

# WEST BENGAL STATE UNIVERSITY

## DRAFT SYLLABI STRUCTURE IN BOTANY OF THE 4-YEAR UNDERGRADUATE PROGRAMME (HONOURS) UNDER NEP BASED CREDIT SYSTEM

<b>SEMESTER I</b> <b>T+P</b> <b>50+50</b> <b>Exam-50</b>	<b>Major (DSC)</b>
<b>DS1 (5)</b> <b>DS-1T (3),</b> <b>Microbiology</b> <b>25</b> <b>and</b> <b>Phycology</b> <b>25</b>	<b>THEORY: 50 marks</b>  <b>Microbiology - 25 Marks</b> (30 lectures)  <b>Unit 1:</b> Introduction to the microbial world Binomial nomenclature, difference between Prokaryotic and Eukaryotic microorganisms, development of microbiology as a discipline, spontaneous generation vs biogenesis, contribution of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Alexander Fleming. Germ theory of disease, Role of microbiology in fermentation, Development of the field of soil microbiology. Primary concept of microorganism – 3 domain concept.  <b>Unit 2:</b> Viruses Physiochemical and biological characteristics; general structure with special reference to subviral particles (Satellite virus, Viroids and Prions); groups of virus, DNA virus (T-phage, $\lambda$ phage), lytic and lysogenic cycle, RNA virus (TMV) – physico-chemical characteristics and its mode of multiplication.  <b>Unit 3:</b> Bacteria General characteristics, Microbial nutrition, growth and metabolism. Types - archaeobacteria, eubacteria, and mycoplasma; cell structure; nutritional types; Reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).  <b>Unit 4:</b> Applied Microbiology Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

**Phycology - 25 Marks**

(30 lectures)

**Unit 5:** General characteristics; ecology and distribution; range of thallus organization; cell structure and components; cell wall, pigment system, reserve food (only groups represented in the syllabus), flagella and flagellar roots; methods of reproduction; classification; criteria, evolution of sex in algae; SET (serial endo symbiotic) theory; classification of Lee 2015 (only up to groups); significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, M.O.P. Iyengar).

**Unit 6:** Cyanophyta and Xanthophyta

Ecology and occurrence; range of thallus organization; cell structure; reproduction, morphology and life-cycle of *Nostoc* and *Vaucheria*.

**Unit 7:** Chlorophyta and Charophyta

General characteristics; occurrence; range of thallus organization; cell structure; reproduction. Morphology and life-cycles of *Volvox*, *Oedogonium*, *Chara*. Evolutionary significance of Prochloron.

**Unit 8:** Phaeophyta and Rhodophyta

Characteristics; occurrence; range of thallus organization; cell structure; reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus* and *Polysiphonia*.

**Unit 9:** Applied Phycology

Role of algae in the environment, agriculture, biotechnology and industry, bioremediation.

**Practical 50 marks****Microbiology - 25**

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root nodule.
3. Demonstration of the preparation of media, sterilization and sub culturing.
4. Gram staining of bacteria from curd sample; Endospore staining with malachite green using the (endospores taken from soil bacteria).

**Phycology - 25**

5. Study of vegetative and reproductive structures of *Nostoc*, *Volvox*,

**DS-1P (2),  
Microbiology  
10+15  
and  
Phycology  
10+15**

*Oedogonium*, *Chara*, *Vaucheria*, *Ectocarpus*, *Fucus* and *Polysiphonia*, through temporary preparations and permanent slides. Prochloron through electron micrographs.

6. Illustration through drawing prism with magnification of vegetative and reproductive structure of *Oedogonium*, *Chara*, *Vaucheria*.

### **Suggested Readings**

#### **Microbiology**

1. Atlas, R.M..... Principles of Microbiology [McGraw Hill]
2. Willey, M.J., Sherwood, L.M. & Woolverton, C.J...rescot, Harley and Klein's..... Microbiology [McGraw Hill]
3. Madigan, M.T., Martinko, J.M. & Parker, J. Brock..... Biology of Microorganisms [Prentice Hall]
4. Tortora, G.J., Funke, B.R. & Case, C.L..... Microbiology - An Introduction [Dorling Kindersley India Pvt. Ltd. for Pearson Education]
5. Pelczar, M.J., Chan, P.C.S. & Krieg, N.R. Microbiology [Tata McGraw Hill]
6. Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. & Painter, P.R..... General Microbiology [Macmillan Education Ltd.]
7. Banerjee, A.K. & Banerjee, N. .... Fundamentals of Microbiology and Immunology [New Central Book Agency]
8. Dey, N.C., Dey, T.K. & Sinha, D..... Medical Bacteriology. Mycology.... NCBA]

#### **Phycology**

1. Chapman, V.J. & Chapman, D.J..... The Algae [Macmillan, London]
2. Lee, R.E. 2015..edition 5..... Phycology [Cambridge Univ. Press]
3. Kumar, H.D. & Singh, HN..... Introductory Phycology [East-West Press Pvt. Ltd]
4. Sharma, O.P..... Text Book of Algae [(Tata McGraw Hill)]
5. Smith, G.M..... Cryptogamic Botany Vol. 1 [McGraw Hill]
6. Vashistha, B.R., Singh, A.K. & Singh, V.P..... Algae [S. Chand & Co. Pvt. Ltd.]
7. Bold, H.C. & Wynne, M.J. .... Introduction to Algae: Structure & Reproduction [Prentice Hall])
8. Ganguly, H.C. & Kar, A.K..... College Botany Vol.-I [New Central Book Agency]
9. Chopra, G.L. .... A text book of Algae [S. Nagin & Co. New Delhi]
10. Hoek, C., Mann, D.G. & Jahns, H.M. 1995 ..... Algae: an.. [Cambridge Univ. Press]

<p><b>SEMESTER II</b>  <b>T+P</b>  <b>50+50</b>  <b>Exam-50</b></p>	<p><b>Major (DSC)</b></p>
<p><b>DS-2 (5),</b>  <b>DS2T (3)</b>  <b>Mycology 25</b>  <b>and</b>  <b>Phytopathology</b>  <b>25</b></p>	<p><b>Theory: 50 marks</b></p> <p><b>Fungi-25 Marks</b> (30 lectures)</p> <p><b>Unit 1: Introduction to true fungi</b>  General characteristics; affinities with plants and animals; idea of Fungi as a separate kingdom of life; thallus organization; cell wall composition; nutrition; sexual (with reference to sporocarp) and asexual (spore forming bodies in deuteromycetes) reproduction; classification (Hawksworth et al 1995). Concepts of Molecular identification, Barcoding and Tree of Life.</p> <p><b>Unit 2: Chytridiomycota and Zygomycota</b>  Characteristic features; ecology and significance; thallus organisation; reproduction; life cycle with reference to <i>Synchytrium</i>, <i>Rhizopus</i>.</p> <p><b>Unit 3: Ascomycota</b>  General characteristics (asexual and sexual fruiting bodies); ecology; life cycle, heterokaryosis and parasexuality; life cycle with reference to <i>Saccharomyces</i>, <i>Penicillium</i>, <i>Neurospora</i>, <i>Ascobolus</i>, <i>Claviceps purpurea</i>.</p> <p><b>Unit 4: Basidiomycota</b>  General characteristics; ecology; black stem rust of wheat, life cycle with reference to spore forms; concept of macrocyclic, microcyclic, demicyclic, heteroecious, autoecious rusts. <i>Puccinia</i> (physiological specialization), Loose and covered smut (symptoms only). <i>Agaricus</i>; bioluminescence, fairy rings and mushroom cultivation (general account).</p> <p><b>Unit 5: Allied Fungi</b>  General characteristics; status of slime molds; occurrence; types of plasmodia; types of fruiting bodies.</p> <p><b>Unit 6: Oomycota</b>  General characteristics; ecology; life cycle and classification, concept as a separate kingdom of life with reference to <i>Phytophthora</i>, <i>Albugo</i>, <i>Saprolegnia</i>.</p> <p><b>Unit 7: Symbiotic associations</b></p>

Lichen – Occurrence; general characteristics; growth forms and range of thallus organization; nature of associations of algal and fungal partners; reproduction; ecological and economic significance; Mycorrhiza - ectomycorrhiza, endomycorrhiza and their significance.

**Unit 8: Applied Mycology**

Role of fungi in biotechnology; application of fungi in food industry (flavour & texture, fermentation, baking, organic acids, enzymes, mycoproteins); secondary metabolites (pharmaceutical preparations); agriculture

(biofertilizers); mycotoxins; biological control (mycofungicides, mycoherbicides, mycoinsecticides, myconematicides); medical mycology.

**Phytopathology- 25**

(30 lectures)

**Unit 9:** Definitions and Concepts of plant disease: Parasite, Pathogen and Vector, Inoculum and Inoculum density, Infection, Susceptibility and Virulence, Etiology; symptoms - types; necrotroph, biotroph & hemibiotroph; disease, disease types, disease triangle, disease cycle (monocyclic & polycyclic); sporadic, endemic, epidemic and pandemic diseases with examples that had significant impact in human history; Koch's Postulates.

**Unit 10:** Host - Parasite Interaction: recognition concept and infection.

Disease development - role of enzymes, toxins, growth regulators. Defense strategies - structural and biochemical mechanisms (Constitutive and Induced). Roles of Phytoalexins, Phytoanticipins & PR proteins, elicitors, HR response. Genetics of Plant - Pathogen interaction - Flor's gene for gene hypothesis, Concept of R gene, Avr gene and Effectors. Resistance – systemic acquired and induced systemic resistance.

**Unit 11:** Disease Management: Chemical, Biological, Cultural & Integrated management methods; quarantine; disease diagnosis, disease clinics and disease forecasting (preliminary ideas).

**Unit 12:** Prevention and control of plant disease and role of quarantine.

Casual organism, disease cycle and management of bacterial diseases – *Citrus* canker, *Ralstonia* wilt of Tomato, viral diseases – Tobacco Mosaic virus, Chilli Leaf Curl, Bean Yellow Mosaic, Fungal and Oomycete diseases – Early and Late blight of potato, Black stem rust of wheat, Blast of Rice and Wheat, Downy Mildews (*Pseudoperonospora cubensis*) and Powdery Mildew of Cucurbits (*Podosphaera xanthii*), plant disease epidemiology- basic concepts, elements of disease, plant pathologist's contribution to crops and society.

**DS2P (2)**  
**Mycology**  
**10+15**  
**and**  
**Phytopathology**  
**10+15**

## **Practical – 50 marks**

### **Fungi: 25 marks**

- 1. Introduction to the world of fungi** (unicellular, coenocytic/septate mycelium, ascocarps & basidiocarps) through temporary slide preparation and permanent slides.
- 2. Micrometry** (measurement of reproductive unit).
- 3. *Rhizopus*** - study of asexual stage from temporary mounts and sexual structures through temporary slide preparation and permanent slides.
- 4. *Aspergillus* and *Penicillium*** - study of asexual stage from temporary mounts and sexual stage through temporary slide preparation and permanent slides.
- 5. *Ascobolus*** - sectioning through ascocarp and micrometry.
- 6. *Agaricus*** - specimens of button stage and full-grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
- 7. *Albugo*** - study of symptoms of plants infected with *Albugo*; asexual phase study through section/temporary mounts and sexual structures through permanent slides.
- 8. Lichens** - study of growth forms of lichens (crustose, foliose and fruticose) on different substrates.
- 9. Mycorrhizae** - ectomycorrhiza and endomycorrhiza (Photographs).

### **Phytopathology-25 marks**

- 10. *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.
- 11. Phytopathology-** Herbarium specimens of bacterial diseases- *Citrus* canker;  
viral diseases - TMV, Vein clearing symptom from any available specimen;  
fungal diseases - Early and Late blight of potato, Black stem rust of wheat and Blast of Rice, Powdery and downy mildew from any available specimen.
- 12. Isolation of pathogen from diseased leaf, inoculation of fruit, demonstration of media preparation, pure culture isolation.**

### **Suggested Readings**

#### **Mycology and Phytopathology**

1. Ainsworth, G.C., Sparrow, F.K. and Sussman, A.S. (Eds)...The Fungi: An Advanced Treatise Vol. IVA & B, (Academic Press]
2. Hawksworth, D.L., Kirk, P.M., Pegler, D.N. and Sutton, B.C. 1995...Ainsworth & Bisby's Dictionary of Fungi, 8h Ed. [CAB International]
3. Webster, J.....Introduction to Fungi [Cambridge University Press]
4. Alexopoulos, C.J., Mims, C.W. and Blackwell, M. ....Introductory Mycology [John Wiley & Sons Inc).

	<p>5. Moore-Landecker, E..... Fundamentals of the Fungi 4th Ed [Prentice Hall]</p> <p>6. Ingold, C.T. and Hudson H.J.....The biology of the Fungi 6" Ed [Chapman &amp; Hall ]</p> <p>7. Vashistha, B.R... .....Fungi [S. Chand &amp; Co. Ltd.]</p> <p>8. Sharma, P.D.....Fungi and Allied Organisms [Narosa Pub. House]</p> <p>9. Ganguly, H.C. and Kar, A.K....College Botany Vol. II[New Central Book Agency]</p> <p>10. Chopra, G.L. and Verma, V.....A text Book of Fungi [Pradeep Publication]</p> <p>11. Agrios, G.N. (2006)..... Plant Pathology, 5th edition, Academic Press, U.K.</p> <p>12. H. S. Chaube and V. S. Punthir.(2009)..... Crop Diseases and their Management. Prentice Hall (India).</p>
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### DRAFT SYLLABI STRUCTURE IN BOTANY OF THE 4-YEAR UNDERGRADUATE PROGRAMME (HONOURS) UNDER NEP BASED CREDIT SYSTEM

	<b>Minor 1</b>
<p><b>MA-1 (5)</b>  <b>T=50</b>  <b>10+50</b>  <b>P=50</b>  <b>10+30</b>  <b>Phycology</b>  <b>Microbiology</b>  <b>Mycology</b>  <b>Phytopathology</b>  <b>Archegoniate</b></p>	<p><b>Biodiversity (Microbes, Algae, Fungi and Archegoniate)</b>  <b>Theory-50 Marks</b></p> <p><b>Unit 1: Microbes</b> (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.</p> <p><b>Unit 2: Algae</b> (12 Lectures)  General characteristics; ecology and distribution; range of thallus organization and reproduction; classification of algae (Lee 1989); morphology and life-cycles of <i>Nostoc</i>, <i>Oedogonium</i>, <i>Fucus</i>, <i>Polysiphonia</i>. Economic importance of algae.</p> <p><b>Unit 3: Fungi and PhytoPathology</b> (12 Lectures)  Introduction - General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification (Hawksworth et al 1995); true Fungi- general characteristics, ecology and</p>

significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); symbiotic associations – Lichens - general account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

**PhytoPathology:** Terms & Definitions - Pathogen, Propagule, Vector, Inoculum, Infection, Symptoms (necrosis, wilt, spot, blight, hypoplastic & hyperplastic).// Disease & Disease Cycle, Disease Triangle, Disease Management // Koch's postulates // Phytoalexins.// Symptoms, Causal organisms, Disease cycle & Control measures of - (a) Tungro virus disease of rice & (b) Late blight of potato.

#### **Unit 4: Introduction to Archegoniate (2 Lectures)**

Unifying features of archegoniates, transition to land habit, alternation of generations.

#### **Unit 5: Bryophytes (10 Lectures)**

General characteristics, adaptations to land habit, classification (Proskauer 1954, up to class), range of thallus organization. Systematic position, morphology, anatomy and reproduction of *Marchantia*, *Anthoceros* and *Funaria* (developmental details not to be included). Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

#### **Unit 6: Pteridophytes (8 Lectures)**

General characteristics, classification (Sporne 1975), early land plants (*Cooksonia* and *Rhynia*). Systematic position, morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris* (developmental details not to be included). Heterospory and seed habit, stelar evolution. Ecological and economic importance of Pteridophytes.

#### **Unit 7: Gymnosperms (6 Lectures)**

General characteristics, classification (Sporne), systematic position, morphology, anatomy and reproduction of *Cycas* and *Pinus*. (developmental details not to be included). Ecological and economic importance.

#### **Practical 50 Marks**

1. Gram staining of bacteria from curd sample.
2. Study of vegetative and reproductive structures of *Nostoc* (electronmicrographs), *Oedogonium* (Preparation of temporary slides), *Fucus* and *Polysiphonia* through permanent slides.
3. *Rhizopus* and *Penicillium* - Asexual stage from temporary mounts and sexual structures through permanent slides.
4. *Puccinia* - herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves (permanent slides) of both the hosts.
5. *Agaricus* - specimens of button stage and full-grown mushroom; sectioning of gills of *Agaricus*.



	<p>6. Lichens - study of growth forms of lichens (crustose, foliose and fruticose).  7. Mycorrhiza - ectomycorrhiza and endomycorrhiza (Photographs).  8. <i>Marchantia</i> - morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae, v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).  9. <i>Funaria</i>- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores, permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.  10. <i>Selaginella</i>- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m. microsporophyll and megasporophyll, l.s. strobilus (permanent slide).  11. <i>Equisetum</i> - morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore, w.m.spores (wet and dry), t.s rhizome (permanent slide).  12. <i>Pteris</i> - morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores, t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).  13. <i>Cycas</i> - morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores, l.s. ovule, t.s. root (permanent slide).  14. <i>Pinus</i> - morphology of long and dwarf shoots, male and female cone, t.s. needle, stem, w.m. microsporophyll, w.m. microspores, l.s. female cone, female cone (permanent slide).</p>
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**Minor -2**

<p><b>MA-2 (5)</b>  <b>T=50</b>  <b>10+50</b>  <b>P=50</b>  <b>10+30</b>  <b>Plant Ecology and Taxonomy</b></p>	<p><b>Plant Ecology and Taxonomy</b></p> <p><b>Theory – 50 Marks</b></p> <p><b>Unit 1:</b> Introduction (2 Lectures).</p> <p><b>Unit 2:</b> Ecological factors – Soil - Origin, composition, soil profile; water- states of water in the environment; Light and temperature - variation optimal and limiting factors; Shelford law of tolerance. Adaptation of hydrophytes and xerophytes.</p> <p><b>Unit 3:</b> Plant communities - characters; Ecotone and edge effect; succession; processes and types.</p> <p><b>Unit 4:</b> Ecosystem (8 Lectures) - structure; energy flow trophic organisation; food chains and food webs, Ecological pyramids; production and productivity; biogeochemical cycling; cycling of carbon, nitrogen.</p> <p><b>Unit 5:</b> Phytogeography (4 Lectures) - principle biogeographical zones; Endemism.</p> <p><b>Unit 6:</b> Introduction to plant taxonomy (2 Lectures) - identification,</p>
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classification, nomenclature.

**Unit 7:** Identification (4 Lectures) - functions of herbarium, important herbaria and botanical gardens of the world and India; documentation - Flora, Keys.

**Unit 8:** Taxonomic evidences (6 Lectures) - from palynology, cytology, phytochemistry and molecular data.

**Unit 9:** Taxonomic hierarchy (2 Lectures) - ranks, categories and taxonomic groups.

**Unit 10:** Botanical nomenclature (6 Lectures) - principles and rules (ICN); ranks and names; binominal system, typification, author citation, valid publication.

**Unit 11:** Classification (6 Lectures) - types of classification - artificial, natural and phylogenetic. Classification of Bentham and Hooker (up to series), general idea of Cronquist's classification (1981).

**Unit 12:** Numerical taxonomy and cladistics (4 Lectures) – characters, variations, cluster analysis, phenograms, cladograms (definitions and differences).

**Practical = 50 Marks**

1. Study of instruments used to measure microclimatic variables - Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.

2. Determination of pH and analysis of two soil samples for carbonates, chlorides, nitrates, organic matter and by rapid field test.

3.(a) Study of morphological adaptations of hydrophytes (*Nymphaea* petiole) and xerophytes (*Nerium* leaf) (four each).

3(b) Study of biotic interactions of Stem parasite (*Cuscuta*), Epiphytes (Orchid root).

4. Determination of minimal quadrat size for the study of herbaceous vegetation in the College/ suitable site by species area curve method. (Species to be listed).

5. Quantitative analysis of herbaceous vegetation in the college campus /suitable site for frequency and comparison with Raunkiaer's frequency distribution law.

6. Study of vegetative and floral characters of the following families (Description, V.S. of flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham and Hooker's system of classification): Brassicaceae – *Nasturtium indicum*; Asteraceae – *Eclipta* and *Tridax*; Solanaceae – *Nicotiana plumbaginifolia*, *Solanum nigrum*, Lamiaceae - *Leonurus sibiricus*, *Leucas aspera* and *Ocimum sanctum*; Liliaceae - *Allium*.

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

# WEST BENGAL STATE UNIVERSITY

## DRAFT SYLLABI STRUCTURE IN BOTANY OF THE 4-YEAR UNDERGRADUATE PROGRAMME (HONOURS) UNDER NEP BASED CREDIT SYSTEM

### (SKILL ENHANCEMENT COURSE)

#### FLORICULTURE AND GARDENING

##### **Objectives:**

The course aims to make students understand the theoretical and practical details of nursery and gardening. Knowledge so gained will provide them with the means for their employment and also of others.

##### **Learning outcomes:**

The students will be able to distinguish and choose the plant species amenable for nursery and gardening. They can develop their own nursery for livelihood and marketing purposes. The course will also equip the students with the basic skill needed to design and lay gardens.

**Syllabus**—3 Credit (Classes 30+ Project)

**Unit-1.** Introduction to Nursery and Gardening

**Unit-2.** Definition and types of nurseries; physical resources for nurseries; selection of nursery site, ecological conditions, important nursery operations.

**Unit-3.** Definition and components of gardens; types of gardening (landscape and home gardening). Scope and objective of gardening; garden landscaping with specific reference to Kew Botanical garden, AJC Bose Indian Botanic Garden, Kolkata

**Unit-5 Plant Propagation Methods-** Seed dormancy – causes and methods of breaking it; seed germination, types and factors affecting it. Vegetative propagation; artificial and natural methods; Concept of soilless cultivation with special reference to sand culture and hydroponics.

**Unit- 6:** Training/ Workshop/ Field visit, establishment of nursery

## **MUSHROOM CULTIVATION TECHNIQUE**

### **Objectives:**

The course aims to make students understand the theoretical and practical details of mushroom cultivation technique. Knowledge so gained will provide them with the means for self-employment and also employment of others.

### **Learning outcomes:**

The students will be able to distinguish edible and nonedible mushrooms and can choose the fast grown as well as nutritious mushrooms. They can develop their own nursery for livelihood and marketing purposes. The course will also equip the students with the basic skill needed to design and lay mushroom house.

### **Syllabus—3 Credit (Classes 30+ Project)**

**Unit -1.**Introduction to mushrooms

**Unit -2.**Mushrooms -Taxonomical rank -History and Scope of mushroom cultivation - Edible and Poisonous Mushrooms-Vegetative characters

**Unit -3:** Common edible mushrooms-Button mushroom (*Agaricus bisporus*), Milky mushroom (*Calocybe indica*), Oyster mushroom (*Pleurotus sajorajju*) and paddy straw mushroom (*Volvariella volvcea*).

**Unit -3:** Principles of mushroom cultivation- Structure and construction of mushroom house and sterilization of substrates. Spawn production culture media preparation- production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation, spawning, spawn running, harvesting, oyster and paddy straw mushroom cultivation. Problems in cultivation - diseases, pests and nematodes, weed moulds and their management strategies.

**Unit- 4:** Health benefits of mushrooms-Nutritional and medicinal values of mushrooms.Therapeutic aspects- antitumor effects.

**Unit -5:** Post harvest technology -Preservation of mushrooms - freezing, dry freezing, drying, canning, quality assurance and entrepreneurship .Value added products of mushrooms.

**Unit- 6:** Training/ Workshop/ Field visit Sterilization and sanitation of mushroom house, instruments and substrates Preparation of mother culture, media preparation, inoculation, incubation and spawn production Cultivation of oyster mushroom using paddy straw/agricultural wastes

## **TECHNIQUE OF VERMICOMPOSTING**

### **Objectives:**

The course aims to make students understand the theoretical and practical details of nursery and gardening. Knowledge so gained will provide them with the means for their employment and also of others.

### **Learning outcomes:**

The students will be able to distinguish and choose the earthworm species for vermicomposting. They can develop their own nursery for livelihood and marketing purposes. The course will also equip the students with the basic skill needed to design vermicomposting beds.

### **Syllabus- 3 Credit (Classes 30+ Project)**

**Unit-1.** Introduction to Vermiculture. Definition, meaning, history, economic importance and value in maintenance of soil structure. Choosing the right worm. Useful species of earth worms, local species

**Unit-2.** Vermicomposting materials and their classification. Feeding habits and food for composting worms.

**Unit-3.** Vermicomposting methods such as –Small scale and large scale pit method; heap method, window method etc. Factors affecting vermicomposting such as pH, moisture, temperature.

**Unit-4.** Vermicompostin: general procedure in homes; Maintenance of vermicomposting beds. Harvesting the worms,Earthworm Predators, Parasites and pathogens.

**Unit-5.** Application of vermicomposting in Agriculture and Horticulture practices. Advantages of vermicomposting.

**Unit-5.** Training/ Workshop/ Field visit/ establishment of vermicomposting unit.

## TISSUE CULTURE TECHNIQUE AND MICROPROPAGATION

### Objectives:

The objective of the course is to provide basic and applied training in the subject for development of skills for a successful career in entrepreneurship, generate technically trained human resource for tissue culture industries and as instructors in schools and junior colleges.

**Learning outcomes** Entrepreneurs who wish to establish their own labs will be benefitted with the lab to land training; researchers in plant tissue culture who have a focus on commercial applications such as crop improvement, secondary metabolite production, and various strategies for inducing genetic interference; persons who want to understand basic laboratory setup, handling of explant tissue, nutrient medium and establishing the culture, and incubation of cultures.

**Syllabus**-3 credits (Classes 30+ Project)

**Unit-1. Introduction to plant tissue culture:** Definition, brief history, principle and significance of tissue culture; cellular totipotency – cytodifferentiation: factors affecting vascular tissue differentiation, cell cycle and TE differentiation; organogenic differentiation: induction, factors affecting shoot bud differentiation

**Unit- 2. Laboratory organization and Instrumentation:** Design and layout for wash area, media preparation, sterilization and storage room, transfer area for aseptic manipulations, culture rooms, and observation/data collection areas. labwares, good laboratory practices, good safety. Working principle, maintenance and management of following instruments: Laminar air flow, autoclave, distillation unit, pH meter, orbital shaker, microscope, deep freezer, growth chamber  
Sterilization: Importance,

**Unit-3. Tissue culture media:** Introduction, Types of Media and its importance; Preparation of stocks, pH and Buffers and their significance in media. Media Constituents (Vitamins, Unidentified supplements, carbohydrate for energy source, Nitrogen source and organic supplements, complex substances, hormones, Activate charcoal).

**Unit-4. Plant hormones:** Role of Plant hormones (auxins, cytokinins, abscissic acid, ethylene and Gibberellins) in plant development.

**Unit-5. Aseptic techniques:** Methods of sterilization of equipments, culture media and explants:-Washing and preparation of glassware's, packing and sterilization, media sterilization, surface sterilization, aseptic workstation, precautions to maintain aseptic conditions.

**Unit-6. Micropropagation:** Meristem culture for the production of virus free plants. Nucellus culture for clonal propagation and large scale multiplication, strategies of micropropagation. Stages of micropropagation via axillary shoot proliferation in monocots and dicots and methods of micropropagation through organogenesis. Micropropagation - direct and indirect somatic embryogenesis. Low cost methods for micropropagation.