School of Studies in Botany
Vikram University, Ujjain (MP)

SYLLABUS

B. Sc. (HONS.) Botany
(For UTD)

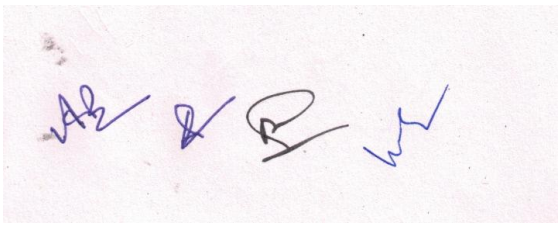
FOUR YEARS (8 SEMESTER) CBCS

(FOR UTD)

(UNDER NEW EDUCATION POLICY)

Course Structure
Choice Based Credit System (CBCS)

2021-2025 ONWARDS



Preamble

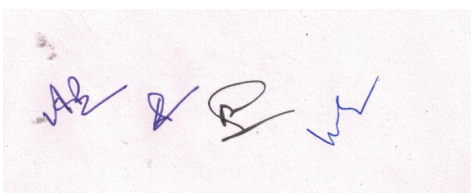
Today plant science is a fusion of the traditional components with the modern aspects of biochemistry, molecular biology and biotechnology. Over the years, plant science (Botany) has shown enormous gain in information and applications owing to tremendous inputs from research in all its aspects. With global recognition of the need for conservation, field plant biologists have contributed significantly in assessing plant diversity. Taxonomists have explored newer dimensions for the classification of plants. New insights have been gained in functional and structural aspects of plant development by utilizing novel tools and techniques for botanical research. Challenging areas of teaching and research have emerged in ecology and reproductive biology. Concern for ever increasing pollution and climate change is at its highest than ever before. Keeping these advancements in view, a revision of the curriculum at the undergraduate level is perfectly timed. From the beginning of 2021-2022 session, the Botany students across Indian Universities shall have the benefit of a balanced, carefully-crafted course structure taking care of different aspects of plant science, namely plant diversity, physiology, biochemistry, molecular biology, reproduction, anatomy, taxonomy, ecology, economic botany and the impact of environment on the growth and development of plants. All these aspects have been given due weightage over the eight semesters. It is essential for the undergraduate students to acquaint themselves with various tools and techniques for exploring the world of plants up to the sub- cellular level. A paper on this aspect is proposed to provide such an opportunity to the students before they engage themselves with the learning of modern tools and techniques in plant science. Keeping the employment entrepreneurship in mind, applied courses have also been introduced. These courses shall provide the botany students hands on experience and professional inputs. On the whole, the curriculum is a source of lot of information and is supported by rich resource materials. It is hoped that a student graduating in Botany with the new curriculum will be a complete botanist at Honours level.

A. Programme Objectives

1. The objective of the Bachelor's Program in Botany is to equip the students to gain conceptual and analytical skills about morphological, anatomical, physiological, biochemical and cellular aspects of lower and higher plants.

2. The program emphasizes to apply knowledge acquired about different taxa of plants for their manipulations, biomolecules and conservation.

3. The imparting of laboratory training for bioassay protocols of biological materials, their manipulative treatments, emerging tissue culture and genetic recombinant techniques, and bioinformatics databases and tools.



B. Programme Outcomes

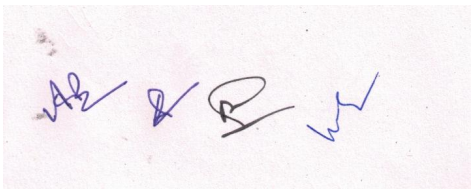
The Bachelors in Botany Program will cater to the expanding demand for skilled manpower, which is equipped with an understanding of modern research protocols and ethics involving plants and their cellular and molecular materials in conservation of plant biodiversity, environmental conservation and management, plant health and yield management, and their survival in nature to maintain natural biodiversity and ecological balance.

A B.Sc. Botany student should be able to independent study and researches related to-

1. Taxonomic identification of plants including their chemotaxonomy, molecular taxonomy and creation of herbaria.
2. Application of modern emerging methodological and analytical tools and techniques in qualitative and quantitative assessment of biological materials and processes.
3. Extraction of biological molecules and sub-molecules and their biochemical, genetic and molecular characteristics and dynamics.
4. Designing of bioassay experiments including ex-situ culture of threatened and important plants for their conservation and variety improvement.
5. Undertaking of independent researches involving genomics, metabolomics, and protemics of plant taxa.
6. Competition at national and international to pursue career in advanced studies in research and industrial establishments.
7. Independent documentation and communication of scientific results in the public domain as well as peer-reviewed scientific magazines and journals.
8. Filing of intellectual property rights to national and international registries.

C. Programme Specific Outcomes (Psos)

A successful graduate student will be able to identify plants belonging to different taxa and prepare standard herbaria. The student will be able to design and execute experiments related to biochemistry, physiology, genetics and molecular biology of plants. He/ She will be able to pursue independent researches in basic and applied researches in governmental, industrial and private academic and research establishments.



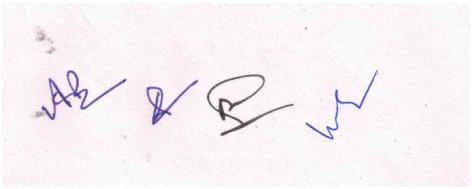
CBCS Ordinance no-14

All School of Studies in Vikram University, Ujjain will have Choice Based Credit System (CBCS) in M.Sc. and B.Sc. (Hons.) (For UTD). The undergraduate degree will be of Four years duration (eight semesters), with multiple exit options within this period, with appropriate certification (After Completion Minimum Credits i.e, 49 Credits First Year (Two Semesters) Completed – Certificate in Faculty awarded , 98 Credits Second Years (Four Semesters) Completed – Diploma in Faculty awarded, 140 Credits Third Years (Six Semesters) Completed – Bachelor in Faculty awarded and 192 Credits Fourth Years (Eight Semesters) Completed – Bachelor in Research awarded). The student will have to earn 192 actual credits (Valid Credits) in total eight semesters (Four years duration). The course will comprise of Lecture (L), Seminars (S), Practical (P), Library Assignments (LA), Project work (PW) and Lab Training / Internship etc.

The Semester will consist of 16-18 weeks of academic work. One Credit is equivalent to one hour (60 minutes) of teaching (Lecture) or two hours (120 minute) of S, P, LA and PW per week in a semester. The credits for the course have been distributed among the courses under Core Courses, Discipline Specific Electives (DSE), Generic Electives (GE), Ability Enhancement Course Compulsory (AECC), Ability Enhancement Elective Course (AEEC) and Comprehensive Viva voce categories. The credits associated with the courses will be valid credits.

During the semester, a teacher offering the course will do the continuous evaluation of the student at three points of time by conducting three tests of 25% marks each. Of these, two must be written tests and the third may be written test/Quiz/Seminar, Assignment for theoretical courses. Marks obtained in two best tests out of three will be awarded to the student. In each course, there shall be End Semester Examination of 120 Marks. Each student has to appear in at least two tests and including semester examination; otherwise, the student will be awarded Ab grade in that course. Examination and evaluation of the courses will be as per Ordinance 14 of the Vikram University, Ujjain.

The details of the course are given below-:



VIKRAM UNIVERSITY, UJJAIN MP

SUBJECT-BOTANY

(Session -2021-2025 onwards)

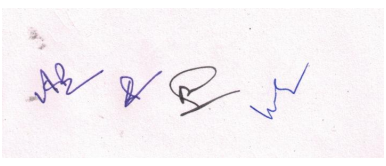
B. Sc. (Hons) FOUR YEARS (EIGHT SEMESTERS), CBCS SCHEME (NEP)

The Students will get:

1. Honours Certificate after completion of 1st Year (50 credits minimum and 60 credits maximum)
2. Honours Diploma after completion of 2nd Years (100 credits minimum and 120 credits maximum)
3. B. Sc.(Hons.) Degree after completion of 3rd Year (150 credits minimum and 180 credits maximum)
4. B. Sc.(Hons.) with Research degree after completion of 4th Year (200 credits minimum and 240 credits maximum)

Course Code	Course Name	Course type	Credits	Marks		
				Internal Examination Marks 25%	University Examination Marks 75%	Total Marks
B. Sc. I (Hons) SEMESTER						
BOT 101	Language (Communicative English)	Communicative English	3	15	45	60
BOT 102	Biomolecules and Cell Biology	Core-I	5	25	75	100
BOT 103	Phycology and Microbiology	Core-II	5	25	75	100
BOT 104	Biodiversity (Microbes, Algae, Fungi and Archegoniate)	GE-I	5	25	75	100
BOT 105	Computer Application	AECC-I	4	20	60	80
BOT 106	Practical-I	Skill Enhancement Elective Course	3	15	45	60
Total			**25**			**500**
B. Sc. II (Hons) SEMESTER						
BOT 201	Language (Regional)	Hindi	3	15	45	60
BOT 202	Mycology and Phytopathology	Core-III	5	25	75	100
BOT 203	Ecology	Core-IV	5	25	75	100
BOT 204	Biostatistics	GE-II	5	25	75	100
BOT 205	Environment Science	AECC-II	3	15	45	60
BOT 206	Practical-II	Skill Enhancement Elective Course	3	15	45	60
Total			**24**			**480**
B. Sc. III (Hons) SEMESTER						
BOT 301	Anatomy of Angiosperm	Core-V	5	25	75	100
BOT 302	Economic Botany	Core-VI	5	25	75	100
BOT 303	Plant Ecology and Taxonomy	GE-III	5	25	75	100
BOT 304	Mushroom Culture Technology	AEEC-I	4	20	60	80
BOT 305	Lab Training I / Internship	Training I /Internship	3	15	45	60
BOT 306	Practical-III	Skill	3	15	45	60

		Enhancement Elective Course				
Total			**25**			**500**
B. Sc. IV (Hons) SEMESTER						
BOT 401	Plant Metabolism	Core course-VII	5	25	75	100
BOT 402	Plant Physiology	Core course-VIII	5	25	75	100
BOT 403	Analytical Techniques In Plant Sciences	GE-IV	5	25	75	100
BOT 404	Industrial and Environmental Microbiology	AEEC-II	3	15	45	60
BOT 405	Lab Training II /Internship	Training II /Internship	3	15	45	60
BOT 406	Practical-IV	Skill Enhancement Elective Course	3	15	45	60
Total			**24**			**480**
B. Sc. V (Hons) SEMESTER						
BOT 501	Plant Systematic	Core course-IX	5	25	75	100
BOT 502	Archegoniate	Core course-X	5	25	75	100
BOT 503	Ethnobotany	GE-V	5	25	75	100
BOT 504	Nursery and Gardening	AEEC-III	3	15	45	60
BOT 505	Practical-V	Skill Enhancement Elective Course	3	15	45	60
Total			**21**			**420**
B. Sc. VI (Hons) SEMESTER						
BOT 601	Reproductive Biology of Angiosperms	Core course-XI	5	25	75	100
BOT 602	Genetics	Core course-XII	5	25	75	100
BOT 603	Plant Anatomy and Embryology	GE-VI	5	25	75	100
BOT 604	Biofertilizers	AEEC-IV	3	15	45	60
BOT 605	Practical-VI	Skill Enhancement Elective Course	3	15	45	60
Total			**21**			**420**
B. Sc. VII (Hons) SEMESTER						
BOT 701	Molecular Biology	Core course-XIII	5	25	75	100
BOT 702	Bioinformatics	DSE-I	5	25	75	100
BOT 703	Horticultural Practices and Post-Harvest Technology	DSE-II	5	25	75	100
BOT 704	Herbal Technology	AEEC-V	4	20	60	80
BOT 705	Lab Training III/Internship	Training III /Internship	4	20	60	80



BOT 706	Practical-VII	Skill Enhancement Elective Course	3	15	45	60
Total			**26**			**520**
B. Sc. VIII (Hons) SEMESTER						
BOT 801	Plant Biotechnology	Core course-XIV	5	25	75	100
BOT 802	Intellectual Property Rights	DSE-III	5	25	75	100
FSB 803	Project (or) Dissertation and Viva Voce	DSE-IV/Project (or) Dissertation	9	45	135	180
FSB 804	Comprehensive Viva Voce		4		80	80
FSB 805	Practical-VIII (Skill Enhancement Elective Course)	Skill Enhancement Elective Course	3	15	45	60
Total			**26**			**520**
Grand Total			**192**			**3840**

Categories: Group Code
Core Courses
Discipline Specific Electives (DSE)
Generic Electives (GE)
Ability Enhancement Course Compulsory (AECC)
Ability Enhancement Elective Course (AEEC)
Skill Enhancement Elective Course
Compressive Viva voce
Justification: After Completion Minimum Credits)
49 Credits First Year (Two Semesters) Completed – Certificate in Faculty awarded
98 Credits Second Years (Four Semesters) Completed – Diploma in Faculty awarded
140 Credits Third Years (Six Semesters) Completed – Bachelor in Faculty awarded
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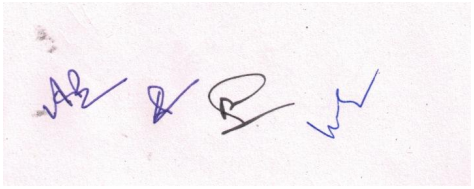


SUBJECT: BOTANY (HONS) FIRST YEAR, CBCS SCHEME
SEMESTER-I
COURSE CODE NO.: BOT 101: LANGUAGE (ENGLISH)
(COMMUNICATIVE ENGLISH)

Course Objectives:

1. Understand the types of communication
2. Analyse the verbal communication and non verbal communication
3. Practice dynamics of professional presentations
4. Know how to translate the foreign language
5. Know how to write letters both personal and professional

Course Learning Outcome:

1. To know the beauty of the coherence of Language and Literature
2. To demonstrate the awareness of evolution theory of language by varied culture
3. To study the formation of new words
4. To apply literary terminology for Narrative, Poetic and Dramatic genres
5. To explore literary elements
6. To identify and use the figures of speech
7. To appreciate literary form and structure in shaping a text's meaning

Unit-I: Introduction:

Theory of Communication - Types and modes of Communication

Unit-II: Language of Communication:

Verbal and Non-verbal (Spoken and Written)-Personal, Social and Business - Barriers and Strategies-Intra Personal, Inter Personal and Group Communication

Unit-III: Speaking Skills:

Monologue-Dialogue- Group Discussion-Effective Communication/ Mis- Communication - Interview - Public Speech

Unit-IV: Reading and Understanding:

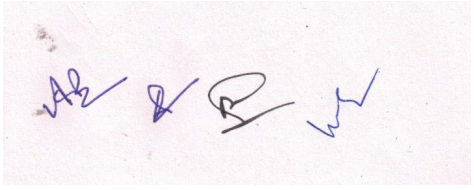
CloZe Reading - Comprehension - Summary Paraphrasing - Analysis and Interpretation - Translation (from Indian language to English and vice-versa) Literary/Knowledge Texts

Unit-V: Writing Skills:

Documenting - Report Writing - Making notes - Letter Writing

Suggested Readings:

1. Language through Literature (forthcoming) ed. Dr. Gauri Mishra, Dr Ranjana Kaul, Dr Brat Biswas
2. Fluency in English Part II Oxford University Press, 2006



3. Business English, Pearson, 2008.

COURSE CODE NO.: BOT 102: BIOMOLECULES AND CELL BIOLOGY (CORE-I)

Course Objective:

1. Biomolecules and Cell biology study will help the students to gain knowledge on the activities in which the giant molecules and miniscule structures that inhabit the cellular world of life are engaged.
2. This will provide inside into the organization of cell, its features and regulation at different levels.
3. 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.

Course Learning Outcomes

This course will be able to demonstrate foundational knowledge in understanding of:

1. The relationship between the properties of macromolecules, their cellular activities and biological responses
2. Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle
3. Contemporary approaches in modern cell and molecular biology.

Unit 1: Biomolecules: Types and significance of chemical bonds; Structure and properties of water; pH and buffers. Carbohydrates: Nomenclature and classification; Monosaccharides; Disaccharides; oligosaccharides and polysaccharides.

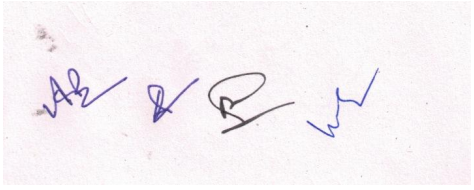
Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacyl glycerols structure, functions and properties; Phosphoglycerides.

Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.

Nucleic acids: Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

Unit 2: Bioenergenetics: Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as a energy currency molecule. Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theroy), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.

Unit3: The cell : Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory). Cell wall and plasma membrane: Chemistry, structure and function of Plant cell wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis. Cell organelles: Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.



Unit 4: Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament. Chloroplast, mitochondria and peroxisomes, Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast, Endomembrane system: Endoplasmic Reticulum – Structure, targeting and insertion of proteins in the ER, protein folding, processing; Smooth ER and lipid synthesis, export of proteins and lipids; Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Lysosomes

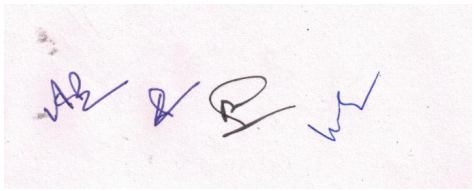
Unit 5: Cell division : Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases.

Practical

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/Rhoeo/Crinum.
3. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
4. Measurement of cell size by the technique of micrometry.
5. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
6. Study of cell and its organelles with the help of electron micrographs.
7. Cytochemical staining of : DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
8. Study the phenomenon of plasmolysis and deplasmolysis.
9. Study the effect of organic solvent and temperature on membrane permeability.
10. Study different stages of mitosis and meiosis.

Suggested Readings

1) Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning
2) Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone
3) Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4) Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company
5) Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company.
6) Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7) Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
8) Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
9) 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



COURSE CODE NO.: BOT 103: PHYCOLOGY AND MICROBIOLOGY (CORE-II)

Course Objective:

To gain knowledge of diversity, life forms, life cycles, morphology and importance of micro-organisms (Bacteria and algae).

Course Learning Outcomes

Students would have understanding of the classification, characteristic 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.

Unit 1: Introduction to microbial world: Microbial nutrition, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

Unit 2: Viruses : Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

Unit 3: Bacteria : Discovery, general characteristics; Types-archaebacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

Unit 4: Algae: General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; methods of reproduction; Classification; criteria, system of Fritsch, and evolutionary classification of Lee (only upto groups); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar). Role of algae in the environment, agriculture, biotechnology and industry.

Unit 5: Cyanophyta and Xanthophyta: Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of Nostoc and Vaucheria

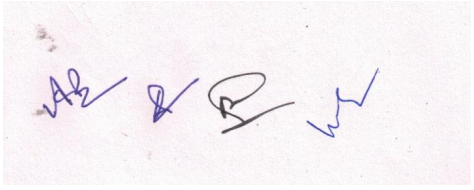
Chlorophyta and Charophyta: General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Chlamydomonas, Volvox, Oedogonium, Coleochaete, Chara. Evolutionary significance of Prochloron.

Phaeophyta and Rhodophyta: Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Ectocarpus, Fucus and Polysiphonia.

Practical

Microbiology

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.



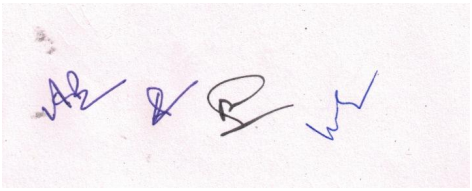
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).

Phycology

1. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Volvox, Oedogonium, Coleochaete, Chara, Vaucheria, Ectocarpus, Fucus and Polysiphonia, Procholoron through electron micrographs, temporary preparations and permanent slides.

Suggested Readings

1) Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2) Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
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.
7) Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.



COURSE CODE NO.: BOT 104: BIODIVERSITY (MICROBES, ALGAE, FUNGI AND ARCHEGONIATE) (GENERIC ELECTIVE-I)

Course Objectives:

Biodiversity generally refers to the variety and variability of life on earth. Plants are relevant to humans as they provide us with food, shelter, clothing, energy, health, aesthetic beauty, environment and even economy. This paper is relevant to ALL students.

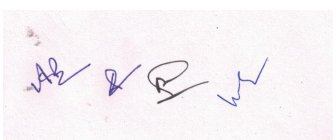
1. Introduction to Biodiversity ranging from Microbes (Viruses and Bacteria), to Fungi, to various plant groups (Algae and Archegoniates-Bryophytes, Pteridophytes and Gymnosperms).
2. Information on the Ecological and Economic Importance of Microbes, Fungi and various plant groups to enable students understand and appreciate relevance of Microbes and Plants to environment and human well-being.
3. Insight into the line of Plant Evolution on Earth and the consequent Biodiversity is instrumental in creating Awareness on the threats to biodiversity and sensitize young minds towards the Biodiversity Conservation for sustainable development.

Course Learning Outcomes:

1. Combination of Theoretical and Practical components will provide comprehensive information and insight into the fascinating world of Microbes and Plants.
2. Hands on Training will help students learn use of microscope, mounting, section-cutting and staining techniques for the study of plant materials.
3. Making Drawings in Practical Records will enhance understanding morphological and structural details and related functional aspects in diverse plant groups.
4. Use of Illustrations, Photographs, Charts, Permanent Slides, Museum and Herbarium Specimens along with ICT Methods will provide an interesting insight into the beautiful world of microbes and plants.
5. Scope of Biodiversity includes Medicinal field, Industry, Agriculture, Research and Study, Job Opportunities and Environmental Conservation. This paper is both informative and interesting and will enable students to learn about Biodiversity not only as a plant or nature lover, but also for higher academic pursuits, particularly in the field of Biological Sciences, Environment and Biodiversity Conservation.

Unit 1: Microbes : Viruses – Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; **Bacteria** – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit2: Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: Nostoc, Chlamydomonas,



Oedogonium, Vaucheria, Fucus, Polysiphonia. Economic importance of algae.

Unit 3: Fungi: Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of Rhizopus (Zygomycota) Penicillium, Alternaria (Ascomycota), Puccinia, Agaricus (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit 4: Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations, Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of Marchantia and Funaria.(Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of Sphagnum.

Unit 5: Pteridophytes: General characteristics, classification, Early land plants (Cooksonia and Rhynia). Classification (up to family), morphology, anatomy and reproduction of Selaginella, Equisetum and Pteris, (Developmental details not to be included), Heterospory and seed habit, stellar evolution. Ecological and economical importance of Pteridophytes, Gymnosperms: General characteristics; Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus (Developmental details not to be included), Ecological and economical importance

Practical

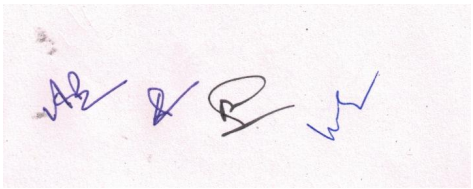
1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of Nostoc, Chlamydomonas (electron micrographs), Oedogonium, Vaucheria, Fucus* and Polysiphonia through temporary preparations and permanent slides. (* Fucus - Specimen and permanent slides)
5. *Rhizopus* and Penicillium: Asexual stage from temporary mounts and sexual structuresthrough permanent slides.
6. *Alternaria*: Specimens/photographs and tease mounts.
7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. Agaricus: Specimens of button stage and full grown mushroom; Sectioning of gills of Agaricus.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. Marchantia- morphology of thallus, w.m. rhizoids and scales, v.s. thallus throughgemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores(temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
12. Selaginella- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
13. Equisetum- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore,w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
14. Pteris- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores(temporary slides), t.s.

rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).

15. Cycas- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet,v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
16. Pinus- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, , l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. &r.l.s. stem (permanent slide).

Suggested Readings

1) Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2) Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.
3) Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4) Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5) Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6) Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7) Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8) Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.



COURSE CODE NO.: BOT 105: COMPUTER APPLICATION (ABILITY ENHANCEMENT COURSE COMPULSORY-I)

Course objectives: To enable the students to:

1. Acquire knowledge in basic features of Microsoft office, windows basics and filemanagement.
2. Develop familiarity with internet basics, email and accessing internet.

Course outcomes: The students will be able to:

1. Apply different data and text processing software to create documents, presentation andanalysis.
2. Use computers to access academic data bases for education, information and research.

Unit I: Computer fundamentals: Over view about computers:

a. Components of computers
b. Input/output devices
c. Secondary storage devices
d. Number systems: decimal, binary, octal, hexadecimal
e. Representation of information: BCD, EBCDIC, ASCII
f. Representation of Data: files, records, files
g. File organization and access
h. Security and safety of data
i. Introduction to operating systems

Unit II: MS-Windows: Introduction:

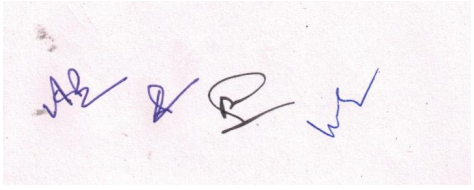
a. Exploring the desk top
b. Running multiple programmes
c. Accessories
d. Control Panel
e. Managing documents and folders

Unit III: MS-Word: Starting MS-WORD:

a. Creating and formatting a document
b. Changing font and point size
c. Table creation and operations
d. Auto correct, auto text, spell check, Thesaurus
e. Word Art inserting objects
f. Mail merge, letter, label, envelope
g. Page set-up, page preview
h. Printing a document

Unit IV: MS-Excel

a. Starting Excel



b. Work Sheet, Cell, Inserting Data into Rows/Columns
c. Alignment, Text-wrapping
d. Strong data, Auto sum
e. Use of functions, referencing formula cells in other formulae
f. Naming cells and ranges, Goal seek
g. Generating games
h. Integrating Worksheet data and charts with WORD
i. Creating Hyperlink to a WORD document
j. Page set-up, Print Preview, Printing Worksheets.

Unit V: MS-Power Point:

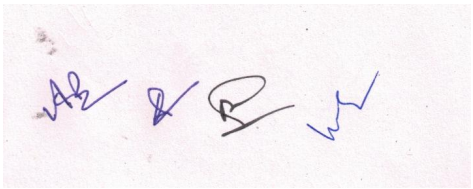
a. Starting MS- Power point
b. Auto Wizard, Creating a presentation using Autocontent Wizard
c. Blank Presentation, Creating, saving and printing a presentation
d. Adding a slide to a presentation
e. Navigation through a presentation, slide sorter, Slide show, Editing slides
f. Using clipart, word Art gallery
g. Adding Transitions and Animation Effects, Setting timing for slide show, preparing note pages, preparing audiences handout, printing presentation Documents.

Unit VI: Internet: Genesis and use of Internet

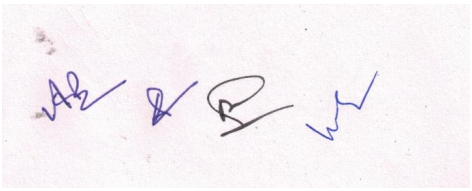
a. Software and hardware requirements for Internet
b. Accessing the Internet, web page, using search engine, accessing the Internet from MS-Office applications

Suggested readings:

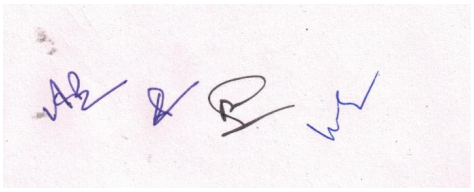
1) Norton, P. Introduction to computers. Tata McGraw-hill publishing company Ltd., New Delhi. 2008. 6th Edn.
2) Saxena, S. A first course in computers (based on Windows XP and office XP). Vikas publishing house Pvt. Ltd., New Delhi. 2010.



COURSE CODE NO.: BOT 106: PRACTICAL-I
(SKILL ENHANCEMENT ELECTIVE COURSE-I)



SUBJECT: BOTANY (HONS) FIRST YEAR, CBCS SCHEME
SEMESTER-II
COURSE CODE NO.: BOT 201: LANGUAGE (REGIONAL) (HINDI)



COURSE CODE NO.: BOT 202: MYCOLOGY AND PHYTOPATHOLOGY (CORE-III)

Course Objective:

1. 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

Course Learning Outcomes

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

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

Unit 1: Introduction to true fungi: General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification. Chytridiomycota and Zygomycota: Characteristic features; Ecology and significance; Thallus organisation; Reproduction; Life cycle with reference to Synchytrium, Rhizopus .

Unit 2: Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to Saccharomyces, Aspergillus, Penicillium, Alternaria, Neurospora and Peziza, **Basidiomycota :** General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological Specialization), loose and covered smut (symptoms only), Agaricus; Bioluminescence, Fairy Rings and Mushroom Cultivation.

Unit 3: Allied Fungi: General characteristics; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies, **Oomycota :** General characteristics; Ecology; Life cycle and classification with reference to Phytophthora, Albugo.

Phytopathology: Terms and concepts; General symptoms; Geographical distribution of diseases; Etiology; Symptomology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of plant diseases, and role of quarantine.

Bacterial diseases – Citrus canker and angular leaf spot of cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing, Fungal diseases – Early blight of potato, Black stem rust of wheat, White rust of crucifers.

Unit 4: Symbiotic associations : Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza-Ectomycorrhiza, Endomycorrhiza and their significance,

Unit 5: Applied Mycology: Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites

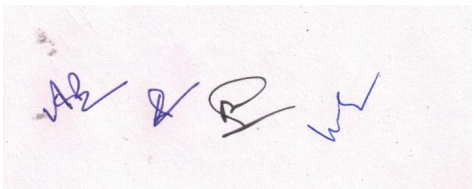
(Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology.

Practical

1. Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).
2. Rhizopus: study of asexual stage from temporary mounts and sexual structures through permanent slides.
3. Aspergillus and Penicillium: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
4. Peziza: sectioning through ascocarp.
5. Alternaria: Specimens/photographs and temporary mounts.
6. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
7. Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, fairy rings and bioluminescent mushrooms to be shown.
8. Study of phaneroplasmodium from actual specimens and /or photograph. Study of Stemonitis sporangia.
9. Albugo: Study of symptoms of plants infected with Albugo; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.
10. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)
11. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

Suggested Readings

1) Agrios, G.N. (1997) Plant Pathology, 4th edition, Academic Press, U.K.
2) Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3) Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3rd edition.
4) Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
5) Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.



COURSE CODE NO.: BOT 203: ECOLOGY (CORE-IV)

Course Objective:

1. To introduce the students with environmental factors affecting the plants, the basic principles of ecology and phytogeography.
2. To make them understand complex community patterns and processes, and ecosystem functioning.

Course Learning Outcomes:

1. It acquaint the students with complex interrelationship between organisms and environment; make them understand methods to studying vegetation, community patterns and processes, ecosystem functions, and principles of phytogeography.
2. This knowledge is critical in evolving strategies for sustainable natural resource management and biodiversity conservation.

Unit 1: Introduction: Basic concepts; Levels of organization. Inter-relationships between the living world and the environment, the components and dynamism, homeostasis, Soil: Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.

Unit 2: Water: Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table, Light, temperature, wind and fire: Variations; adaptations of plants to their variation, Biotic interactions: Trophic organization, basic source of energy, autotrophy, heterotrophy; symbiosis, commensalism, parasitism; food chains and webs; ecological pyramids; biomass, standing crop.

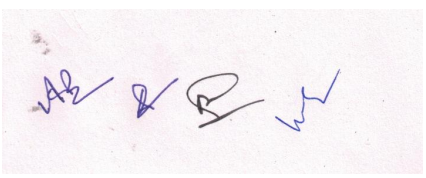
Unit 3: Population ecology: Characteristics and Dynamics .Ecological Speciation, Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.

Unit 4: Ecosystems: Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids, Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.

Unit 5: Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation.

Practical

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and

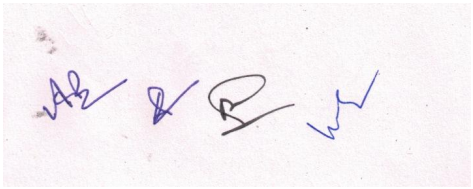


minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.

2. Determination of pH of various soil and water samples (pH meter, universal indicator/Lovibond comparator and pH paper)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
7. (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).
8. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
9. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
10. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
11. Field visit to familiarise students with ecology of different sites.

Suggested Readings

1) Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2) Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3) Sharma, P.D. (2010). Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.
4) Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
5) Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition



COURSE CODE NO.: BOT 204: BIOSTATISTICS (GENERIC ELECTIVES-II)

Course Objective:

To have knowledge of analysis of scientific data

Course Learning Outcomes:

1. Understanding of interpreting the scientific data that is generated during scientific experiments
2. It is the responsibility of biostatisticians and other experts to consider the variables in subjects to understand them, and to make sense of different sources of variation.
3. In essence, the goal of biostatistics is to disentangle the data received and make valid inferences that can be used to solve problems in public health.
4. Biostatistics uses the application of statistical methods to conduct research in the areas of biology, public health, and medicine.
5. Many times, experts in biostatistics collaborate with other scientists and researchers.

Unit 1:

Biostatistics - definition - statistical methods - basic principles; Variables -measurements, functions, limitations and uses of statistics.

Unit 2:

Collection of data primary and secondary - types and methods of data collection procedures - merits and demerits; Classification - tabulation and presentation of data – samplingmethods;

Unit 3:

Measures of central tendency - mean, median, mode, merits & demerits of harmonic and geometric mean - . Measures of dispersion - range, standard deviation, mean deviation, standard error, skewness and kurtosis, quartile deviation –merits and demerits; Co- efficient of variations.

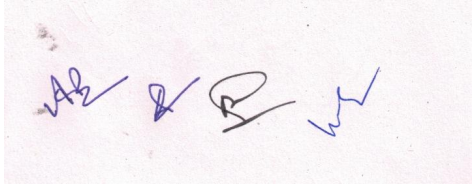
Unit 4:

Correlation - types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression.

Unit 5:

Statistical inference - hypothesis - simple hypothesis - student't' test - chi square test, F-test.
Basic concept of probability, Introduction to bionomial, poisson and Normal distribution; Usesof advance softwares (MS-excel, SPSS, Sigmaplot and R) in modern biostatistics

Practical:



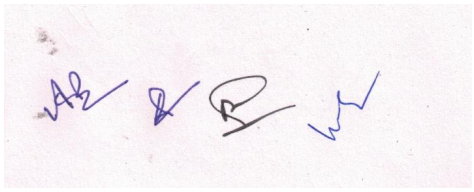
1) Classification - tabulation and presentation of data
2) Calculation of mean, mode, median, standard deviation, quartile deviation, standard error and coefficient of variance
3) Calculation of correlation coefficient values by Karl Pearson's and Spearman Rank methods
4) Statistical inference - hypothesis – student 't' test - chi square test
5) Addition and multiple rules of probability
6) One way analysis of variance
7) Uses of software in biostatistics

Suggestive Readings:

1. Mann, S. P. (2016). Introductory Statistics, 9th edition. Hoboken, NJ, Jone Wiley and Sons Inc. Danniel, W.W. (1987). *Biostatistic.* New York,NY: John Wiley Sons.
2. Khan, I.A., Khanum, A. (2004). *Fundamentals of Biostatistics*, 5th edition. Hyderabad: Ukaaz publications
3. Zar, J.H. (2014). *Biostatistical Analysis*, 5th edition. London, London: Pearson Publication.

Additional Resources:

1. Pandey, M. (2015). *Biostatistics Basic and Advanced.* New Delhi, Delhi: M V Learning.
2. Sundarrao, P.S.S., Richards, (1996). *An introduction to Biostatistics*, 3rd edition. Vellore, Tamil Nadu: J. Christian Medical College.



COURSE CODE NO.: BOT 205: ENVIRONMENT SCIENCE
(ABILITY ENHANCEMENT COMPULSORY COURSE-II)

Course Objectives:

1. To know the importance of environmental studies and methods of conservation of natural resources
2. Describe the structure and function of an ecosystem and explain the values and Conservation of bio-diversity.
3. Explain the sources, environmental effects and control measures of various types of pollutions.
4. Select the appropriate methods for waste management.
5. Recall social issues and legal provision and describe the necessities for environmental act.

Course Learning Outcome:

1. Knowledge of the environment and the role of human beings in shaping the environment
2. Understand various components of the environment and interfaces
3. Critically appreciate the environmental concerns of today

Unit-I: Natural Resources:

Definition, scope, and importance of environmental sciences -Need for public awareness- Natural resources: Forest resources, Water resources, Land resources, Mineral resources, and Energy resources - Role of an individual in conservation of natural resources.

Unit-II: Ecosystem and Biodiversity:

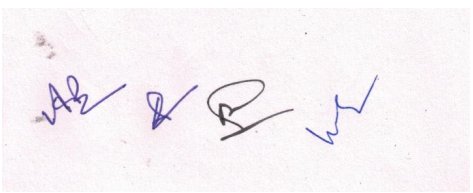
Concept of an ecosystem - Structure and function of an ecosystem - Food chains, food webs and ecological pyramids - Biodiversity - Definition, value of biodiversity- Hot spots of biodiversity - Threats to biodiversity - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-III: Environmental Pollution:

Sources, consequences and control measures of Air pollution, Water pollution, Soil pollution, Thermal pollution and nuclear pollution; Environmental threats -, Acid rain, Climate change, Global warming (Greenhouse effect), Ozone layer depletion. Fireworks: current environmental issues.

Unit-IV: Management of Environmental Pollution:

Causes, effects, treatments methods and control measures of solid waste, municipal waste, biomedical waste - Waste minimization techniques - Cleaner technology-- Disaster management: floods, earthquake, cyclone, landslides and Tsunami.



Unit-V: Social Issues and the Environment:

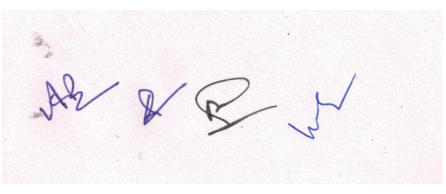
Water conservation, rain water harvesting- Environmental impact assessment- Precautionary and polluters pay principle- environment protection act - air (prevention and control of pollution) act - water (prevention and control of pollution) act - Population explosion - Family Welfare Programmes - Environment and human health - Human Rights - Women and Child Welfare.

Practicals:

1. Determination of requisite size of the quadrant for vegetation analysis.
2. Analysis of frequency distribution of plants in a piece of vegetation by quardrat method.
3. To determine chlorophyll content of the given plant material.
4. To determine basal cover of trees in a forest ecosystem/forest plantation.
5. Quantitative analysis of soil organic carbon.
6. Quantitative analysis of soil pH.
7. To study pore space, water holding capacity and bulk density of soil.
8. Identification of rocks and minerals on the basis of physical characters.
9. Temporary wet amount technique for the observation of living organism.
10. Ecological comments on charts/material/fresh plant material (as per syllabus).
11. Comments on economic uses of plant material (as per syllabus).
12. Preparation of field report based on the survey of local flora.
13. Study of centre of diversity of plants from maps.
14. Comments on life cycle of some economically important insects.
15. Identification of museum specimens of some economically important fishes.
16. Study of flora and fauna through charts and maps.
17. Preparation of field report based on the visit to a Wild Life Sanctuary/National Park/Zoo/Biosphere Reserve.

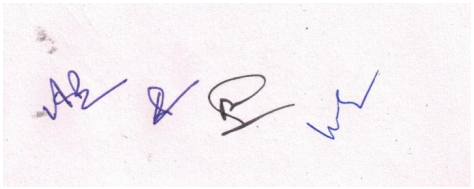
Suggested Readings:

1. Dhameja, S. K., Environmental Engineering and Management, S. K. Kataria and sons, New Delhi, 1st Edition2015.
2. Anubha Kaushik and Kaushik C.P., Environmental Science & Engineering" New Age international Publishers, New Delhi, 2010.
3. Gilbert M. Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., 2nd edition, 2004.
4. Erach Bharucha, Textbook for Environmental Studies, UGC, New Delhi, 2004.
5. Miller T.G. Jr., "Environmental Science", Wadsworth Publishing Co. USA, 2nd Edition2004.
6. Erach Bharucha, "The Biodiversity of India", Mapin publishing Pvt. Ltd., Ahmedabad India, 2002.
7. Trivedi R.K., "Handbook of Environmental Laws", Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro media, 2003.
8. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
9. Wager K.D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.



10. Sawyer C. N, McCarty P. L, and Parkin G. F., Chemistry for Environmental Engineering, McGraw-Hill, Inc., New York, 1994.

COURSE CODE NO.: BOT 206: PRACTICAL-II
(SKILL ENHANCEMENT ELECTIVE COURSE-II)



SUBJECT: BOTANY (HONS) SECOND YEAR, CBCS SCHEME
SEMESTER-III
COURSE CODE NO.: BOT 301: ANATOMY OF ANGIOSPERM (CORE-V)

Course Objective:

1. To acquaint the students with internal basic structure and cellular composition of theplant body.
2. To correlate structure with important functions of different plant parts.
3. Study of various tissue systems and their development and functions in plants

Course Learning Outcomes:

1. Knowledge of various cells and tissues, meristem, epidermal and vascular tissue system in plants.
2. Various aspects of growth, development of the tissues and differentiation of various plant organs. Knowledge of basic structure and organization of plant parts in angiosperms.
3. Correlation of structure with morphology and functions.

Unit 1: Introduction and scope of Plant Anatomy: Applications in systematic, forensics and pharmacognosy.

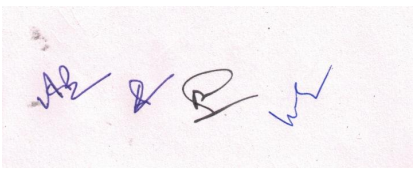
Unit 2: Structure and Development of Plant Body: Internal organization of plant body: The three tissue systems, types of cells and tissues. Development of plant body: Polarity, Cytodifferentiation and organogenesis during embryogenic development.

Unit 2: Tissues : Classification of tissues; Simple and complex tissues (no phylogeny); cyto-differentiation of treachery elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers

Unit 3: Apical meristems: Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Origin, development, arrangement and diversity in size and shape of leaves; Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin oflateral root.

Unit 4: Vascular Cambium and Wood : Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects and reaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels

Unit 5: Adaptive and Protective Systems: Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni-



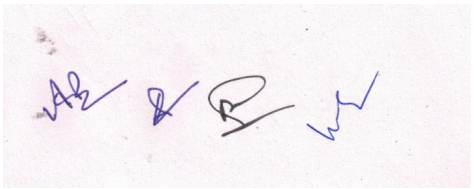
and multicellular, glandular and nonglandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes and hydrophytes.

Practical

1. Study of anatomical details through permanent slides/temporary stain mounts/ macerations/ museum specimens with the help of suitable examples.
2. Apical meristem of root, shoot and vascular cambium.
3. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Xylem: Tracheary elements-tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
5. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
6. Phloem: Sieve tubes-sieve plates; companion cells; phloem fibres.
7. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
8. Root: monocot, dicot, secondary growth.
9. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
10. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
11. Adaptive Anatomy: xerophytes, hydrophytes.
12. Secretory tissues: cavities, lithocysts and laticifers.

Suggested Readings

1) Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
2) Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
3) Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
4) Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.



COURSE CODE NO.: BOT 302: ECONOMIC BOTANY (CORE-VI)

Course Objective:

1. To make the students familiar with economic importance of diverse plants that offer resources to human life.
2. It emphasizes the plants used as- food for man, fodder for cattle, feed for poultry, plants having medicinal value and also plant source of huge economic value etc

Course Learning Outcomes:

1. After studying Economic Botany, students would have first hand information of plants used as food, the various kinds of nutrients available in the plants.
2. The dietary requirements of proteins, fats, amino-acids, vitamins etc that can be met by plants.
3. The students will learn to perform the micro-chemical tests to demonstrate various components.
4. The students will learn about the use of fiber plants, beverages, fruits and vegetables that are integral to day to day life of plants.
5. Students will learn to explore the regional diversity in food crops and other plants and their ethno-botanical importance as well.

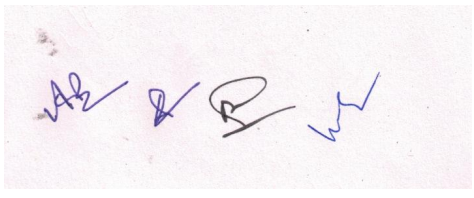
Unit 1: Origin of Cultivated Plants: Concept of Centres of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity, **Timber plants :**General account with special reference to teak and pine

Unit 2: Cereals : Wheat and Rice (origin, morphology, processing & uses); Brief account of millets.
Legumes: Origin, morphology and uses of Chick pea, Pigeon pea and fodder legumes, Importance to man and ecosystem.

Unit 3: Sources of sugars and starches : Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.
Listing of important spices, their family and part used. Reference to fennel, saffron, clove and black pepper Economic importance with special Spices, Beverages: Tea, Coffee (morphology, processing & uses), **Fibers:** Classification based on the origin of fibers; Cotton, Coir and Jute (morphology, extraction and uses).

Unit 4: Sources of oils and fats : General description, classification, extraction, their uses and health implications groundnut, coconut, linseed, soybean, mustard and coconut (Botanical name, family & uses). Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.

Unit 5: Natural Rubber : Para-rubber: tapping, processing and uses. **Drug-yielding plants:**Therapeutic and habit-forming drugs with special reference to Cinchona, Digitalis, Papaver and Cannabis; Tobacco (Morphology, processing, uses and health hazards).

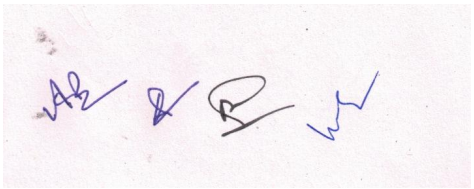


Practical

1. Cereals: Wheat (habit sketch, L. S/T.S. grain, starch grains, micro-chemical tests)Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. Legumes: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. Sources of sugars and starches: Sugarcane (habit sketch; 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).
4. Spices: Black pepper, Fennel and Clove (habit and sections).
5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. Sources of oils and fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushed seeds.
7. Essential oil-yielding plants: Habit sketch of Rosa, Vetiveria, Santalum and Eucalyptus
8. (Specimens/photographs).
9. Rubber: specimen, photograph/model of tapping, samples of rubber products.
10. Drug-yielding plants: Specimens of Digitalis, Papaver and Cannabis.
11. Tobacco: specimen and products of Tobacco.
12. Woods: Tectona, Pinus: Specimen, Section of young stem.
13. Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

Suggested Readings

1) Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2) Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3) Chrispeels, M.J. and Sadava, D.E. 1994 Plants, Genes and Agriculture. Jones & Bartlett Publishers.



COURSE CODE NO.: BOT 303: PLANT ECOLOGY AND TAXONOMY (GENERIC ELECTIVE-III)

Course Objective:

1. Objectives: To make students understand ecology and basic ecological concepts, inter-relation between the living world and environment.
2. Also to make them aware about identification,nomenclature and classification.

Course Learning Outcome:

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

Unit 1: Introduction, **Ecological factors :** 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. Adaptation of hydrophytes and xerophytes

Unit 2: Ecosystem: Structure; energy flow tropic organization; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous, **Phytogeography:** Principle biogeographical zones; Endemism

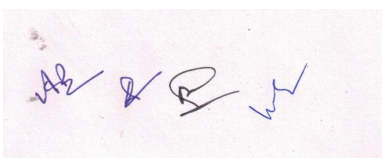
Unit 3: Plant communities: Characters; Ecotone and edge effect; Succession; Processes and types, Introduction to plant taxonomy: Identification, Classification, Nomenclature; **Identification:** Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access

Unit 4: Taxonomic evidences from palynology, cytology, phytochemistry and molecular data; **Taxonomic hierarchy**: Ranks, categories and taxonomic groups; **Botanical nomenclature:** Principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication, rejection of names, principle of priority and its limitations.

Unit 5: Classification : Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (up to series), Engler and Prantl (upto series); Biometrics, numerical taxonomy and cladistics 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. Comparison of bulk density, porosity and rate of infiltration of water in soil of three habitats.
   (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),

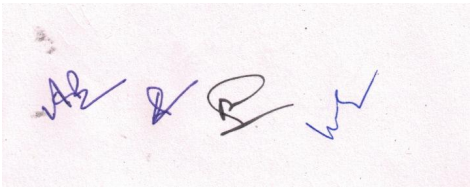


Epiphytes, Predation (Insectivorous plants)

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 / Lilium / Allium.
7. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings

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. 3rd edition.



COURSE CODE NO.: BOT 304: MUSHROOM CULTURE TECHNOLOGY
(ABILITY ENHANCEMENT ELECTIVE COURSE-I)

Course Objective:

1. Objective of this paper is to make aware student about the mushroom growing techniques.
2. Mushrooms have medicinal and nutritional value students will be make aware of this aspect.
3. National and international market that helps in economy of country students will be make aware about this also as this is low cost input process but benefits/outcomes are high.

Course Learning Outcomes:

1. As mushroom cultivation is a booming field Goverment of India is also supporting this type of work because students can learn the techniques and small scale and large scale industries can be established by the students.
2. Hand on experience will be given to students so they can utilize this training in long run. In small area also they can establish the bussiness..

Unit 1: Introduction, history; Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of edible mushrooms available in India - Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus.

Unit 2:Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication.

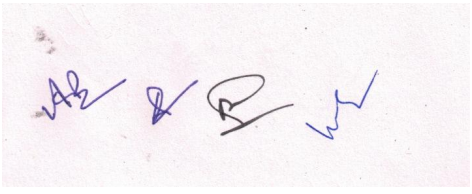
Unit 3: Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation; - Low cost technology, composting technology in mushroom production

Unit 4: Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.

Unit 5: Food Preparation: Types of foods prepared from mushroom.Research Centres - National level and Regional level. Cost benefit ratio - Marketing in India and abroad, Export Value.

Practical:

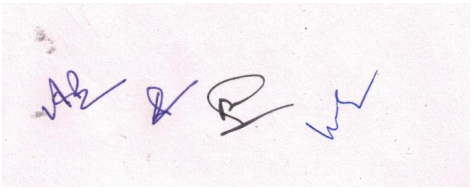
1. Principle and functioning of instruments used in the various techniques.
2. Preperation of various types of media.
3. Preperation of spawn.
4. Study of poisnous and non poisonous mushroom



5. Study of diseases of mushroom.
6. Nutritional and market value of mushroom
7. Centres of mushroom
8. Techniques for the cultivation of *Agaricus , Pleurotus and Ganoderma*
9. *Visit to Institute and* cultivation centre.

Suggested Readings

1) Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2) Swaminathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3) Tewari, Pankaj Kapoor, S.C., (1988). Mushroom cultivation, Mittal Publications, Delhi.
4) Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition, Vol. I & Vol. II.

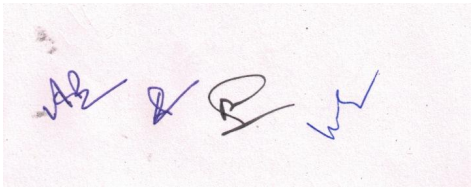


COURSE CODE NO.: BOT 305: LAB TRAINING I / INTERNSHIP
(TRAINING-I/INTERNSHIP)

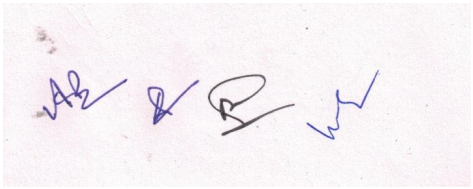
Course Objective: To provide students exposure to Botanical Garden/ industrial set-up and to enable students observe, first hand, work flow and processes in plant product industries and associated enterprises

Learning Outcome: The student will be able to appreciate different processing and production technologies in various industrial settings. The student will be exposed to the diverse setting in plant product industries

Review of the state of research in a particular problem involving food, and development of hypothesis, Planning and conducting the experiment, Periodic analysis of data and preparation of report, Final preparation of project report as dissertation to be submitted in partial fulfillment of B.Sc. Programme.



COURSE CODE NO.: BOT 306: PRACTICAL-III
(SKILL ENHANCEMENT ELECTIVE COURSE-III)



SUBJECT: BOTANY (HONS) SECOND YEAR, CBCS SCHEME
SEMESTER-IV
COURSE CODE NO.: BOT 401: PLANT METABOLISM (CORE-VII)

Course Objective:

1. A comprehensive study of different pathways including their biochemistry and to some extent the molecular details.
2. Current understanding of regulation and integration of metabolic processes in plants with reference to crop productivity.
3. Significance of metabolic pathways for metabolic engineering in producing transgenics.
4. To gain the knowledge of physiological and biochemical processes in the plant system

Course Learning Outcomes:

1. Concept and significance of metabolic redundancy in plants.
2. Students will also be able to learn the similarity and differences in metabolic pathways in animals and plants.
3. To have understanding of water and nutrient uptake and movement in plants, role of mineral elements, translocation of sugars, Role of various plant growth regulators, phytochrome cytochromes and phototropins, and flowering stimulus.

Unit 1: Concept of metabolism: Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes).

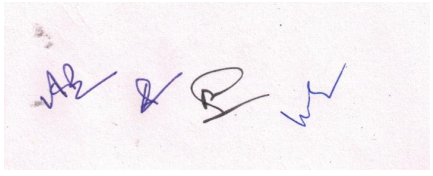
Unit 2: Carbon Assimilation: Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centers, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO_2 reduction, photorespiration, C_4pathways; Crassulacean acid metabolism; Factors affecting CO_2 reduction.

Unit 3: Carbohydrate metabolism: Synthesis and catabolism of sucrose and starch; **Carbon Oxidation:** Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle; TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.

Unit 4: ATP-Synthesis: Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyers conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.

Lipid metabolism: Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination, α oxidation.

Unit 5: Nitrogen metabolism: Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.



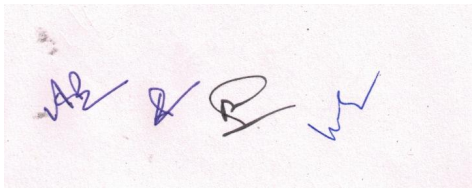
Mechanisms of signal transduction: Receptor-ligand interactions; Second messenger concept, Calcium calmodulin, MAP kinase cascade.

Practicals:

1. Chemical separation of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.
7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.
9. Demonstration of absorption spectrum of photosynthetic pigments.

Suggested Readings

1) Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons.
2) U.S.A. 4th edition.
3) Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
4) Harborne, J.B. (1973). Phytochemical Methods. John Wiley & Sons. New York.



COURSE CODE NO.: BOT 402: PLANT PHYSIOLOGY (CORE-VIII)

Course Objective:

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:

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

Unit 1: Plant-water relations: Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap– cohesion-tension theory, Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomata movement

Unit 2: Mineral nutrition: Essential and beneficial elements, macro and micronutrients, methods of study and use of nutrient solutions, criteria for essentiality, mineral deficiency symptoms, roles of essential elements, chelating agents.

Nutrient Uptake: Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems,proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.

Unit 3: Translocation in the phloem: Experimental evidence in support of phloem as the site of sugar translocation. Pressure–Flow Model; Phloem loading and unloading; Source–sink relationship.

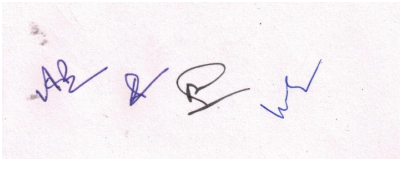
Plant growth regulators: Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.

Unit 4: Physiology of Flowering: Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.

Unit 5: Phytochrome, crytochromes and phototropism: Discovery, chemical nature, role in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

Practicals:

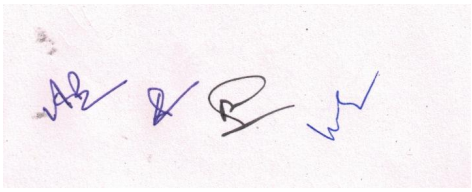
1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water potential of given tissue (potato tuber) by weight method.



3. Study of the effect of wind velocity and light on the rate of transpiration in excised twig/leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. To calculate the area of an open stoma and percentage of leaf area open through stomata in a mesophyte and xerophyte (both surfaces).
6. To study the phenomenon of seed germination (effect of light).
7. To study the effect of different concentrations of IAA on Avena coleoptile elongation (IAA Bioassay).
8. To study the induction of amylase activity in germinating barley grains.
9. Demonstration experiments
10. To demonstrate suction due to transpiration.
11. Fruit ripening/Rooting from cuttings (Demonstration).
12. Bolting experiment/Avena coleptile bioassay (demonstration).

Suggested Readings

1) Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2) Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3) Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.



COURSE CODE NO.: BOT 403: ANALYTICAL TECHNIQUES IN PLANT SCIENCES (GENERIC ELECTIVE-IV)

Course Objective:

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

Course Learning Outcomes:

Understanding of principles and use of light, confocal transmission and electron microscopy, centrifugation, spectrophotometry, chromatography, x-ray diffraction technique and chromatography techniques

Unit 1: Imaging and related techniques

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

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

Unit 3: **Radioisotopes**

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

Spectrophotometry : Principle and its application in biological research.

Unit 4: Chromatography

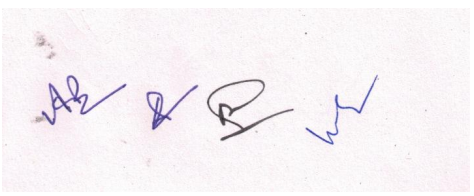
Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography

Unit 5: Characterization of proteins and nucleic acids

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

Practicals:

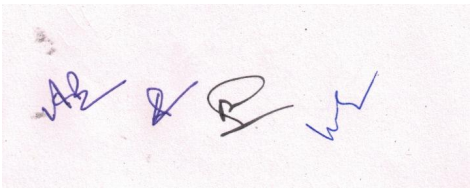
1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.



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).

Suggested Readings:

1. Cooper, G.M., Hausman, R.E. (2009). *The Cell: A Molecular Approach*, 5th edition.Washington, D.C.: ASM Press & Sunderland, Sinauer Associates, MA.
2. Iwasa,J, Marshall , W. (2016). Karps's Cell and Molecular Biology ; Concepts and experiments. New Jersey, U.S.A.: John Wiley & Sons.



COURSE CODE NO.: BOT 404: INDUSTRIAL AND ENVIRONMENTAL MICROBIOLOGY (ABLITY ENHANCEMENT ELECTIVE COURSE-II)

Course Objective:

1. To introduce students with the industrial microbiology: concepts, principles, scope and application
2. To introduce students with the environmental microbiology: concepts, principles, scope and application

Course Learning Outcomes:

Upon successful completion of the course, students are expected to be able to:

1. Understand how microbiology is applied in manufacturing of industrial products
2. Know about design of bioreactors, factors affecting growth and production
3. Understand the rationale in medium formulation & design for microbial fermentation, sterilization of medium and air
4. Comprehend the different types of fermentation processes
5. Comprehend the techniques and the underlying principles in upstream and down- stream processing
6. Learn the occurrence, abundance and distribution of microorganism in the environmentand their role in the environment and also learn different methods for their detection
7. Understand various biogeochemical cycles – Carbon and Nitrogen, and microbesinvolved
8. Understand the basic principles of environment microbiology and application of the samein solving environmental problems – waste water treatment and bioremediation
9. Comprehend the various methods to determine the quality of water

Unit 1:

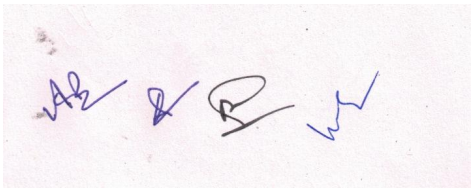
Scope of microbes in industry and environment; institutes of microbial research

Unit 2: Bioreactors/Fermenters and fermentation processes

Solid-state and liquid-state (stationary and submerged) fermentations; Batch and continuous Fermentations; Components of a typical bioreactor, Types of bioreactors: laboratory, pilot scale and production fermenters; Constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter.

Unit 3: **Microbial production of industrial products**

Microorganisms involved, microorganisms generally regarded as safe (GRAS), media, fermentation conditions, downstream processing and uses; Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying; production of industrially important products: enzyme (amylase); organic acid (citric acid); alcohol (ethanol); antibiotic (penicillin)



Unit 4: Microbial enzymes of industrial interest and enzyme immobilization

Overview of enzymes used for industrial applications, Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes: glucose isomerase and penicillin acylase

Unit 5: Microbes and quality of environment.

Distribution of microbes in air, soil and water; isolation of microorganisms from soil, air and water

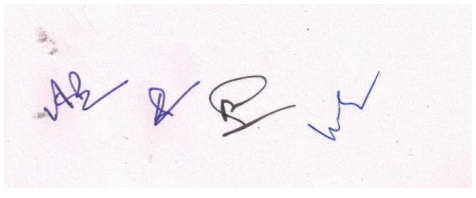
Microbial flora of water: Water pollution: various sources and control measures; role of microbes in sewage and domestic waste water treatment systems. Microorganisms as indicators of water quality: coliforms and fecal coliforms.

Practical:

1. Principles and functioning of instruments in microbiology laboratory (autoclave, laminar air flow, incubators, types of fermenters)
2. Preparation of different culture media (Nutrient medium/ Luria Bertani medium/Potato dextrose medium/Czapek Dox medium)
3. Hydrolysis of casein / starch by microorganisms
4. Alcohol production by yeast using sugar/ jaggery
5. Serial dilution method for isolation of microorganisms from water and soil and study of aeromicroflora.
6. Determination of BOD, COD, TDS and TOC of water samples
7. Determination of coliforms in water samples using eosin methylene blue (EMB) medium
8. A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations and a report to be submitted.

Suggested Readings:

1. Pelzar, M.J. Jr., Chan E.C. S., Krieg, N.R. (2010). *Microbiology: An application based approach*. New Delhi, Delhi: McGraw Hill Education Pvt. Ltd., Delhi.
2. Tortora, G.J., Funke, B.R., Case. C.L. (2007). *Microbiology*. San Francisco, SF: PearsonBenjamin Cummings,. 9th edition
3. Stanbury, P.F., Whitaker, A., Hall, S.J. (2016) *Principles of Fermentation*
4. *Technology***.** Amesterdam, NDL**:**Elsevier Publication
5. Patel, A.H. (2008) *Industrial Microbiology*, Bangalore, India: McMillan India Limited
6. Mohapatra. P.K. (2008). *Textbook of Environmental Microbiology* New Delhi, Delhi,
7. I.K. International Publishing House Pvt.Ltd.
8. Bertrand, Jean-Claude, Caumette, P. , Lebaron, P, Matheron, R., Normand, P., Sime-Ngando, T. (2015) *Environmental Microbiology: Fundamentals and Applications*. Amesterdam, Netherlands, Springer
9. Joe, S., Sukesh (2010). *Industrial Microbiology*. New Delhi, Delhi: S.Chand &Company Pvt. Ltd.,
10. Additional Sources
11. Casida, J.R. (2016). *Industrial Microbiology.* New, Delhi, Delhi, New Age InternationalPublishers



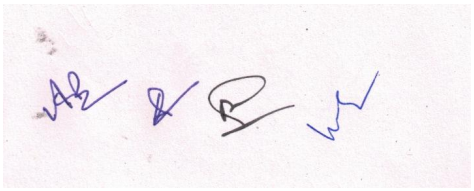
12. Atlas, Bartha. (1997). *Microbial Ecology: Fundamentals and Applications*. San Fransisco, SF. Pearson
13. Sharma, P.D. (2005)., *Environmental Microbiology*. Meerut, UP: Alpha Science International, Ltd

COURSE CODE NO.: BOT 405: LAB TRAINING II /INTERNSHIP
(TRAINING II/INTERNSHIP)

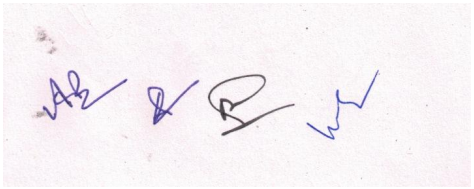
Course Objective: To provide students exposure to Botanical Garden/ industrial set-up and to enable students observe, first hand, work flow and processes in plant product industries and associated enterprises

Learning Outcome: The student will be able to appreciate different processing and production technologies in various industrial settings. The student will be exposed to the diverse setting in plant product industries

Review of the state of research in a particular problem involving food, and development of hypothesis, Planning and conducting the experiment, Periodic analysis of data and preparation of report, Final preparation of project report as dissertation to be submitted in partial fulfillment of B.Sc. Programme



COURSE CODE NO.: BOT 406: PRACTICAL-IV
(SKILL ENHANCEMENT ELECTIVE COURSE-IV)



SUBJECT: BOTANY (HONS) THIRD YEAR, CBCS SCHEME
SEMESTER-V
COURSE CODE NO.: BOT 501: PLANT SYSTEMATIC (CORE-IX)

Course Objective:

To gain the knowledge on the taxonomy, phylogeny of plants

Course Learning Outcomes

1. Understanding of systematics its importance in bioresource utilization and biodiversity management.
2. Nomenclature pattern, Phylogeny, Classification systems of the plants.

Unit 1: Significance of Plant systematic: Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Field inventory; Functions of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys:Single access and Multi-access.

Unit 2: Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).
Botanical nomenclature: Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.

Unit 3: Systems of classification: Major contributions of Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker (upto series) and Engler and Prantl (upto series); Brief reference of Angiosperm Phylogeny Group (APG III) classification.

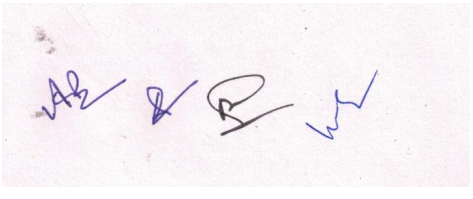
Unit 4: Biometrics, numerical taxonomy and cladistics: Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Unit 5: Phylogeny of Angiosperms : Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades; Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

Practical

1. 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):

   a. Ranunculaceae - Ranunculus, Delphinium
   b. Brassicaceae - Brassica, Alyssum / Iberis
   c. Myrtaceae - Eucalyptus, Callistemon
   d. Umbelliferae - Coriandrum /Anethum / Foeniculum

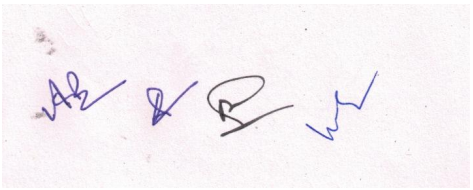


e. Asteraceae - Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax
f. Solanaceae - Solanum nigrum/Withania
g. Lamiaceae - Salvia/Ocimum
h. Euphorbiaceae - Euphorbia hirta/E.milii, Jatropha
i. Liliaceae - Asphodelus/Lilium/Allium
j. Poaceae - Triticum/Hordeum/Avena

2. Field visit (local) – Subject to grant of funds from the university.
3. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Readings

1) Singh, (2012). Plant Systematics: Theory and Practice Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2) Jeffrey, C. (1982). An Introduction to Plant Taxonomy. Cambridge University Press, Cambridge.
3) Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). Plant Systematics-A Phylogenetic Approach. Sinauer Associates Inc., U.S.A. 2nd edition.
4) Maheshwari, J.K. (1963). Flora of Delhi. CSIR, New Delhi.
5) Radford, A.E. (1986). Fundamentals of Plant Systematics. Harper and Row, New York.



COURSE CODE NO.: BOT 502: ARCHEGONIATE (CORE-X)

Course Objective:

1 The course aims at making a familiarity with special groups of plants joined together by a common feature of *sexual reproduction involving Archegonia*.

2 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.

3 Study of *morphology, anatomy, reproduction and developmental changes*therein through typological study should create a knowledge base in understanding plant diversity, economic values, taxonomy of lower group of plants.

Course Learning Outcomes:

1. The students will be made aware of the group of plants that have given rise to land habit and the flowering plants.
2. Through field study they will be able to see these plants grow in nature and become familiar with the biodiversity.
3. 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.

Unit 1: Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations.

Unit 2: Bryophytes: General characteristics; Adaptations to land habit; Classification; Range of thallus organization.

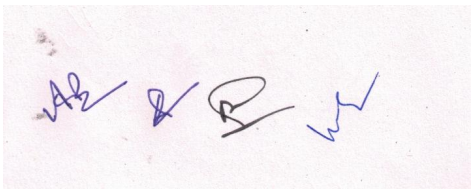
Type Studies- Bryophytes: Classification (up to family), morphology, anatomy and reproduction of Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria; Reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros and Funaria (developmental stages not included); Ecological and economic importance of bryophytes with special reference to Sphagnum.

Unit 3: Pteridophytes: General characteristics; Classification; Early land plants (Cooksonia and Rhynia).

Unit 4: Type Studies- Pteridophytes: Classification (up to family), morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris (Developmental details not to be included).Apogamy, and apospory, heterospory andseed habit, telome theory, stelar evolution; Ecological and economic importance.

Unit 6: Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus and Gnetum (Developmental details not to be included); Ecological and economic importance.

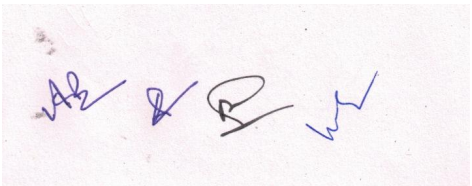
Practical



1. Riccia – Morphology of thallus.
2. Marchantia- Morphology of thallus, whole mount of rhizoids & Scales, vertical sectionof thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
3. Anthoceros- Morphology of thallus, dissection of sporophyte (to show stomata, spores,pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
4. Pellia, Porella- Permanent slides.
5. Sphagnum- Morphology of plant, whole mount of leaf (permanent slide only).
6. Funaria- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule and protonema.
7. Psilotum- Study of specimen, transverse section of synangium (permanent slide).
8. Selaginella- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).
9. Equisetum- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).
10. Pteris- Morphology, transverse section of rachis, vertical section of sporophyll, wholemount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
11. Cycas- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).
12. Pinus- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores
13. (temporary slides), longitudinal section of female cone, tangential longitudinal section &radial longitudinal sections stem (permanent slide).
14. Gnetum- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)
15. Botanical excursion

Suggested Readings

1) Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
2) Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
3) Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot. Allahabad.
4) Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
5) Vanderpoorten, A. & Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University Press.



COURSE CODE NO.: BOT 503: ETHNOBOTANY (GENERIC ELECTIVES-V)

Course Objective:

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

Course Learning Outcomes:

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.

Unit 1: Ethnobotany

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 c) Resins and oils and miscellaneous uses.

Unit 2: Methodology of Ethnobotanical studies

1. Field work
2. Herbarium
3. Ancient Literature
4. Archaeological findings
5. Temples and sacred places.

Unit 3: Role of ethnobotany in modern Medicine

Medico-ethnobotanical sources in India;Significance of the following plants in ethno botanical 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.

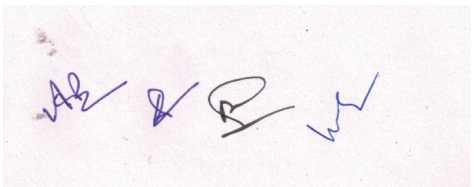
Unit 4:

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

Unit 5: Ethnobotany and legal aspects

Ethnobotany as a tool to protect interests of ethnicgroups. Sharing of wealth concept with few examples from India. Biopirac

Practical:



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

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

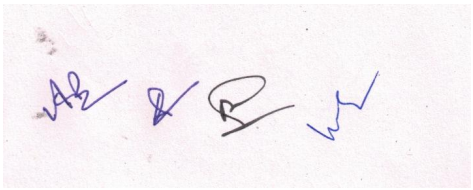
Project work-documentation, literature survey, and collection of information on ethnobotanically useful plants from traditional healers)

Suggestive Readings:

1.Gupta , R., Rajpal , T., (2012) Concise R.,(2011) , Plant Taxonomy past Present and Future . TERI Press

2.Gupta , R., Rajpal , T., (2012) Concise Mc Graw Hill Publication

3.Jain, S.K. (1995). *Manual of Ethnobotany.* Rajasthan: Scientific Publishers.



COURSE CODE NO.: BOT 504: NURSERY AND GARDENING
(ABILITY ENHANCEMENT ELECTIVE COURSE- III)

Course Objective:

To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of ornamental plants

Course Learning Outcomes

1. Students would have an understanding of how nursery of the plants is prepared?
2. How rooting is promoted in the stem cuttings?
3. How seeds are stored and what are the soil conditions for seed sowing and seedling growth? How landscaping is designed?

Unit 1: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

Unit 2: Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification.

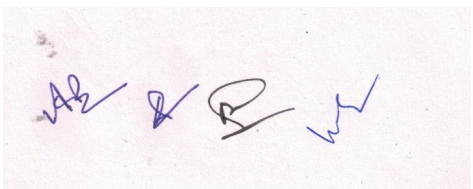
Unit 3: Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glass house.

Unit 4: Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

Unit 5: Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

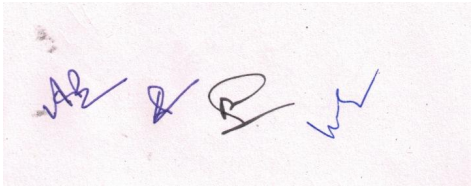
Practical:

1. Breaking of seed dormancy
2. Seed viability tests
3. Preparation of stem cutting, air layering
4. soil layering and manuring
5. compost preparation
6. Diseases and pests of plants

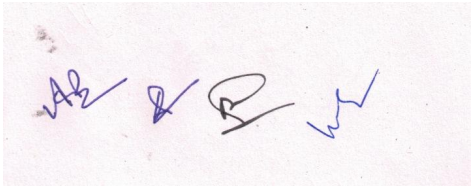


Suggested Readings

1) Bose T.K. & Mukherjee, D., 1972, Gardening in India, Oxford & IBH Publishing Co., New Delhi.
2) Sandhu, M.K., 1989, Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
3) Kumar, N., 1997, Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
4) Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5) Agrawal, P.K. 1993, Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
6) Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.



COURSE CODE NO.: BOT 505: PRACTICAL-V
(SKILL ENHANCEMENT ELECTIVE COURSE-V)



SUBJECT: BOTANY (HONS) THIRD YEAR, CBCS SCHEME
SEMESTER-VI
COURSE CODE NO.: BOT 601: REPRODUCTIVE BIOLOGY OF ANGIOSPERMS (CORE-XI)

Course Objective:

To have knowledge of the flowering and fruiting, reproduction processes, role of pollinators, anther, ovule and seed development.

Course Learning Outcomes:

Student would have an understanding of

1. Induction of flowering, molecular and genetic aspects of flower development.
2. Anther structure, pollen development, dispersal and pollination
3. Ovule, embryo sac development and fertilization,
4. Endosperm development and its importance
5. Alternative pathways of reproduction and their importance
6. Student would be able to apply this knowledge for conservation of plants, pollinators and fruit development

Unit 1: Introduction: History (contributions of G.B. Amici, W. Hofmeister, E. Strasburger, S.G. Nawaschin, P. Maheshwari, B.M. Johri, W.A. Jensen, J. Heslop-Harrison) and scope

Reproductive development: Induction of flowering; flower as a modified determinate shoot. Flower development: genetic and molecular aspects.

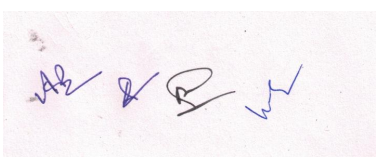
Unit 2: Anther and pollen biology: Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure, NPC system; Palynology and scope (a brief account); Pollen wall proteins; Pollen viability, storage and germination; abnormal features: Pseudomonads, polyads, massulae, pollinia.

Unit 3: Ovule: Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of Polygonum type); Organization and ultrastructure of mature embryo sac.

Pollination and fertilization: Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization.

Unit 4: Self incompatibility: Basic concepts (interspecific, intraspecific, homomorphic, heteromorphic, GSI and SSI); Methods to overcome self- incompatibility: mixed pollination, bud pollination, stub pollination; Intra-ovarian and in vitro pollination; Modification of stigma surface, parasexual hybridization; Cybrids, in vitro fertilization.

Unit 5: Embryo, Endosperm and Seed : Structure and types; General pattern of development of dicot and monocot



embryo and endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of embryo; Unusual features; Embryo development in Paeonia. Seed structure, importance and dispersal mechanisms

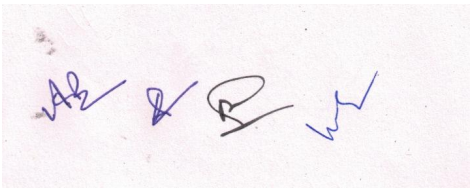
Polyembryony and apomixes: Introduction; Classification; Causes and applications.

Practical

1. Anther: Wall and its ontogeny; Tapetum (amoeboid and glandular); MMC, spore tetrads, uninucleate, bicelled and dehisced anther stages through slides/micrographs, male germ unit (MGU) through photographs and schematic representation.
2. Pollen grains: Fresh and acetolyzed showing ornamentation and aperture, psuedomonads, polyads, pollinia (slides/photographs,fresh material), ultrastructure of pollen wall(micrograph); Pollen viability: Tetrazolium test.germination: Calculation of percentage germination in different media using hanging drop method.
3. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, unitegmic, bitegmic; Tenuinucellate and crassinucellate; Special structures: Endothelium, obturator, hypostase, caruncle and aril (permanent slides/specimens/photographs).
4. Female gametophyte through permanent slides/ photographs: Types, ultrastructure of mature egg apparatus.
5. Intra-ovarian pollination; Test tube pollination through photographs.
6. Endosperm: Dissections of developing seeds for endosperm with free-nuclear haustoria.
7. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.

Suggested Readings

1) Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition.
2) Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd. Delhi.
3) Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands.
4) Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands.



COURSE CODE NO.: BOT 602: GENETICS (CORE-XII)

Course Objective:

To have knowledge of Mendelian's and non-Mendelian's inheritance, Chromosome biology andstructure and function of genes.

Course Learning Outcomes:

1. To generate interest among the students in Genetics and make them aware about the importance and opportunities in higher education and research, the first unit should be Introductory dealing with how this area has revolutionized all aspects of our life from its growth from Mendel to Genetic Engineering.
2. Modes of inheritance of traits/ phenotypes and Phenotype-genotype correlation are the basic learning.

Unit 1: Mendelian genetics and its extension: Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Numericals; Polygenic inheritance.

Unit 2: Extrachromosomal Inheritance: Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial Mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in Paramecium.

Unit 3: Linkage, crossing over and chromosome mapping : Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.

Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

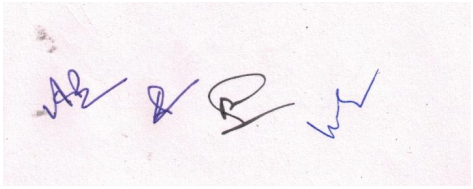
Unit 4: Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method.Role of Transposons in mutation.DNA repair mechanisms.

Fine structure of gene: Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.

Unit 5 : Population and Evolutionary Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift; Genetic variation and Speciation.

Practical

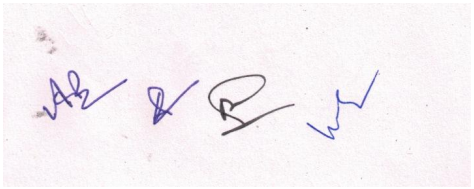
1. Meiosis through temporary squash preparation.



2. Mendel's laws through seed ratios.
3. Laboratory exercises in probability and chi-square.
4. Chromosome mapping using point test cross data.
5. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
6. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
7. Blood Typing: ABO groups & Rh factor.
8. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
9. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
10. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Colour blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached ear lobe.

Suggested Readings

1) Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.
2) Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.
3) Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
4) Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.



COURSE CODE NO.: BOT 603: PLANT ANATOMY AND EMBRYOLOGY (GENERIC ELECTIVES-VI)

Course Objective:

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

Course Learning Outcomes:

1. Knowledge regarding anatomy equipped the students to identify different types of tissues and make them able to correlate their physiology in a better away.
2. This will also help them to understand how different plant tissue evolve and modify their structure and functions with respect to their environment.
3. 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: Root and shoot apical meristems; Simple and complex tissues
Organs: Structure of dicot and monocot root stem and leaf.

Unit 2: Secondary Growth: Vascular cambium – structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood)
Adaptive and protective systems: Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

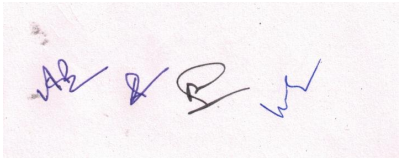
Unit 3: Structural organization of flower: Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Unit 4: Pollination and fertilization: Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms.

Unit 5: Embryo and endosperm: Endosperm types, structure and functions; Dicot and monocot embryo; Embryo- endosperm relationship
Apomixis and polyembryony: Definition, types and Practical applications

Practical

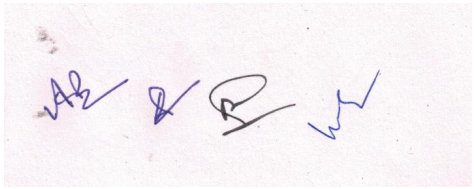
1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).
4. Root: Monocot: Zea mays; Dicot: Helianthus; Secondary: Helianthus (only Permanent slides).



5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (Nerium leaf); Hydrophyte (Hydrilla stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circinotropous, amphitropous/ campylotropous.
9. Female gametophyte: Polygonum (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Suggested Readings

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.



COURSE CODE NO.: BOT 604: BIOFERTILIZERS
(ABILITY ENHANSMENT ELECTIVE COURSE- IV)

Course Objective:

To gain the knowledge on the following aspects

1. Eco-friendly fertilizers like Rhizobium, Azospirilium Azotobactor, cyanobacteria and mycorrhizae, their identification, growth multiplication
2. Organic farming and recycling of the organic waste

Course Learning Outcomes:

1. The student would have a deep understanding of ecofriendly fertilizers.
2 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.
3. 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.

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.

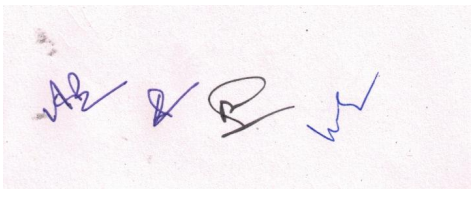
Unit 3: Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

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.

Unit 5: Organic farming – Green manuring and organic fertilizers, Recycling of bio- degradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

Practical:

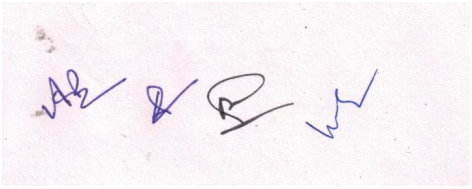
1. Isolation of *Anabaena* from *Azolla* leaf
2. Study of Rhizobium from root nodules of leguminous plants by Gram staining method
3. Test for pH, No2, SO4, Cl and organic matter of different composts
4. Observation of mycorrhizae from roots



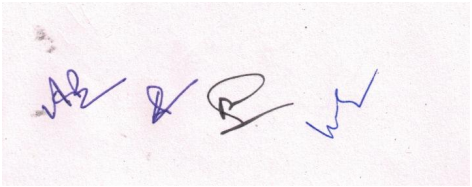
5. isolation of arbuscular mycorrhizal spores from rhizospheric soil
6. Spots, Specimen /photographs of earthworm, azolla, arbuscules . vesicles
7. Biocontrol photographs -pheromons trap,Trichoderma,, Pseudomonas, , Neem etc, , Identification and application
8. Photographs of biocompost methods,
9. Projects on any topic mentioned in the syllabus, with Rhizobium technology, , AMF technology, Organicfarming, vermicomposting,, biocompost , *Azolla* culture

Suggested Readings

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



COURSE CODE NO.: BOT 605: PRACTICAL-VI
(SKILL ENHANCEMENT ELECTIVE COURSE-VI)



SUBJECT: BOTANY (HONS) FOURTH YEAR, CBCS SCHEME
SEMESTER-VII
COURSE CODE NO.: BOT 701: MOLECULAR BIOLOGY (CORE-XIII)

Course Objective:

To gain the knowledge of structure and functions of DNA and RNA

Course Learning Outcomes:

1. Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
2. Processing and modification of RNA and translation process, function and regulation of expression.
3. Application in biotechnology

Unit 1: Nucleic acids: Carriers of genetic information, Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment.

Unit 2: The Structures of DNA and RNA / Genetic Material: DNA Structure: Miescher to Watson and Crick-historic perspective, DNA structure, Salient features of double helix, Types of DNA, Types of genetic material, denaturation and renaturation, cot curves; Organization of DNA- Prokaryotes, Viruses, Eukaryotes.RNA Structure Organelle DNA -- mitochondria and chloroplast DNA.The Nucleosome Chromatin structure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

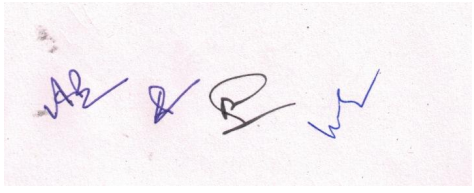
Unit 3: The replication of DNA: Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi- conservative and semi discontinuous replication, RNA priming; Various models of DNA replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA, replication of the 5'end of linear chromosome; Enzymes involved in DNA replication.

Transcription: Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in E.coli. Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.

Unit 4: Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features).

Processing and modification of RNA Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I and group II intron splicing, alternative splicing eukaryotic mRNA processing(5' cap, 3' polyA tail); Ribozymes; RNA editing and mRNA transport.

Unit 5: Translation: Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyl tRNA synthetases; Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of protein synthesis; Post-translational modifications of proteins.

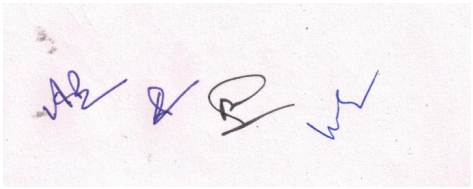


Practical

1. Preparation of LB medium and raising E.Coli.
2. Isolation of genomic DNA from E.Coli.
3. DNA isolation from cauliflower head.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
7. Photographs establishing nucleic acid as genetic material (Messelson and Stahl's, Avery et al, Griffith's, Hershey & Chase's and Fraenkel & Conrat's experiments)
8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing mechanism in group I & group II introns; Ribozyme and Alternative splicing.

Suggested Readings

1) Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
2) Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5th edition.
3) Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
4) Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
5) Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.



COURSE CODE NO.: BOT 702: BIOINFORMATICS (DISCIPLINE SPECIFIC COURSE-I)

Course Objective:

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

Course Learning Outcomes:

1. With a working knowledge of the practical and theoretical concepts of bioinformatics, you will be well qualified to progress onto advanced graduate study.
2. 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: Introduction to Bioinformatics: Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

Databases in Bioinformatics: Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

Unit 2: Biological Sequence Databases: National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database.

EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.

DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ.

Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR.

Swiss-Prot: Introduction and Salient Features.

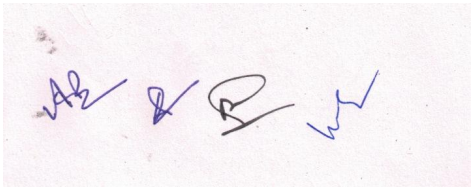
Unit 3: Sequence Alignments: Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

Unit 4: Molecular Phylogeny: Methods of Phylogeny, Software for Phylogenetic Analyses, and Consistency of Molecular Phylogenetic Prediction.

Unit 5: Applications of Bioinformatics: Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship (QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement

Practical

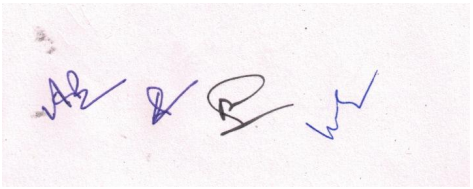
1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.



3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

Suggested Readings

1) Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2) Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3) Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings.



COURSE CODE NO.: BOT 703: HORTICULTURAL PRACTICES AND POST- HARVEST TECHNOLOGY (DISCIPLINE SPECIFIC ELECTIVES-II)

Course Objective:

1. This course deals with overall post harvest management of fruits and vegetables from farm to fork.
2. The students are expected to gain knowledge on various management technologies on pre-harvest and post harvest of fruits and vegetables.
3. Students are also expected to gain knowledge on conventional and modern packaging methods.

Course Learning Outcome:

Students will acquire knowledge on post harvest management tools and novel packaging techniques.

Unit 1: Introduction: Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism.

Landscaping and garden design: Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.

Unit 2: Ornamental plants: Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants [rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (opuntia, agave and spurges)] Ornamental flowering trees (Indian laburnum, gulmohar, Jacaranda, Lagerstroemia, fishtail and areca palms, semul, coraltree).

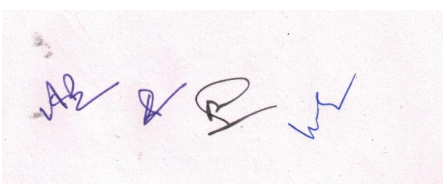
Fruit and vegetable crops: Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops; Identification of some fruits and vegetable varieties (citrus, banana, mango, chillies and cucurbits).

Unit 3: Floriculture: Cut flowers, bonsai, commerce (market demand and supply); Importance of flower shows and exhibitions.

Horticultural crops - conservation and management: Documentation and conservation of germplasm; Role of micropropagation and tissue culture techniques; Varieties and cultivars of various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture.

Unit 4:Horticultural techniques: Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations.

Post-harvest technology: Importance of post harvest technology in horticultural crops; Evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing loses during storage and transportation; Food



irradiation - advantages and disadvantages; food safety.

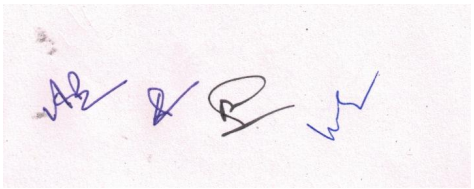
Unit 5: Disease control and management: Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices; Identification of common diseases and pests of ornamentals, fruits and vegetable crops.

Practical

Field trip: Field visits to gardens, standing crop sites, nurseries, vegetable gardens and horticultural fields at IARI or other suitable locations.

Suggested Readings

1) Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2) Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3) NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4) Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.
5) Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.



COURSE CODE NO.: BOT 704: HERBAL TECHNOLOGY
(ABILITY ENHANSMENT ELECTIVE COURSE-V)

Course Objectives:

This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

Upon completion of this course the student should be able to:

1. Understand raw material as source of herbal drugs from cultivation to herbal drug product
2. Know the WHO and ICH guidelines for evaluation of herbal drugs
3. Know the herbal cosmetics, natural sweeteners, nutraceuticals
4. Appreciate patenting of herbal drugs, GMP .

Course Learning Outcomes:

Knowledge Skills

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

Professional and Practical Skills

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

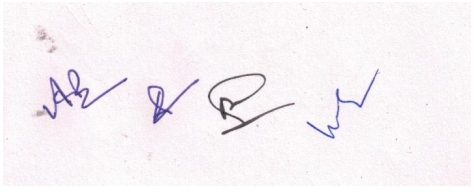
Unit 1: Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.

Unit 2: Pharmacognosy - systematic position medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.

Unit 3: Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; Catharanthus roseus (cardiotonic), Withania somnifera (drugs acting on nervous system), Clerodendron phlomoides (anti-rheumatic) and Centella asiatica (memory booster).

Unit 4: Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)

Unit 5: Medicinal plant banks micro propagation of important species (Withania somnifera, neem and tulsi-



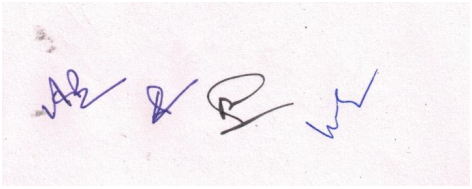
Herbal foods-future of pharmacognosy)

Practicals:

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids

Suggested Readings:

1) Glossary of Indian medicinal plants, R.N.Chopra, S.L.Nayar and I.C.Chopra, 1956. C.S.I.R, New Delhi.
2) The indigenous drugs of India, Kanny, Lall, Dey and Raj Bahadur, 1984. International Boo Distributors.
3) Herbal plants and Drugs Agnes Arber, 1999. Mangal Deep Publications.
4) Ayurvedic drugs and their plant source. V.V. Sivarajan and Balachandran Indra 1994. Oxford IBH publishing Co.
5) Ayurveda and Aromatherapy. Miller, Light and Miller, Bryan, 1998. Banarsidass, Delhi.
6) Principles of Ayurveda, Anne Green, 2000. Thomsons, London.
7) Pharmacognosy, Dr.C.K.Kokate et al. 1999. Nirali Prakashan.

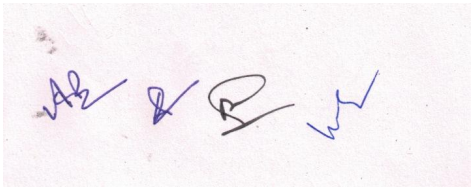


COURSE CODE NO.: BOT 705: LAB TRAINING III /INTERNSHIP
(TRAINING-III/INTERNSHIP)

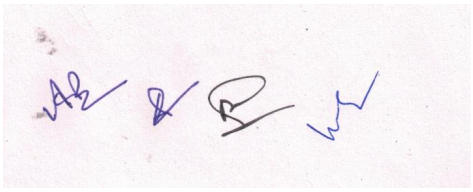
Course Objective: To provide students exposure to Botanical Garden/ industrial set-up and to enable students observe, first hand, work flow and processes in plant product industries and associated enterprises

Learning Outcome: The student will be able to appreciate different processing and production technologies in various industrial settings. The student will be exposed to the diverse setting in plant product industries

Review of the state of research in a particular problem involving food, and development of hypothesis, Planning and conducting the experiment, Periodic analysis of data and preparation of report, Final preparation of project report as dissertation to be submitted in partial fulfillment of B.Sc. Programme



COURSE CODE NO.: BOT 706: PRACTICAL-VII
(SKILL ENHANCEMENT ELECTIVE COURSE-VII)



SUBJECT: BOTANY (HONS) FOURTH YEAR, CBCS SCHEME
SEMESTER-VIII
COURSE CODE NO.: BOT 801: PLANT BIOTECHNOLOGY (CORE- XIV)

Course Objective:

1. To give students new knowledge and widening of the knowledge acquired in other course by handling of classical and modern plant biotechnology processes, including tissue culture for healthy plants, plants with improved characteristics.
2. To explore the use of biotechnology to both generate genetic variation in plants and to understand how factors at the cellular level contribute to the expression of genotypes and hence to phenotypic variation.
3. Understanding of biotechnological processes such as recombinant DNA technology and its applicative value in pharmaceuticals (vaccines, antibodies, antibiotics etc.), food industry (transgenic crops with improved qualities (nutraceuticals, industrial enzymes etc.), agriculture (biotic and abiotic stress tolerant plants, disease and pest resistant plants, improved horticultural varieties etc.), ecology (plants role in bioremediation). This knowledge is central to our ability to modify plant responses and properties for global food security and commercial gains in biotechnology and agriculture.
4. In the laboratory classes, students will perform some of the techniques currently used to generate information and detect genetic variation.

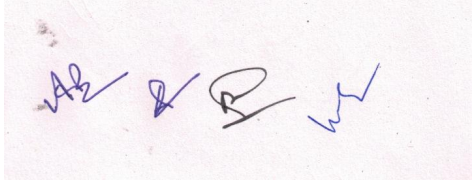
Course Learning Outcomes

The successful students will be able to:

1. Learn the basic concepts, principles and processes in plant biotechnology.
2. Have the ability of explanation of concepts, principles and usage of the acquired knowledge in biotechnological, pharmaceutical, medical, ecological and agricultural applications.
3. Use basic biotechnological techniques to explore molecular biology of plants
4. Explain how biotechnology is used to for plant improvement and discuss the biosefty concern and ethical issue of that use.

Unit 1: Plant Tissue Culture: Historical perspective; Composition of media; Nutrient and hormone requirements (role of vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation, androgenesis, virus elimination, secondary metabolite production, haploids, triploids and hybrids; Cryopreservation; Germplasm Conservation).

Unit 2: Recombinant DNA technology: Restriction Endonucleases (History, Types I-IV, biological role and application); Restriction Mapping (Linear and Circular); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).



Unit 3: Gene Cloning: Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCR-mediated gene cloning; Gene Construct; construction of genomic and cDNA libraries, screening DNA libraries to obtain gene of interest by genetic selection; complementation, colony hybridization; PCR

Unit 4: Methods of gene transfer: Agrobacterium-mediated, Direct gene transfer by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics– selectable marker and reporter genes (Luciferase, GUS, GFP).

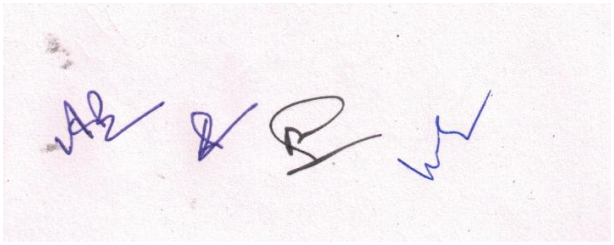
Unit 5: Applications of Biotechnology: Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits (Flavr Savr tomato, Golden rice); Improved horticultural varieties (Moondust carnations); Role of transgenics in bioremediation (Superbug); edible vaccines; Industrial enzymes (Aspergillase, Protease, Lipase); Gentically Engineered Products–Human Growth Hormone; Humulin; Biosafety concerns.

Practical

1. Preparation of MS medium.
2. Demonstration of in vitro sterilization and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
4. Isolation of protoplasts.
5. Construction of restriction map of circular and linear DNA from the data provided.
6. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.
7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr tomato through photographs.
8. Isolation of plasmid DNA.
9. Restriction digestion and gel electrophoresis of plasmid DNA.

Suggested Readings

1) Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
2) Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
3) Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication House Pvt. Ltd., New Delhi. 5th edition.
4) Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons, U.K. 5th edition.
5) Stewart, C.N. Jr. (2008). Plant Biotechnology & Genetics: Principles, Techniques and Applications. John Wiley & Sons Inc. U.S.A.



COURSE CODE NO.: BOT 802: INTELLECTUAL PROPERTY RIGHTS
(DISCIPLINE SPECIFIC ELECTIVES-III)

Course Outcome:

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
3. To disseminate knowledge on copyrights and its related rights and registration aspects
4. To disseminate knowledge on trademarks and registration aspects
5. To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
6. To aware about current trends in IPR and Govt. steps in fostering IPR

Course Outcome:

1. The students once they complete their academic projects, shall get an adequate knowledge on patent and copyright for their innovative research works
2. During their research career, information in patent documents provides useful insight on novelty of their idea from state-of-the art search. This provide further way for developing their idea or innovations
3. Pave the way for the students to catch up Intellectual Property (IP) as an career option:
    a. R&D IP Counsel
    b. Government Jobs – Patent Examiner
    c. Private Jobs
    d. Patent agent Patent agent and Trademark agent
    e. Entrepreneur

Unit 1: Introduction to intellectual property right (IPR): Concept and kinds. Economic importance; IPR in India and world: Genesis and scope, some important examples.IPR and WTO (TRIPS, WIPO).

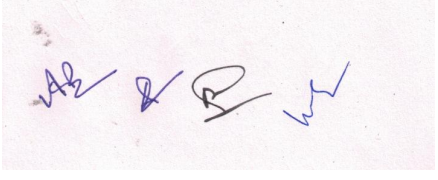
Unit 2: Patents: Objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents; working of patents; Infringement

Copyright: Introduction, Works Infringement. protected under copyright law, Rights, Transfer

Trademarks: Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defenses', Domain name.

Unit 3: Geographical Indications: Objectives, Justification, International Position, Multilateral Treaties, National Level; Indian Position.

Protection of Traditional Knowledge : Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio-Prospecting and Bio-Piracy, Alternative ways, Protect ability, need for a Sui-Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional



Knowledge Digital Library.

Unit4: Industrial Designs: Objectives, Rights, Assignments, Infringements, Defenses' of Design Infringement

Protection of Plant Varieties: Plant Varieties Protection-Objectives, Justification, International Position, Plant varieties protection in India; Rights of farmers, Breeders and Researchers; National gene bank, Benefit sharing; Protection of Plant Varieties and Farmers' Rights Act, 2001;

Unit 5: Information Technology Related Intellectual Property Rights: Computer Software and Intellectual Property, Database and Data Protection, Protection of Semi-conductor chips, Domain Name Protection

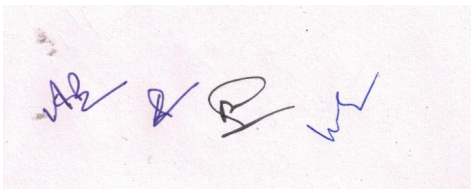
Biotechnology and Intellectual Property Rights: Patenting Biotech Inventions: Objective, Applications, Concept of Novelty, Concept of inventive step, Microorganisms, Moral Issues in Patenting Biotechnological inventions.

Practical:

1. Important Definitions ;
2. Filing Of Design Application
3. Type Of Applications
4. Ordinary Application. An Ordinary Application Does Not Claim Priority. B. Reciprocity Application. A Reciprocity Application Claims Priority Of An Application Filed Previously In A Convention Country. Such An Application Shall Be Filed In India Within Six Months From The Date Of Filing In Convention Country. This Period Of Six Months Is Not Extendable.
5. Examination And Registration Of Designs
6. The Patent Office Journal
7. Piracy Of Registered Designs And Consequences Thereof
8. Post Registration Procedures
9. Transfer Of Rights
10. General Services ; Use & Acquisition Of Registered Design By Government
11. General Powers Of Controller
12. Evidences Etc.
13. Restrictive Conditions In Contracts Etc.; Appeals
14. Requirements Before Delivery On Sales; Timelines

Suggested Readings

1) N.S. Gopalakrishnan & T.G. Agitha, (2009) Principles of Intellectual Property Eastern Book Company, Lucknow.
2) Kerly's Law of Trade Marks and Trade Names (14th Edition) Thomson, Sweet & Maxweel.
3) Ajit Parulekar and Sarita D' Souza, (2006) Indian Patents Law – Legal & Business Implications; Macmillan India Ltd.
4) B.L.Wadehra (2000) Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India.
5) P. Narayanan (2010) Law of Copyright and Industrial Designs; Eastern law House, Delhi.



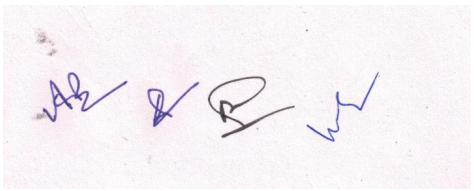
COURSE CODE NO.: BOT 803: PROJECT (OR) DISSERTATION AND VIVA VOCE
(DISCIPLINE SOECIFIC ELECTIVES-IV/PROJECT (OR) DISSERTATION

Course Objective:

1. To learn about field work techniques
2. To understand pilot survey relevance
3. To teach about specific Survey/laboratory techniques chosen by the student.
4. To train for basic principles in Envirnmental Biotechnology/ Herbal Technology/ plant Chemistry/ Industrial Production etc.
5. To conduct primary data collection for a specific topic in one specific field.
6. To teach various analysis techniques.
7. To prepare report on the basis of data and analysis undertaken.

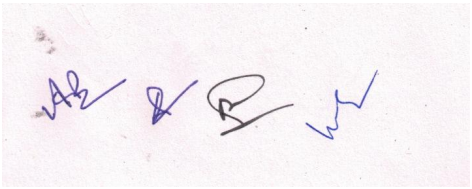
Dissertation/Project Work:

Students of B.Sc. (Hons.) Botany should undergo a /Dissertation/project work/ in plant training work for a period of 03 months during the fourth Year (eight semester). The programme is arranged by thedepartment of Microbial Technology in consultation with the industries inside and outside Madhya Pradesh. The purpose of the programme is to get hands-on experience on various aspects of industries that form the strong foundation for the young plant technologists. The department will allot students to the industry, in consultation with the industry concerned and based on merit of the students. The selected student should report for the programme on the stipulated date and attend the programme regularly without any lapse. On completion, each student should prepare a project / training report duly certified by the supervisor in the industry, a seminar should be conducted in the department. The bona -fide project/ training report attested by the head of the department will be evaluated by the external/Internal examiner and a viva voce will be conducted. The scheme of the project report evaluation and viva-voce is as given above.



COURSE CODE NO.: BOT 804: COMPREHENSIVE VIVA VOCE

A comprehensive viva-voce will be conducted at the end of the eight semester of the programme by a board of four examiners.



COURSE CODE NO.: BOT 805: PRACTICAL-VIII
(SKILL ENHANCEMENT ELECTIVE COURSE-VIII)