

**Proposed Syllabus and Scheme of Examination
for
B.Sc. (Pass) with Botany**

Under Choice Based Credit System (CBCS)

Submitted
to
Utkal University
Vani Vihar, Bhubaneswar



Board of Studies in Botany
P.G. Department of Botany
Utkal University, Vani Vihar
Bhubaneswar 751004

10 June, 2015

Core Courses

Semester-I

Core Course: Botany Paper I - 100 Marks

Biodiversity (Microbes, Algae, Fungi and Archegoniate)

(Credits: Theory-4, Practicals-2)

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

[70 marks (Mid Sem 20 + End Sem 50), Practical-30]

Lectures: 60 [40 Theory + 20 Practical classes]

THEORY

Lectures: 60

Unit 1: Microbes (10 Lectures)

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

Unit 2: Algae (12 Lectures)

General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc*, *Chlamydomonas*, *Oedogonium*, *Vaucheria*, *Fucus*, *Polysiphonia*. Economic importance of algae.

Unit 3: Fungi (12 Lectures)

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

Unit 4: Archegoniate and Bryophyte (12 Lectures)

Unifying features of archegoniates, Transition to land habit, Alternation of generations.

General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. (Developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit 5: Pteridophytes & Gymnosperms (14 Lectures)

General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. (Developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economical importance of Pteridophytes.

General characteristics, classification. Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included). Ecological and economical importance.

Practical

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

Suggested Readings

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

Semester-II

Core Course Botany –Paper II – 100 Marks

Plant Ecology and Taxonomy

(Credits: Theory-4, Practicals-2)

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

[70 marks (Mid Sem 20 + End Sem 50),Practical-30]

Lectures: 60 [40 Theory + 20 Practical classes]

THEORY

Lectures: 60

Unit 1: Ecological factors

(10 Lectures)

Introduction to plant ecology and taxonomy. Soil: Origin, formation, composition, soil profile. Water: States of water in the environment, precipitation types. Light and temperature: Variation Optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.

Unit 2: Plant communities and Ecosystems

(10 Lectures)

Characters; Ecotone and edge effect; Succession; Processes and types. Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids production and productivity; Biogeochemical cycling; Cycling of carbon, nitrogen and Phosphorous

Unit 3: Phytogeography and Plant Taxonomy

(14 Lectures)

Principle biogeographical zones; Endemism. Identification, Classification, Nomenclature. Functions of Herbarium, important herbaria and botanical gardens of the world and India; Documentation: Flora, Keys: single access and multi-access, Taxonomic evidences from palynology, cytology, phytochemistry and molecular data. Taxonomic hierarchy: Ranks, categories and taxonomic groups

Unit 4: Botanical nomenclature

(12 Lectures)

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

Unit 5: Classification and numerical taxonomy

(14 Lectures)

Classification: Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series), Engler and Prantl (upto series). Biometrics, numerical taxonomy and cladistics: cluster analysis; phenograms, cladograms (definitions and differences).

Practical

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH, and analysis of two soil samples for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency by rapid field test.
3. (a) Study of morphological adaptations of hydrophytes and xerophytes (four each). (b) Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (Orobanchae), Epiphytes, Predation (Insectivorous plants)
4. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method. (species to be listed)

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

Suggested Readings

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

Semester-III

Core Course Botany –Paper III- 100 Marks

Plant Anatomy and Embryology

(Credits: Theory-4, Practicals-2)

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

[70 marks (Mid Sem 20 + End Sem 50), Practical-30]

Lectures: 60 [40 Theory + 20 Practical classes]

THEORY

Lectures: 60

Unit 1: Tissues and Organs

(10 Lectures)

Root and shoot apical meristems; Simple and complex tissues. Structure of dicot and monocot root stem and leaf.

Unit 2: Secondary Growth and special tissues

(14 Lectures)

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

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

Unit 3: Structural organization of flower

(10 Lectures)

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

Unit 4: Pollination and fertilization

(14 Lectures)

Pollination mechanisms and adaptations; Double fertilization; Seed-structure appendages and dispersal mechanisms. Apomixis and polyembryony: Definition, types and practical applications.

Unit 5: Embryo and endosperm

(12 Lectures)

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

Practical

1. Study of meristems through permanent slides and photographs.
2. Tissues (parenchyma, collenchyma and sclerenchyma); Macerated xylary elements, Phloem (Permanent slides, photographs)
3. Stem: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
4. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* (only Permanent slides).
5. Leaf: Dicot and Monocot leaf (only Permanent slides).
6. Adaptive anatomy: Xerophyte (*Nerium* leaf); Hydrophyte (*Hydrilla* stem).
7. Structure of anther (young and mature), tapetum (amoeboid and secretory) (Permanent slides).
8. Types of ovules: anatropous, orthotropous, circumtropous, amphitropous/ campylotropous.
9. Female gametophyte: *Polygonum* (monosporic) type of Embryo sac Development (Permanent slides/photographs).
10. Ultrastructure of mature egg apparatus cells through electron micrographs.
11. Pollination types and seed dispersal mechanisms (including appendages, aril, caruncle) (Photographs and specimens).
12. Dissection of embryo/endosperm from developing seeds.
13. Calculation of percentage of germinated pollen in a given medium.

Suggested Readings

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
2. Mauseth, J.D. (1988). Plant Anatomy. The Benjamin/Cummings Publisher, USA.

Semester-IV

Core Course Botany –Paper IV-100

Plant Physiology and Metabolism

(Credits: Theory-4, Practicals-2)

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

[70 marks (Mid Sem 20 + End Sem 50),Practical-30]

Lectures: 60 [40 Theory + 20 Practical classes]

THEORY

Lectures: 60

Unit 1: Plant-water relations and nitrogen metabolism (10 Lectures)

Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation. Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit 2: Mineral nutrition and Phloem translocation (14 Lectures)

Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps. Translocation in phloem: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

Unit 3: Photosynthesis (12 Lectures)

Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C₃, C₄ and CAM pathways of carbon fixation; Photorespiration.

Unit 4: Respiration (10 Lectures)

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

Unit 5: Enzyme, Plant growth regulators and Plant response (14 Lectures)

Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition. Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Practical

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

Demonstration experiments (any four)

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

Suggested Readings

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

Discipline Specific Elective Courses

Two (2) be selected from each of the three disciplines

Semester-V

Discipline Centric Elective Botany-DSE-I, Botany Paper-I, 100 Marks

Economic Botany and Biotechnology

(Credits: Theory-4, Practicals-2)

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

[70 marks (Mid Sem 20 + End Sem 50), Practical-30]

Lectures: 60 [40 Theory + 20 Practical classes]

THEORY

Lectures: 60

Unit 1: Origin of Cultivated Plants, Cereals and Legumes (10 Lectures)

Concept of centres of origin, their importance with reference to Vavilov's work. Rice cultivation process, Economic importance. Cereals:- Wheat -Origin, morphology, uses. Legumes: General account with special reference to Gram and soybean

Unit 2: Spices and Beverages (10 Lectures)

General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses). Tea (morphology, processing, uses)

Unit 3: Oils and Fats and Fibre Yielding Plants (10 Lectures)

General description with special reference to groundnut. General description with special reference to Cotton (Botanical name, family, part used, morphology and uses)

Unit 4: Plant tissue culture (10 Lectures)

Introduction to biotechnology. Micropropagation; Anther culture, haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications. Protoplast culture, Hybrid and Cybrids. Somatic embryogenesis, Secondary metabolite production. Application of tissue culture in plant improvement.

Unit 5: Recombinant DNA Techniques (18 Lectures)

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR. Hybridoma and monoclonal antibodies, ELISA and Immunodetection. Molecular diagnosis of human disease, Human gene Therapy.

Practical

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
4. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

Suggested Readings

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

Semester-VI

Discipline Specific Elective Botany-DSE-I, Botany Paper-II, 100 Marks

Cell and Molecular Biology

(Credits: Theory-4, Practicals-2)

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

[70 marks (Mid Sem 20 + End Sem 50), Practical-30]

Lectures: 60 [40 Theory + 20 Practical classes]

THEORY

Lectures: 60

Unit 1: Techniques in Biology

(8 Lectures)

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

Unit 2: Cell and Cell Organelles

(14 Lectures)

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

Unit 4: Cell Membrane, Cell Wall and Cell Cycle

(10 Lectures)

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

Unit 4: Genetic material and Cell Cycle

(14 Lectures)

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

Unit 5: Transcription and Gene Expression

(12 Lectures)

Types of structures of RNA (mRNA, tRNA, rRNA), RNA polymerase- various types; Translation (Prokaryotes and eukaryotes), genetic code. Regulation of gene expression: Prokaryotes: Lac operon and Tryptophan operon; and in Eukaryotes.

Practical

1. To study prokaryotic cells (bacteria), viruses, eukaryotic cells with the help of light and electron micrographs.

2. Study of the photomicrographs of cell organelles
3. To study the structure of plant cell through temporary mounts.
4. To study the structure of animal cells by temporary mounts-squamous epithelial cell and nerve cell.
5. Preparation of temporary mounts of striated muscle fiber
6. Study of mitosis and meiosis (temporary mounts and permanent slides).
7. Study of plasmolysis and deplasmolysis on *Rhoeo* leaf.
8. Measure the cell size (either length or breadth/diameter) by micrometry.
9. Study the structure of nuclear pore complex by photograph (from Gerald Karp)
10. Study of special chromosomes (polytene & lampbrush) either by slides or photographs.
11. Study DNA packaging by micrographs.
12. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.

Suggested Readings

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

Skill Enhancement Courses

Semester-III

Skill Enhancement Courses-1 (SEC –1):

Biofertilizers – 50 marks

(Credits-2: Lectures: 30)

THEORY (Each class 1 hour)

[50 marks (Mid Sem 10 + End Sem 40)]

Unit-I	General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.	4 lectures
Unit-II	<i>Azospirillum</i> : isolation and mass multiplication – carrier based inoculant, associative effect of different microorganisms. <i>Azotobacter</i> : classification, characteristics – crop response to <i>Azotobacter</i> inoculum, maintenance and mass multiplication.	8 lectures
Unit-III	Cyanobacteria (blue green algae), <i>Azolla</i> and <i>Anabaena azollae</i> association, nitrogen fixation, factors affecting growth, blue green algae and <i>Azolla</i> in rice cultivation.	4 lectures
Unit-IV	Mycorrhizal association, types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.	8 lectures
Unit-V	Organic farming – Green manuring and organic fertilizers, Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field Application.	6 lectures

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

Semester-IV

Skill Enhancement Courses-2 (SEC –2):

Herbal Technology – 50 marks

(Credits-2: Lectures: 30)

THEORY (Each class 1 hour)

[50 marks (Mid Sem 10 + End Sem 40)]

Unit-I	Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants.	6 lectures
Unit-II	Pharmacognosy - systematic position m edicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek, Indian Goose berry and Ashoka.	6 lectures
Unit-III	Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; <i>Catharanthus roseus</i> (cardiotonic), <i>Withania somnifera</i> (drugs acting on nervous system), <i>Clerodendron phlomoides</i> (anti-rheumatic) and <i>Centella asiatica</i> (memory booster).	6 lectures
Unit-IV	Analytical pharmacognosy: Drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds)	8 lectures
Unit-V	Medicinal plant banks micro propagation of important species (<i>Withania somnifera</i> , neem and tulsi- Herbal foods-future of pharmacognosy)	4 lectures

Suggested Readings

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

Semester-V

Skill Enhancement Courses-3 (SEC –3A):

Floriculture – 50 marks

(Credits-2: Lectures: 30)

THEORY (Each class 1 hour)

[50 marks (Mid Sem 10 + End Sem 40)]

Unit-I	Introduction: History of gardening; Importance and scope of floriculture and landscape gardening.	2 lectures
Unit-II	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; Topiary; Role of plant growth regulators.	8 lectures
Unit-III	Ornamental Plants: Flowering annuals; Herbaceous perennials; Divine vines; Shade and ornamental trees; Ornamental bulbous and foliage plants; Cacti and succulents; Palms and Cycads; Ferns and Selaginellas; Cultivation of plants in pots; Indoor gardening; Bonsai.	4 lectures
Unit-IV	Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water garden. Some Famous gardens of India	4 lectures
	Landscaping Places of Public Importance: Landscaping highways and Educational institutions.	4 lectures
Unit-V	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, Gladiolous, Marigold, Rose, Liliium, Orchids).	6 lectures
	Diseases and Pests of Ornamental Plants.	2 lectures

Suggested Readings

1. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publishers.

Semester-V

Skill Enhancement Courses-3 (SEC –3B):

Nursery and Gardening – 50 marks

(Credits-2: Lectures: 30)

THEORY (Each class 1 hour)

[50 marks (Mid Sem 10 + End Sem 40)]

Unit-I	Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.	4 lectures
Unit-II	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.	6 lectures
Unit-III	Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants – green house - mist chamber, shed root, shade house and glass house.	6 lectures
Unit-IV	Gardening: definition, objectives and scope - different types of gardening – landscape and home gardening - parks and its components - plant materials and design – computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	8 lectures
Unit-V	Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.	6 lectures

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-VI

Skill Enhancement Courses-4 (SEC-4):
Mushroom Culture Technology – 50 marks
(Credits-2: Lectures: 30)
THEORY (Each class 1 hour)
[50 marks (Mid Sem 10 + End Sem 40)]

Unit-I	Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms. Types of edible mushrooms available in India - <i>Volvariella volvacea</i> , <i>Pleurotus citrinopileatus</i> , <i>Agaricus bisporus</i> .	5 lectures
Unit-II	Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag.	6 Lectures
Unit-III	Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production.	6 lectures
Unit-IV	Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickles, papads), drying, storage in salt solutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins.	8 lectures
Unit-V	Food Preparation_: Types of foods prepared from mushroom. Research Centres - National level and Regional level. _Cost benefit ratio - Marketing in India and abroad, Export Value.	5 lectures

Suggested Readings

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