## Ch. Charan Singh University, Meerut Campus

**M.Sc. Botany (Choice Based Credit System) Syllabus**

Effective from session 2016-17

### Distribution of marks in different courses

<table>
<thead>
<tr>
<th>I Semester</th>
<th>Course Title</th>
<th>Credits</th>
<th>Total Marks (Int.+Ext.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Compulsory Theory I/</td>
<td>Phytotechniques and Biostatistics</td>
<td>4</td>
<td>40+40</td>
</tr>
<tr>
<td>BOTC.C.T II/</td>
<td>Microbiology</td>
<td>4</td>
<td>40+40</td>
</tr>
<tr>
<td>BOTC.C.T III/</td>
<td>Algae and Bryophytes</td>
<td>4</td>
<td>40+40</td>
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<tr>
<td>BOTC.C.T IV/</td>
<td>Taxonomy of Angiosperm and Economic Botany</td>
<td>4</td>
<td>40+40</td>
</tr>
<tr>
<td>BOTC.C.Practical - I (4 Hours)</td>
<td>Based on Courses I-IV</td>
<td>2+2+2+2</td>
<td>80</td>
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<tr>
<td>BOTOET I (Open Elective Theory I):</td>
<td>Self-Study-1A. Hindi/B. English/C. Urdu/D. Sanskrit</td>
<td>4</td>
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<tr>
<td><strong>Total Credits/marks</strong></td>
<td></td>
<td><strong>28</strong></td>
<td><strong>500</strong></td>
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<thead>
<tr>
<th>II Semester</th>
<th>Course Title</th>
<th>Credits</th>
<th>Total Marks</th>
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</thead>
<tbody>
<tr>
<td>BOTC.C.T V/</td>
<td>Mycology and Plant Pathology</td>
<td>4</td>
<td>40+40</td>
</tr>
<tr>
<td>BOTC.C.T VI/</td>
<td>Pteridophytes, Gymnosperms and Palaeobotany</td>
<td>4</td>
<td>40+40</td>
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<tr>
<td>BOTC.C.T VII/</td>
<td>Molecular Biology and Biotechnology</td>
<td>4</td>
<td>40+40</td>
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<tr>
<td>BOTC.C.T VIII/</td>
<td>Cell Biology &amp; Genetics</td>
<td>4</td>
<td>40+40</td>
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<tr>
<td>BOTC.C.P II (4 Hours)</td>
<td>Based on Courses V-VIII</td>
<td>2+2+2+2</td>
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<tr>
<td>BOTOET (Open Elective Theory II)</td>
<td>Disaster Management</td>
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<td><strong>Total Credits/marks</strong></td>
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<td><strong>28</strong></td>
<td><strong>500</strong></td>
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<thead>
<tr>
<th>III Semester</th>
<th>Course Title</th>
<th>Credits</th>
<th>Total Marks</th>
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<tbody>
<tr>
<td>BOTC.C.T IX/</td>
<td>Plant Water relations; Growth and Development</td>
<td>4</td>
<td>40+40</td>
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<tr>
<td>BOTC.C.T X/</td>
<td>Phytochemistry and Metabolism</td>
<td>4</td>
<td>40+40</td>
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<tr>
<td>BOTC.C.T XI/</td>
<td>Anatomy and Reproduction in Angiosperms</td>
<td>4</td>
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<tr>
<td>BOTC.C.T XII/</td>
<td>Plant Ecology and Phytogeography</td>
<td>4</td>
<td>40+40</td>
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<tr>
<td>BOTC.C.P III (4 Hours)</td>
<td>Based on theory courses IX-XII</td>
<td>2+2+2+2</td>
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<tr>
<td>BOTOET III (Open Elective Theory III):</td>
<td>Environmental Awareness</td>
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<td><strong>Total Credits/marks</strong></td>
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<td><strong>500</strong></td>
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<tr>
<td>Specializations</td>
<td>IV Semester</td>
<td>Course Title (Core Elective Courses (Set of two courses each for specialization) CET I+ IV/V, CET II +III, CET-VI+VII)</td>
<td>Credits</td>
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<td>-----------------------------------------------------</td>
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<tr>
<td>BOT.C.E.T-I. Plant Biotechnology</td>
<td>Course XIII /</td>
<td>A. Recombinant DNA technology</td>
<td>4</td>
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<td></td>
<td>Course XIV /</td>
<td>A. Plant Tissue Culture</td>
<td>4</td>
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<tr>
<td>BOT.C.E.T. II. Microbial and Environmental Biotechnology</td>
<td>Course XV /</td>
<td>B. Microbial Biotechnology</td>
<td>4</td>
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<tr>
<td></td>
<td>Course XVI /</td>
<td>B. Environmental Biotechnology</td>
<td>4</td>
</tr>
<tr>
<td>BOT.C.E.T.III. Applied and Stress Physiology</td>
<td>Course XIII /</td>
<td>C. Stress Physiology of Plants</td>
<td>4</td>
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<tr>
<td></td>
<td>Course XIV /</td>
<td>C. Applied Plant Physiology</td>
<td>4</td>
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<tr>
<td>BOT.C.E.T.IV Medicinal Botany</td>
<td>Course XV /</td>
<td>D. Pharmacognosy</td>
<td>4</td>
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<td></td>
<td>Course XVI /</td>
<td>D. Post -Harvest technology of medicinal plants</td>
<td>4</td>
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<tr>
<td>BOT.C.E.T V Biodiversity and Conservation</td>
<td>Course XV /</td>
<td>E. Diversity in Plants, their origin and evolution</td>
<td>4</td>
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<tr>
<td></td>
<td>Course XVI</td>
<td>E. Biodiversity conservation and Plant Resources</td>
<td>4</td>
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<tr>
<td>BOT.C.E.T VI. Applied Plant Pathology</td>
<td>Course XV /</td>
<td>F. Applied Mycology</td>
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<tr>
<td></td>
<td>Course XVI /</td>
<td>F. Molecular Plant Pathology</td>
<td>4</td>
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<tr>
<td>BOT.C.E. T7 Computer Science &amp; Bioinformatics</td>
<td>Course XIII /</td>
<td>G. Elementary Computer knowledge</td>
<td>4</td>
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<td></td>
<td>Course XIV /</td>
<td>G Genomics &amp; Bioinformatics</td>
<td>4</td>
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<tr>
<td>BOT.C.C.P. IV (4 hours)</td>
<td>Practical based on two sets of Core Electives Based on theory courses XIII-XIV and two out of XV-XVI</td>
<td>2+2+2+2</td>
<td>80</td>
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<tr>
<td>BOTOET IV (Open Elective Theory IV):</td>
<td>Self-Study 4</td>
<td>Team work on Intellectual Property Rights/ Projects/ Assignments provided by</td>
<td>4</td>
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</tbody>
</table>
A candidate can select any two sets of elective courses from XIII to XXVIII (as per availability in the institution) to serve as specialization(s). Each core (compulsory and elective) course will have 4 hours theory and 4 hours practical in each week, equaling 4+2=6 credits. In each semester there will be one open elective of 4 credits each. A minimum of 108 credits are required to be earned for successful completion of the Master’s degree including a minimum of 72 credits of Core Compulsory, 24 credits of Core elective and 12 credits of open elective courses. All regulations of CBCS courses as provided by the University ordinances and modified from time to time will become effective from the given dates. A minimum of 30% marks separately in internal and external assessment of each course and an aggregate of 40% marks in all the courses (including practical) is required for passing. In case of failing to obtain 30% marks in internal assessment of any paper, the candidate will not be eligible to appear in external examination of that course. Internal assessment will be based on:

- Quizzes -2: (from first Unit) Each for 4 marks
- Tests-2: for 8 marks each (based on 2 units each)
- Seminar/ Term Paper: 8 marks in each paper

Eligibility for admission to the course: B.Sc (Bio)/B.Sc. (CBZ)/B.Sc. (Life Sc.)/Hons. with minimum 55% marks and Intermediate with second division (45%) or with 50% aggregate marks in B.Sc and Intermediate both. In the subject itself minimum 50% marks are necessary for eligibility.
Basic Botanical techniques:
1. Different types of stains, their preparation and uses: Safranin, fast green, hematoxylin, iodine, cotton blue, crystal violet, ruthenium red, Janus green, Gram’s stains, Acetocarmine
2. Microscopy: Principle, parts and functioning of electron microscopes including stereoscopic binocular, dark field illumination, confocal, phase contrast, fluorescence and polarizing microscopes, camera lucida, SEM, TEM. STEM.
3. Microtomy: dehydration, clearing and embedding of material, section cutting, dewaxing.
4. Collection and preparation of herbarium sheets; preservation and storage of plant materials

Biophysical methods
5. Instrumentation, principle and Methods of fractionation- Cell sorting, Chromatography, Electrophoresis, Centrifugation, X-ray diffraction

Methods of quantitative analysis-
6. Spectrophotometry, MS, NMR, ESR, ORD/CD spectrometers,
8. Immunological methods: immunodiffusion, immuno-electrophoresis, crossed immuno-electrophoresis, counter- RIA, ELISA, Immunoblotting

Statistical methods
9. Classification and presentation of data, graphical presentation: frequency polygon and curve, cumulative frequency curve. Distribution
10. Measures of Central tendency: mean, mode, median and their properties.
11. Measures of dispersion: Mean deviation, standard deviation and coefficient of variation.

Simple correlation, coefficient and regression,
12. Principle of experimental designs, randomized block and Latin square designs and Analysis of Variance (ANOVA).
BOTC.C.T.II Microbiology 4 credits/50 Hours

Unit – I 10 Hours
1. Development of microbiology as science, important contribution of pioneer microbiologists; golden era of microbiology.
2. Isolation, purification and cultivation of microbes from soil, water and air.
3. Important criteria used for classifications of microorganisms (morphological, ecological, biochemical, molecular and numerical).

Unit – II 10 Hours
Bacteria:
5. Archaeobacteria and Eubacteria: Characters, Ultrastructure, nutrition, genetic recombination (Transformation, Transduction, Conjugation), and economic importance.
6. Cyanobacteria: salient features, biological and economic importance.
7. Phytoplasma: General characteristics, structure, reproduction and role in causing plant diseases.

Unit – III 10 Hours
Virus:
8. Biological nature, characteristics and ultrastructure of Plant (TMV, Polaro, Papaya Mosaic Virus), animal (retro viruses and hepatitis B virus) and bacterial virus (T4 phi X174, M13), replication, transmission and economic importance of viruses.
9. Structure, reproduction and importance of viroids, virusoids, prions

Unit – IV 10 Hours
11. Innate and adaptive immune system: Types of Immunity, antigens, antigenicity, structure and function of antibody molecules, monoclonal antibodies, Antigen-antibody interactions (serology), activation & differentiation of B and T Cell, B & T cells receptors, MHC molecules compliment system, immune response during bacterial (tuberculosis), parasitic (malaria) and Viral (HIV) infections, vaccine.

Unit – V 10 Hours
12. Distribution of microbes in air, water, soil and human body.
13. Microbes for control of pollution.
14. Microbial enzymes and their applications.
15. Microbes in nanobiotechnology.
<table>
<thead>
<tr>
<th>BOTC.C.T.III</th>
<th>Algae and Bryophytes</th>
<th>4 credits/50 Hours</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Unit – I</td>
<td>10 Hours</td>
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<tr>
<td><strong>Algae:</strong></td>
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<tr>
<td>1.</td>
<td>Classification and salient features of different classes of Algae.</td>
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<td>2.</td>
<td>Algal cell biology.</td>
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<td>3.</td>
<td>Algal pigments, food reserves, flagellation and their importance in classification.</td>
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<td>4.</td>
<td>Major contributions of algologists in India.</td>
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<td>5.</td>
<td>Thallus organisation, reproduction and life cycle patterns.</td>
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<td>6.</td>
<td>Economic importance of algae as food, feed, source of chemicals and drugs, Bioenergy, Algal biofertilizers, industrial uses.</td>
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<td>7.</td>
<td>Algae as source of bioremediation, bioindicator (algal blooms),</td>
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<tr>
<td><strong>Unit – II</strong></td>
<td></td>
<td>10 Hours</td>
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<tr>
<td>8.</td>
<td>Comparative study of classes of Chlorophyceae, Xanthophyceae and Bacillariophyceae, with help of diagram:</td>
<td></td>
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<tr>
<td>a.</td>
<td>Range of thallus organization including ultrastructure.</td>
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<tr>
<td>b.</td>
<td>Methods of reproduction.</td>
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<td>c.</td>
<td>Variation in life cycles.</td>
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<tr>
<td>d.</td>
<td>With special reference to Hydrodictyon, Pithophora, Ulva, Cosmariun, Bryopsis and Stigeocodium.</td>
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<tr>
<td><strong>Unit – III</strong></td>
<td></td>
<td>10 Hours</td>
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<tr>
<td>10.</td>
<td>Comparative study of Phaeophyceae and Rhodophyceae with reference to:</td>
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<tr>
<td>a.</td>
<td>Range of thallus organization.</td>
<td></td>
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<tr>
<td>b.</td>
<td>Method of reproduction.</td>
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<tr>
<td>C.</td>
<td>Variation in life cycles.</td>
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<tr>
<td><strong>Bryophytes:</strong></td>
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<tr>
<td>11.</td>
<td>Classification of Bryophytes and their distribution in India.</td>
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<tr>
<td>12.</td>
<td>Range of thallus structure (plant body) and anatomy in Bryophytes (with suitable examples)</td>
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<td>14.</td>
<td>Major contribution of bryologist in India.</td>
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<tr>
<td><strong>Unit – IV</strong></td>
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<td>10 Hours</td>
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<tr>
<td>15.</td>
<td>Evolutionary tendencies in sporophytes of Bryophytes (Progressive sterilization of sporogenous tissue)</td>
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<tr>
<td>17.</td>
<td>Ecology and economic importance of Bryophytes.</td>
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</table>
Taxonomy of Angiosperms and Economic Botany  

Unit- I  
10 Hours

Taxonomy of Angiosperms:
1. History of plant Taxonomy.
3. Taxonomic evidences: Morphology, Plant anatomy, Palynology, Embryology, Cytology, Phytochemistry, Genome analysis and DNA hybridization technique in relation to taxonomy, numerical taxonomy, serotaxonomy.

Unit- II  
10 Hours
4. The species concept: Taxonomic hierarchy, species, genus, family and other categories, Principles used in assessing relationship, delimitation of taxa and attribution of rank. Variation and specialization in plants.
5. Phylogenetic systems of classification: Hutchinson, Cronquist, Takhtajan and Dahlgren. Outlines, merits and demerits.
6. Basic knowledge of phylocode and A P G system.

Unit- III  
10 Hours
7. Range of floral structure and phylogeny in:  
I. Dicotyledons:  
a. Magnoliidae with special reference to Magnoliaceae, Capparidaceae, Piperaceae,  
b. Hamamelidae with special reference to Moraceae, and Casuarinaceae,  
c. Caryophyllidae with special reference to Cactaceae, Chenopodiaceae and Polygonaceae,  
d. Dilleniidae with special reference to Tiliaceae, Sterculiaceae, Violaceae,  
e. Rosidae with special reference to Lythraceae, Combretaceae,  
f. Asteridae with special reference to Boraginaceae, Scrophulariaceae, Bignoniaceae

Unit- IV  
10 Hours
II. Monocotyledons:  
a. Alismatidae,  
b. Commelinidae with special reference to Commelinaceae and Zingiberaceae,  
c. Arecidae with special reference to Araceae,  
d. Liliidae with special reference to Amaryllidaceae  
e. Orchidaceae

Unit- V  
10 Hours

Economic Botany:  
8. Botanical names, families, Plant part(s) used and uses of the economically important plants belonging to following categories:  
Fiber plants  
Spices and condiments  
Beverages  
Medicinal plants  
Non-wood plant products (NWPPs): rubber, dyes, resin, gums etc.
Unit – I
10 Hours
1. General characters of fungi, and range of thallus organization in fungi.
2. Types of reproduction in fungi.
3. Unique aspects of (i) fungal cells, (ii) molecular biology of fungi.
6. Differentiation in fungi: control of i) Dimorphism. ii) conidiation. iii) mating (with the help of Sex hormones).

Unit – II
10 Hours
8. A general account and affinities of the following groups with special reference to systematic position, structure and reproduction of organisms mentioned hereunder:
   I. The Fungi belonging to kingdom Protozoa:
      a. Myxomycota (myxomycetes): Stemonites, Ceratiomyxa,
      b. Plasmodiophoromycota (Plasmodiophorales) Plasmodiophora.
   II. The Fungi belonging to Kingdom Chromista: Saprolegnia, Phythium, Phytopthora, Albugo,
   III. The Kingdom Fungi:
      a. Chytridiomycota: Synchytrium,
      b. Blastocladiomycota: Allomyces, Coelomomyces
      c. Zygomycota: Saksancea, Pilobolus, Entomophthora
      d. Ascomycota: Taphrina, Phyllactinia, Erysiphae, Neurospora, Peziza
      e. Basidiomycota: Puccinia, Uromyces, Hemiliea, Melampsora, Tilletia, Ustilago
      f. Anamorphic fungi (Deuteromycotina): With reference to their telomorph, also wherever possible; Cercospora, Helminthosporium, Curvularia, Alternaria, Fusarium, Colletotrichum, Aspergillus, Penicillium.

Unit – III
10 Hours
9. Fungal interactions: I. Role of antibiotics, hyphal interference, II. Mycoparasitism, III. Commensalism, Mycorrhizae, Lichens (Structure, types, reproduction, importance),
10. Symptoms of fungal, bacterial and viral plant diseases.
12. Host-parasite relationship, role of enzymes and toxins in disease development.
13. Effect of infection on physiology of host.
14. Effect of environment on disease development-epiphytotics, plant disease forecasting

Unit – IV
10 Hours
15. Disease control by Physical methods, chemical methods, crop rotation, plant quarantines, resistance
16. Integrated pest management mechanism, its advantages, disadvantages and
future prospects.

19. Principles of biological control of air-borne and soil-borne plant diseases. Fungi as biocontrol agents of air-borne and soil-borne plant diseases (antibiosis, hyphal interference and mycoparasitism)

**Unit V**

10 Hours

20. Etiology and control of the following crop diseases:

- **Paddy**: Paddy blast, Bacterial leaf blight.
- **Wheat**: Black Stem rust, Bunt of wheat, Flag smut.
- **Jowar**: Grain Smut.
- **Sugarcane**: Smut, Red rot.
- **Cotton**: Wilt
- **Grape**: Downy and powdery mildew
- **Apple**: Apple scab
- **Groundnut**: Tikka disease.
- **Fibre**: Rust of *Linum*
- **Coriander**: Gall of coriander.
 BOTC.C.T. -VI: Pteridophytes, Gymnosperms and Palaeobotany  4 credits/50 Hours

Unit – I  10 Hours

**Pteridophytes:**
1. Classification of Pteridophytes; specific characters of important classes.
2. Salient features, comparative organography, systematics, reproduction and Phylogeny of the following:
   a. Psilopsida: Psilophytales (*Rhynia, Horneophyton*) and Psilotales (*Psilotum, Tmesipteris*).
   b. Lycopsida: Protopsidodendrales (*Protopsidodendron*), Lepidodendrales (*Lepidodendron, Stigmaria*), Lepidospermales (*Lepidocarpon*) and Isoetales (*Isoetes*).
   c. Sphenopsida: Hyeniales (*Calamophyton*), Sphenophyllales (*Sphenophyllum*) and Calamitales (*Calamites*).

Unit – II  10 Hours

3. Telome concept, Stelar system and evolutionary tendencies.
5. Apogamy, apospory, parthenogenesis.
6. Soral evolution in Pteridophytes; Alternation of generations.

Unit – III  10 Hours

**Gymnosperms:**
7. Classification and distribution of gymnosperms with special reference to India. Study of morphology, structure and life history as illustrated by the following:
   Pteridospermales: Palaeozoic and Mesozoic group with reference to Lyginopteridaceae (*Lyginopteris*), Medullosaceae (*Medullosa*), Glossopteridaceae and Caytoniaceae.
9. Cycadales: A detailed account including distribution of living Cycads.
13. Coniferales: *Abies, Cupressus, Podocarpus* and *Araucaria*.

Unit – IV  10 Hours

16. Evolutionary tendencies in Gymnosperms.
17. Economic importance of Gymnosperms.

Unit – V  10 Hours

**Palaeobotany:**
20. Geological areas and distribution of plants in geological time scale.
22. Techniques of study of fossils; Distribution of fossils in India
BOT.C.T.-VII: Molecular Biology and Elementary Biotechnology 4 credits/50 Hours

Unit – I 10 Hours
1. Nucleic Acids: Nature, Structure, Conformational analysis of DNA and RNA, (t-RNA, micro-RNA), DNA replication (Origin and fork) and its biosynthesis, transpositions and mechanisms of transposition
2. Protein Synthesis: mechanism of protein synthesis in prokaryotes and eukaryotes, transcription, RNA processing, translation and regulation of protein synthesis in prokaryotes (Structural, regulatory genes and operon model).

Unit – II 10 Hours
3. Definition, Basic concepts, Principles and scope of Biotechnology.
4. Recombinant DNA technology, basic concept in genetic engineering, tool and techniques of recombinant DNA technology.
5. Enzymology of genetic engineering: Restriction enzymes, DNA ligase, Polymerase etc.

Unit – III 10 Hours
7. Gene cloning: principles and techniques, choice of vectors, DNA synthesis and sequencing, Analysis and expression of cloned genes in host cells, RAPD, RFLP, AFLP

Unit – IV 10 Hours
9. PCR: Principles, techniques and modification, Gene cloning vs PCR; Uses and applications of PCR.

Unit – V 10 Hours
11. Transgenic (Genetically modified) Plants: Genetic engineering of plants, Aims, strategies for development of transgenic plants (with suitable examples),
12. Agrobacterium – the natural genetic engineer, T-DNA and transposon mediated gene-tagging, chloroplast mediated transformation and its utility,
Unit – I  
1. The Dynamic cell: Structural organization of plant cell, specialized plant cell.  
3. Plant Cell inclusions, their structure and function; Mitochondria, Chloroplast, Ribosome, Dictyosomes, Lysosomes, ER, Microbodies and Plasmodesmata.  

Unit – II  
5. Chromatin Organisation: Chromosome structure and composition, Centromere, Telomere, Euchromatin and Heterochromatin, Karyotypes, Polytenes, Lamp brush chromosomes and Sex chromosomes.  
7. Numerical changes in chromosomes and Haploid  
   a) Euploidy/Polyploidy: Classification, production, role in evolution, utility in crop improvement.  
   b) Aneuploidy : Trisomics, tetrasomics, monosomy, multisomy- meiotic behaviours, breeding behaviour.  

Unit – III  
9. Allelic and non-allelic interaction of genes.  
10. Multiple alleles: alleles, coat colour in rodents, blood groups in Humans, self-incompatibility  

Unit – IV  
11. Linkage and crossing over: chromosome mapping, linkage groups, mechanism of chromosome pairing and synaptonemal complex.  
12. Sex determination in plants.  
14. Cell cycle & Apoptosis: Biochemical and genetic mechanism and significance  
   a) Irregularities in Mitosis and  
   b) Programmed Cell Death (PCD).  
   c) Cytoskeleton with emphasis on spindle apparatus, motor movements.  

Unit – V  
15. Apomixis: Cytogenetic basis and types of Apomictic reproduction  
17. Concept of gene: gene structure and expression; gene fine structure, cis-trans test, Biochemical genetics, introns.  
BOT.C.T. IX :  Plant-Water Relations & Growth and Development  4credits/50 Hours

Unit – I  10 Hours

Soil - water-plant relations:
1. Functional aspects of plant cell structure: colloidal systems, Water as a universal solvent, pressures and potentials.
2. Active and passive absorption of water. Factors affecting water absorption
3. Role of micro and macro mineral nutrients, their physiological functions and deficiency symptoms, Hydroponics.

Unit – II  10 Hours

5. Driving forces and resistances in transpiration; stomatal movement mechanism.
6. Ascent of sap, Translocation of solutes in plants; sensor- regulator system, sucrose sensing mechanism.
7. Stress Physiology: Plant response to biotic and abiotic stress, mechanism of stress tolerance, HR and SAR, water deficit and drought resistance mechanism of salinity, metal toxicity, freezing heat and oxidative stress resistance,

Unit – III  10 Hours

Growth & Development:
8. Discovery, chemical structure, physiological role, mechanism of action, bioassay and practical applications of following plants hormones:
   a. Auxins
   b. Gibberellins
   c. Cytokinins
9. Hormone receptors, cell signaling and Signal transduction

Unit – IV  10 Hours

10. Elementary idea of structure and functions of ABA, Ethylene, Ascorbic Acid, Brassinosteroids, Polyamines, Jasmonic acid and Salicylic acid.
11. Sensory photobiology: detection structure, chemistry, physiology, function and mechanism of action of phytochromes, cryptochromes and phototropins.
12. Photoperiodism; Photoinduction and vernalization, Role of florigen, vernalin, phytochrome and C/N ratio in flowering.

Unit – V  10 Hours

14. Seed germination and seedling growth, metabolism of nucleic acid, mobilization of reserved food material, hormonal control of seedling growth, gene expression during seedling growth.
15. Endogenous rhythms
16. Plant movements
17. Ageing and Senescence
Energy flow:
1. Fundamentals of thermodynamics and bioenergetics
2. Buffers, pH Scale, redox potential
3. Structure and functions of ATP;
4. Forces stabilizing macromolecules, Basic structure (all orders) and function of proteins, fats and carbohydrates

Fundamentals of Enzymology:
5. Classification, mechanism of enzyme action and catalysis, Allosteric mechanism, active sites, isoenzymes, Coenzymes, steady state enzyme kinetics, Michaelis - Menten equation and its significance.
6. Protein – ligand binding mechanism, Hill’s equation, Bisubstrate reactions,
7. Ramachandran’s Plot

Photochemistry and Photosynthesis and Carbohydrate Metabolism:
9. Carbon assimilation – the calvin cycle (C3 cycle), Photorespiration and its significance, the C4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.

Respiration and fatty acid metabolism:
10. Overview of plant respiration, glycolysis, the TCA cycle, electron transport and ATP synthesis, oxidative phosphorylation; coupled reaction, group transfer, biological energy transducers,
11. Pentose phosphate pathway, glyoxylate cycle, alternative oxidase system;
12. Fatty acid metabolism and mechanism of regulation

Nitrogen and sulphur metabolism:
13. Overview of biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction, ammonium assimilation, nucleotide metabolism.

Secondary metabolites:
15. Elementary idea of secondary metabolites like alkaloids, lignin and phenolics (terpenes, phenols) with emphasis on flavonoids.
BOT.C.T. XI : Anatomy and Reproduction in Angiosperms 4 credits/50 Hours

Unit-I 10 Hours

Plant Anatomy:
1. Shoot development: organisation of shoot apical meristem (SAM), Cytological and molecular analysis, Leaf (Marginal meristem).

Unit – II 10 Hours
3. Epidermal structures, ontogeny and classification of stomata, trichomes and secretory glands
5. Xylem: Structure and development of tracheary elements.

Unit - III 10 Hours

Embryology:
10. Female gametophyte: Megasporogenesis, organisation and types of embryo sac, gene function during megagametogenesis, ultra structure of embryo sac.
11. Anther: Structure, microsporogenesis, tapetum, pollen development, including pollen wall, pollen germination and pollen tube growth, development of male gametophyte, palynology and its applications.

Unit – IV 10 Hours
12. Pollen-Pistil interactions, Pollination mechanism and vectors, double fertilization.
13. Sexual Incompatibility: its genetic basis, molecular aspects, physiology and biochemistry. Barriers to fertilization, methods to overcome incompatibility.

Unit – V 10 Hours
15. Endosperm: development, types, haustoria, mosaic endosperm, ruminate endosperm, xenia, metaxenia.
16. Embryogenesis: nutrition and growth of embryo; development of dicot and monocot embryos.
17. Fruit growth and development: with special reference to legumes and cucurbits.
18. Seed anatomy
19. Apomixis and Parthenocarpy: types and importance.
Unit – I

1. Ecological factors (light, air, water, topographic, edaphic, biotic)
2. Ecological concepts of species: Genecology and Ecological niche.

Unit – II

5. Ecological succession: Process concept and trends. Climax. (Xerosere, hydrosere)
7. Production Ecology: Measurement methods and productivity in different ecosystems.

Unit – III

9. Pollution: Kinds of pollution (Air, Water, Soil and Noise) and green house gases, Ozone hole, and global warming.

Unit – IV

10. Recycling of waste: Biogas, utilization and disposal of organic wastes and inorganic wastes,
11. Biodiversity and It’s conservation.

Unit – V

CORE ELECTIVE COURSES

C.E.T.I. - PLANT BIOTECHNOLOGY

BOTCourse XIII A. : Recombinant DNA Technology 4 credits/50 Hours

Unit – I 10 Hours
1. Genetic Engineering - Definition and explanation, restriction enzymes and restriction modification system.
2. Restriction of Chimeric DNA- staggered cleavage, addition of oligopolymer tailing; blunt end ligation
3. Cloning and expression vectors – Definition and explanation: Use of promoters and expression cassettes. Virus expression vectors; Artificial chromosomes as vector- BAC, MAC and YAC.

Unit – II 10 Hours
4. Gene sequencing: Different methods of gene isolation, Techniques for sequencing (Maxam and Gilbert method, Sanger’s dideoxy method); Organo-chemical gene synthesis mechanism; c DNA synthesis using reverse transcriptase,
5. Genomics, Proteomics and Bioinformatics.

Unit – III 10 Hours
6. Isolation and purification of RNA, DNA (genomic and plasmid) and proteins; different separation methods. Analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis; isoelectric focusing gels

Unit – IV 10 Hours
7. Protein sequencing methods, detection of post translational modifications of proteins, methods of analysis of gene expression at RNA and protein level, large scale expression such as Microarray based techniques.

Unit – V 10 Hours
9. RNA interference- Introduction, RNAi as tool for gene expression. RNAi as a potential therapy
BOTC.E.T.I- PLANT BIOTECHNOLOGY

Course XIV A.: Plant Tissue Culture 4 credits/50 Hours

Unit – I 10 Hours
1. Planning and organization of tissue culture laboratory; Basic techniques of plant tissue culture.
2. Induction and maintenance of callus and cell suspension culture.
3. Study of differentiation through organogenesis and embryogenesis.

Unit – II 10 Hours
4. Cell line selection through suspension culture for the production of stress resistant plants, their application in crop improvement.
5. Tissue culture techniques for haploid production and their application in agriculture.
6. Meristem culture for mass and clonal propagation of ornamental plants, virus resistant plants and forests trees.

Unit – III 10 Hours
7. In-vitro Pollination, shotgun wedding, embryo rescue technique and embryo culture.
8. Encapsulation of somatic embryos and shoot apices for artificial seeds.

Unit – IV 10 Hours
10. Protoplast isolation, culture and regeneration.
11. Somatic hybridization and selection mechanism for hybrids and cybrids, with special reference to crop plants.
12. Delivery systems for gene transfer in plant through co-cultivation of explants and Agrobacterium or thorough direct methods-electroporation, silicon carbide method.

Unit – V 10 Hours
14. Industrial application of plant tissue culture for:
i) Secondary metabolism for commercial purpose.
ii) Scale up and down stream processing for secondary metabolites.
Course XV B: Microbial Biotechnology 4 credits/50 Hours

Unit – I  10 Hours
1. Sources and characters of industrial microbes, their isolation and methods for induction of mutations; stabilization of mutants and their isolation.
2. Fermentation technology; microbial growth, application of fermentation; batch, fed batch and their continuous cultures of microbes.

Unit – II  10 Hours
5. Microbial transformations with special reference to steroids and alkaloids, polysaccharides.

Unit – III  10 Hours
6. Microbiology and up gradation of alcoholic beverages.
7. Commercial production of organic acids like acetic, lactic, citric and gluconic acids.
8. Commercial production of important amino acids, insulin, steroids, vitamins and perfumes.

Unit – IV  10 Hours
10. Immobilization of microbial enzymes and whole cells and their applications in industries.
11. Use microbes in food, feed and dairy; Bioprocess engineering; Down stream processing, various steps for large-scale protein purification.
12. Single cell proteins, physiological aspects, SCP from hydrocarbons, waste materials and renewable resources, improvement in SCP production.
13. Industrial sources of enzymes; Cellulases, Xylanases, Pectinases, Amylases, Lipases, and Proteases, their production and applications.

Unit – V  10 Hours
15. Petroleum Microbiology
BOTC.E.T.-II MICROBIAL AND ENVIRONMENTAL BIOTECHNOLOGY
Course XVI B: Environmental Biotechnology 4 credits/50 Hours

**Unit – I** 10 Hours

1. Pollution and Pollutants: Cost of pollution, Kinds of Pollution and Pollutants- Air, Water, and Soil Pollution, Their effects on Plants and Ecosystems;
2. Role of Plants in Pollution Management.

**Unit – II** 10 Hours

3. Climate Change: Greenhouse Gases (CO₂, CH₄, N₂O, CFCs: sources and roles), Ozone layer and Ozone hole, Consequences of Climate change (acid rain, global warming, sea level rise, UV radiation).

**Unit – III** 10 Hours

4. Ecosystem Stability: Concept (resistance and resilience), Ecological Perturbations (natural and anthropogenic) and Their Impacts on Plants and Ecosystems, Ecology of Plant Invasion, Environmental Impact Assessment (EIA), Ecosystem Restoration.

**Unit – IV** 10 Hours


**Unit – V** 10 Hours

BOT.C.E.T.-III APPLIED AND STRESS PHYSIOLOGY
Course XIII C: Stress Physiology of Plants 4 credits/50 Hours

Unit-I 10 Hours
1. Biological stress vs. Physical Stress, Types of stresses and general methods of measurement of stress response (Strain),
2. Stress physiology in crop improvement
3. Response to UV stress: Injury and resistance mechanism

Unit-II 10 Hours
4. Response to low temperature stress: Chilling, freezing, frost injury and mechanism of resistance, Adaptations

Unit-III 10 Hours
6. Response to nutrient deficiency stress
7. Heavy metal stress, injury and mechanism of resistance, adaptations
8. Salinity stress, Ionic and salt stress injury, mechanism of resistance

Unit-IV 10 Hours
9. Response to water deficit: Desiccation, Dehydration injury; Mechanism of resistance, Adaptations
10. Response to water excess: Flooding, hypoxia, Mechanism of resistance, Adaptations

Unit-V 10 Hours
11. Causative agents for Biotic Stresses
12. Mechanism of Resistance against Fungal, Bacterial and viral pathogens
Course XIV C: Applied Plant Physiology 4 hrs/week/ 4 credits/50 Hours

Unit -I  10 Hours

Crop Productivity
1. Role of crop physiology in agriculture,

Unit-II  10 Hours

Physiology of Crop species
4. Concept of source and sink, factors influencing source and sink size and productivity. Environmental factors determining crop growth. Light, temperature and VPD, effect of photoperiod and thermoperiod on duration of growth stages.
7. Rootstock and scion interactions.

Unit-III  10 Hours

Post-Harvest Physiology
10. Concept of physiological maturity of seeds - post harvest changes in biochemical constituents in field crops - loss of viability, loss of nutritive value, environmental factors influencing post-harvest deterioration of seeds.

Unit-IV  10 Hours
11. Physiological and biochemical changes during fruit ripening and storage. Senescence and post harvest life of cut flowers.
13. Molecular approach in regulation of fruit ripening. Transgenic technology for improvement of shelf-life.

Unit-V  10 Hours

Chemistry of Plant Produced Chemicals
1. Essential plant nutrients (major, secondary and micro), organic manures (farm yard, compost, sewage sludge, green manure, biogas slurries, etc.), production and
manufacture and uses of various nitrogenous, phosphatic, potassic and complex fertilizers and fertilizer mixtures, liquid fertilizers, biofertilizers, integrated plant nutrient systems.

Course XVD: Pharmacognosy 4 hours/week/4 credits/50 Hours

UNIT -I 10 Hours
1. Introduction and Scope of Pharmacognosy: Pharmacognosy and modern medicine
2. Crude plant drugs
   a) Sources: Geographical, Biological, Cell Culture and Sea
   b) Classification: Morphological (Organized and unorganized), Taxonomical, Chemical, Pharmacological and alphabetical
3. Indigenous traditional drugs and their market adulteration of Boerhaavia, Shankhupuspi (Clitoria), Indian goose-berry, Ocimum, Commiphora, Andrographis.

UNIT -II 10 Hours
4. Types of Plant drugs and their Pharmacognostic study
   a) Root drugs; Glycyrrhiza and Ipecac, Rauwolfia, Shatavari (Asparagus), Coleus, Withania
   b) Rhizome drugs, Ginger (Zingiber)
   c) Leaf drugs, Andrographis, Clitoria, Senna, Artemisia
   d) Bark drugs: Terminalia arjuna, Holorrhea, Taxus
   e) Flower drugs: Saffron (Crocus), Safflower (Carthamus), Spilanthes
   f) Seed drugs: Piper longum, Mucuna
   g) Fruit drugs: Cumin (Carum cuminum), Amla (Emblica), Senna pods (Cassia senna)
   h) Whole plant drugs: Catharanthus roseus

UNIT -III 10 Hours
5. Evaluation of the drugs; Organoleptic, Microscopic, Physical, Chemical and Biological methods of evaluation
6. A brief account of various drug constituents: Carbohydrates, Cardiac glycosides, alkaloids, volatile oils, resins quinines and steroids with particular reference to Acacia gum, amla, Coleus, Shatavari, Rauwolfia

UNIT -IV 10 Hours
7. Medicinal Principles and powder analysis of Curcuma, Cloves, Senna, Fennel and Cinnamon

UNIT -V 10 Hours
8. Large scale Industrial preparation of Crude Drugs
   a) Types of reactors used and extraction methods
   b) Active principles and non-active principle of drugs
   c) Import and Export potentials of Crude Drugs
   d) Preparation of crude drugs in indigenous system of medicine
   e) Quality control test – contamination, Adulteration
9. Regulatory issues in herbal drug development

C.E.P. XVD/ Practicals (Labs) 4 Hrs/ week 2 Credits

Practical Lab- (Special) - D
1. Histochemical analysis of the following chemical compounds:
   a) Alkaloids b) Steroids c) Quinones d) Resins e) Glucosides
   f) Pigments g) Volatile oils
2. Organoleptic evaluation of the following:
   a) *Glycyrrhiza* (Root) b) Ginger (Rhizome) c) Eucalyptus (leaf)
   d) *Terminalia arjuna* (Bark) f) *Strychnos nuxvomica* (seed)
3. Powder analysis. a) Curcuma b) Cloves c) Senna d) Fennel
   e) Cinnamon : Market drugs: a) Turmeric b)Chillies c)Coriander
   d) Wheat and Jowar
4. Qualitative and Quantitative tests for
   a)Alkaloids b)Carbohydrates c) Anthroquinones d) Tannins e) Steroids f) Terpenoids
5. Growing chosen Medicinal plants in an experimental plot and preparation of Crude Drug for commercial market – Project
6. Collection of crude drugs from the market and studying their characteristics
7. Preparation of exhibits
8. Record
BOTCET-IV : MEDICINAL BOTANY

Course XVI-D: Post-harvest technology of Medicinal Plants
4 Hours/ week/ 4 credits/ 50 Hours

UNIT –I
10 Hours
1. Introduction: Origin, development and evolution of Medicinal Botany
2. Importance of active principles and uses of medicinal plants in different traditional systems of medicine and Allopathy

UNIT –II
10 Hours
3. Origin, Historical background. Active principles uses and cultivation practices of the following medicinal plants
   a) Andrographis paniculata b) Asparagus racemosus c) Bacopa monnieri d) Coleus forskohlii
e) Rauwolfia serpentina f) Withania somnifera
4. Origin, Historical background, Active principles uses and cultivation practices (including organic farming) of the following aromatic plants: a) Lemon grass (Cymbopogon flexuosus) b) Citronella c) Palmarosa d) Eucalyptus citriodora

UNIT –III
10 Hours
5. Post-harvest Management of Medicinal plants: Drying / Distillation, grading, packing and storage
6. Distillation of aromatic plants: a) Description of distillation UNIT s b) Principles of distillation c) Methods of distillation d) Maintenance and precautions for distillation UNIT s se) Yield and recovery of different aromatic plants

UNIT –IV
10 Hours
7. Conservation of Medicinal Plants; Threatened and endangered Medicinal Plants – in-situ and ex-situ conservation
8. Preparation of Crude drugs in different systems of medicine

UNIT-V
10 Hours
10. IPR – Patents

Reference
1. Cultivation of medicinal and aromatic crops by Farooqui and Sreeramulu. Univ. Press
2. Textbook of Pharmacognosy by Young Ken – Heber W and Young Ken
3. Pharmacognosy of indigenous drugs by K. Raghunathan and Roma Mitra
4. Pharmacognosy- Kokate et al
5. Pharmacognosy- Mohammed Ali
6. Pharmacognosy- Wallis
7. Pharmacognosy- Trease & Evans-1996
8. Pharmacognosy- Shaw and Quadri
9. Pharmacognosy- Tyler, Brady and Robbins
10. Cultivation of Medicinal plants-Purohit & Vyas CBS, 2006
C.E.P.XVI/D Practicals (Labs)  
4 Hrs/ week -2 Credits

Practical Lab- (Special)

1. Germination studies and nursery management of medicinal and aromatic plants.
2. Organoleptic and Microscopic analysis, identification and adulteration check of the following crude drugs.
   a) Leaf drugs Cassia sps
   b) Root drugs Rauwolfia serpentina vs. R. tetraphylla
   c) Bark drugs Holarrhena pubiscens vs Terminalia arjuna
   d) Flower drugs Carthamus tinctorius
   e) Whole plant drugs Catharanthus roseus
3. Histochemical identification of the following chemical substances: a) Carbohydrates
   b) Proteins, c) Amino acids d) Starch e) Tannins f) Enzymes
4. Histological identification of tissue systems and deposits
   a) Epidermis, b) Parenchyma, c) Collenchyma, d) Phloem, e) Xylem, f) Crystals etc.
5. Estimation of oil content in aromatic crops (Clemenger apparatus/SCE)

Record
BOTCET-V : BIODIVERSITY AND CONSERVATION

Course XV-E: Diversity in Plants, their origin and evolution 4 credits/ 50 Hours

Unit – I 10 Hours

Sustainable Development:
1. Global movement for sustainability
2. People’s mandate on sustainable development
3. Strategies for sustainable development
4. Contribution of telecommunication and information technology to sustainability
5. Social perspectives for sustainable development
6. Political perspectives for sustainable development
7. Concept of circular economy

Unit – II 10 Hours

Origin of Agriculture:
8. Meaning of Agriculture, Development of Agriculture
9. Origin of cultivated plants, Indo-Burmese Centre of Origin,
10. Contribution of Vavilov,
11. Domestication of crop plants
12. Plant introduction

Unit – III 10 Hours

Green revolution:
13. Benefits and adverse consequences, beyond green revolution
14. Plants as Avenue trees: Selection of avenues and avenue trees, planting schemes
15. Plants as Pollution control agents: Tolerance of plants to different pollutants

Unit – IV 10 Hours

Origin, evolution and cytotaxonomy of
16. Cereals and millets (wheat, paddy, bajra and jowar),
17. Legumes (peas, gram, soybean, black gram, lentil and cowpea),
18. Sugarcane and starches (beetroot, potato, sweet potato),

Unit – V 10 Hours

20. A general account of non-wood forest products (NWFPs) such as bamboos, gum, tannins, dyes, resins and beverages.
21. A general account of the organizations and functions of Indian Council of Agricultural Research (ICAR). Council of Scientific and Industrial Research (CSIR) and the Department of Biotechnology (DBT)
Unit - I  
1. Biodiversity: Definition; factors responsible for determination of Biodiversity; 
2. Global concern over climate change.

Unit - II  
3. Levels of Biodiversity: Genetic, Species, Ecological, Evolutionary and Agrobiodiversity. 
4. Types of Biodiversity: (Diversity Indices)- Alpha(α), Beta (β), Gamma(γ) Diversity. 
5. Conservation of Biodiversity 
  a) In situ Stratagy : National parks, Wild life sanctuaries, biosphere reserves and world heritage sites. 
  b) Ex-situ Stratagy : By seeds, reclamation, Afforestation, tree Plantation, seed banks, gene banks, cryobanks 
  c) Restoration or Rehabilitation of Endangered species.

Unit - III  
6. Biodiversity at world level: Biodiversity at global and country level, wild plant wealth. 
7. Ecosystem diversity in India: Desert, forest, Grassland ecosystem, wetland, Mangroves. 
8. Species Diversity: Endemic species, cultivated plants/Agro- diversity, Endangered plants.

Unit - IV  
9. Threats to Biodiversity: 
  a) Causal factors of threat – Developmental pressure, encroachment, exploitation, human induced disaster, Management of natural and human resources, political and policy issues. 
  b) Threat to Ecosystem, species and genetic Diversity. 
Categories of threats : Endangered, Vulnerable, Rare and Threatened 
10. Natural disaster: floods, earthquake, cyclone, landslides, Disaster management.

Unit - V  
11. Plant resources, Concept, Status and Concern 
12 Basic concepts of local plant diversity and its economic importance 
13. World centres of primary diversity of domesticated plants 
14. General account of activities of BSI, NBPGR for conservation and non-formal conservation efforts
Introduction Techniques and Information Technology
1. Introduction to Molecular Plant Pathology
2. Molecular techniques in plant pathology, RFLPs, RAPDs, polymerase chain reaction (PCR, RTPCR) - Analysis of PCR products and serological techniques based on immunofluorescence, chromosome karyotyping.
3. Fungal protoplasts and Vegetative compatibility groupings.
4. Information Technology in Plant Pathology: Plant disease clinics; use of database and application of Bioinformatics in plant pathology - a general account.

UNIT - II

Plant Pathogen Interactions
5. Recognition: Early events, Adhesion, spore eclosion, adhesion of germ tubes and hyphae factors affecting adhesion, hydrophobins.
6. Elicitors: Distribution, production and nature, fungal wall elicitors (carbohydrates and glycoprotein elicitors) elicitors from plant cell walls, microbial enzyme elicitors, mode of action and diverse plant defense mechanisms.
7. Signal Transduction: Intracellular signals, short distance intercellular signals and systemic signals.
8. Second Messengers: Calcium ion and Calcium dependent enzymes, cyclic AMP, Proteins, H2O2 and Ethylene.

UNIT - III

Genetics of Plant Pathogen Interactions
1. Genetics of Plant Disease:
2. Basic features of sexual reproduction; Fungal nucleus; Gene organization
3. Genes and disease; Variability of organisms (Mutation, Heterokaryosis and Parasexuality).
4. Physiological Specialization, origin of races, concept of biological forms.
5. Molecular variability of fungal pathogens.
15. Genetics of virulence in pathogens: Genes involved in pathogenesis; Virulence by pathogens; brief account on plant pathogenic genes in fungi, bacteria and viruses.
16. Types of plant resistance to pathogens:
   i) Non-host resistance, True resistance (Vertical and Horizontal resistance).
   ii) Apparent resistance, Gene-for-gene concept, Flor's concept, Breeding resistant varieties.

UNIT - IV

Pathogen Ingress and Plant Resistance
17. Plant defense responses: Generation of signals Local and systemic responses, fungal resistance genes in plants, defense genes and fungal avirulence genes.

UNIT - V

transformation methods and identification of transformants.
20. Engineering resistance against fungal and viral pathogens: Coat protein mediated resistance (CPMR) and antisense genes and gene silencing.
21. Antifungal and antibacterial strategies: Candidate genes to combat microbial pathogens (Chitinase, Thionine, Permutins, Lysozymes and Lectins) and antifungal proteins (Ribosome inactivating proteins - RIPs).

C.E.P.XV F Practicals (Labs)  
4 Hrs/ week 2 Credits

Practical Lab- (Special)
1. Isolation and separation of fungal nucleic acids and proteins by gel electrophoresis.
2. RFLPs of fungal nucleic acids and RAPDs of fungal DNA.
3. Amplification of Fungal DNA by PCR.
5. Elaboration of phytoalexins by TLC methods.
6. Record and Herbarium of diseased plants.

Reference Books:
BOTCET VI: APPLIED PLANT PATHOLOGY

Course XVI F: Molecular Plant Pathology  4hrs/week/4 Credits/ Total 50 hrs

UNIT- I                   10 Hours
1. Introduction and History of Plant Pathology
2. Classification of plant diseases: Symptomology of Fungal, Bacterial, Viral and Phytoplasmal diseases
4. Nematode disease - Root knot of tomato caused by Meloidogyne
5. General account of post-harvest fungal diseases of food crops, fruits and vegetables and their management.

UNIT- II                   10 Hours

Plant diseases caused by Bacteria, Viruses, Viroids, Phytoplasma and Spiroplasmas
6. Plant diseases caused by Bacteria:
   a) Wildfire of Tobacco
   b) Angular leaf spot of Cotton
   c) Leaf spot of Mango
   d) Wilt of Potato
   e) Wilt of Tomato
   f) Soft rot and Scab of Potato
7. Plant diseases caused by Viruses & Viroids:
   a) Bhindi vein clearing
   b) Papaya leaf curl
   c) Bunchy top of Banana
   d) Rice Tungro
   e) Bud necrosis of Groundnut
   f) Bean common mosaic
   g) Potato spindle tuber
8. Plant diseases caused by Phytoplasmas and Spiroplasmas:
   a) Grassy shoot of Sugarcane
   b) Little leaf of Brinjal
   c) Sesamum phyllody

UNIT- III                   10 Hours

Fungal Diseases of Cereals
9. Cereals:
   a) Bakanae disease of Rice
   b) Sheath blight disease of Rice
   c) Loose smut of Wheat
   d) Karnal bunt of Wheat
   e) Grain smut of Sorghum
   f) Loose smut of Sorghum
   g) Downy mildew of Bajra
   h) Common smut of Maize
UNIT-IV 10 Hours
Fungal diseases caused by Plantation crops, Pulses and oil seeds,
10. Plantation crops:
a. Coffee Rust
b. Blister blight of Tea
c. Stem rot of Rubber
11. Pulses and Oil Seeds:
a) Pigeon pea Wilt b) Chick pea Blight
c) Rust of Groundnut
d) Sunflower Rust
e) Linseed Rust
f) Coconut Bud rot

UNIT- V 10 Hours
Fungal Diseases of Fruits, Vegetables and Cash crops
12. Fruits:
a) Downy mildew of Grapes;
b) Powdery mildew of grapes
c) Mango Anthracnose
d) Citrus Gummosis
13. Vegetables:
a) Powdery mildew of Cucurbits
b) Leaf spot of Tomato
c) Leaf spot of Brinjal
d) Club root of Crucifers
e) Chilli Die-back
14. Cash crops:
a) Whip smut of Sugarcane
b) Cotton Wilt
c) Damping off of Tobacco
d) Black Shank of Tobacco
e) Turmeric Leaf spot

C.E.P.XVI F Practicals (Labs) 4 Hrs/ week 2 Credits
Practical Lab- (Special)
1. Diagnosis of plant diseases and proof of pathogenicity according to Koch's postulates.
3. Plant disease diagnosis by studying symptoms in the field.
4. Preparation of semi-permanent slides of diseased material, eg. Leaf spots, blights, mildews, rots, wilts, rusts and smuts.
5. Micrometry and standardization of microscope.
6. Measurement of fungal spores and mycelium and camera lucida drawings
7. Record and Herbarium of diseased plants.
Course XIII -G: Elementary Computers Knowledge  4 hrs/week/4 Credits/ Total 50 Hours

Unit-I 10 Hours

Unit-II 10 Hours

Unit-III 10 Hours
MS-WORD: .File, edit, cut, copy, paste, standard tool bar, formatting, toolbar, paste special, hyper link, clear, select all, find, replace, go to, Header & Footer, page, break, date & time, auto text, symbol, picture & word art, Fonts, paragraph, change case, Spelling & grammar, word count, auto correct, Table, sort EXCEL: New, open, save, (File Menu), concept of book sheet, selecting whole columns & rows. Cut, copy, paste, paste special, fill clear, delete, delete sheets, find replace, go to Toolbar, insert cells, rows, columns. Chart, format cells, autocorrect, Spell check, sort. POWERPOINT: Introduction to PowerPoint, slideshow, insert new slide, duplicate slide, apply design, Slide Show.

Unit-IV 10 Hours
Introduction to internet, Introduction to DBMS, Computer Networks, Types of Networks LAN/MAN/WAN, Network Topology, OSI Model/TCP IP Model, Firewalls, VPN, Cryptography, Public Key, Private key, Encryption, Decryption, Digital Signature,

Unit-V 10 Hours
CET-VII : COMPUTER SCIENCE & BIOINFORMATICS

Course XIV-G: Genomics & Bioinformatics 4 hrs/week/4 Credits/Total 50 Hours

Unit-I 10 Hours
1. Bioinformatics - Introduction; Definition & Concept, Role of Bioinformatics, Introduction of Internet in Biology & objectivity, Services of Internet used for Biological Data, Human Genome Project.

Unit- III 10 Hours
2. Database System- Definition; Purpose of Database System; Advantages of Database System, Relational Database- Definition; Relational Data Model, Database- Primary Databases & Secondary Databases, Sequence Databases(EMBL, GenBank, DDBJ, SWISS-PROT, PIR, TrEMBL), Protein Family/Domain Databases (PROSITE, Pfam, PRINTS & SMART)

Unit- IV 10 Hours
3. Sequence comparison algorithm, Dynamic programming, Dot plot matrix, sequence scoring schemes (weight matrix as Identify scoring, genetic code scoring scheme chemical scoring, observed Substitution matrix and Gap penalties),Sequence database similarity searching algorithms, local alignment, global alignment, FAST A, BLAST (BLASTP, BLASTN, BLASTX, TBLASTN, TBLASTX) and similarity searching scores and their statistical interpretation

Unit-V 10 Hours
4. Motifs and Domains, algorithm for multiple alignments, Biological motifs, micro array, Phylogenetic prediction: Relationship of Phylogenetic analysis to sequence alignment, Genome complexity and phylogenetic analysis, concept of evolutionary trees. Maximum parsimony method, distance method, maximum likelihood method
OPEN ELECTIVES (Offered by the department for the students of other courses)

OET -I: DISASTER MANAGEMENT
4 hrs/ week/ 4 Credits/ 50 hrs

UNIT- I

10 Hours

Introduction to Disasters: Concepts, and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks.

UNIT- II

10 Hours

Disasters: Classification, natural hazards and Man-made disasters, Causes, Impacts (including social, economic, political, environmental, health, psychosocial, etc.) Differential impacts- in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics and climatic change.

UNIT- III

10 Hours

Approaches to Disaster Risk reduction: Disaster management cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural-nonstructural measures, roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), states, Centre, and other stake-holders. CBRN disaster, NDMA, NDRF, NIDM, STATE DM.

UNIT- IV

10 Hours

Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc. Climate Change Adaptation. Relevance of indigenous knowledge, appropriate technology and local resources

UNIT-V

10 Hours

Disaster Risk Management in India: Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, DM Act and Policy, Other related policies, plans, programmes and legislation)

Suggested Reading list:


Coppola P Damon, 2007. Introduction to International Disaster Management,


Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.

Government of India, 2009. National Disaster Management Policy,

Gupta Anil K, Sreeja S. Nair. 2011 Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi


Kapur, Anu & others, 2005: Disasters in India Studies of grim reality, Rawat Publishers, Jaipur


OPEN ELECTIVES (Offered by the department for the students of other courses)

OET -II: ENVIRONMENTAL AWARENESS  
4 hrs/ week/ 4 Credits/ 50 hrs

UNIT- I  
10 Hours
1. Multidisciplinary nature of environmental studies, Definition, scope and importance, Need for public awareness.

UNIT- II  
10 Hours
2. Renewable and non-renewable resources: Natural resources and associated problems.
   a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
   b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
   c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
   d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
   e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
   f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources.

UNIT- III  
10 Hours
3. Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers.
5. Ecological succession.
6. Food chains, food webs and ecological pyramids.
7. Introduction, types, characteristic features, structure and function of the following ecosystem:-
   a. Forest ecosystem,  b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- IV  
10 Hours
8. Social Issues and the Environment
9. From Unsustainable to Sustainable development
10. Urban problems related to energy
11. Water conservation, rain water harvesting, watershed management

UNIT- V  
10 Hours
Tentative List of Open Electives offered by Campus Departments in semester II and III, respectively for CBCS students of 2016-18

History:
1. Indian rituals and Karma
2. Indian Culture and heritage

Urdu:
1. Urdu Proficiency
2. Mass Media

Psychology:
1. Personality Development and Communication Skills
2. Yoga and Meditation

Chemistry:
1. Green Chemistry
2. Analysis and identification of chemicals

Mathematics:
1. Optimization techniques
2. Basic cryptography

Zoology:
1. Poultry Science
2. Wild life and Forestry

Toxicology:
1. Chemical disaster Management
2. Forensic toxicology

Statistics:
1. Applied Statistics
2. Essential Statistics

Physics:
1. Introduction to Nanotechnology
2. Electron Microscopy

Botany:
1. Disaster Management
2. Environmental Awareness

Microbiology:
1. Food Safety and Quality Control
2. Public Health and Hygiene

**English:**
1. Human Society
2. Personality development and Communication skills

**Hindi:**
1. Functional Hindi
2. Hindi journalism

**Economics:**
1. Basic economics
2. Developments in Indian Economics

**Genetics and Plant Breeding:**
1. Crop Physiology
2. Crop Biochemistry

**Sociology:**
1. Rural Development: concepts and Dimensions
2. Social Change in India

**Political Science:**
1. Human rights
2. Constitution of India