and Company.

3. Koller, D. (2011). The Restless Plant. Edited by Elizabeth Van Volkenburgh, Haward University Press, Cambridge, Massachusetts, and London, England.
4. Crang, R., Lyons-Sobaski, S., Wise, R. (2018) Plant Anatomy- A Concept based approach to the structure of seed plants, Springer Nature, Switzerland.

Additional Resources:

Trewavas A. (2017). The foundations of plant intelligence. Interface Focus 7: 20160098. http://dx.doi.org/10.1098/rsfs.2016.0098

GENERIC ELECTIVES (GE-10)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course
		Lecture	Tutorial	Practical/ Practice		
Informatics and Statistics for Biology and Allied Sciences	GE-10	4	2	2	0	**Nil**

Learning Objectives

The Learning Objectives of this course are as follows:

- To build an understanding in silico/computational approaches in various aspects of understanding biology and biological research.
- To build analytical skills and integrate the principles of statistical analyses for robust interpretation of biological observations.

Learning outcomes

The student will understand

- the basics of bioinformatics and develop awareness of the interdisciplinary nature of this field.
- learn about biological databases, sequence retrieval, alignment, and phylogenetic analysis using various tools.

- understand the basic concept of sampling methods, data classification, presentation and statistical analysis.

SYLLABUS OF GE-10

Unit 1: Introduction to Bioinformatics **1.5 Weeks**

Historical background, Aims and scope, bioinformatics in Genomics, Transcriptomics, Proteomics, Metabolomics, Systems biology and drug discovery, Applications and Limitations in bioinformatics.

Unit 2: Biological databases **02 Weeks**

Introduction to biological databases - Primary, secondary and composite databases. Study of following databases: NCBI (GenBank, PubChem, PubMed and its tools (BLAST)), introduction to EMBL, DDBJ, UniProt, PDB and KEGG.

Unit 3: Basic concepts of Sequence alignment **02 Weeks**

Similarity, identity and homology. Concepts of alignment (gaps and penalty); Alignment – pairwise and multiple sequence alignments

Unit 4: Molecular Phylogeny **02 Weeks**

Introduction to Molecular Phylogeny, methods of construction of phylogenetic trees: maximum parsimony (MP), maximum likelihood (ML) and distance (Neighbor-joining) methods.

Unit 5: Biostatistics **01 Week**

Biostatistics – definition, Basics of descriptive and inferential statistics; Limitations and applications of biostatistics.

Unit 6: Data types and presentation **1.5 Weeks**

Primary and secondary data; Sampling methods (in brief); tabulation and presentation of data;

Unit 7: Descriptive Statistics **02 Weeks**

Measures of central tendency - mean, median, and mode; Measures of dispersion - range, standard deviation, and standard error.

Unit 8: Correlation and Regression **1.5 Weeks**

Types and methods of correlation, Introduction to simple regression equation; similarities and dissimilarities between correlation and regression.

Unit 9: Statistical inference **1.5 Weeks**

Hypothesis – (simple hypothesis), student's t test, chi-square test.

(Note: Numerical based questions of unit 7, 8 and 9 should be covered only in practical)

Practicals:

1. Biological databases (NCBI, EMBL, UniProt, PDB)
2. Literature retrieval from PubMed
3. Sequence retrieval (protein and gene) from NCBI (formats - FASTA, GenBank and GenPept formats)
4. Protein Structure retrieval from PDB (in pdb format) and visualization by viewing tools (Ras Mol/ J mol/Mol*/Swiss 3D Viewer/Pymol)
5. Multiple sequence alignment (MEGA/Clustal omega)
6. Construction of phylogenetic tree (PHYLIP/ MEGA/ Clustal omega).
7. Making of Bar diagrams, Pie chart, Histogram, Frequency polygon, Cumulative frequency curve (any four) in the given data set using Microsoft Excel
8. Calculation of mean, mode, median, standard deviation and standard error (through manual calculation and using Microsoft Excel) (use only ungrouped data)
9. Calculation of correlation coefficient values by Karl Pearson's /Spearman Rank methods (through manual calculation and using Microsoft Excel)
10. Student's t-test (using Microsoft Excel only), chi square test (Manual and using Microsoft Excel)

Suggested readings:

1. Ghosh, Z., Mallick, B. (2008). *Bioinformatics – Principles and Applications*, 1st edition. New Delhi, Delhi: Oxford University Press.
2. Baxevanis, A.D., Ouellette, B.F., John (2005). *Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins*, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
3. Roy, D. (2009). *Bioinformatics*, 1st edition. New Delhi, Delhi: Narosa Publishing House.
4. Andreas, D., Baxevanis, B.F., Francis, Ouellette. (2004). *Bioinformatics: A practical guide to the analysis of genes and proteins*, 3rd edition. New Jersey, U.S.: John Wiley and Sons.

5. Khan, I.A., Khanum, A. (2004). Fundamentals of Biostatistics, 5th edition. Hyderabad: Ukaaz publications.
6. Campbell, R.C. (1998). Statistics for Biologists. Cambridge, U.S.A.: Cambridge University Press

Additional Resources:

1. Pevsner, J. (2009). Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.
2. Xiong, J. (2006). Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press.
3. Mount, D.W. (2004). Bioinformatics: Sequence and Genome analysis 2nd edition, Cold Spring Harbor Laboratory Press, USA.
4. Zar, J.H. (2012). Biostatistical Analysis, 4th edition. London, London: Pearson Publication.
5. Pandey, M. (2015). Biostatistics Basic and Advanced. New Delhi, Delhi: M V Learning.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

Nomenclature of certificate/diploma/degrees:

- ✓ After securing 44 credits (from semester I and II), by completing one year of study of the UG honours Programme with Botany as a single core discipline, if a student exits after following due procedure, he or she shall be awarded **Undergraduate Certificate in Botany.**

- ✓ After securing 88 credits (from semester I, II, III & IV), by completing two years of study of the UG honours Programme with Botany as a single core discipline, if a student exits after following due procedure, he or she shall be awarded **Diploma in Botany.**

- ✓ After securing 132 credits (from semester I to VI), by completing three years of study of the UG honours Programme with Botany as a single core discipline, if a student exits after following due procedure, he or she shall be awarded **Bachelor of Science (Honours) in Botany.**

- ✓ After securing 176 credits (from semester I to VIII), by completing four years of study of the UG honours Programme with Botany as a single core discipline

and writes dissertation, the student shall be awarded **Bachelor of Science (Honours with Research) in Botany.**

- ✓ After securing 176 credits (from semester I to VIII), by completing four years of study of the UG honours Programme with Botany as a single core discipline and engages in Academic Project/Entrepreneurship, the student shall be awarded **Bachelor of Science (Honours with Academic Project/Entrepreneurship) in Botany.**