

(CBCS) B.SC. LIFE SCIENCE

Biodiversity (Microbes, Fungi, Algae and Archegoniates)
(LSCC2)
Core Course - (CC) Credit:6

Course Objective(2-3)

This course aims at making a familiarity with special groups of Bacteria, Viruses, Fungi , algae and plants reproduction . Creating an understanding by observation and table study of representative members of phylogenetically important groups should be able to make students learn the process of evolution in a broad sense. Study of morphology, anatomy, reproduction and developmental changes thereinthrough typological study should create a knowledge base in understanding plant diversity, economic values, taxonomy of lower group of plants. To acquaint the students with external and internal basic structure and cellular composition of the Bacteria, Viruses, Fungi, Bryophytes and Pteridophytes and Gymnosperms .To gain knowledge of diversity, life forms, life cycles, morphology and importance of microorganisms (Bacteria and algae.)To introduce students with various fungal groups and lichens, their ecology, classification, characteristics, reproduction and economic Importance

2. To introduce students with the phytopathology, its concepts and principles
3. To acquaint with various plant diseases, causal organisms and their control

To correlate structure with important functions of different organs of the organisms .

Study of various tissue systems and their development and functions in plants

Course Learning Outcomes

the students will be made aware of the various groups of organisms , Bacteria, viruses, algae bryophytes, pteridophytes and gymnosperms that have given rise to land habit .. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity. to my knowledge students should create their small digital reports where they can capture the zoomed in and zoomed out pictures as well as

videos in case they are able to find some rare structure or phenomenon related to these plants. Students would have understanding of the classification, characteristics features, cell structure and growth and reproduction in viruses, bacteria, and various groups of marine and fresh water algae and their ecological and economic importance.

Upon completion of this course, the students will be able to:

1. Understand the world of fungi, and pathogens of plants
2. Appreciate the characteristics of the fungi
3. Understand the ecological and economic significance of lichen
4. Understand the application of mycology in various fields of economic and ecological significance
5. Understand the economic and pathological importance of fungi, bacteria and viruses
6. Identify common plant diseases and their control measures

Unit 1

MICROBES (14 Lectures)

a) Viruses – Discovery; General Structure- RNA virus (TMV) and DNA virus (Tphage); Replication-Lytic and Lysogenic Cycle; Economic Importance.

b) Bacteria – Discovery; General Characteristics and Cell Structure; Reproduction-Vegetative, Asexual and Genetic Recombination (Conjugation, Transformation and Transduction); Economic Importance.

Unit 2

ALGAE (8 Lectures)

General Characteristics; Outline Classification (Fritsch); Economic Importance; Thallus Organization and Reproduction in Nostoc, Chlamydomonas, Vaucheria and Ectocarpus

Unit 3

FUNGI (8 Lectures)

General Characteristics; Outline Classification (Webster); Economic Importance; Thallus Organization and Reproduction in Rhizopus, Penicillium, Alternaria and Puccinia

Unit 4

ARCHEGONIATES (30 Lectures)

a) Bryophytes (10 Lectures) General Characteristics; Outline Classification; Ecological and Economic Importance; Morphology, Structure and Reproduction in Marchantia, Anthoceros and Funaria.

Unit 5

b) Pteridophytes (10 Lectures) General Characteristics; Outline Classification; Economic Importance; Morphology, Structure and Reproduction in Selaginella, Equisetum and Pteris.

Unit 6

c) Gymnosperms (10 Lectures) General Characteristics; Outline Classification; Economic Importance; Morphology, Structure and Reproduction in Cycas and Pinus.

Practical

MICROBES

a) Viruses- Structure of TMV and T-Phage (EMs/ Models/ Photographs); Lytic and Lysogenic Cycle (Line Drawings/ Photographs).

b) Bacteria-Types and Structure (Permanent Slides/ Photographs); EM Bacterium; Binary Fission and Conjugation (Photographs).

Chlamydomonas-E.M., Nostoc, Vaucheria and Ectocarpus- Study of Vegetative and Reproductive Structures through Temporary Preparations and Permanent Slides.

Rhizopus, Penicillium and Alternaria- Asexual Stage from Temporary/ Tease Mounts, Puccinia-Black Stem Rust of Wheat and Infected Barberry Leaves (Herbarium Specimens/ Photographs), Tease Mounts of Spores on Wheat, Section of infected portion of Wheat and Barberry (Permanent Slides).

a) Bryophytes: Marchantia-Morphology of Thallus, W.M. Rhizoids, V.S. Thallus through Gemma Cup, W.M. Gemma (all Temporary Slides), L.S. Sporophyte (Permanent slide). Anthoceros- Morphology of Thallus, W.M. Rhizoids, L.S./ T.S. Capsule, W.M. Spores, W.M. Pseudoelaters, (all Temporary Slides), L.S. Sporophyte (Permanent slide). Funaria- Morphology of Gametophyte bearing Sporophyte, W.M. Rhizoids, W.M. Leaf, W.M. Operculum, W.M. Peristome, W.M. Spores (all Temporary Slides), L.S. Capsule (Permanent Slide).

b) Pteridophytes: Selaginella- Morphology, T.S. Stem, W.M. Strobilus, W.M. Microsporophyll and Megasporophyll (all Temporary Slides), L.S. Strobilus (Permanent

Slide). Equisetum- Morphology, T.S. Stem (Internode), L.S./ T.S. Strobilus, W.M. Sporangiochore, W.M. Spores (Wet and Dry) (all Temporary Slides). Pteris- Morphology, V.S. Sporophyll, W.M. Sporangium, W.M. Spores (all Temporary Slides), W.M. Prothallus with Sex Organs (Permanent Slide).

c) Gymnosperms: Cycas- Morphology (Coralloid Roots, Leaf, Microsporophyll, Megasporophyll), T.S. Coralloid Root (Permanent Slide), V.S. Leaflet, V.S. Microsporophyll, W.M. Spores (all Temporary Slides), L.S. Ovule (Permanent Slide). Pinus- Morphology (Long and Dwarf Shoots, Male and Female Cones), W.M. Dwarf Shoot, T.S. Needle, L.S/ T.S. Male Cone, W.M. Microsporophyll, W.M. Microspores (all Temporary Slides), L.S Female Cone (Permanent Slide).

References

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, McGraw Hill, India. 6th edition.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson
6. R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
8. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
9. Agrios, G.N. 1997 Plant Pathology, 4th edition, Academic Press, U.K.
10. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
11. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
12. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
13. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, Indi
14. Parihar N.S 1972, Bryophyta . Central Book depot Allahabad
- Parihar NS. 1972. Pteridophyta. Central Book depot Allahabad
- Puri , P, Bryophyta.

Vashistha BR

Singh, Pandey, Jain.

Kaur I and Uniyal PL 2019. . Text Book of Gymnosperms

which are based on CBCS syllabus and give readers entire new phylogenetic system of classification and many more recent trends in research.

references may be made to works of Christenhauz and Reveal 2011 for gymnosperms

Crandall- Stotler et al fo

Teaching Learning Process

Visual media would be used for teaching. Botany Department, University of Delhi may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. College teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process

Assessment Methods

Making drawings from the temporary preparations as practical record books. We may ponder over making students involve in highlighting the salient features of the genera/ groups through digital media such as ppt and animations.

Keywords

Bacteria, Viruses, Algae, Cyanobacteria, algal reproduction, viroids, bacterial reproduction, Fungi, Ascomycota, Puccinia Agaricus, slime molds, symbiotic association, economic importance, Fungal disease, Bacterial disease, TMV

Course Objective(2-3)

The Objective of this paper is to provide basic knowledge of plant internal architecture and cellular composition and reproduction. This help them to understand how different plant tissue structure evolve and modify their functions with respect to their environment.

Course Learning Outcomes

Knowledge regarding anatomy equipped the students to identify different types of tissues and make them able to correlate their physiology in a better away. This will also help them to understand how different plant tissue evolve and modify their structure and functions with respect to their environment. Knowledge regarding embryology make them understand how reproduction play significant role in defining population structure, natural diversity and sustainability of ecosystem in a better way

Unit 1

Meristematic and permanent tissues (8 lectures)

Simple (parenchyma, collenchyma, sclerenchyma) and complex tissues (xylem, phloem), Root and shoot apical meristems (describe theories in brief with special reference to Tunica Corpus and Korper-Kappe theory)

Unit 2

Organs (4 lectures)

Structure of dicot and monocot root stem and leaf.

Unit 3

Secondary Growth (8 lectures)

Vascular cambium: structure and function, seasonal activity. Secondary growth in root

and stem, Wood (heartwood and sapwood)

Unit 4

Adaptive and protective systems (8 lectures)

Epidermis (trichomes and hair), cuticle, stomata: structure and type (Metcalfe and Chalk Classification); General account of adaptations in xerophytes and hydrophytes (Examples may be cited from Nerium, Opuntia, Hydrilla and Nymphaea).

Unit 5

Introduction to Reproduction (5 lectures)

Modes of reproduction in plants: vegetative options - natural and artificial; introduction and Significance of sexual reproduction.

Unit 6

Structural organization of flower (10 lectures)

Organization of flower, Structure; Anther and Pollen (No developmental stage); Ovules: Structure and types; Embryo sac: Types special reference to Polygonum type.

Unit 7: Pollination and fertilization (10 lectures)

Pollination mechanisms and adaptations; Double fertilization and triple fusion; Seed: Structure (Dicot and Monocot, No developmental stages) appendages and dispersal mechanisms.

Unit 8: Embryo and endosperm (10 lectures)

Endosperm types (one example of each type), structure and functions; Dicot and Monocot embryo; Embryo endosperm relationship (General account).

Practical

Practical

1. Study of meristems through permanent slides and photographs.

2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)

3. Stem: Monocot: Zea mays; Dicot: Helianthus.
4. Root: Monocot: Zea mays; Dicot: Helianthus.
5. Leaf: Dicot and Monocot (only Permanent slides).
6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).
7. Structure of anther (young and mature).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac (Permanent slides/photographs).
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) Photographs/specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

References

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas. Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.
3. Raven P. et al. Biology of plants Seventh edition (2005). W. H. Freeman, New York :

Additional Resources:

1. Dickison, W.C. (2000). Integrated Plant anatomy .Academic press Inc.
2. Fahn, A. (1982). Plant anatomy. Pergamon Press, Oxford.

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination. **Practicals:** Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically

represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking.

Assessment Methods

Theory:The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students. Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improve their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation. The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals:For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

Keywords

meristem, secondary growth, Vascular cambium, anther, embryo sac, pollination, double fertilization, endosperm, reproductive biology.

Plant Ecology and Taxonomy
(LSCC3)

Core Course - (CC) Credit:6

Course Objective(2-3)

To make students understand ecology and basic ecological concepts, interrelation between the living world and environment. Also to make them aware about identification,

nomenclature and classification.

Course Learning Outcomes

After successful completion of the course the student shall have adequate knowledge about the basic principals of environment and taxonomy.

Unit 1

Introduction (1 lecture)

Inter-relation between the living world and environment

Unit 2

Ecological factors (11 lectures)

Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance.

Unit 3

Plant communities (6 lectures)

Characters; Ecotone and edge effect; Succession; Processes and types (autogenic, allogenic, autotrophic, heterotrophic, primary and secondary)

Unit 4

Ecosystem (8 lectures)

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit 5

Phytogeography (4 lectures)

Principle biogeographical zones; Endemism (definition and types)

Unit 6

Introduction to plant taxonomy (1 lecture)

Identification, Classification, Nomenclature.

Unit 7 Identification (5 lectures)

Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit 8 Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. (6 lectures)

Unit 9 Taxonomic hierarchy (2 lectures) Ranks, categories and taxonomic groups

Unit 10 Botanical nomenclature (6 lectures)

Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Unit 11 Classification (6 lectures)

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (up to series), Engler and Prantl (up to series).

Unit 12 Biometrics, numerical taxonomy and cladistics (4 lectures)

Characters; variations; OTUs, character weighting and coding; cluster analysis; phenograms, cladograms (definitions and differences).

Practical

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer, hygrometer, rain gauge and lux meter.

2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.

3 (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).

(b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*), Epiphytes, Predation (Insectivorous plants)

4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
5. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law
6. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification): Brassicaceae - Brassica, Alyssum / Iberis; Asteraceae - Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax; Solanaceae - Solanum nigrum, Withania; Lamiaceae - Salvia, Ocimum; Liliaceae - Asphodelus / Liliium / Allium.
7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted on the herbarium sheet with appropriate label.)

References

1. Kormondy, E.J. (1996). Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
2. Sharma, P.D. (2010) Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
3. Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.
4. Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and talk and chalk method. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination.

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking and evaluation

Assessment Methods

Theory: The students are continuously evaluated based on a written assignment, class test and/or presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students. Each student in a class is given a different topic to prepare a Assignment/PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improve their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation. The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks.

Keywords

Environment, Soil, Water, Plant communities, Succession, Ecosystem, Phytogeography, Endemism, Plant taxonomy, Taxonomic hierarchy, Botanical Nomenclature, Classification, Biometrics

Plant Physiology and Metabolism (LSCC1) Core Course - (CC) Credit:6

Course Objective(2-3)

The course aims at making students realize how plants function, namely the importance of water, minerals, hormones, and light in plant growth and development; understand transport mechanisms and translocation in the phloem, and appreciate the commercial applications of plant physiology.

Course Learning Outcomes

The students are able to correlate morphology, anatomy, cell structure and biochemistry with plant functioning. The link between theory and practical syllabus is established, and the employability of youth would be enhanced. The youth can also begin small-scale enterprises.

Unit 1

Plant-water relations (8 Lectures)

Importance of water, water potential and its components, pathway of water movement, ascent of sap, transpiration and its significance, factors affecting transpiration, root pressure and guttation, stomatal movements – only ion theory.

Unit 2

Mineral nutrition (8 Lectures)

Essential elements, macro- and micronutrients, criteria of essentiality of elements, methods of studying mineral requirement (Hydroponics, Aeroponics), role of essential elements, transport of ions across membrane, active and passive transport, carriers, channels and pumps.

Unit 3

Translocation in phloem (6 lectures)

Composition of phloem sap, girdling experiments, Pressure Flow Model, phloem loading and unloading.

Unit 4

Photosynthesis (10 Lectures)

Historical contribution of Julius von Sachs, Blackman, Emerson, Engelmann, Hill. Arnon; photosynthetic pigments (chlorophyll a and b, xanthophyll, carotene); photosystem I and II, reaction centre, antenna molecules; electron transport and mechanism of ATP synthesis, C3 pathway; C4 and CAM plants (in brief, no pathways); photorespiration

Unit 5

Respiration (6 Lectures)

Glycolysis, anaerobic respiration, TCA cycle, oxidative phosphorylation, glyoxylate cycle, RQ.

Unit 6

Enzymes (4 Lectures)

Structure and properties, K_m (no derivation), mechanism of enzyme catalysis and enzyme inhibition.

Unit 7: Nitrogen metabolism (6 Lectures)

Biological nitrogen fixation - nodulation in detail, nitrate and ammonia assimilation, dinitrogenase, NR, NiR, transamination.

Unit 8: Plant growth regulators (6 Lectures)

Discovery, physiological roles of auxins, gibberellins, cytokinins and ethylene.

Unit 9: Plant response to light and temperature (6 Lectures)

Photoperiodism - discovery (SDP, LDP, day neutral plants); phytochrome (discovery and structure), red and far-red light response on photomorphogenesis (general account), florigen (brief account).

***NO STRUCTURES AND FORMULAE TO BE ASKED IN THE EXAM**

Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of the environmental factor light on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. To Study Hill's reaction.
5. To study the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity on O_2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.

Demonstration experiments

1. Bolting.

2. Effect of auxins on rooting.
 3. Suction due to transpiration.
 4. Hydroponics (using a photograph).
 5. To demonstrate the delay of senescence by cytokinins.
 6. To study the phenomenon of seed germination (effect of light and darkness)
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References

Bhatla, S.C. & Lal, M.A. 2018. Plant Physiology, Development and Metabolism, Springer Nature, Singapore Pte Ltd, Singapore.

Hopkins, W. G. & Huner, N. P. A. 2009. Introduction to Plant Physiology, 4th edn, Wiley India Pvt. Ltd, New Delhi.

Kochhar, S.L. & Gujral, S.K. 2017. Plant Physiology: Theory and Applications, Foundation Books, imprint of Cambridge University Press India Pvt, Ltd, Delhi.

Taiz, L., Zeiger, E., Moller, I. M. & Murphy, A. 2015. Plant Physiology and Development, 6th edn, Sinauer Associates Inc., Sunderland, MA, USA.

Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual, Narosa Publishing House, New Delhi.

Additional Resources:

Taiz, L., Zeiger, E., Moller, I. M. & Murphy, A. 2018. Plant Physiology and Development, International 6th edn, Oxford University Press, Sinauer Associates, New York, USA.

Teaching Learning Process

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Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students. Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improve their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Keywords

Movement of water, ascent of sap, transpiration, stomatal movements, mineral nutrients, active and passive transport, translocation, plant growth regulators, photoperiodism, photomorphogenesis

Analytical Techniques in Plant Sciences (LSDS3) Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To gain the knowledge on various techniques and instruments used for the study of plant biology

Course Learning Outcomes

Understanding of principles and use various methods, tools and techniques used in plant

sciences such as light microscopy, confocal transmission and electron microscopy, centrifugation, spectrophotometry, chromatography, x-ray diffraction technique and chromatography techniques

Unit 1

Imaging and related techniques (15 lectures)

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2

Cell fractionation (8 lectures)

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CaCl₂ gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3

Radioisotopes (4 lectures)

Use in biological research, auto-radiography, pulse chase experiment.

Unit 4

Unit 4

Spectrophotometry (4 lectures)

Principle and its application in biological research.

Unit 5

Chromatography (8 lectures)

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ionexchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6

Characterization of proteins and nucleic acids (6 lectures)

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAG

Practical

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
 2. Demonstration of ELISA.
 3. To separate nitrogenous bases by paper chromatography.
 4. To separate sugars by thin layer chromatography.
 5. Isolation of chloroplasts by differential centrifugation.
 6. To separate chloroplast pigments by column chromatography.
 7. To estimate protein concentration through Lowry's methods.
 8. To separate proteins using PAGE.
 9. To separation DNA (marker) using AGE.
 10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
 11. Preparation of permanent slides (double staining).
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References

1. Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.
2. Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A. 39

Teaching Learning Process

- 1) Lectures and seminars
- 2) Problem oriented learning
- 3) Individual seminar
- 4) Presentation and interpretation to other students
- 5) Discussion of published research articles on the selected topics
- 6) Practical will introduce the students to a range of tools and techniques of biotechnology

Assessment Methods

Assessment must encourage and reinforce learning.

Assessment must enable robust and fair judgments about student performance.

Assessment practices must be fair and equitable to students and give them the opportunity to demonstrate what they have learned.

Assessment must maintain academic standards.

Assessment will be by written class test, assignment, project work, viva for internal assessment and written theory and practical examination for university evaluation.

Keywords

Microscopy, Flow cytometry, Chromosome banding , FISH, , SCM, Centrifugation, radioisotopes, spectrophotometry, chromatography, electrophoresis, PAGE, mass spectrometry

Course Objective(2-3)

A computer-based approach is now central to biological research. Bioinformatics operates at the intersection of biology and informatics and has a strong mathematical component. Training students in various aspects of Bioinformatics is the objective of this course.

Course Learning Outcomes

With a working knowledge of the practical and theoretical concepts of bioinformatics, you will be well qualified to progress onto advanced

graduate study. The portfolio of skills developed on the programme is also suited to academic research or work within the bioinformatics industry as well as range of commercial settings.

Unit 1

Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.

Unit 2

Biological databases (5 lectures)

Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, Drug Bank, ZINC, CSD). Structure viewers (Ras Mol, J mol).

Unit 3

Data Generation and Data Retrieval (5 lectures)

Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez)

Unit 4

Basic concepts of Sequence alignment (10 lectures)

Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Scoring Matrices/ Amino acid substitution matrices (PAM and BLOSUM), and CLUSTALW.

Unit 5

Phylogenetic analysis (10 lectures)

Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods.

Unit 6

Applications of Bioinformatics (20 lectures)

Functional genomics (genome-wide and high throughput approaches to gene and protein function), Protein structure prediction and analysis- Levels of protein structure. gene prediction methods and tools. Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

Practical

1. Sequence retrieval (protein and gene) from NCBI.
2. Structure download (protein and DNA) from PDB.
3. Molecular file formats - FASTA, GenBank, Genpept, GCG, CLUSTAL, Swiss-Prot, FIR.
4. Molecular viewer by visualization software.

5. Translate a nucleotide sequence and select the correct reading frame of the polypeptide from the output sequences.
 6. Predict the structure of protein from its amino acid sequence.
 7. BLAST suite of tools for pairwise alignment.
 8. Sequence homology and Gene annotation.
 9. Construction of phylogenetic tree.
 10. Generating phylogenetic tree using PHYLIP.
 11. Gene prediction using GENSCAN and GLIMMER.
-

References

Bioinformatics – Principles and Applications (2008), 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India), ISBN: 9780195692303.

Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed.,

Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey), ISBN: 0-47147878-4.

Essential Bioinformatics (2006), 1st ed. Jin Xiong, Cambridge University Press, ISBN:9780521706100

Bioinformatics (2009), 1st ed. Daebeshwar Roy, Narosa Publishing House, ISBN:9788173199882

Additional Resources:

Pevsner J. (2009). Bioinformatics and Functional Genomics, II Edition, Wiley Blackwell.

Bioinformatics: Sequence and Genome analysis, 2nd edition (2004), David W. Mount, Cold Spring Harbour Laboratory Press. ISBN-13: 978-0879697129.

Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition

(2004), Andreas D. Baxevanis and B.F. Francis Ouellette, John Wiley and Sons. ISBN-13: 978- 0471478782.

Teaching Learning Process

Multimedia tutorials and hands on training over biological data using world wide web services.

Interactive classroom teaching of mathematical modelings and Computer programs.

Assessment Methods

Theoretical tests with the help of assignments, project works, presentations, and through practical examinations.

Keywords

Biological Databases, Sequence Alignment, Phylogenetics Analysis, Protein Structure prediction and analysis.

Cell and Molecular Biology
(LSDS2)
Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

Cell biology study will help the students to gain knowledge on the activities in which the giant molecules and minuscule structures that inhabit the cellular world of life are engaged. This will provide inside into the organization of cell, its features and regulation at different levels. Through the study of biomolecules (i.e protein, carbohydrate, lipid and nucleic acid) and cell organelles, they will be able to understand the various metabolic processes such as respiration, photosynthesis etc. which are important for life. It would help in gaining the knowledge of structure and functions of DNA and RNA

Course Learning Outcomes

This course will be able to demonstrate foundational knowledge in understanding of: The relationship between the properties of macromolecules, their cellular activities and

biological responses Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle Contemporary approaches in modern cell and molecular biology. Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process. Processing and modification of RNA and translation process, function and regulation of expression. Application in biotechnology

Unit 1

Techniques in Biology (8 Lectures)

Principles of microscopy; Light Microscopy; Phase contrast microscopy; Fluorescence microscopy; Confocal microscopy; Sample Preparation for light microscopy; Electron microscopy (EM)- Scanning EM and Scanning Transmission EM (STEM); Sample Preparation for electron microscopy; X-ray diffraction analysis.

Unit 2

Cell as a unit of Life (2 Lectures)

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape; Eukaryotic Cell components.

Unit 3

Cell Organelles (20 Lectures)

Mitochondria:- Structure, marker enzymes, composition; Semiautonomous nature; Symbiont hypothesis; Proteins synthesized within mitochondria; mitochondrial DNA. Chloroplast-Structure, marker enzymes, composition; semiautonomous nature, chloroplast DNA. ER, Golgi body & Lysosomes:-Structures and roles. Peroxisomes and Glyoxisomes:_Structures, composition, functions in animals and plants and biogenesis. Nucleus:- Nuclear Envelope- structure of nuclear pore complex; chromatin; molecular organization, DNA packaging in eukaryotes, euchromatin and heterochromatin, nucleolus and ribosome structure (brief)

Unit 4

Cell Membrane and Cell Wall (6 Lectures)

The functions of membranes; Models of membrane structure; The fluidity of membranes; Membrane proteins and their functions; Carbohydrates in the membrane; Faces of the membranes; Selective permeability of the membranes; Cell wall.

Unit 5

Cell Cycle (6 Lectures)

Overview of Cell cycle, Mitosis and Meiosis; Molecular controls.

Unit 6

Genetic material (6 Lectures)

DNA: Miescher to Watson and Crick- historic perspective, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment, DNA structure, types of DNA, types of genetic material. DNA replication (Prokaryotes and eukaryotes): bidirectional replication, semi—conservative, semi discontinuous RNA priming, θ mode of replication, replication of linear, ds-DNA, replicating the 5 end of linear chromosome including replication enzymes.

Unit 7: Transcription (Prokaryotes and Eukaryotes) (6 Lectures) Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code.

Unit 8: Regulation of gene expression (6 Lectures) Prokaryotes:Lac operon and Tryptophan operon ; and in Eukaryotes.

Practical

- 1.To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.
- 2.Study of the photomicrographs or cell organdies
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. To prepare temporary stained preparation of mitochondria from striated muscle cells /cheek epithelial cells using vital stain Janus green.
7. Study of mitosis and meiosis (temporary mounts and permanent slides).

8. Study the effect of temperature, organic solvent on semi permeable membrane.
9. Demonstration of dialysis of starch and simple sugar.
10. Study of plasmolysis and deplasmolysis on Rhoeo leaf.
- .11. Measure the cell size (either length or breadth/diameter) by micrometry.
12. Study the structure of nuclear pore complex by photograph (from Gerald Karp) Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
13. Study DNA packaging by micrographs.
14. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

References

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinaucr Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

Teaching Learning Process

Visual media would be helpful. Botany Department, University of Delhi may be entrusted with preparation of good visual aids that would help students get a feel of the subject and they find the subject interesting. College teachers can form a group and work out these possibilities of visual aids that would enhance teaching learning process.

Assessment Methods

Making drawings ma be made a compulsory part of practical record books, We may ponder over making students involve in highlighting the salient features of the genera/ groups through digital media such as ppt and animations.

Keywords

Microscopy,X-ray diffraction, eukaryotic cell, mitochondria, chloroplast, Golgi body, nucleus , chromatin , membrane protein , meiosis,ribosomes,DNA replication,transcription, gene expression

Economic Botany and Biotechnology (LSDS1) Discipline Specific Elective - (DSE) Credit:6

Course Objective(2-3)

To gain the knowledge on the economically important of plants, their life cycle, processing, plant part used, application of biotechnology for the production of plant resources and production of new varieties

Course Learning Outcomes

Understanding of morphology,and processing and economic value of plant sources of cereals, legumes,spices, oil,rubber, timber and medicines

Unit 1

Origin of Cultivated Plants (4 lectures)

Concept of centres of origin, their importance with reference to Vavilov's work.

Unit 2

Cereals (4lectures): Wheat -Origin, morphology, uses

Unit 3

Legumes (6 lectures) General account with special reference to Gram and soybean

Unit 4

Spices (6 lectures) General account with special reference to clove and black pepper
(Botanical name, family, part used, morphology and uses)

Unit 5

Beverages (4 lectures) Tea (morphology, processing, uses)

Unit 6

Oils and Fats (4 lectures) General description with special reference to groundnut

Unit 7: Fibre Yielding Plants (4 lectures) General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 8: Introduction to Plant Biotechnology (1 lecture)

Unit 9: Tissue Culture Technology (9 lectures), Introduction; nutrient media; aseptic and culture conditions; developmental pathways: direct and indirect organogenesis and embryogenesis; single cell and protoplast culture.

Unit 10: Recombinant Technology (18 lectures) Molecular techniques: Blotting techniques (Southern, Northern and Western); PCR; Molecular DNA markers (RAPD, RFLP, SNPs) and DNA fingerprinting in plants, Genetic Engineering Techniques: Gene cloning vectors (pUC 18, pBR322, BAC, YAC, Ti plasmid); construction of genomic and cDNA libraries; screening for gene of interest by DNA probe hybridisation, complementation; Insertion of genes into plant tissues (Agrobacterium mediated, electroporation, micro-projectile bombardment); selection of recombinants by selectable marker and reporter genes (GUS, luciferase, GFP). Applications: Bt cotton, Roundup ready soybean, Golden rice, Flavr-Savr tomato, edible vaccines, industrial enzyme production, Bioreactors Applications: Micropropagation, androgenesis, gynogenesis, embryo and endosperm culture, secondary metabolite production, germplasm conservation.

Practical

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests

2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

References

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.

Additional Resources:

Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking.

Assessment Methods

The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students. Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students

improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher.

Keywords

Vavilove, Cultivated plants, , Wheat, Gram , soyabean, spices, Tea, cotton, groundnut, tissue culture, recombinant DNA technology, Molecular markers, RAPD, PCR, ELISA.

Biofertilizers (LSSE1) Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To gain the knowledge on the following aspects 1. Eco-friendly fertilizers like Rhizobium, Azospirillum Azotobactor, cyanobacteria and mycorrhizae, their identification, growth multiplication 2. Organic farming and recycling of the organic waste

Course Learning Outcomes

The student would have a deep understanding of ecofriendly fertilizers. They will be able to understand the growth and multiplication conditions of useful microbes such as Rhizobium, cyanobacteria, mycorrhizae, Azotobactor etc, their role in mineral cycling and nutrition to plants. The can also think of the methods of decomposition of biodegradable waste and convert into the compost

Unit 1

General account about the microbes used as biofertilizer – Rhizobium –

isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis. (4 lectures)

Unit 2

Azospirillum: isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication. (8 lectures)

Unit 3

Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation. (4 lectures)

Unit 4

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants. (8 lectures)

Unit 5

Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application. (6 lectures)

Unit 6

Practical

Isolation of Anabaena from Azolla leaf

Study of Rhizobium from root nodules of leguminous plants by Gram staining method

Test for pH, NO₂, SO₄, Cl and organic matter of different composts

Observation of mycorrhizae from roots

isolation of arbuscular mycorrhizal spores from rhizospheric soil

Spots

Specimen /photographs of earthworm, azolla, arbuscules . vesicles

Biocontrol photographs -pheromons trap,Trichoderma,, Pseudomonas, , Neem etc, ,

Identification and application

Photographs of biocompost methods,

Projects on any topic mentioned in the syllabus, with Rhizobium technology, , AMF

technology, Organicfarming, vermicomposting,, biocompost , Azolla culture

References

1. Dubey,

References

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay -Publication, New Delhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New _Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic _Farming Akta Prakashan, Nadiad

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination.

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the

experiment during class hours. The students are asked to submit their record notebooks to the teacher/s for checking.

Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students. Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Practicals: For continuous evaluation two tests are conducted; one on the table work experiments for 10 marks, and the other on setups for 10 marks. The total marks obtained is scaled down to 10. Ten marks are allotted for record notebooks, and 5 marks for attendance. The Internal Assessment for practicals comprises 50 % of the total marks:

Keywords

Rhizobium, Azotobacter, , inoculum, , cyanobacteria, nitrogen fixation, Azolla, VAM, mycorrhizae

Ethnobotany
(LSSE3)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To have the knowledge of the plants used by the local communities, tribals, ethnic

groups, their nutritive and medicinal value.

Course Learning Outcomes

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

Unit 1

Ethnobotany (6Lectures)

Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. 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 tribals: a) Food plants, b) intoxicants and beverages and c) Resins and oils and miscellaneous uses.

Unit 2

Methodology of Ethnobotanical studies (6 lectures) a) Field work b) Herbarium c) Ancient Literature d) Archaeological findings e) temples and sacred places.

Unit 3

Role of ethnobotany in modern Medicine (10 lectures) Medicoethnobotanical sources in India; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadirachta indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*.

Unit 4

Role of ethnobotany in modern medicine with special example of *Rauvolfia serpentina*, *Trichopus zeylanicus*, *Artemisia*, *Withania*. Role of ethnic groups in conservation of plant genetic resources. Endangered taxa and forest management (participatory forest management).

Unit 5

Ethnobotany and legal aspects (8 lectures) Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy,

Unit 6

Intellectual Property Rights and Traditional Knowledge.

Practical

Collection , identification and preparation of herbarium of three ethenobotanically important plants with appropriate references

Preparation of crude extract of ethenobotanically important plants with appropriate references (any method to be used)

Project work-documentation, literature survey, and collection of information on ethnobotanically useful plants from traditional healers)

References

- 1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
- 2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981
- 3) Lone et al,. Palaeoethnobotany
- 4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists,Lucknow, India.
- 5) S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.
- 6) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah._
- 7) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996_
- 8) Faulks, P.J. 1958.An introduction to Ethnobotany, Moredale pub. Ltd.

Additional Resources:

Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons-

Chichester

Teaching Learning Process

To engage students and transform them into active learners the students are updated with latest books and review articles. The experiments included in the paper are performed individually or in group and are followed by group discussions and interjections

Assessment Methods

The students are assessed on the basis of oral presentations and regular class tests. Students are continuously assessed during practical class.

Submission of class records is mandatory. This exercise develops scientific skill as well as methods of recording and presenting scientific data.

Keywords

Tribals, minor forest products, intoxicants, beverages, Resins, Field work, Herbarium, sacred groves. ethnobotanical practices, Azadiractha indica, Ocimum sanctum, Vitex negundo. Gloriosa superba, Indigofera, tinctoria. ethnomedicines, conservation, Traditional Knowledge.

Intellectual Property Right
(LSSE6)
Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To have knowledge of roles regulations, laws and processes of patents, copyright trade marks and concepts of traditional knowledge and protection of plant varieties .

Course Learning Outcomes

Students would have deep understanding of patents copyrights, their importance. They can think about the importance of traditional knowledge, bio-prospecting, biopiracy. They would gain the knowledge of farmers rights and the importance on indigenous plant varieties, concept of novelty and biotechnological inventions

Unit 1

Introduction to intellectual property right (IPR) (2 lectures)

Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

Unit 2

Patents (3 Lectures) Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

Unit 3

Copyrights (3 Lectures) Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement

Unit 4

Trademarks (3 Lectures) Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name

Unit 5

Geographical Indications (3 Lectures) Objectives, Justification, International Position, Multilateral Treaties, National Level, Indian Position

Unit 6

Protection of Traditional Knowledge (4 Lectures)

Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prosppecting and Bio-Piracy, Alternative ways, Protectability, needfor a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

Unit 7: Industrial Designs (2 Lectures) Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

Unit 8: Protection of Plant Varieties (2 Lectures) Plant Varieties Protection- Objectives, Justification, International Position, Plant varieties protection in India. Rights of Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues farmers, Breeders and Researchers. National gene bank, Benefit sharing. Protection of Plant Varieties and Farmers' Rights Act, 2001.

Unit 9: Information Technology Related Intellectual Property Rights (4 Lectures) Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-conductor chips, Domain Name Protection Unit 10: Biotechnology and Intellectual Property Rights. (4 Lectures) Patenting Biotech Inventions

Practical

Patent search

Trademark search

copyright infringement (Plagiorism checkby Urkundand other available software,

Geographical Indicators

(i) food- Malabar pepper, Basmati rice, Darjeeling Tea, and Requefort cheese,

(ii) handlooms (Kota Doria, Banarasi Sari, , Muga Silk, Kanchipuram),

III- Industry (Mysore agarbatti, Feni Goa, Champagne, (France).

IV. Natural resources- (Makrana marbles Two example of each category Biopiracy-neem , turmeric

Industrial designs- Jewellery design, chair design, car design, Bottle design, Aircraft design,

IPR e diary

References

NK Acharya.2001.Text Book on Intellectual Property Rights: (copyright, Trademark, Patent Design, Geographical Indications, Protection of New Plant Varieties & Farmers

Rights and Protection of Biodiversity).

SP Gogia. Asia Law House's textbook On Intellectual Property Rights (IPR) For B.S.L & L.L.B Asia Law House

:

Additional Resources:

M.K. Bhandari. Central Law Publication's Law Relating to Intellectual Property Rights (IPR) Central Law Publications

Teaching Learning Process

Theory: The theory topics are covered in lectures with the help of PowerPoint presentations and the chalkboard. Students are encouraged to ask questions. The reading list has been suitably upgraded. When the entire syllabus is completed, a few lectures are devoted to discuss the previous years' question papers, thus preparing the students for the examination.

Practicals: Every practical session begins with detailed instructions, followed by students conducting the experiment/s. When all the students have collected the data, the observations are discussed. Any deviation from the expected trend in results is explained. The students are encouraged to graphically represent the data and record the experiment during class hours.

Assessment Methods

Theory: The students are continuously evaluated based on a class test and the presentation given by each student. The answer scripts of the test are returned to the students and the test paper is discussed at length. Students who are absent for the test are allowed to appear for the test at a later date; the question paper is suitably modified for such students. Each student in a class is given a different topic to prepare a PowerPoint presentation. All the remaining students listen to the presentation of each student, and peer students are also encouraged to ask questions. Presentations by students improves their reasoning and communication skills. The presentations of students are evaluated by the teacher based on the content, effectiveness of the presentation, whether any new information has been added, and lastly on the answers given by students to the questions posed by the teacher. An assignment can be given in place of the presentation.

The Internal Assessment has a break-up as 10 marks for the test, 10 marks for the presentation/ assignment and 5 marks for the attendance, and comprises 25 % of the total marks.

Keywords

Patents, IPR, Copyrights, trademarks, geographical indicators, traditional knowledge, industrial design, plant varieties, novelty, biotechnology

Medicinal Botany (LSSE2) Skill-Enhancement Elective Course - (SEC) Credit:4

Course Objective(2-3)

To introduce students to complementary and alternative medicine and provide them an opportunity

To explore uses of plants as medicine ranging from traditional indigenous approach for treating ailments to modern pharmaceuticals

·To inculcate awareness about the rich diversity of medicinal plants in India.

Course Learning Outcomes

Knowledge Skills

- An appreciation of the contribution of medicinal plants to traditional and modern medicine and the importance of holistic mode of treatment of the Indian traditional systems of medicine.
- To develop an understanding of the constraints in promotion and marketing of medicinal plants.

Professional and Practical Skills

- Transforming the knowledge into skills for promotion of traditional medicines.
- Developing entrepreneurship skills to establish value addition products, botanical extracts and isolation of bioactive compounds.

Unit 1

Scope and importance of medicinal plants in the traditional systems of medicine and modern medicine. Importance of preventive and holistic healing in the Indian traditional systems of medicine. Ayurveda : History, origin, fundamental doctrine and concepts of Panchamahabhutas, Saptadhatu and Tridosha in relation to health and disease.

Unit 2

Therapeutic and pharmaceutical uses of important plants used in the Ayurveda system of medicine. Concept of Rasayan drugs. Siddha Origin, concepts, therapeutic and pharmaceutical uses of important plants used in Siddha system of medicine. Unani : History, concept of Umoor-e-Tabiya (Fundamentals of Physique), therapeutic and pharmaceutical uses of plants used in Unani system of medicine

Unit 3

Nutraceuticals and polyherbal formulations. Plants used for the treatment of hepatic disorders, cardiac diseases, infertility, diabetes, blood pressure, cancer and skin diseases. Role of AYUSH, NMPB and AIIA in the promotion of medicinal plants.

Unit 4

Adulteration of herbal drugs. Evaluation and Standardization of crude drugs. Fundamentals of Pharmacognosy. Organoleptic, microscopic and phytochemical evaluation of plant drugs.

Unit 5

Conservation of Endangered and Endemic Medicinal plants. Red Data List Criteria. In situ Conservation : Biosphere Reserves, National Parks, Sacred Groves. Ex-situ conservation : Botanic Gardens, National Gene Banks, Plant cell, tissue, and Organ culture, Cryopreservation. Role of NBPGR, CIMAP, JNTBGRI and RRL

Unit 6

General aspects of cultivation and propagation of medicinal plants. WHO Guidelines of Good Agricultural and Cultivation Practices (GACP). Objectives of the Nursery, classification and important components of nursery. Greenhouse technology.

Propagation through cuttings, layering, grafting and budding.

Practical

1. Identification and medicinal value of locally available medicinal plants in the field.
 2. Study of organoleptic, macroscopic and microscopic parameters of any two plant drugs. Sections and powder microscopic evaluation.
 3. Isolation of bioactive compounds in the lab and phytochemical analysis of the crude extract of various parts of medicinal plants.
 4. Study of ingredients and medicinal uses of common polyherbal formulations used in the traditional systems of medicine.
 5. Project Report based on visit to Pharmaceutical Industries and/or Institutes.
 6. E-presentations : Traditional Systems of Medicine, Contribution of medicinal plants to alternative and modern medicine, Conservation strategies of medicinal plants, Nutraceuticals, Rasayana drugs, Medicinal plants and non-communicable diseases, Cultivation, marketing and utilisation of medicinal plants.
 7. Laboratory Records
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References

- P.C. Trivedi 2006. Medicinal Plants Traditional Knowledge. I.K. International Publishing House Pvt. Ltd. India.
- P.C. Trivedi, 2009. Medicinal Plants. Utilisation and Conservation. Aavishkar Publishers, Jaipur, India.
- William C. Evans 2010. Trease and Evans's Pharmacognosy. 16 th Edition. Saunders Ltd. .
- Purohit and Vyas, 2008. Medicinal Plant Cultivation : A Scientific Approach, 2nd edition. Agrobios, India.
- S.B. Gokhale, C.K. Kokate 2009. Practical Pharmacognosy. Nirali Prakashan, India.
- Bharti Chaudhry, 2019. A Handbook of Common Medicinal Plants Used in Ayurveda. Kojo Press, India.
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Teaching Learning Process

To encourage innovation, to link theoretical knowledge with practical training and

application of knowledge to find practical solutions to the challenges encountered in the field of traditional medicine.

To hold regular and structured workshops, seminars, field trips, collaboration with Research institutions, Industry and other Government Organizations, in order to facilitate peer learning and skill enhancement.

To complement classroom teaching with discussions, presentations, quizzes, interpretation of results, short projects, writing project reports and field exposure.

Assessment Methods

Continuous Evaluation

(Project/ E-presentation :10 marks, Lab Records :

Attendance in Practicals

Practical Examination :

Keywords

Medicinal plants, Ayurveda, Siddha, Unani, Holistic healing, Phytochemicals, Pharmacognosy, Polyherbals, Conservation, Propagation.

Nursery and Gardening
