

Core Courses Semester-I BOTANY (Hons)

Core Course BOT. CC – I : Microbiology and Phycology- 100 marks

(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	Introduction to microbial world, microbial nutrition, growth and metabolism.	2 lectures
	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). Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases.	5 lectures
Unit-II	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). Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).	5 lectures
Unit-III	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; and 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.	6 lectures
Unit-IV	Cyanophyta:- Ecology and occurrence, range of thallus organization, cell structure, heterocyst, reproduction. economic importance; role in biotechnology. Morphology and life-cycle of <i>Nostoc</i> .	5 lectures
	Chlorophyta:- General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of <i>Chlamydomonas</i> , <i>Volvox</i> , <i>Oedogonium</i> , <i>Coleochaete</i> . Evolutionary significance of <i>Prochloron</i> .	5 lectures
Unit-V	Charophyta:- General characteristics; occurrence, morphology, cell structure and life-cycle of <i>Chara</i> ; evolutionary significance.	2 lectures
	Xanthophyta:- General characteristics; range of thallus organization; Occurrence, morphology and life-cycle of <i>Vaucheria</i> .	3 lectures
	Phaeophyta:- Characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycles of <i>Ectocarpus</i> and <i>Fucus</i> .	3 lectures
	Rhodophyta:- General characteristics, occurrence, range of thallus organization, cell structure and reproduction. Morphology and life-cycle of <i>Polysiphonia</i> .	4 lectures

BOT. CC – I Practical (20 classes, each class of 2h)

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	Study of vegetative and reproductive structures of <i>Nostoc</i> , <i>Chlamydomonas</i> (electron micrographs), <i>Volvox</i> , <i>Oedogonium</i> , <i>Coleochaete</i> , <i>Chara</i> , <i>Vaucheria</i> , <i>Ectocarpus</i> , <i>Fucus</i> and <i>Polysiphonia</i> , <i>Prochloron</i> through electron micrographs, temporary preparations and permanent slides.

Suggested Readings

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
2. Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, McGraw Hill, India. 6th edition.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.
6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.

Semester-I BOTANY (Hons)

Core Course BOT. CC – II: Biomolecules and Cell Biology –
100 marks (Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)
[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	Biomolecules:- Types and significance of chemical bonds; Structure and properties of water; pH and buffers.	2 lectures
	Carbohydrates: Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols – mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage – starch, insulin)	3 lectures
	Lipids: Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties.	2 lectures
	Proteins: Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quaternary; Isoelectric point; Protein denaturation and biological roles of proteins.	2 lectures
	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.	4 lectures
Unit-II	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.	3 lectures
	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 theory), Michaelis – Menten equation, enzyme inhibition and factors affecting enzyme activity.	4 lectures
Unit-III	The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Origin of eukaryotic cell (Endosymbiotic theory).	2 lectures
	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.	3 lectures
Unit-IV	Cell organelles: Nucleus; Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.	3 lectures
	Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary filament.	2 lectures
	Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast.	2 lectures
	Endoplasmic Reticulum, Golgi Apparatus, Lysosomes	2 lectures
Unit-V	Cell division: Eukaryotic cell cycle, different stages of mitosis and meiosis. Cell cycle, Regulation of cell cycle.	6 lectures

BOT. CC – II Practical (20 classes, each class of 2h)

Practical	<ol style="list-style-type: none">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 <i>Onion/Rhoeo/Crinum</i>.3. Demonstration of the phenomenon of protoplasmic streaming in <i>Hydrilla</i> 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. Study the phenomenon of plasmolysis and deplasmolysis.8. Study different stages of mitosis and meiosis using aceto carmine and aceto orcin method.
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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
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Semester-I/III (Interdisciplinary):

GENERIC ELECTIVE BOT. GE- 1 : Biodiversity (Microbes, Algae, Fungi & Archegoniate) – 100 marks (Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	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.	8 Lectures
Unit-II	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 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	14 Lectures
Unit-III	Introduction to Archegoniate Unifying features of archegoniate, 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.	7 Lectures
Unit-IV	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, stelar evolution.Ecological and economical importance of Pteridophytes.	6 Lectures
Unit-V	Gymnosperms General characteristics, classification.Classification (up to family), morphology, anatomy and reproduction of Cycas and Pinus.(Developmental details not to be included).Ecological and economical importance.	5 Lectures

BOT. GE- 1- LAB 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 structures through permanent slides.
6. Alternaria: Specimens/photographs and tease mounts.
7. Puccinia: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; 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: ectomycorrhiza and endomycorrhiza (Photographs)
11. Marchantia- morphology of thallus, w.m. rhizoids and scales, V.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. Funaria- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. 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).
14. 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).
15. 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).
16. 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).
17. 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. 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.

BOT. - DSC-1 OF SEM-1 IS SAME AS BOT-GE-1 OF SEM- 1/ III

Semester-II BOTANY (Hons)

Core Course BOT. CC – III: Mycology and Phytopathology – 100 marks (Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	Introduction to true fungi: Definition, General characteristics; Affinities with plants and animals; Thallus organization; Cellwall composition; Nutrition; Classification. Chytridiomycetes: General account	5 lectures
	Zygomycota: General characteristics; Ecology; Thallus organisation; Life cycle with reference to <i>Rhizopus</i> .	4 lectures
	Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to <i>Saccharomyces</i> , <i>Aspergillus</i> , <i>Penicillium</i> , <i>Alternaria</i> and <i>Neurospora</i> , <i>Peziza</i> .	5 lectures
Unit-II	Basidiomycota: General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat <i>Puccinia</i> (Physiological Specialization), loose and covered smut (symptoms only), <i>Agaricus</i> ; Bioluminescence, Fairy Rings and Mushroom Cultivation.	5 lectures
	Allied Fungi: General characterises; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies.	3 lectures
	Oomycota: General characteristic; Ecology; Life cycle and classification with reference to <i>Phytophthora</i> , <i>Albugo</i> .	4 lectures
Unit-III	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.	4 lectures
Unit-IV	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.	5 Lectures
Unit-V	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 disease of Cotton. Viral diseases – Tobacco Mosaic viruses, vein clearing. Fungal diseases – Early blight of potato, Black stem rust of wheat, white rust of crucifers.	5 lectures

BOT. CC – III Practical (20 classes, each class of 2h)

Practical 1	<p>Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps).</p> <ol style="list-style-type: none">2. <i>Rhizopus</i>: study of asexual stage from temporary mounts and sexual structures through permanent slides.3. <i>Aspergillus</i> and <i>Penicillium</i>: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.4. <i>Peziza</i>: sectioning through ascocarp.5. <i>Alternaria</i>: Specimens/photographs and temporary mounts.6. <i>Puccinia</i>: 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. <i>Agaricus</i>: Specimens of button stage and full grown mushroom; sectioning of gills of <i>Agaricus</i>, fairy rings and bioluminescent mushrooms to be shown.8. <i>Albugo</i>: Study of symptoms of plants infected with <i>Albugo</i>; asexual phase study through section/ temporary mounts and sexual structures through permanent slides.9. 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 endo mycorrhiza (Photographs)10. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Viral diseases: TMV, Fungal diseases: Early blight of potato, and White rust of crucifers.
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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.

Semester-II BOTANY (Hons)

Core Course BOT. CC – IV: Archegoniate – 100 marks (Credits-6: Theory-4, Practical-2)

**THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)
[75 marks (Mid Sem 15 + End Sem 60)]**

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	Introduction: Unifying features of archegoniates; Transition to land habit; Alternation of generations.	2 lectures
Unit-II	Bryophytes: General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Classification (up to family). <i>Riccia, Marchantia, Pellia, Porella, Anthoceros, Sphagnum and Funaria</i> ; Reproduction and evolutionary trends in <i>Riccia, Marchantia, Anthoceros</i> and <i>Funaria</i> (developmental stages not included). Ecological and economic importance of bryophytes with special reference to <i>Sphagnum</i> .	12 lectures
Unit-III	Pteridophytes: General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of <i>Psilotum, Selaginella, Equisetum, Pteris</i> and <i>Marsilea</i> (Developmental details not to be included). Apogamy, and apospory, heterospory and seed habit, telome theory, stelar evolution. Ecological and economic importance.	10 lectures
Unit-IV	Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of <i>Cycas, Pinus, Ginkgo</i> and <i>Gnetum</i> . (Developmental details not to be included). Ecological and economic importance.	8 lectures
Unit-V	Fossils: Geographical time scale, fossils and fossilization process. Morphology, anatomy and affinities of <i>Rhynia, Calamites, Lepidodendron, Lyginopteris</i> and <i>Cycadeoidea</i> .	8 lectures

BOT. CC – IV Practical (20 classes, each class of 2h)

Practical	<ol style="list-style-type: none"> 1. <i>Riccia</i> – Morphology of thallus. 2. <i>Marchantia</i>- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallus through Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides). 3. <i>Anthoceros</i>- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide). 4. <i>Pellia, Porella</i>- Permanent slides. 5. <i>Sphagnum</i>- Morphology of plant, whole mount of leaf (permanent slide only). 6. <i>Funaria</i>- 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. <i>Psilotum</i>- Study of specimen, transverse section of synangium (permanent slide). 8. <i>Selaginella</i>- 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. <i>Equisetum</i>- Morphology, transverse section of internode, longitudinal section of strobilus, transverse section of strobilus, whole mount of sporangiphore,
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	<p style="text-align: center;">whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slide).</p> <p>10. <i>Pteris</i>- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).</p> <p>11. <i>Cycas</i>- 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).</p> <p>12. <i>Pinus</i>- 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 (temporary slides), longitudinal section of female cone, tangential longitudinal section & radial longitudinal sections stem (permanent slide).</p> <p>13. <i>Gnetum</i>- Morphology (stem, male & female cones), transverse section of stem, vertical section of ovule (permanent slide)</p> <p>14. Botanical excursion.</p>
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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. Vander-Poorteri 2009 Introduction to Bryophytes. COP.

Semester-II / IV (Interdisciplinary):

GENERIC ELECTIVE BOT. GE- 1I .: Plant Anatomy and Embryology – 100 marks
(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)
[75 marks (Mid Sem 15 + End Sem 60)]
Lectures: 60 [40 Theory + 20 Practical classes]

Unit –I : Meristematic and Permanent tissues 08 Lectures

Root and shoot, apical meristem, simple and complex tissues.

Organs

Structure of dicot and monocot root stem and leaf.

Unit – II : Secondary Growth 11 Lectures

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 – II : Structural organisation of flower 11 Lectures

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organisation and ultrastructure of mature embryo sac.

Pollination and fertilisation

Pollination mechanism and adaptation; Double fertilisation; Seed – structure appendages and dispersal mechanisms.

Unit – IV: Embryo and endosperm 05 Lectures

Endosperm types, structure and function; Dicot and monocot embryo; Embryo – endosperm relationship.

Unit – V: Apomixis and Polyembryony 05 Lectures

Definition, types and practical applications

BOT. GE- 1I - LAB Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchymas and sclerenchyma); Macerated Xylary elements, phloem (permanent slide, 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 slide).
8. Types of ovules: anatropous, orthotropous, cecidotropous, amphitropous, campylotropous. 9. Female gametophyte: Polypodium (monosporic) type of embryo sac

development (permanent slides / photographs). 10. Ultra structure of mature egg apparatus cells through electron micrographs. 11. Polynations types and seed dispersal mechanisms (including appendages, aril, caruncla) (photographs and specimens). 12. Dissection of embryo / endosperm from developing seeds.

Suggested Readings

1. Bhojwani, S.S. & Bhatanagar, S.P. (2011) . Embryology of angiosperms. Vikas publication House Pvt. . Ltd. New Delhi. 5th Ed.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin Cummings Publiosher . USA.

Semester- II - BOTANY

BOT. DSC – II : Plant Ecology and Taxonomy

(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit I: Introduction

Ecology 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. Adaption of hydrophytes and xerophytes.

Plant communities

Characters; Ecotone and edge effect; Succession; Processes and types.

Unit II: Ecosystem

Structure; energy flow trophic 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 III: 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

Taxonomic evidences from palynology, cytology, phytochemistry and molecular data.

Unit IV: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 V: Classification

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

Biometrics, numerical taxonomy and cladistics

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

BOT. DSC –II (LAB),Practical 25 Marks

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 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.
4. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each).
(b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (Orobanchae), Epiphytes, Predation (Insectivorous plant).
5. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
6. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
7. 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*.
8. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label (to be submitted in the record book).

Suggested Reading

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.

BOTANY Semester-III

Core Course V: Anatomy of Angiosperms – 100 marks

(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy.	2 lectures
	Tissues: General account of plant tissues & tissue system, Anatomico – Physiological Classification of Plant tissue as detailed by Haberlandt.	5 Lectures
	Meristems and Meristematic tissue system	3 Lectures
Unit-II	Stem: Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation)	3 Lectures
	Leaf: Structure of dicot and monocot leaf, Kranz anatomy.	1 Lecture
	Root: Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap; origin of lateral root	3 Lectures
	Organisation and types of vascular bundle, Root-stem transition	2 Lectures
Unit-III	Vascular Cambium: Structure, function and seasonal activity of cambium; Secondary growth in root and stem.	4 Lectures
	Adaptive and Non adaptive types of Anomalous Secondary growth. Secondary growth in monocot stem	5 Lectures
Unit –IV	Adaptive and Protective Systems Epidermal tissue system, cuticle, epicuticular waxes, trichomes (uni- and multicellular, glandular and Non glandular, two examples of each), stomata (classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes, hydrophytes, epiphytes and lithophytes	5 Lectures
Unit - V	Mechanical Tissue System- Mechanical tissues and their ontogeny, Principles of organisation and distribution.	5 Lectures
	Secretory System:- Hydathodes, Cavities (02) lenticels and laticifers.	2 Lectures

BOT-CC-V Practical (20 classes, each class of 2h)

Practical 1.	Study of anatomical details through permanent slides/temporary stainmounts/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.
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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 Benjamin/Cummings Publisher, USA.
4. Esau, K. (1977). Anatomy of Seed Plants. John Wiley & Sons, Inc., Delhi.

Semester-III

Core Course VI: Economic Botany – 100 marks
(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours) [75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	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.	3 lectures
Unit-II	Cereals : Wheat and Rice (origin, morphology, processing & uses), brief account of millets.	3 lectures
	Legumes: General account, importance to man and ecosystem.	3 lectures
	Sugars & Starches: Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.	3 lectures
Unit-III	Spices: Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper	4 lectures
	Beverages: Tea, Coffee (morphology, processing & uses)	4 lectures
	Drug-yielding plants: Therapeutic and habit-forming drugs with special reference to <i>Cinchona</i> , <i>Digitalis</i> , <i>Papaver</i> and <i>Cannabis</i> .	4 lectures
	Tobacco: Tobacco (Morphology, processing, uses and health hazards)	2 lectures
Unit-IV	Oils & Fats: General description, classification, extraction, their uses and health implications groundnut, coconut, linseed and <i>Brassica</i> and Coconut (Botanical name, family & uses)	4 lectures
	Essential Oils: General account, extraction methods, comparison with fatty oils & their uses.	4 lectures
Unit-V	Natural Rubber: Para-rubber: tapping, processing and uses.	2 lectures
	Timber plants: General account with special reference to teak and pine.	2 Lectures
	Fibres: Classification based on the origin of fibres, Cotton and Jute (morphology, extraction and uses).	2 lectures

BOT-CC-VI Practical (20 classes, each class of 2h)

Practical	<ol style="list-style-type: none">1. Cereals: Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).2. Legumes: Soya bean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).3. Sugars & 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. Oils & Fats: Coconut- T.S. nut, Mustard–plant specimen, seeds; tests for fats in crushedseeds.7. Essential oil-yielding plants: Habit sketch of <i>Rosa</i>, <i>Vetiveria</i>, <i>Santalum</i> and <i>Eucalyptus</i> (specimens/photographs).8. Rubber: specimen, photograph/model of tapping, samples of rubber products.9. Drug-yielding plants: Specimens of <i>Digitalis</i>, <i>Papaver</i> and <i>Cannabis</i>.10. Tobacco: specimen and products of Tobacco.11. Woods: Tectona, Pinus: Specimen, Section of young stem.12. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fibre).
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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. (2003). Plants, Genes and Agriculture. Jones & Bartlett Publishers.

Semester-III

Core Course VII: Genetics – 100 marks

(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	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.	16 lectures
Unit-II	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 <i>Paramecium</i> .	6 lectures
Unit-III	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.	12 lectures
Unit-IV	Variation in chromosome number and structure: Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploid	8 lectures
	Gene mutations: Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: CIB method. Role of Transposons in mutation. DNA repair mechanisms.	6 lectures
Unit-V	Fine structure of gene: Classical vs molecular concepts of gene; Cis-Trans complementation test for functional allelism; Structure of Phage T4, rII Locus.	6 lectures
	Population and Evolutionary Genetics: Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.	6 lectures

BOT-CC-VII Practical (20 classes, each class of 2h)

Practical	<ol style="list-style-type: none">1. Meiosis through temporary squash preparation.2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.3. Chromosome mapping using test cross data.4. Pedigree analysis for dominant and recessive autosomal and sex linked traits with floral chart.5. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).6. Blood Typing: ABO groups & Rh factor.7. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.8. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
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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. (2012). Concepts of Genetics. Benjamin Cummings, U.S.A. 10th 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.

Semester-IV

Core Course VIII: Molecular Biology – 100 marks

(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	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).	4 lectures
Unit-II	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.	8 lectures
	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.	6 lectures
Unit-III	Central dogma and genetic code: Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features)	2 lectures
	Mechanism of Transcription: Transcription in prokaryotes; Transcription in eukaryotes	4 lectures
	Processing and modification of RNA: Split genes-concept of introns and exons, removal of introns, spliceosome machinery, splicing pathways, group I & group II intron splicing, alternative splicing eukaryotic mRNA processing (5' cap, 3' polyA tail); Ribozymes, exon shuffling; RNA editing and mRNA transport.	5 lectures
Unit-IV	Translation (Prokaryotes and eukaryotes): 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.	6 lectures
Unit-V	Regulation of transcription in prokaryotes and eukaryotes: Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in <i>E.coli</i> . Eukaryotes: transcription factors, heat shock proteins, steroids and peptide hormones; Gene silencing.	5 lectures

BOT-CC-VIII Practical (20 classes, each class of 2h)

Practical	<ol style="list-style-type: none">1. Preparation of LB medium and raising <i>E.Coli</i>.2. Isolation of genomic DNA from <i>E.Coli</i>.3. DNA isolation and RNA estimation by orcinol method.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.
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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). iGenetics- 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.

Semester-IV

Core Course IX: Plant Ecology and Phytogeography – 100 marks

(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours)

[75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	Introduction Concept of ecology, Autoecology, Synecology, system ecology, Levels of organization. Inter-relationships between the living world and the environment, the components of environmental, concept of hydrosphere and lithosphere and dynamism, homeostasis.	2 lectures
Unit-II	Soil: Importance; Origin; Formation; Composition; Physical; Chemical and Biological components; Soil profile; Role of climate in soil development.	5 lectures
	Water: Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.	2 lectures
	Light, temperature, wind and fire: Variations; adaptations of plants to their variation.	4 lectures
Unit-III	Biotic interactions:	2 lectures
	Population ecology: Characteristics and Dynamics .Ecological Speciation	4 lectures
	Plant communities: Concept of ecological amplitude; Habitat and niche; Characters: analytical and synthetic; Ecotone and edge effect; Dynamics: succession – processes, types; climax concepts.	4 lectures
Unit-IV	Ecosystems: Structure; Processes; Trophic organisation; Food chains and Food webs; Ecological pyramids.	4 lectures
	Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus.	5 lectures
Unit-V	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.	8 lectures

BOT-CC-IX Practical (20 classes, each class of 2h)

Practical 1.	<p>Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer /hygrometer, rain gauge and lux meter.</p> <ol style="list-style-type: none">Determination of pH of various soil and water samples (pH meter, universal indicator /Lovibond comparator and pH paper)Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.Determination of organic matter of different soil samples by Walkley & Black rapid titration method.Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.Determination of dissolved oxygen of water samples from polluted and unpolluted sources.(a). Study of morphological adaptations of hydrophytes and xerophytes (four each). (b). Study of biotic interactions of the following: Stem parasite (<i>Cuscuta</i>), Root parasite (<i>Orobanche</i>) Epiphytes, Predation (Insectivorous plants).Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.Field visit to familiarise students with ecology of different sites.
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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.

Semester-IV

Core Course X: Plant Systematics – 100 marks

(Credits-6: Theory-4, Practical-2)

THEORY (Each class 1 hour): PRACTICAL (Each class 2 hours) [75 marks (Mid Sem 15 + End Sem 60)]

Lectures: 60 [40 Theory + 20 Practical classes]

Unit-I	Plant identification, Classification, Nomenclature; Biosystematics.	2 lectures
	Identification: 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	5 lectures
Unit-II	Taxonomic hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).	5 lectures
	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.	5 lectures
Unit-III	Systematics- an interdisciplinary science: Evidence from palynology, cytology, phytochemistry and molecular data.	6 lectures
	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.	6 lectures
Unit-IV	Biometrics, numerical taxonomy and cladistics: Characters; Variations; OTUs, character weighting and coding; cluster analysis; Phenograms, cladograms (definitions and differences).	4 lectures
Unit-V	Phylogeny of Angiosperms: Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly and clades).origin& evolution of angiosperms; co-evolution of angiosperms and animals; methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).	7 lectures

BOT-CC-X Practical (20 classes, each class of 2h)

Practical 1.	<p>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):</p> <p>Ranunculaceae - <i>Ranunculus</i>, <i>Delphinium</i> Brassicaceae - <i>Brassica</i>, <i>Alyssum</i> / <i>Iberis</i> Myrtaceae - <i>Eucalyptus</i>, <i>Callistemon</i> Umbelliferae - <i>Coriandrum</i> / <i>Anethum</i> / <i>Foeniculum</i> Asteraceae - <i>Sonchus</i>/<i>Launaea</i>, <i>Vernonia</i>/<i>Ageratum</i>, <i>Eclipta</i>/<i>Tridax</i> Solanaceae - <i>Solanum nigrum</i>/<i>Withania</i> Lamiaceae - <i>Salvia</i>/<i>Ocimum</i> Euphorbiaceae - <i>Euphorbia hirta</i>/<i>E.milii</i>, <i>Jatropha</i> Liliaceae - <i>Asphodelus</i>/<i>Lilium</i>/<i>Allium</i> Poaceae - <i>Triticum</i>/<i>Hordeum</i>/<i>Avena</i></p> <p>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)</p>
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Suggested Readings

1. Singh, G. (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.

Semester-IV BOT (HONS.) SEC-II

Skill Enhancement Courses (Course Specific Skill)-H: Mushroom Culture Technology

Time - 2 hrs. F.M. - 50 [40 (Sem.) + 10 (Intviva/pr)] Credit - 2 Lectures - 30

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Unit-I	Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of edible mushrooms available in India - <i>Volvariella volvacea, Pleurotus citrinopileatus, Agaricus bisporus.</i>	5 lectures
Unit-II	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.	6 Lectures
Unit-III	Pure culture: Medium, sterilization, preparation of spawn, multiplication. 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.	6 lectures
Unit-IV	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.	8 lectures
Unit-V	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.	5 lectures

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.

Semester III Bot. (GEN.)

DSC-III CORE COURSE BOTANY -PAPER III

Plant Anatomy and Embryology

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)

Lectures – 60 [40(Th.) + (Pr.)

THEORY

Unit I: Meristematic and permanent tissues (8 Lectures)

Root and shoot apical meristems; Simple and complex tissues .

Organs

Structure of dicot and monocot root stem and leaf. (4 Lectures)

Unit-II :Secondary Growth (8 Lectures)

Vascular cambium - structure and function, seasonal activity. Secondary growth in root and stem, Wood (heartwood and sapwood).

Adaptive and protective systems (8 Lectures)

Epidermis, cuticle, stomata; General account of adaptations in xerophytes and hydrophytes.

Unit –III Structural organization of flower (8 Lectures)

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs, organization and ultrastructure of mature embryo sac.

Pollination and fertilization (8 Lectures)

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

Unit-IV Embryo and endosperm (8 Lectures)

Endosperm types, structure and functions; Dicot and monocot embryo, Embryo endosperm relationship.

Unit-V Apomixis and polyembryony (8 Lectures)

Definition, types and practical applications.

DSC-III 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

- I. 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.

Semester IV BOT (GEN)

DSC-IV CORE COURSE BOTANY -PAPER IV

Plant Physiology and Metabolism

Time – 3 hrs. F.M. – 100 [60(Sem) +15 (Int.) + 25 (Pr.)] Credits: -04(Th.) +02(Pr.)

Lectures – 60 [40(Th.) + (Pr.)

THEORY

Unit I: Plant-water relations (8 Lectures)

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

Unit II: Mineral nutrition (8 Lectures)

Essential elements, macro and micronutrients; Criteria of essentiality of elements: Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Translocation in phloem (6 Lectures)

Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit III : Photosynthesis (12 Lectures)

Photosynthetic Pigments (Chi a, b, xanthophylls, carotene); Photosystem I and II. reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C. C4 and CAM pathways of carbon fixation; Photorespiration.

Unit IV : Respiration (6 Lectures)

Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylaie. Oxidative Pentose Phosphate Pathway.

Enzymes (4 Lectures)

Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.

Nitrogen metabolism (4 Lectures)

Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit V : Plant growth regulators (6 Lectures)

Discovery and physiological roles of auxins, gibbereliins, cytokinins, ABA, ethylene.

Plant response to light and temperature (6 Lectures)

Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red I ight responses on photomorphogenesis; Vernal ization.

DSC-IV Practical

1. Determination of osmotic potential of plant cell sap by plasmolytic method.

2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O₂ evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Suggested Readings

1. Taiz, L., Zeiger, E., (2010). Plant Physiology. Sinauer Associates Inc., U.S.A. 5th Edition.
2. Hopkins, V.G., Hiller, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

