

Annexure 2B



Parishkar College of Global Excellence, Jaipur

**B.Sc. Botany Honours
Choice Base Credit System (CBCS)**

Faculty Members

Dr. Ramesh Chand Swami
(HOD, Department of Botany)
Dr. Preeti Sharma
Mr. Arvind Sharma
Mrs. Nidhi Priya Sharma

B.Sc. Botany Honours
Choice Base Credit System (CBCS)
(Scheme and Syllabus Under Choice Based Credit System)

Details of Course- Botany
Core Courses –Botany Honours

1. Algae and Microbiology
2. Biomolecules and Cell Biology
3. Mycology and Phytopathology
4. Archegoniate
5. Morphology and Anatomy
6. Economic Botany
7. Basics of Genetics
8. Molecular Biology
9. Plant Ecology and Phytogeography
10. Plant Systematics
11. Reproductive Biology of Angiosperms
12. Plant Physiology
13. Plant Metabolism
14. Plant Biotechnology

Discipline Specific Electives-Botany (Any Four except five)

1. Stress Biology
2. Plant Breeding
3. Research Methodology
4. Analytical Techniques in Plant sciences
5. Biostatistics

Skill Enhancement courses-Botany (Any two)

1. Biofertilizers
2. Mushroom culture technology
3. Herbal Technology
4. Food Processing and Marketing Technology
5. Nursery management and gardening

Generic Elective courses- Botany (Any Four)

1. Biodiversity (Microbes, Algae, Fungi and Archegoniate)
2. Plant Ecology and Taxonomy
3. Plant Anatomy and Embryology
4. Plant Physiology and Metabolism
5. Economic Botany and Biotechnology
6. Environmental Technology

Ability Enhancement compulsory course

1. Environmental Science
2. English communication

B.Sc. Botany Honours

Core Course I: Algae and Microbiology

Credit: Theory 4; Practical 2

Lectures: 60

Objectives

- To study microbial nutrition of microbes.
- To educate the students the basic concept of virus.
- To educate the students the basic knowledge of harmful and useful bacteria.
- Students acquire knowledge the economic importance of the algae.

Course learning Outcomes

- The students will develop the understanding of importance of microbes.
- Microbes such as bacteria, viruses, algae will play a major role in attending paper of competition exam.
- The students will able to understand the structure, character of microbes & their relationship to plants.
- The students will able to identify algae and distribution of algae in India.

Unit 1

(15 lectures)

S.No.	Syllabus
1.	Introduction to microbial world: Microbial nutrition, growth and metabolism. Economic importance of viruses and bacteria with reference to vaccine production, role in agriculture – role in N₂ fixation, as biofertilizers, industry, medicine and pollution control in air, soil, water.

Unit 2

(15 lectures)

S.No.	Syllabus
1.	Viruses: General structure, physiochemical and biological characteristics; classification (Baltimore), replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV)
2.	Bacteria: General characteristics; Cell structure, bacteria culture and Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction, mycoplasma and phytoplasma Phycotoxins and Mycotoxins

Unit 3**(15 lectures)**

S.No.	Syllabus
3.	Algae: General characteristics; Ecology and distribution; range of thallus organization; Cell structure and components; reserve food, reproduction; Classification; Role of algae in the environment, agriculture, biotechnology and industry.

Unit 4**(15 lectures)**

S.No.	Syllabus
4.	Members of Algae: Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of <i>Nostoc</i>, <i>Vaucheria</i>, <i>Chlamydomonas</i>, <i>Chara</i>, <i>Ectocarpus</i>, and <i>Polysiphonia</i>

➤ Suggested Practicals-

- 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**
- 3. Bacterial Gram staining**
- 4. Culture media preparation (Nutrient Agar, Potato Dextrose Agar)**
- 5. Isolation of microbes by streak plate method.**
- 6. Study of vegetative and reproductive structures of *Oscillatoria*, *Nostoc*, *Chara* (electron micrographs), *Vaucheria*, *Ectocarpus* and *Polysiphonia* (freshwater samples) through 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 R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8th edition.**
- 6. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi. 7. A Text Book of Practical Botany I- Ashok Bendre and Ashok Kumar**

- *Innovative and research oriented applied botany-*
 - **Algae as biofuel/food supplements**
 - **Algae as biofertilizers**
 - **Future aspects of Fungi in Pharmaceuticals**
 - **Industrial waste management by use of Algae**

B.Sc. Botany Honours

Core Course II: Biomolecules and Cell Biology

Credit: Theory 4; Practical 2

Lectures: 60

Objectives

- To provide basic knowledge of biomolecules.
- To educate the students about enzyme structure, function & its mode of action.
- To gain knowledge of cell and cell organelle.
- To learn about the cell division & regulation of cell cycle.

Course learning Outcomes

- This course, enhance the students to understand the importance of biomolecules.
- These biomolecules are involved in building organism & aid in growth & development of cell.
- The basic concept of enzymes & its mode of action will be helpful in studying the topic in both theoretical & practical aspect.
- The cell biology gives a strong foundation on basic unit of life.
- The basic understanding of cell and cell organ able will enable students to understand various prospecting of applied sciences.

Unit 1

(15 lectures)

S.No.	Syllabus
1.	The cell: Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells
2.	Cell wall and plasma membrane: Structure, chemical composition and function of Plant cell wall and plasma membrane function; fluid mosaic model; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis

Unit 2

(15 lectures)

S.No.	Syllabus
1.	Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin
2.	Cell organelles: Structure and function of Chloroplast, mitochondria, ER, Golgi, Ribosome, lysosomes and peroxisomes
3.	Cell division: Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases (in brief).

Unit 3**(15 lectures)**

S.No.	Syllabus
1.	Biomolecules Carbohydrates: Structure and function of Carbohydrates and its types
2.	Proteins: Structure of amino acids; protein structure and types, Protein denaturation and biological roles of proteins.
3.	Lipids: Definition and major classes of storage and structural lipids; Fatty acids (unsaturated and saturated) structure and functions
4.	Nucleic acids: Structure of nitrogenous bases, nucleotides; Types of nucleic acids (DNA and RNA)

Unit 4**(15 lectures)**

S.No.	Syllabus
	Enzymes: Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis – Menten equation, Mechanism of enzyme inhibition –competitive, non – competitive, uncompetitive, mixed and irreversible inhibition. Allosteric regulation in metabolic pathways. Applications of enzymes

➤ *Suggested Practicals*

- 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. Study of structure and working mechanism in different types of microscopes.**
- 4. Study of various stains and staining procedures.**
- 5. Study of cell and its organelles with the help of electron micrographs.**
- 6. Study the phenomenon of plasmolysis and deplasmolysis.**
- 7. Study the effect of organic solvent and temperature on membrane permeability.**
- 8. 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.**

B.Sc. Botany Honours
Core Course III: Mycology and Phytopathology

Credit: Theory 4; Practical 2
Lectures: 60

Objectives

- To learn about characteristics, classification, nutrition and reproduction of fungi. □ To impact knowledge of lichen and mycorrhiza □ To educate about applied mycology.
- To have basic knowledge of integrated pest management and phytopathology.

Course Learning Outcomes

- Acquire deep knowledge of reproduction and life cycle of certain fungal form.
- Learn about symbiotic association of lichen and mycorrhiza and their significance.
- Gain knowledge of role of fungi in food industry, pharmaceutical preparation and agriculture.
- This course enable the students to learn about diseases of plants and their control.

Unit 1

(15 lectures)

S.No.	Syllabus
1.	Introduction to true fungi General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Reproduction, Classification
2.	Members of Fungi General characteristics; Ecology; Life cycle with reference to <i>Phytophthora</i>, <i>Albugo</i>, <i>Rhizopus</i>, <i>Saccharomyces</i>, <i>Aspergillus</i>, <i>Penicillium</i>, <i>Neurospora</i>, <i>Peziza</i>, <i>Puccinia</i>, <i>Agaricus</i>, <i>Alternaria</i>

Unit 2

(15 lectures)

S.No.	Syllabus
1.	Symbiotic associations Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization:classification Nature of associations of algal and fungal partners; Reproduction; Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and their significance.

Unit 3**(15 lectures)**

S.No.	Syllabus
1.	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 Phycotoxins; Biological control, Medical mycology, Dermal mycology of Humans

Unit 4**(15 lectures)**

S.No.	Syllabus
1.	Phytopathology Terms and concepts; General symptoms; Integrated pest management Bacterial diseases – <i>Citrus canker and angular leaf spot of cotton</i> . Viral diseases – <i>Little leaf of Brinjal, Tobacco Mosaic viruses, vein clearing</i> . Fungal diseases – <i>Early blight of potato, Black stem rust of wheat, White rust of crucifers, Green ear disease of bajra, Red rot of sugarcane</i> .

➤ *Suggested Practicals*

- 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. *Albugo*: Study of symptoms of plants infected with *Albugo*; 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 endomycorrhiza (Photographs)**
- 10. Phytopathology: Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, little leaf of brinjal, yellow vein mosaic of bhindi, vein clearing**

Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers. Green ear disease of bajra, Red rot of sugarcane

- *Innovative and research oriented applied botany*- □
 - Future aspects of fungi in pharmaceuticals
 - Fungi as biofertilizers

➤ *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.**
6. Vashishta B.R. (2010) **Botany for Degree Students Fungi. S.Chand Publication, New Delhi, India.**

B.Sc. Botany Honours

Core Course IV: Archegoniate

Credit: Theory 4; Practical 2

Lectures: 60

Objectives

- To learn about characteristics and land adaption in archegoniate (bryophytes, pteridophytes and gymnosperm).
- To study morphology, anatomy and reproduction of certain members of archegoniate plants.
- To study primitive and advanced feature of fossil from like *Lepidodendron* and *Rhynia*. □ To educate about ecological and economic importance of archegoniate plants.

Course Learning Outcomes

- Identify the certain members of archegoniate in the field.
- Understand plant diversity and their life cycle pattern.
- Understand about fossilization and primitive feature in fossils. □ Appreciate their ecological importance.

Unit 1

(15 lectures)

S.No.	Syllabus
1.	Introduction: Unifying features of archegoniate; Transition to land habit; Alternation of generations.
2.	Bryophytes: General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of <i>Riccia</i>, <i>Marchantia</i>, <i>Anthoceros</i>, <i>Sphagnum</i> and <i>Funaria</i>; (developmental stages not included). Ecological and economic importance of bryophytes with special reference to <i>Sphagnum</i>.

Unit 2

(15 lectures)

S.No.	Syllabus
1.	Pteridophytes: Classification (up to family), morphology, anatomy and reproduction of <i>Psilotum</i>, <i>Selaginella</i>, <i>Equisetum</i> and <i>Pteris</i> (Developmental details not to be included).
2.	Apogamy, and apospory, heterospory and seed habit, telome theory, stelar evolution; Ecological and economic importance

Unit 3**(15 lectures)**

S.No.	Syllabus
1.	Gymnosperms: General characteristics, classification (up to family), morphology, anatomy and reproduction of <i>Cycas</i>, <i>Pinus</i> and <i>Ephedra</i> (Developmental details not to be included); Ecological and economic importance.

Unit 4**(15 lectures)**

S.No.	Syllabus
1.	Paleobotany in India: Brief study of the fossil deposits in India. Important Indian Paleobotanical Institutes, contributions of Indian Paleobotanist - Birbal Sahni – Birbal Sahni Institute. fossil Pteridophytes – <i>Lepidodendron</i> , <i>Rhynia</i> , <i>Calamites</i> ; fossil Gymnosperm – <i>Williamsonia</i> . Applied aspects of Paleobotany - exploration of fossil fuels

➤ ***Suggested Practicals***

1. ***Riccia* – Morphology of thallus.**
2. ***Marchantia*- Morphology of thallus, whole mount of rhizoids & Scales, whole mount of Gemmae (all temporary/ permanent 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. ***Sphagnum*- Morphology of plant, whole mount of leaf (permanent slide only).**
5. ***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.**
6. ***Psilotum*- Study of specimen, transverse section of synangium (permanent slide).**
7. ***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).**
8. ***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).**
9. ***Pteris*- 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).**
10. ***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).**

11. ***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(temporary slides), longitudinal section of female cone, tangential longitudinal section &radial longitudinal sections stem (permanent slide).
12. ***Ephedra***- Morphology, transverse section of stem, vertical section of reproductive organ
13. Permanent slides/ specimen of fossil members.
14. **Botanical educational trip** (Botanical garden/ biosphere reserve/ sea shore/ forest).

➤ ***Innovative and research oriented applied botany-***

□ **Study on Affinities between bryophytes and gymnosperms and vice versa** □
Scope of new criteria and features for classification of Archegoniates

➤ ***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

B.Sc. Botany Honours
Generic Elective: Botany
Biodiversity (Microbes, Algae, Fungi and Archegoniate)

Credit: Theory 4; Practical 2
Lectures: 60

Objectives

- To impart knowledge of basic concept of bacteriology & virology.
- To study various types of algae, fungi, bryophytes, Pteridophytes and gymnosperm.
- To acquire knowledge about the economic value of important algae, fungi, bryophytes, Pteridophytes, & gymnosperm.
- To teach about basics of lichen and Mycorrhizae.

Course Learning Outcomes

- Students will learn general structure, reproduction & economic importance of virus and bacteria.
- Identifying bacteria, fungi and understand their impact on human being and plants.
- Understanding characteristics, distribution, and economic importance of algae.
- Differentiate various algae, bryophytes, pteridophytes & gymnosperm.

Unit 1

(15 Lecturess)

S.No..	Syllabus
1.	Microbes Viruses: Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Viral like agents viroids, prions, TSEs, Phylloidy disease, Economic importance
2.	Bacteria: Early earth/ Microbial Evolution, General characteristics and cell structure; bacteria culture; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance, mycoplasma

Unit 2

(15 Lecturess)

S.No..	Syllabus
3.	Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae: Cyanophyceae: <i>Nostoc</i>; Chlorophyceae – <i>Chlamydomonas</i>, <i>Chara</i>, Xanthophyceae – <i>Vaucheria</i>; Phaeophyceae – <i>Ectocarpus</i>; Rhodophyceae – <i>Polysiphonia</i>. Economic importance
4.	Fungi: Introduction – General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction, and classification of fungi: Zygomycota: <i>Rhizopus</i>; Ascomycota: <i>Penicillium</i>, Basidiomycota: <i>Puccinia</i>, <i>Agaricus</i>; Deuteromycota: <i>Alternaria</i> Economic Importance of fungus. Symbiotic Associations-Lichens: General account, reproduction, and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit 3**(15 Lectures)**

S.No..	Syllabus
1.	Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations.
2.	Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification: morphology, anatomy, and reproduction of <i>Riccia</i>, <i>Marchantia</i>, <i>Anthoceros</i> and <i>Funaria</i>. Ecology and economic importance of bryophytes.

Unit 4**(15 Lectures)**

S.No..	Syllabus
1.	Pteridophytes : General characteristics, classification: Early land plants (<i>Lepidodendron</i> and <i>Rhynia</i>). Morphology, anatomy, and reproduction of <i>Selaginella</i>, <i>Equisetum</i> and <i>Pteris</i>. Heterospory and seed habit, Stelar evolution. Economic importance of Pteridophytes.
2.	Gymnosperms: General characteristics, Classification: Morphology, anatomy and reproduction of <i>Cycas</i>, <i>Pinus</i> and <i>Ephedra</i>. Economic importance of gymnosperm.

➤ **Suggested Practicals**

1. Study of Phyllody disease.

2. Types of Bacteria from permanent slides/photographs; *Citrus canker*, little leaf of brinjal, yellow vein mosaic of bhindi

3. Bacterial Gram staining,

4. Culture media preparation (Nutrient Agar, Potato Dextrose Agar)

5. Isolation of microbes by streak plate method.

6. Study of vegetative and reproductive structures of *Oscillatoria*, *Nostoc*, *Chara* (electron micrographs), *Vaucheria*, *Ectocarpus* and *Polysiphonia* through temporary preparations and permanent slides.7. Study of vegetative and reproductive structures of *Rhizopus* and *Penicillium*: through permanent slides.8. *Alternaria*: Specimens/photographs and tease mounts.9. *Puccinia* and *Agaricus*: 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.

10. Specimens of available mushroom.

11. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)

12. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)

13. Study of vegetative and reproductive structures of *Riccia*, *Marchantia*, *Anthoceros* and *Funaria*14. Study of vegetative and reproductive structures of *Selaginella*, *Equisetum* and *Pteris*15. Study of vegetative and reproductive structures of *Cycas*, *Pinus* and *Ephedra* 16. Study of fossil specimens(photographs) - (*Lepidodendron* and *Rhynia*).

- ***Innovative and research oriented applied botany- □ Algae as biofuel/food supplements***
- **Algae as biofertilizers**
 - **Future aspects of Fungi in Pharmaceuticals**

➤ ***Suggested Readings***

1. **Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 12; 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. **Singh V. Jain D. K., Pande P. C. (2010). A Text Book of Botany - textbook of botany. Rastogi publication, Meerut, India.**
7. **Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.**
8. **Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.**
9. **Vashishta, P.C., Sinha, A.K., Kumar (2010). A text book of Botany for degree students, Gymnosperm. S. Chand. Delhi, India.**
10. **Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad**

B.Sc. Botany Honours
Generic Elective: Botany
Plant Ecology and Taxonomy

Credit: Theory 4; Practical 2
Lectures: 60

Objectives

- To acquire knowledge of plant population, community and plant succession.
- To study ecosystem and biogeochemical cycling of carbon, nitrogen and phosphorus.
- To provide understanding of phytogeography & learn about endangered plant of Rajasthan.
- To disseminate the knowledge of classification & IUCN and Taxonomic evidences.
- To learn about angiospermic families.

Course Learning Outcomes

- Learn about the inter relationship between living world and environment.
- Acquire knowledge about the effect of different abiotic and biotic factor in the environment.
- Understand about the fundamental aspect of ecosystem, plant community.
- Learn about taxonomic rules and evidences in plant taxonomy.
- Identify plants on the basis of characteristic feature of different families of angiosperm.

Unit 1

(15 Lectures)

S.No.	Syllabus
1.	Introduction Introduction, scientist and its scope Atmosphere and its layer; plants adaptation of Hydrophytes , Mesophytes & Xerophytes
2.	Environment and climate -Abiotic factor water, light, temperature, soil (development, profile, physical -chemical characteristics of soil) Biotic factor: Interaction between animal & plants
3.	Ecosystem-Structure, energy flow trophic organization, food chains & food web, ecological pyramid, production and productivity, Biogeochemical cycling: cycling of carbon, nitrogen and phosphorus. Plant Sucession-plant sucession types and its process

Unit 2

(15 Lectures)

S.No.	Syllabus
1.	Plant Communities Plant population, plant community characteristics, frequency, density, abundance and cover; ecotype, ecad
2	Phytogeography Principle biogeographical zones, vegetation of India & Rajasthan. Plant conservation strategies in situ & ex -situ conservation Red data book. Endangered plants of Rajasthan.

Unit 3

(15 Lectures)

S.No.	Syllabus
1	Introduction to plant Taxonomy Introduction principles and rules of IUCN (International code of Nomenclature); Binomial nomenclature ;accredited herbariums of Rajasthan
2	Classification types: artificial, natural, phylogenetic, <i>Carolus Linnaeus</i>, <i>Bentham & Hooker</i> and <i>Engler and Prantl</i>
3	Taxonomic evidences from anatomy, embryology, palynology and phylogeny

Unit 4

(15 Lectures)

S.No.	Syllabus
1.	Study of Angio spermic families – Ranunculaceae, Brassicaceae, Rosaceae, Leguminosae, Euphorbiaceae, Malvaceae, Apiaceae, Asclepiadaceae, Verbenaceae, Solanaceae, Rubiaceae, Cucurbitaceae, Asteraceae, Poaceae, Liliaceae, Lamiaceae

➤ Suggested Practicals

1. Study of instruments used to measure microclimatic variables: Soil thermometer, psychrometer/hygrometer, rain gauge.
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 water holding capacity of soil.
4. Dissolved oxygen content, BOD and pH of water.
5. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (*Nerium*, *Calotropis*, *Capparis*, *Casuarina*, *Nelumbo*, *Hydrilla*, *Nymphaea*, *Eichhornia*)
(b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*, *Tinospora*).
6. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)
7. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
8. 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*, *Iberis*;

Asteraceae –*Sonchus*, *Ageratum*, *Helianthus*, *Tridax*

Solanaceae –*Datura stramonium*, *Withania*

Lamiaceae -*Salvia*, *Ocimum*

Liliaceae - *Asphodelus* / *Lilium* / *Allium*.

Fabaceae- *Pisum sativum*, *Cassia fistula*, *Senna tora*, *Acacia nilotica*, *Prosopis cineraria*

Rubiaceae- *Hamelia*

Euphorbiaceae- *Ricinus communis*, *Euphorbia pulcherima*, *Jatropha*

9. **Mounting of any ten properly dried and pressed specimen of any wild plants with herbarium label (to be submitted in the record book).**

➤ ***Innovative and research oriented applied botany-***

- ***Comparative study of modern and classical trends in classification for generating new criteria and ideas***
- ***Plant resistance in high temperature and their productivity***
- ***Different seasonal impacts on plant growth***
- ***Cultivation of commercial crops in rajasthan***
- ***Endangered plant species discovery and their conservation*** □ ***Reduction of noise pollution by plants***

➤ ***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. Odum E., Barrick M., and Barrett G.W. (2017) Fundamentals of Ecology. Cengage; India
4. **Simpson, M.G. (2006). Plant Systematics. Elsevier Academic Press, San Diego, CA, U.S.A.**
5. **Singh, G. (2012). Plant Systematics: Theory and Practice. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.**
6. Sharma O. (2017) Plant Taxonomy. Mc Graw Hill Education, India. Practical

B.Sc. Botany Honours
Discipline Specific Elective
Plant Breeding
Credits: Theory-4, Practical-2
Lectures: 60

Objectives

- Understand the methods of crop improvement.
- Understand the importance of horticulture in human welfare.

Course learning Outcomes

- It leads to improved crop management practices.
- Develop high yielding varieties.
- Role of Biotechnology in crop improvement.

Unit 1

(10 lectures)

S.No.	Syllabus
1.	Plant Breeding: Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important achievements and undesirable consequences of plant breeding.

Unit 2

(20 lectures)

S.No.	Syllabus
1.	Methods of crop improvement: Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self-pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations

Unit 3

(10 lectures)

S.No.	Syllabus
1.	Quantitative inheritance: Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human beings. Monogenic vs polygenic Inheritance.

Unit 4**(20 lectures)**

S.No.	Syllabus
1.	Inbreeding depression and heterosis History, genetic basis of inbreeding depression, Ideotype Breeding, Hybrid breeding and genetic basis of Heterosis, Applications.
2.	Crop improvement and breeding : Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop improvement

➤ *Suggested Readings*

1. Singh, B.D. (2005). **Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.**
2. Chaudhari, H.K. (1984). **Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.**
3. Acquaah, G. (2007). **Principles of Plant Genetics & Breeding. Blackwell Publishing.**

➤ *Innovative and research oriented applied botany-*

- *Creating new plant varieties through cross pollination.*

B.Sc. Pass course
Skill Enhancement Course
Biofertilizers
(Credits 2)
Lectures: 30

Objectives

- To gain the knowledge of eco-friendly bio fertilizer.
- To learn about mycorrhizal association with crop plants.
- To educate about organic farming and recycling of organic waste. **Course learning**

Outcomes

- Students will be aware about business opportunity in the field of plant sciences.
- Students can utilize biofertilizer, vermicomposting for increasing yield of crop plants.

Unit 1

(8 Lectures)

S.No.	Syllabus
1	General account about the microbes used as biofertilizer – Trichoderma, Rhizobium, PGPR. Biopesticides – Calotropis and Neem decoction. Biological control
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 2

(7 Lectures)

S.No.	Syllabus
1	Cyanobacteria (blue green algae), Azolla and Anabaena azollae association, nitrogen fixation, factors affecting growth, blue green algae and Azolla in rice cultivation.

Unit 3

(8 Lectures)

S.No.	Syllabus
1	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 4**(7 Lectures)**

S.No.	Syllabus
1	Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.

➤ *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. Vyas,S.C, Vyas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

➤ *Innovative and research oriented applied botany-*

- **Futuristic approach to biofertilizers**

- **Biofertilizers in enhancememnt of useful secondary metabolites □ Development of Green Plastic and it's scope**

B.Sc. Pass course
Skill Enhancement Course
Mushroom Culture Technology
(Credits 2)
Lectures: 30

Objectives

- To make aware students about the mushroom growing techniques.
- To teach nutritional and medicinal value of mushroom.
- Students will learn about cultivation and storage techniques of mushroom.

Course learning Outcomes

- Students will learn the cultivation techniques of mushroom
- Students can learn the techniques and small or large scale industries can be established by students.
- To teach pest & diseases of mushroom
- This course enables them to export and marketing of mushroom

Unit 1

(7 Lectures)

S.No.	Syllabus
1	Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - Calocybe indica, Lentinus edodes(Shiitake), <i>Ganoderma lucidum</i> (Rishi), <i>Hericium erinaceus</i> (Lion's Mane), <i>Pleurotus eryngii</i> (King Oyster), <i>CORDYCEPS SINENSIS</i> , <i>Flammulina filiformis</i> (Enoki), <i>Flammulina filiformis</i> (Oyster) <i>Volvariella volvacea</i> , <i>Agaricus bisporus</i> (Button). Natural condition for mushroom cultivation.

Unit 2

(8 Lectures)

S.No.	Syllabus
1	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. 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 3**(7 Lectures)**

S.No.	Syllabus
1	Pure culture-spawn preparation: Pure culture - preparation of medium (PDA and Oatmeal agar medium), Sterilization, Preparation of test tube slants to store mother culture, Culturing of <i>Pleurotus</i> mycelium on Petri plates, Preparation of mother spawn in saline bottle and polypropylene bag and their multiplication

Unit 4**(8 Lectures)**

S.No.	Syllabus
1	Storage and nutrition: Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content – Vitamins.
2	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.

➤ 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.

➤ Innovative and research oriented applied botany-

- Mushroom cultivation for high nutritive value as substitute of non vegetarian products
- Growth of economically important varieties of mushrooms in high temperature conditions

