Learning Outcome based Curriculum Framework (LOCF)

For

Choice Based Credit System (CBCS)

Syllabus

B.Sc. (Program) in Botany

w.e.f. Academic Session 2020-21

Kazi Nazrul University

Asansol, Paschim Bardhaman

West Bengal 713340

Semester – I

Course Name: Phycology and Microbiology

Course Code: BSCPBOTC101

Course Type: **Core**	Course Details: **CC-1**			L-T-P: **4-0-4**	
Credit: 6	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

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

- Develop understanding on the concept of microbial nutrition
- Classify viruses based on their characteristics and structures
- Develop critical understanding of plant diseases and their remediation.
- Examine the general characteristics of bacteria and their cell reproduction/ recombination
- Increase the awareness and appreciation of human friendly viruses, bacteria, algae and their economic importance
- Conduct experiments using skills appropriate to subdivisions

Unit I: Introduction to microbial world

- Histroy and development of microbiology (In brief) – contributions of Antoni van Leuwenhoek, Edward Jenner, Loius Pasteur, Robert Koch, De Bary and A. Flemming.
- Principles and modern approaches of bacterial taxonomy, General idea about Bergey's Mannual, Three domain system by C. Woese (1991).
- Microbial nutrition, nutritional types, growth and metabolism.
- Economic importance of bacteria with reference to their role in agriculture (Biofertilizers, Biopesticides) and industry [fermentation (Alcohol production general account) and medicine (Penicillin production general account).
- Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases.

Unit II: Viruses and Bacteria

- Viruses: General characteristics of viruses (size, symmetry, culture characteristics, general structure including concept of capsomere and peplomere, chemical composition), structure of TMV and T_2;

- Viral multiplication – Lytic cycle and Lysogeny (excluding regulation).
- Brief idea about Prions and Viroids.
- Bacterial structure and function - Capsule, flagella, pili, cell wall (chemical composition and characteristics), plasma membrane, ribosomes, cytoplasmic inclusions (PHB, Volutin). Plasmids and bacterial chromosome, endospore (structure only);
- Basics of genetic recombination in bacteria: Transformation, Conjugation and Transduction. Artificial transformation.
- Basic immunology (only outline) – Innate and acquired immunity, active and passive immunity, humoral (antibody mediated) and cellular (cell mediated) immunity, primary and secondary response, general structure of antibody and its types.

Unit III: Algae, Cyanophyta and Xanthophyta

- Introduction; Habitat and distribution; thallus organization; origin and evolution of sex in algae; Life cycle patterns.
- Broad outline of classification of Fritsch (1935)
- Comparative account of: Cyanophyceae, Chlorophyceae, Charophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae.
- Cell structure and reproduction of Cyanophyceae and Diatoms.
- Life histories of *Oedogonium, Vaucheria, Ectocarpus* and *Polysiphonia*.

Unit IV: Algal Biotechnology

- Economic importance of algae; Algal cultivation methods, Commercial cultivation and economic importance of green algae, brown and red algae.
- Algae in pollution control (sewage treatment), Biofertilizer, Single Cell Protein (SCP).

Practical Microbiology

- Demonstration of the functioning of Autoclave, Hot-air oven, Laminar air-flow, Filtration, Incubator and tools like inoculating loops/needles, petriplates, spreader, culture tubes etc.
- Preparation of standard bacteriological media (Nutrient agar and Nutrient broth).
- Preparation of slants, stabs and agar plates.
- Demonstration of Sub-culturing technique.
- Microscopic examination of bacteria from natural habitats: curd and root nodules of leguminous plants (simple staining only)
- Differential staining: Gram staining (Using standard *E. coli* and *Bacillus* cultures)

Phycology

- Study of the following genera: *Oscillatoria, Gloeotrichia, Scytonema, Oedogonium,Vaucheria and Chara.*

- Identification of all the genera included in the theoretical syllabus by their vegetative and reproductive structures

Suggested Readings

1. Atlas, R. M. (recent Edition) – Principle of Microbiology, W. E. B. Mc Graw Hill.
2. College Botany Vol. –II.- Gangulee and Kar, New Central Book Agency, Kolkata.
3. Fundamentals of Microbiology and Immunology – A. K. Banerjee & N . Banerjee. New Central Book Agency.
4. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4th edition.
5. Pelczar, M.J. (2001). Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
6. Powar, C. B. and Dasinawalla, H. F. General Microbiology. Vol. II. Himalayan Publishing House, Delhi. Mombay.
7. Sharma, P. D. Microbiology; Rastogi Publications, Meerut.
8. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). Botany for Degree Students. Algae. S Chand and Co, New Delhi.
9. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). Prescott's Microbiology. 9th Edition. McGraw Hill International.
10. Sharma T.A., Dubey, R.C. and Maheshwari, D.K. (1999). A Text Book of Microbiology. S Chand and Co, New Delhi.
11. Studies in Botany, Vol. I. - Mitra, Mitra, Choudhury. Moulik Library, Kolkata.
12. Text Book of Botany, Voli-1, Hait, Ghosh and Bhattacharya, New Central Book Agency.

Semester – II

Course name: Mycology And Phytopathology

Course Code: BSCPBOTC201

Course Type: **Core**	Course Details: **CC-2**	L-T-P: **4-0-4**

Credit: 6	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

On completion of this course, the students will be able to;

- Identify true fungi and demonstrate the principles and application of plant pathology in the control of plant disease.
- Demonstrate skills in laboratory, field and glasshouse work related to mycology and plant pathology.
- Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies
- Identify the common plant diseases according to geographical locations and device control measures

Unit I: Introduction to fungi and classification

- Introduction, Salient features - fungal tissue organization, modification of hyphae; Ecology of fungi; Structure of fungal cell, cell wall, fungal flagella, septum, nutrition, heterothallism, parasexuality.
- Broad outline Classification of Gwynne-Vaughan and Barnes (1926) and Ainsworth and Bisby (1983).
- Phycomycetes: Salient features, life histories of *Synchytrium, Saprolegnia* and *Rhizopus.*
- Ascomycetes: Salient features, Ascus development, types of ascocarps; life histories of *Saccharomyces* and *Ascobolus*.

Unit II: Basidiomycota, Allied fungi and Oomycota

- Basidiomycetes: Salient features (dikaryotization, clamp connection); development of Basidium, life histories of *Agaricus* and *Polyporus*.
- Deuteromycetes: Salient features with special reference to conidial fruit body types;

Unit III: Symbiotic associations and applied Mycology

- Lichen: Classification, thallus organization, reproduction; ecological and economic significance.
- Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and VAM fungi; Role of mycorrhizae and VAM in agriculture and forestry.

Unit IV: Phytopathology

- Plant Diseases: Definition; concepts of parasitism and saprophytism, Koch's postulate.
- Classification of plant diseases based on symptoms.

- Structural and biochemical defense mechanism of plants.
- Control of Plant diseases: Physical, chemical and biological methods.
- Symptoms, disease cycles and control measures of
  Bacterial diseases –Bacterial blight of rice
  Viral diseases- Tobacco Mosaic viruses
  Fungal diseases- Late blight of potato, Black stem rust of wheat.

Practical –

Mycology -

- Study of the following genera: *Rhizopus, Ascobolus, Agaricus* (gill) and *Polyporus.*
- Identification of all the macroscopic and microscopic genera included in the theoretical syllabus. (It should also include *Alternaria* and *Fusarium* of Deuteromycetes).

Phytopathology -

- Study of the following diseases: White rust, Rust of wheat/*Justicia*,
- Study of symptoms of: Brown spot of rice, Bacterial blight of rice, Citrus Canker; Vein clearing in Lady's finger, Late blight of potato, Rust of wheat from herbarium specimens.

[NB. Practicals will also include field study with specimen collection, preservation and their submission with proper documentation. It also includes temporary and where ever necessary permanent slide preparation and submission.]

Suggested Readings

1. Botany for degree students. Fungi. B. R. Vashistha, A. K. Sinha. V. R. Singha (Latest edition). S. Chand
2. College Botany Vol. –II. - Gangulee and Kar, New Central Book Agency, Kolkata.
3. Introduction to Fungi. Webster, J. Cambridge University Press.
4. Introduction to Fungi, Dubey, H. C. Vikas Publishing House.
5. Introduction to Mycology. Alexopoulas, C. J., Mims, C. W. and Blackwell Wiley. Bastern Limited, New Delhi.
6. Introductory Mycology. R. S. Mehrotra and Aneja, K. R. New Age International
7. Studies in Botany, Vol. I. - Mitra, Mitra, Choudhury. Moulik Library, Kolkata.
8. Text Book of Botany, Voli-1 and 2, By Hait, Ghosh and Bhattacharya, New Central Book Agency.
9. Text Book of Fungi, Sharma O.P. Tata McGraw Hill Publishing Co. Latyestedn.
10. Text Book of Fungi, Sharma, O. P. Tata Mc Graw Hill Publishing Co. Latest edn.
11. Plant Pathology. Agrios R. N. academic Press.
12. Plant Pathology, Mehrotra, R. S. Tata Mc Graw Hill Publishing Company. New Delhi
13. Diseases of Crop Plants in India. Rangaswamy, G. Prentice Hall India Pvt. Ltd. New Delhi
14. Plant Diseases. Singh, R. S. Oxford & IBH, New Delhi.

15. Pathogen and Plant Diseases. Pandey, B. P., S. Chand & Company Ltd. Rangaswamy, G. New Delhi.

Semester-III

Course name: Archegoniatae: Bryophytes, Pteridophytes, Gymnosperms

Course Code: BSCPBOTC301

Course Type: **Core**	Course Details: **CC-3**			L-T-P: **4-0-4**	
Credit: 6	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

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

- Demonstrate an understanding of archegoniatae, Bryophytes, Pteridophytes and Gymnosperms
- Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms
- Understanding of plant evolution and their transition to land habitat.
- Demonstrate proficiency in the experimental techniques and methods of appropriate analysis of Bryophytes, Pteridophytes, Gymnosperms

Unit I: Introduction

- Unifying features of archegoniates; Transition to land habit; Alternation of generations and concept of sporophyte and gametophyte.

Unit II: Bryophytes

- Origin of Bryophytes; Habit and distribution; Broad outline of Classification according to Proskauer, (1957), Comparative study of Hepaticopsida, Anthocerotpoida and Bryopsida.
- Morphology, anatomy, reproduction and evolutionary trends in *Marchantia, Anthoceros* and *Funaria*.
- Ecological and economic importance of bryophytes with special reference to *Sphagnum*.

Unit III: Pteridophytes

- Introduction to Palaeobotany – Important terminologies and definitions; Types of fossil on the basis of modes of preservation; Nomenclature, Conditions suitable for fossilization; Importance of fossils and their study; Geological time scale and important events of plant life.

- Introduction to Pteridophyta – Concept of Vascular Cryptogams; stellar organization and its evolution; General features of Pteridophytes; Telome theory, Enation Theory.
- Outline of Sporne (1975) system of classification of pteridophytes up to family.
- A comparative account of fossil members: Geological history and morphoanatomical features of *Rhynia* and *Zosterophyllum*;
- A comparative account of the living members: Distribution, Morphology and anatomy of vegetative structure and reproduction of *Lycopodium, Selaginella, Equisetum*, *Pteris* and *Marsilea.*

Unit IV: Gymnosperms

- General features, evolution of seed habit; outline classification as adopted by Stewart & Rothwell (1993); Economic importance of gymnosperms.
- Morphoanatomical features and Comparative account of the life histories of living members - *Cycas, Pinus, Ginkgo* and *Gnetum*. Their distribution in India.

Practicals –

- Study of the gametophytic and sporophytic structures of the following genera: *Marchantia, Anthoceros and Funaria.*
- Study of external morphology and anatomical features of leaf, stem and reproductive parts of the following: *Lycopodium, Selaginella, Equisetum, Pteris* (leaflet) and *Marsilea* (Sporocarp).
- Study of the morphological and anatomical features of the following: *Cycas* (leaflet, rachis, microsporophyll) and *Pinus* (needle, stem, male cone).
- Macroscopic and microscopic identification of specimens of all extant genera included in the theoretical syllabus of Bryophytes, Pteridophytes and Gymnosperms.
- Study (including mode of preservation) of the following: *Glossopteris* (leaf, specimen), *Lyginopteris* (stem in T. S.),*Vertebraria*(root, specimen).

[NB. Practicals will also include field study with specimen collection, preservation and their submission with proper documentation. It also includes temporary and where ever necessary permanent slide submission.]

Suggested Readings

1. A Text Book of Botany: Lower Plants (2nd edition) Part-I: Bryophta. Singh, Pandey and Jain. 1999. Rastogi Publications. Merut.
2. A Text Book of Botany, Pandey, S. N., Trivedi, P. S. and Misra, S. P. 1989. VikasPublishing House Pvt. Ltd.

3. Bryophytes, a broad perspective. Puri, P. 1973. Atma Ram & Sons. New Delhi.
4. The structure and life of Bryophytes, Watson, E. V. Hutchinson University Library, London.
5. College Botany Vol. –II.- Gangulee and Kar, New Central Book Agency, Kolkata.
6. Cryptogamic Botany Vol. II. GM Smith,Bryophtes and Pteridophytes (2nd edition). Mc.Graw Hill Book Co. New York.
7. E. M. Gifford and A. S. Foster. 1988. Morphology and Evolution of Vascular Plants.
8. N. S. Parihar: An Introduction to Embryophyta Vol-II. Central Book. Allahabad.
9. Studies in Botany, Vol. I. - Mitra, Mitra, Choudhury. Moulik Library, Kolkata.
10. Text Book of Botany, Voli-1 and 2, By Hait, Ghosh and Bhattacharya, New Central Book Agency.
11. K. R. Sporne : The Morphology of Pteridophytes. B. S. Publications. Calcutta
12. P. C. Vasistha. 1980 Botany for degree student Pteridophyta. S. Chand & Company Pvt. Ltd.W. N. Stewart and G. N. Rothwall (recent edition). Palaeobotany and the evolution of Plants. Cambridge University Press.
13. Rashid. 1976. An Introduction to Pteridophyta. Vikas Publishing . New Delhi.
14. Pichi-Sermolli, R. E. R. 1959. In Vistas in Botany. Vol-I (edition. W. B. Turill).
15. S. SundarRajan. 1994. An introduction to Pteridophyta. New Age International Publishing Limited and Willey Eastern Ltd.
16. S. Sundararjan (Wiley Eastern) Introduction to Pteridophyta.
17. Mehra and Bir, Pteridophytic Flora of Darjeeling and Sikim Himalaya. Bishen Singh Mahendra Pal Singh.
18. K. Kubtzki (ed.) Vol-I, The Families & Genera of Vascular Plants Springer Pteridophyta & Gymnosperms 1990. Springer
19. Stewart, W. N. & G. W. Rothwell. 1993. Palaeobotany and Evolution of Plants. Cambridge University Press. 4. Taylor, T. N., E. L.
20. Taylor and M. Krings. 2009. Palaeobotany, the biology and evolution of fossil plants. Elsevier Inc.
21. Beck, C. B. 1988. Origin and evolution of gymnosperms. Columbia University Press.
22. Chamberlain, C. J. 1934. Gymnsoperms – structure and evolution. Chicago Univ. Press.
23. Sporne, K. R. 1974. Morphology of Gymnosperms. Hutchson Univ. Library, London.
24. Bhatnagar, S. P. & A. Moitra. 1996. Gymnosperms. New Age International Ltd., New-Delhi.
25. Biswas, C. & B. M. Johri. 1997. Gymnosoperms. Narosa Publishing House. New Delhi.

Semester-IV

Course name: Plant Systematics

Course Code: BSCPBOTC401

Course Type: **Core**	Course Details: **CC-4**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

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

- Classify Plant systematics and recognize the importance of herbarium and Virtual herbarium
- Evaluate the Important herbaria and botanical gardens
- Interpret the rules of ICN in botanical nomenclature
- Assess terms and concepts related to Phylogenetic Systematics
- Generalize the characters of the families according to Bentham & Hooker's system of classification

Unit I: Significance of Plant systematics and Taxonomic hierarchy

- **Introduction to systematics**; Plant identification, Classification, Nomenclature. Evidences from palynology embryology, cytology, phytochemistry and molecular data. Field inventory; Importance of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: intended (yolked) and bracketed keys.
- **Plant classification** - artifitial, natural and phylogenetic approach, concept of molecular chronometers, Phenetics vs. Cladistics; phylogenetic systematic

Unit II: Botanical Nomenclature and System of Classification

- Principles and rules (ICBN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids.
- Outline of the system of classification – Linnaeus (1753) and Bentham and Hooker (1862-83).

Unit III: Biometrics, Numerical Taxonomy and Cladistics

- Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

Unit IV: Phylogenetic Systematics

- Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly.
- Origin and evolution of angiosperms; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

Unit V: Salient features of the following families with examples from common Indian species and economic importance.

Dicotyledons: Malvaceae, Leguminosae, Apocynaceae, Solanaceae, Scrophulariaceae, Lamiaceae, Verbinaceae, Acanthaceae, Rubiaceae, Asteraceae

Monocotyledons: Poaceae and Orchidaceae

Practical

- 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):
  Malvaceae, Leguminosae, Apocynaceae, Solanaceae, Lamiaceae, Verbinaceae, Asteraceae , (Take at least one genus from each family)
- Field visit (local or outside depending on situation) –
- Mounting of a properly dried and pressed specimen of any 20 wild plants with Herbarium label (to be submitted in the record book).

Suggested Readings

1. College Botany Vol. III. New Central Book Agency. Calcutta.
2. Datta, S. C. 1991. Systematic Botany. Wiley Eastern Ltd. New Delhi, Calcutta.
3. Good, R. Plant Geography. Oxford & IBH.
4. Judd, Campbell, Kellogg. Stevens. 2003. Phylogeny & Evolution of Vascular Plants. Sinaurer Associates Inc. Publishers Sunderland. Massachusetts. USA.
5. Lawrence, G. H. M. 1981. Taxonomy of Vascular Plants. Mc Milian New York.
6. Mitra, J. N. 1974. An Introduction to Systematic Botany and Ecology. The Wall Press.
7. Naik, V. N. Taxonomy of Angiosperms. Tata Mc. Graw Hill Publishers Co. 1981. New Delhi
8. Plant Groups. (Recent Edition). H. Mukherjee. New Central Book Agency.
9. Plant Systematics. Gurucharan Singh. 2005 (2nd Edition). Oxford & IBH.
10. Plant Systematics. Simpson. 2006. Elsivier. 11. S. K. Mukherjee. 1984.
11. Sachdeva, S. K. 1990. Angiosperms, Morphology, Anatomy, Taxonomy, Evolution. Kalyani Publishers, New Delhi.

12. Sporne, K. R. 1974. The Morphology of Angiosperms: The structure and evolution of flowering plants. Hutchinson University Library. London.
13. Stuessy T. F. Plant Taxonomy, The systematic evaluation of Comparative data. Columbia IUniv. Press. Second Edition.
14. Takhtajan, A. 2009. Flowering Plants, Springer.
15. Takhtajan, A. 1986. Diversity & Plant Distribution. Oliver & Boyd.

Semester – V

Course name: Anatomy of Angiosperms

Course Code: BSCPBOTC501

Course Type: **Core**	Course Details: **CC-5**			L-T-P: **4-0-4**	
Credit: 6	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

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

- Develop an understanding of concepts and fundamentals of plant anatomy
- Examine the internal anatomy of plant systems and organs
- Develop critical understanding on the evolution of concept of organization of shoot and root apex.
- Analyze the composition of different parts of plants and their relationships
- Evaluate the adaptive and protective systems of plants

Unit I: Introduction to plant anatomy and plant body

- Cell wall: Structure, growth and thickenings; Adcrustation and incrustation; Pits and Plasmodesmata.
- Tissue: Definition and types (meristematic and permanent tissues); classification of simple and complex tissues; A general account of different types of simple and permanent tissues. Sclereids.
- Tissue system – Epidermal (multiple epidermis, bulliform cells, stomatal types, trichoblasts, glandular hairs), vascular (leaf gap, branch gap, types of vascular bundles) and ground tissue system (Genral features of cortex, pith and medullary rays), Stele types.

Unit II: Adaptive and Protective Systems

- Vascular bundles (types); Stele and its types; Root stem transition; mechanical tissue and their distribution in plant bodies (including principles of their distribution).
- General account on: Cuticle, Stomata, Hydathodes, Cavities, Laticifers, Kranz anatomy

Unit III: Apical meristems

- Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation)
- Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Root cap.

Unit IV: Vascular Cambium and Wood

- Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth (General account); Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.

Practical

- Study of stomata through peal method.
- Staining techniques – simple and differential staining.
- Demonstration of the method of temporary and permanent slide preparation.
- Study of primary structure: Stem: monocot (Maize), dicot (Sunflower); Root: monocot(*Canna*), dicot (Chick pea).
- Microscopic study from permanent slides of: Bulliform cells, stomatal types, lenticels, raphides (acicular and sphaeraphides), cystolith, cavities and laticifers.
- Study of the anomalous structures of stems of the following genera: *Bignonia, Dracaena, Boerhaavia* and *Achyranthes.*
- Maceration of wood elements of *Cucurbita* and *Pinus* stem and their microscopic examination.

Suggested Readings

1. Any local/state/regional flora published by BSI or any other agency.
2. Cutter, E. G. 1978 Plant Anatomy Part I & II. Edward & Arnold
3. Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
4. Esau, K. 1966. Plant Anatomy. John Willey.
5. Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.
6. Fahn, 1982. Plant Anatomy. John Willey.

7. Fahn, A. (1974). Plant Anatomy. Pergmon Press, USA.
8. Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
9. P. Roy. Plant Anatomy, new Central Book Agency, Kolkata-700010.

Course name: Plant Physiology

Course Code: BSCPBOTC502

Course Type: **Core**	Course Details: **CC-5**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

On completion of this course, the students will be able to;

- Understand Water relation of plants with respect to various physiological processes.
- Explain chemical properties and deficiency symptoms in plants
- Classify aerobic and anaerobic respiration
- Explain the significance of Photosynthesis and respiration
- Assess dormancy and germination in plants
- To acquire adequate knowledge about translocation in plants, carbon dioxide concentrating mechanisms, growth regulators and flowering of plants.

Unit I: Water Potential and Other Potential Physiological Aspect of Plant

- Water Potential and its components, water absorption by roots, aquaporins, pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap–theories on Ascent of sap. Transpiration and factors affecting transpiration, antitranspirants; mechanism of stomatal movement – K^+-H^+ antiport theory, role of CO_2, sucrose and ABA and blue light response.
- Essential and beneficial elements; Macro and micronutrients; Hydroponics; Criteria for essentiality of elements; Mineral deficiency symptoms and roles of essential elements; Heavy metal toxicity on plants; Phytoremediation (basic concept).
- Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption and active absorption of ions, carrier mediated transport, uniport, co-transport, symport, antiport; Nernst equation.

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

Unit II: Photosynthesis and Photorespiration

Photosynthesis: Definition, photosynthetic pigments, basic concept about mechanism of light-dependent and light independent reactions; C 3 -, C4 - and CAM pathways of CO_2 fixation; Photorespiration - definition, sites, mechanism and significance

Unit IV: Phytochrome, Phytohormone and Plant Cycle

- Definition and types, bioassay (auxin only), Chemical nature and physiological roles of: Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene.
- Photoperiodism, flowering stimulus, physicochemical nature of phytochrome, role of phytochromes in flowering
- Seed germination - different phases of seed germination, seed dormancy (types, significance and breaking of seed dormancy).

Practical

Plant Physiology –

- Determination of osmotic potential of plant cell sap by plasmolytic method (using *Rhoeo* epidermal peel).
- Determination of amount of water absorption, retention and transpiration.
- Study of the effect of humidity and light on the rate of transpiration in excised twig/leaf.
- Study the effect of KNO_3 on stomatal opening.
- Determination of the effect of CO_2 concentration on the rate of photosynthesis using molar solution of bicarbonate and by measurement of volume of O_2 liberation.

Suggested Readings

1. Conn, E. E. Stumpt, P. K. Bruening, G. and Doi, R. H Cutline of Biochemistry, John Wiley & Sons
2. Ghosh and Mukherjee. Plant Physiology. NCBA
3. Hopkins, W. G. – An Introduction to Plant Physiology, John Wiley & Sons Inc.
4. Morh, H. Schopfer, P. – Plant Physiology Springer Verlag.
5. Sanjeev Pandey, Advance Botany, Volume-1, 2nd Edn, Pub. Books and Allied (P) Ltd. Kolkata.
6. Salisbury, F. B. and Ross, C. W. – Plant Physiology. Wordsworth Publishing Company.
7. Srivastava, H. S. 1999.plant Physiology, Rastogi Publicaation, Meerut.
8. Stryer, L. – Biochemistry, John Wiley & Sons 4. Sarkar &Rakshit – Organic Chemistry.
9. Taiz, L. and Zeiger, E. – Plant Physiology. The Benjamin Cumming Publishing Company.

10. V. K. Jain. Fundamentals of Plant Physiology, S Chand Pub.

Semester – VI

Course name: Cytogenetics

Course Code: BSCPBOTC601

Course Type: **Core**	Course Details: **CC-6**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

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

- Have conceptual understanding of laws of inheritance, genetic basis of loci and alleles and their linkage.
- Comprehend the effect of chromosomal abnormalities in numerical as well as structural changes leading to genetic disorders.
- Develop critical understanding of chemical basis of genes and their interactions at population and evolutionary levels.
- Analyze the effect of mutations on gene functions and dosage.
- Examine the structure, function and replication of DNA.

Unit I: The cell structure and function:

The Cell Theory; Prokaryotic and eukaryotic cells; Cell size and shape. Fluid Mosaic Models of membrane structure; Selective permeability of the membranes. Structure and Functions of: Mitochondria, Chloroplast, ER, Golgi body & Lysosomes; DNA packaging in eukaryotes, euchromatin and heterochromatin.

Unit II: Cell cycle and cell division

Phases of cell cycle, mitosis and meiosis, Regulation of cell cycle checkpoints (role of cyclins and Cdks).

Unit III: Mendelian genetics and its extension

Mendel's laws of inheritance; Monohybrid and dihybrid cross; Test cross; Gene interactions (Incomplete dominance, codominance, complementary genes); Linkage – Coupling and Repulsion hypothesis, Crossing over (General mechanism)

Unit IV: Numerical and structural aberration of chromosomes and mutation

Structural aberrations (Deletion, Duplication, Inversion and Translocation) and Numerical aberrations (Euploidy and aneuploidy – types and definition).

Mutations (Definition, Types – spontaneous and induced; point mutation, Frame Shift Mutation), Mutagenic agents (Base analogues, alkylating agents);

Practical

1. Study of Mitotic cell division and chromosome complements in *Allium cepa* root tips by aceto-orcein squash technique.
2. Study of Meiotic divisions in *Allium cepa* or *Rhoeo spathacea*/*R. discolor* by aceto-carmine staining technique. Determination of chiasma frequency in these plants.
3. Laboratory exercises in probability (coin tossing and dice throwing) and testing goodness of fit of Mendellian ratio by chi-square test.
4. Chromosome mapping using point test cross data.
5. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
6. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
7. Blood Typing: ABO groups & Rh factor (Only blood transfusion compatibility from chart)
8. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes (From photograph).
9. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
10. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Color blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached earlobe.

Suggested Readings

1. Cooper, G.M. and Hausman, R.E. (2009) The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
2. Genes – XI (Lewin)
3. 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.
4. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.

5. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
6. Karp, G. (2010). Cell Biology, John Wiley & Sons, U.S.A. 6th edition.
7. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9th edition.
8. Molecular Biology of the Cell – Bruce Albert
9. Molecular Biology of the Gene – Watson
10. Piter J. Russell: I-Genetics: A Molecular Approach. 3rd edition.
11. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics, John Wiley & Sons Inc., India. 5th edition.

Course name: Plant Ecology and Phytogeagraphy

Course Code: BSCPBOTC602

Course Type: **Core**	Course Details: **CC-6**			L-T-P: **4-0-4**	
Credit: **6**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	20	**40**

Course Learning Outcomes:

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

- Understand core concepts of biotic and abiotic
- Classify the soils on the basis of physical, chemical and biological components
- Analysis the phytogeography or phytogeographical division of India
- Evaluate energy sources of ecological system
- Assess the adaptation of plants in relation to light, temperature, water, wind and fire.
- Conduct experiments using skills appropriate to subdivisions

Unit I: Basic Principles of ecology and ecological factors -

Ecology: Definition, Basic concepts; Levels of organization, Concept of Autecology and Synecology. Abiotic and biotic Components and their interrelationships and dynamism, homeostasis.

Unit II: Ecological adaptations, Population ecology

Ecological adaptation: Morphological, anatomical and physiological adaptations of xerophytes, hydrophytes and halophytes.

Population ecology: Characteristics and population growth, population regulation, growth curves, life history strategies; *r* and *k* selection. Ecological Speciation.

Unit III: Plant Communities and Ecosystem

Community characteristics: analytical and synthetic; Concept of ecological amplitude; Habitat and niche; Ecotone and edge effect; Succession: processes, types (Hydrosere, Xerosere); climax concept. Primary vs Secondary succession.

Ecosystem: Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Ecosystems of India.

Unit IV: Functional Aspects of Ecosystem and Phytogeography

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles of carbon, nitrogen and phosphorus.

Biodiversity (hot spots, megadiversity zones, IUCN threatened species), conservation (*in-situ-, ex-situ* conservation and cryopreservation).

Pollution: Definition causes and remedies with respect to air, water and noise pollution.

Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phyto-geographical division of India (After Independence); Vegetation characteristic of Eastern Himalayas and Sunderbans.

Practical

- 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.
- Study of Ecological adaptations with respect to anatomy of: *Ipomoea aquatica* stem, Phyllode of *Acacia auriculoformis*, *Nerium* leaf and *Vanda* root
- Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) 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.

Suggested Readings

1. Ambasht, R. S. A Text book of plant ecology. Students Friends Co. Varanasi.
2. Dash, M. C. Fundamentals of Ecology. Tata Mc. Graw Hil Publishing Company Ltd.
3. Good, R. Plant Geography. Oxford & IBH.

4. Kormondy, B. J. 1983. Concept of Ecology (Recent edition) Prentice Hall India Ltd. New Delhi.
5. Kuman, H. D. Modern Concept of ecology. Vikas Publications House New Delhi
6. Odum, E. P. fundamentals of Ecology (recent edition) W. B. Sunders & Co. Philadelphia.
7. Plant Ecology. R. Mishra. Oxford & IBH.
8. Sanjeev Pandey, Advance Botany, Volume-1, 2nd Edn, Pub. Books and Allied (P) Ltd. Kolkata.
9. Sharma, P. D. Geology and Environment (10th edition). Rastogi Publications. Meerut.
10. Sharma, p. D. Environmental Biology and Toxxicology (10th edition) Rastogi Publications. Meerut. Odum, E. P. Ecology. Hoit Reinhart and Winston Inc.
11. Treatise on Plant Ecology. K. N. Bhatia and k. K. Sharma. (Recent edition) Pradeep Publications Jalaandhar.
12. Takhtajan, A. 1986. Diversity & Plant Distribution. Oliver & Boyd.

SEC- Skill Enhancement Course – For Program/Pass Course

Semester - III

Course code – BSCPBOTSEC301

Course name: Ethnobotany

Course Type: **SEC**	Course Details: **SEC-301**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

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

- Conceptualize ethnobotany as an interdisciplinary science
- Restate the established methodology of ethnobotany studies
- Categories various indigenous ethnic groups and their environmental practices.
- Understand the legalities associated with ethnobotany.

Unit 1:

Major and minor ethnic groups or Tribals of India, and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils

Unit 2:

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

Unit 3:

Role of ethnobotany in modern Medicine; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Aloe vera*. d) *Eclipta alba* e) *Phyllanthus niruri* f) *Emblica officinalis* g) *Centella asiatica* h) *Saraca indica*. Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina*, *Taxus brevifolia*, *Artemisia vulgaris*, *Withania somnifera*.

Unit 4:

Ethnobotany and legal aspects - Ethnobotany as a tool to protect interests of ethnic groups. Sharing of wealth concept with few examples from India. Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Suggested Readings

1) S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

2) S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981

3) Lone et al,. Palaeoethnobotany

4) S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.

5) S.K. Jain, 1990. Contributions of Indian ethnobotny.Scientific publishers, Jodhpur.

6) Colton C.M. 1997. Ethnobotany – Principles and applications. John Wiley and sons – Chichester

7) Rama Ro, N and A.N. Henry (1996). The Ethnobotany of Eastern Ghats in Andhra Pradesh, India.Botanical Survey of India. Howrah.

8) Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA –SHREE Publishers, Jaipur-1996

9) Faulks, P.J. 1958.An introduction to Ethnobotany, Moredale pub. Ltd. 84

Course Code BSCPBOTSEC302

Course name – Nursery and Gardening

Course Type: **SEC**	Course Details: **SEC-302**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

On completion of this course the students will be able to;

- Understand the process of sowing seeds in nursery
- List the various resources required for the development of nursery
- Distinguish among the different forms of sowing and growing plants
- Analyse the process of Vegetative propagation
- Appreciate the diversity of plants and selection of gardening
- Examine the cultivation of different vegetables and growth of plants in nursery and Gardening

Unit 1: Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.**(4 Lectures)**

Unit 2: Seed structure and types, Seed dormancy; Causes and Methods of breaking dormancy; Seed storage: Seed banks, factors affecting seed viability; Genetic erosion – Seed production technology, seed testing and certification.

Unit 3: Vegetative propagation: air-layering, cutting; treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house, mist chamber, shed root,shade house and glasshouse.

Unit 4: Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components. Gardening operations – soil layering, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes and carrot; Storage and marketing procedures.

Suggested Readings

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

Semester - IV

Course code – BSCHBOTSEC401

Course name: Biofertilizers

Course Type: **SEC**	Course Details: **SEC-401**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

On the completion of this course, the students will be able to;

- Develop their understanding on the concept of bio-fertilizer
- Identify the different forms of biofertilizers and their uses
- Compose the Green manuring and organic fertilizers
- Develop the integrated management for better crop production by using both nitrogenous and phosphate bio fertilizers and vesicular arbuscular mycorrhizal (VAM).
- Interpret and explain the components, patterns, and processes of bacteria for growth in crop production

Unit-1:

General account about the microbes used as biofertilizer, Rhizobium – isolation, identification, mass production, Commercialization; Actinorrhizal symbiosis.

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:

General idea about Plant growth promoting rhizobacteria (PGPR) and Phosphate solubilizing bacteria (PSB) . PGPR traits; Stress hormone Ethylene and PGPR.

Unit- 3:

Cyanobacteria (blue green algae) and Azolla as biofertilizer; Blue green algae and Azolla production; blue green algae and *Azolla* in rice cultivation.

Unit -4:

Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution; VAM fungi, and their influence on growth and yield of crop plants. (6 lectures)

Organic farming – Green manuring and organic fertilizers; Organic Compost and Vermicompost - production and 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. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and organic Farming Akta Prakashan, Nadiad

Course code – BSCHBOTSEC402

Course name – Biostatistics

Course Type: **SEC**	Course Details: **SEC-402**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

At the end of the course the students will be able to,

- Comprehend the fundamental concepts related to descriptive and inferential biostatistics.
- Develop skills in data tabulation, its treatment, analysis, interpretation and graphical representation of data.
- Analyze the implications of inferential statistics in biology.
- Develop their competence in hypothesis testing and interpretation.

Unit I: Biostatistics

History of the field and connection with population genetics, levels of measurements, types of variables, precision vs accuracy.

Unit II: Data Summarization and Visualization

Types of variables, frequency tabulations (EFD, ERFD, ECD), various types of charts, error bars, scatterplots.

Unit III: Descriptive Statistics

Mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co- efficient of variations.

Unit IV: Correlation, Regression and Statistical inference

Types of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression. Hypothesis testing and P values, Confidence Intervals, Student 't' test, chi square test, ANOVA.

Suggested Readings

1. Danniel, W.W.(1987). Biostatistics, New York, John Wiley Sons.

2. Sundarrao, P.S.S and Richards, J. Christian. An introduction to Biostatistics, 3rd edition. Medical College, Vellore

3. Selvin, S. (1991). Statistical Analysis of epidemiological data New York University Press

4. Campbell, R.C. (1998). Statistics for Biologists, Cambridge University Press.

Semester - V

Course code – BSCHBOTSEC501

Course name: Plant Diversity and Human welfare

Course Type: **SEC**	Course Details: **SEC-501**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

After the completion of this course, the learner will be able to:

- Develop understanding of the concept and scope of plant biodiversity
- Identify the causes and implications of loss of biodiversity
- Apply skills to manage plant biodiversity
- Utilize various strategies for the conservation of biodiversity
- Conceptualize the role of plants in human welfare with special reference to India

Unit -1: **- Plant diversity and its scope**

Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level, Agrobiodiversity and cultivated plant taxa. Values and uses of Biodiversity: Ethical and aesthetic values.

Unit -2: **Loss of Biodiversity**

Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss.

Unit -3:

Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservation.

Unit-4:

Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. Importance of forestry their utilization and commercial aspects; Avenue trees; Ornamental plants of India; Alcoholic beverages; Fruits and nuts; Wood and its uses; their commercial importance.

Suggested Readings -

1. Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity – Principles and Practices.Oxford and IBH Publications Co. Pvt. Ltd. New Delhi
2. Singh, J.S., Singh, S.P. and Gupta, S. (2006). Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
3. Reddy, K.V. and Veeraiah, S. (2010). Biodiversity and Plant Resources. Aavishkar publication, New Delhi.
4. Heywood, V. H. and Watson, R. T. (1995). Global biodiversity and Assessment. Cambridge University Press.

Course code – BSCHBOTSEC502

Course name: Mushroom culture technology

Course Type: **SEC**	Course Details: **SEC-502**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

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

- Recall various types and categories of mushrooms.
- Demonstrate various types of mushroom cultivating technologies.
- Examine various types of food technologies associated with mushroom industry.
- Value the economic factors associated with mushroom cultivation
- Device new methods and strategies to contribute to mushroom production.

Unit 1:

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

Unit 2:

Methods of cultivation of edible mushrooms (Oyster, Button and Paddy straw mushrooms). Diseases of Mushroom fungi and methods of remedy. Methods of Mushroom span production. Equipments and Tools required for mushroom as well as spawn production.

Unit 3:

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.

Unit 4:

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.

Semester – VI

Course Code - BSCPBOTSEC601

Course Name: Floriculture

Course Type: **SEC**	Course Details: **SEC-601**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

After completing this course the learner will be able to;

- Develop conceptual understanding of gardening from historical perspective
- Analyze various nursery management practices with routine garden operations.
- Distinguish among the various Ornamental Plants and their cultivation
- Evaluate garden designs of different countries
- Appraise the landscaping of public and commercial places for floriculture.
- Diagnoses the various diseases and uses of pests for ornamental plants.

Unit 1:

Introduction: History of gardening; Importance and scope of floriculture and landscape gardening. Nursery Management and Routine Garden Operations: Sexual and vegetative methods of propagation; Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Shading; Stopping or pinching; Defoliation; Wintering; Mulching;

Unit II:

Ornamental Plants: Flowering annuals; Herbaceous perennials; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Cultivation of plants in pots; Indoor gardening.

Unit III:

Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Lilium, Orchids). Diseases and Pests of Ornamental Plants.

Unit – IV

Landscaping Places of Public Importance: Landscaping highways and Educational institutions

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. (1986). Floriculture in India. Allied Publishers.
2. Adams, C., M. Early and J. Brrok (2011). Principles of Horticulture. Routledge, U.K.

Course Code - BSCPBOTSEC602

Course Name: Fermentation Technology

Course Type: **SEC**	Course Details: **SEC-602**			L-T-P: **4-0-0**	
Credit: **4**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		-	**10**	-	**40**

Course Learning Outcomes:

After completing this course the learner will be able to;

 Employ the process for maintenance and preservation of microorganisms

 Analyze the various aspects of the fermentation technology and apply for Fermentative production

 Demonstrate proficiency in the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover

Unit I

Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.

Unit II

Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.

Unit III

Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture. Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).

Unit IV

Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.

Suggested readings

1. Waites M.J. (2008). Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.

2. Prescott S.C., Dunn C.G., Reed G. (1982). Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.

3. Reed G. (2004). Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA.
4. JR Casida L.E. (2015). Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India.
5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. (2001) Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R. (2003) Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.