**JAMSHEDPUR WOMEN’S COLLEGE**



**DEPARTMENT OF BOTANY**

**B.Sc. BOTANY HONOURS SYLLABUS**

**(LOCF)**

Preamble

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. Such changes have gained momentum with the introduction of Choice Based Credit System (CBCS) which further expects learning outcome based curriculum in order to maximize the benefits of the newly designed curriculum. The learning outcome based curriculum in general and in Botany in particular will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

The template as developed has the provision of ensuring the integrated personality of the students in terms of providing opportunity for exposure to the students towards core courses, discipline specific courses, generic elective courses, ability enhancement courses and skill enhancement courses with special focus on technical, communication and subject specific skills through practical and other innovative transactional modes to develop their employability skills. The template of learning outcome based curriculum has categorically mentioned very well defined expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical, reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, leadership readiness and so on along with very specific learning course outcomes at the starting of each course. Therefore, this template on Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. with Botany/ Botany Honours will definitely be a landmark in the field of outcome based curriculum construction.

**TABLE 1: SCHEME FOR CBCS IN B. SC. HONOURS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl.No.** | **Name of the Courses** | **Total No. of Papers** | **Credits in Theory+(Tutorial/Practical)** | **Total Credits** |
| **1.** | **CC** (Core Courses) | **14** | **06** | **84** |
| **2.** | **DSEC** (Discipline Specific Elective Course) | **04** | **06** | **24** |
| **3.** | **GE** (Generic Elective) | **04** | **06** | **24** |
| **4.** | **AECC** (Ability Enhancement Compulsory Course) | **02** | **04** | **08** |
| **5.** | **SEC** (Skill Enhancement Course) | **02** | **04** | **08** |
|  **TOTAL CREDITS 148** |

**TABLE 2: Semester wise Distribution of B. SC. HONOURS Papers**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SEMESTER** | **CORE COURSE****CC (14 PAPERS)** | **ABILITY ENHANCEMENT COMPULSORY COURSE****AECC (2 PAPERS)** | **SKILL ENHANCEMENT COURSE****SEC (2 PAPERS)** | **DISCIPLINE SPECIFIC ELECTIVE****DSE (4 PAPERS)** | **GENERIC ELECTIVE****GE (4 PAPERS)** |
| **I** | C1 | AECC 1English/MIL Communication |  |  | GE- 1 |
| C2 |
| **II** | C3 | AECC 2Environmental Science |  |  | GE- 2 |
| C4 |
| **III** | C5 |  | SEC- 1 |  | GE- 3 |
| C6 |
| C7 |
| **IV** | C8 |  | SEC- 2 |  | GE-4 |
| C9 |
| C10 |
| **V** | C11 |  |  | DSE- 1 |  |
| C12 | DSE- 2 |
| **VI** | C13 |  |  | DSE- 3 |  |
| C14 | DSE- 4/ PROJECT WORK |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SEMESTER** | **CORE COURSE****CC (14 PAPERS)** | **ABILITY ENHANCEMENT COMPULSORY COURSE****AECC (2 PAPERS)** | **SKILL ENHANCEMENT COURSE****SEC (2 PAPERS)** | **DISCIPLINE SPECIFIC ELECTIVE****DSE (4 PAPERS)** | **GENERIC ELECTIVE****GE (4 PAPERS)** |
| **I** | Algae and Microbiology | English Communication |  |  | GE- 1(Biodiversity: Microbes, Algae, Fungi & Archegoniates) |
| Biomolecules and Cell Biology |
| **II** | Mycology and Phytopathology | Environmental Science |  |  | GE- 2(Plant Ecology & Taxonomy) |
| Archegoniate |
| **III** | Morphology and Anatomy |  | SEC- 1 (Plant Diversity and Human Welfare) |  | GE- 3(Plant Anatomy & Embryology) |
| Economic Botany |
| Genetics |
| **IV** | Molecular Biology |  | SEC- 2 (Mushroom Culture Technology) |  | GE-4(Plant Physiology, Cytogenetics & Biotechnology) |
| Plant Ecology and Phytogeography |
| Plant Systematics |
| **V** | Reproductive Biology of Angiosperms |  |  | DSE- 1(Natural Resource Management) |  |
| Plant Physiology | DSE- 2(Plant Breeding) |
| **VI** | Plant Metabolism |  |  | DSE- 3(Stress Biology) |  |
| Plant Biotechnology | DSE- 4(Biostatistics) |

**SEMESTER I**

**Core course I: Phycology and Microbiology**

**(credits: Theory- 4, Practical- 2) F.M. - 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Introduction to microbial world (15 lectures)**

 Economic importance ofviruses with reference to vaccine production, role in research, medicine and diagnostics, ascausal organisms of plant diseases. Economic importance of bacteria with reference to theirrole in agriculture and industry (fermentation and medicine).

**Unit 2: Viruses and Bacteria (15 lectures)**

General structure and replication; General account of DNA virus (T4 and λ), lytic and lysogenic cycle; RNA virus (TMV), viroides and prions. General characteristics; Archaebacteria, Eubacteria, wall-less forms (mycoplasmas); Cell structure; Reproduction and recombination (conjugation, transformation and transduction).

**Unit 3: Algae, Cyanophyta and Xanthophyta (15 lectures)**

 Range of thallus organization; Classification (by Fritsch), Algal cell structure, Algal evolution,Algal bioprospecting. Ecology and occurrence; Range of thallus organization; Cell structure;Reproduction, Morphology and reproduction *Nostoc* and *Vaucheria***.**

**Unit 4: Chlorophyta and Phaeophyta and Rhodophyta (15 lectures)**

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Volvox, Oedogonium* and *Chara*; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus* and *Polysiphonia*. Commercial cultivation and economic importance of brown and red algae.

**SEMESTER I**

**Core course II: Biomolecules and Cell Biology**

**(credits: Theory- 4, Practical- 2) F.M. - 50**

**QUESTION PATTERN:** Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Biomolecules (20 lectures)**

**Carbohydrates:** Nomenclature and classification; Monosaccharides ;Disaccharides;Oligosaccharides and polysaccharides.

**Proteins:** Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quarternary; Protein denaturation and biological roles of proteins.

**Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

**Unit 2: Enzymes (10 lectures)**

Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group;

Classification of enzymes; Features of active site, substrate specificity, mechanism of

action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis –

Menten equation, Lineweaver–Burk equation, enzyme inhibition and factors affecting

enzyme activity.

**Unit3: Cell Biology and Signal transduction (20 lectures)**

Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells;

Plant and animal cells; Origin of eukaryotic cell (Endosymbiotic theory). Chemistry,

structure and function of Plant cell wall.

Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Lysosomes and Vacuoles. Endomembrane system: Endoplasmic Reticulum – Types and Structure. Golgi Apparatus – organization, protein glycosylation, protein sorting and export from Golgi Apparatus

**Unit 4: Cell division (10 lectures)**

Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle- checkpoints, role of protein kinases. Signal transduction: Receptors and primary and secondary signal transduction.

**SEMESTER 1**

**Generic Elective (GE- 1)**

**Biodiversity (Microbes, Algae, Fungi and Archegoniate)**

 **(Credits: Theory-4, Practical-2) F.M.-70**

**QUESTION PATTERN**: Question no. 1 will be compulsory, and ask for 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.), for 2 marks each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 15 marks each.

**Lectures: 60**

**Unit 1: Microbes (10 lectures)**

Viruses –General structure, TMV; Economic importance

Bacteria –General characteristics and cell structure; Economic importance.

**Unit 2: Algae (12 lectures)**

General characteristics; Morphology and life-cycles of the following: *Nostoc*, *Volvox*, *Oedogonium, Batrachospermum*. Economic importance of algae.

**Unit 3: Fungi (12 lectures)**

General characteristics, life cycle of *Albugo, Peziza, Agaricus, Alternaria*

Symbiotic Associations-Lichens

**Unit 4: Bryophytes (10 lectures)**

General characteristics, morphology, reproduction of *Marchantia, Anthoceros and Sphagnum*

**Unit 5: Pteridophytes (8 lectures)**

General characteristics, morphology and reproduction of *Selaginella* and

*Pteris*.(Developmental details not to be included).Heterospory and seed habit, stelar evolution.

**U nit 6: Gymnosperms (6 lectures)**

General characteristics; morphology, and reproduction of *Pinus*(Developmental details not to be included).

**SEMESTER II**

**Core course III: Mycology and Phytopathology**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN:** Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Introduction to fungi and classification (15 lectures)**

General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification. Mastigomycotina: Characteristic features; Life cycle with reference to Synchytrium, Phytophthora, Albugo. Ascomycotina: General characteristics; Life cycle with reference to Peziza.

**Unit 2: Basidiomycotina, Allied fungi and Deuteromycotina (15 lectures)**

General characteristics; Life cycle with reference to Ustilago, Agaricus; Mushroom cultivation. Allied Fungi: General characteristics; General characteristics of slime molds. Deuteromycotina: General characteristics; Life cycle with reference to Alternaria, Cercospora

**Unit 3: Symbiotic Associations and applied Mycology (15 lectures)**

Lichen – Occurrence; General characteristics; and range of thallus organization, & Economic Importance. Mycorrhiza: Ectomycorrhiza, Endomycorrhiza and their significance.

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

**Unit 4: Phytopathology (10 lectures)**

General symptoms; etiology and control of following diseases:

1. Wart disease of potato
2. Late blight of potato
3. White rust of crucifers
4. Loose smut of wheat
5. Early blight of potato
6. Tikka disease of groundnut
7. Tobacco Mosaic Virus
8. Citrus canker

**SEMESTER II**

**Core course IV: Archegoniate**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Introduction (4 lectures)**

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

**Unit 2: Bryophytes and type of bryophytes (15 lectures)**

General characteristics; Adaptations to land habit; Classification; Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Riccia, Marchantia, Anthoceros, Sphagnum and Funaria*; (developmental stages not included). Ecological and economic importance of bryophytes with special reference to *Sphagnum*

**Unit 3: Pteridophytes (20 lectures)**

General characteristics; Classification; Early land plants (*Rhynia*). Morphology, anatomy and reproduction of *Psilotum*, *Selaginella*,*Equisetum* and *Pteris*(Developmental details not to be included). Heterospory and seed habit, stelar evolution; Common ferns of India; Ecological and economic importance

**Unit 4: Gymnosperms (18 lectures)**

General characteristics, classification (up to family), morphology, anatomy and reproduction of *Cycas*, *Pinus* and *Gnetum* (Developmental details not to be included); Ecological and Economic Importance.

**SEMESTER II**

**Generic Elective (GE-2)**

**Plant Ecology and Taxonomy**

**(Credits: Theory-4, Practical-2) F.M.- 70**

**QUESTION PATTERN**: Question no. 1 will be compulsory, and ask for 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.), for 2 marks each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 15 marks each.

**Unit 1: Introduction to Ecology (2 lectures)**

**Unit 2: Ecological factors (10 lectures)**

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 3: Plant communities (12 lectures)**

Characters; Succession; Processes and types

**Unit 4: Ecosystem (10 lectures)**

Structure; energy flow trophic organisation; Food chains and food webs, Ecological pyramids;

Biogeochemical cycling; Cycling of carbon, nitrogen.

Unit 5: Pollution

Air & Water – Cause & Control.

**U nit 6 Introduction to plant taxonomy (2 lectures)**

Identification, Classification, Nomenclature.

**Unit 7 Taxonomic hierarchy (outline)** (**2 lectures)**

Ranks, categories and taxonomic groups

**U nit 8 Botanical nomenclature (6 lectures)**

Principles and rules of IUCN

**Unit 9 Classification (6 lectures)**

Types of classification-artificial, natural and phylogenetic. Bentham and Hooker (upto series),Hutchinson (upto orders).

Unit 10 Angiospermic Families (10 lectures)

Catharanthaceae, Acanthaceae, Amaranthaceae, Lamiaceae, Cyperaceae

**SEMESTER III**

**Core course V: Anatomy of Angiosperms**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Introduction and scope of Plant Anatomy (4 Lectures)**

Applications in systematics, forensics and pharmacognosy**.**

**Unit 2: Structure and Development of Plant Body (18 Lectures)**

Internal organization of plant body: The three tissue systems, types of cells and tissues.

Classification of tissues; Simple and complex tissues (no phylogeny); cytodifferentiation of

tracheary elements and sieve elements; Pits and Plasmodesmata.

**Unit 3: Meristems (15 Lectures)**

Evolution of concept of organization of shoot and root apex (Apical cell theory, Histogen theory, TunicaCorpus theory, continuing meristematic residue, cytohistological zonation); Types of vascularbundles; Structure of dicot and monocot stem and root. Kranz anatomy. Organization ofroot apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent centre; Rootcap.

**Unit 4: Vascular Cambium and Wood (15 Lectures)**

Structure, function and seasonal activity of cambium; Secondary growth in root and stem.

Axially and radially oriented elements; Types of rays and axial parenchyma; Cyclic aspects andreaction wood; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood,tyloses; Development and composition of periderm, rhytidome and lenticels

**Unit 5: Adaptive anatomy (5 lectures)**

Anatomical adaptations of hydrophytes and xerophytes

**SEMESTER III**

**Core course VI: Economic Botany**

**(credits: Theory- 4, Practical- 2) F.M.-50**

**QUESTION PATTERN:** Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Origin and conservation of Cultivated Plants (14 lectures)**

**Origin, Importance and domestication:** Concept of Centres of Origin;Vavilov’s Centres of Origin and diversity of crop plants, domestication, evaluation, bioprospection, Crop domestication and loss of genetic diversity; **Germplasm augmentation and conservation:** History and importance of germplasm Collection. **Plant Quarantine:** Principles, objectives and relevance of plant quarantine.

**Unit 2: Botany, Utilization of Plant Wealth (Cereals and Millets, Pulses and Legumes, Sources of Sugars and Starches) (14 lectures)**

 Morphology and uses of some selected crops: Cereals:Wheat, Rice, maize, sorghum, pearl millet and minor millets. Pulses: Origin, morphology,uses of pulses (Pigeon pea, Chickpea, Black gram, Soyabean, Pea, Lentil), and Legumes (lab-lab bean,winged bean, French bean). Morphology and processing ofsugarcane, products and by-products. Morphology, propagation & uses of Potato and Sweet Potato.

**Unit 3: Botany, Utilization of Plant Wealth (Spices, Beverages, Oil seeds fats and Essential oils) (16 lectures)**

**Spices:** Listing of important spices (Saffron, Cloves, Cardamom, Cinnamon, Tejpat, Anise, Cumin, Asafoetida, Fenugreek, Fennel, Coriander), their botanical name, family and part used. Origin, distribution, botany, cultivation practices, main chemical constituents, and economic Importance of the Major spices, namely Turmeric, Ginger, Capsicum, Black Pepper , Coriander. **Beverages:** Tea and Coffee : History, origin , growing countries, Botany, cultivation practices. **Oil seeds and** **fats:** General description, classification, extraction and uses of groundnut, coconut, linseed, soybean, mustard. **Essential Oils:** General description, uses extraction / distillation of essential oil, chemical constituents of major essential oil yielding aromatic plants, namely Rose, Geranium, Lemongrass / Citronella, Vetiver, mint, Basil, Lavender, Eucalyptus, Clove and Sandal wood.

**Unit 4: Botany, Utilization and Processing of Plant Wealth (Aromatic Plants, Drug-yielding and Medicinal plants, Timber plants) (16 lectures)**

**Drug-yielding and Medicinal plants:** Fumitories and Masticatories : Processing,

therapeutic uses, and health hazards of habit-forming drugs, with special reference to *Papaver ,* *Cannabis* and Tobacco.

Major Medicinal Plants : Botany, Uses, Cultivation and Processing of major medicinal plants, namely : Ashwagandha, Kalmegh, Satavar, Ghrit Kumari (*Aloe* *vera*), Senna, Bhui Amla (*Phyllanthus*), Stevia, Sarpagandha, Atropa, Digitalis, Giloy (Tinospora)

**Natural Rubber:** Pararubber: tapping, processing and uses.

**Timber plants and Fibres:** General account with special reference to, Saal (*Shorea robusta*), Teak and Pine. General account of the Fiber yielding plants, with special reference to Cotton, Sunhemp, flax, Coir, Jute.

**SEMESTER III**

**Core course VII: Genetics**

**(credits: Theory- 4, Practical- 2) F.M.-50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Mendelian genetics and its extension (16 lectures)**

Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes

and sex chromosomes; Incomplete dominance and codominance; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Numericals; Polygenic inheritance.

**Unit 2: Linkage, crossing over and chromosome mapping** (**12 lectures)**

Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two

factor and three factor crosses; Interference and coincidence; Gene mapping; Sex Linkage.

**Unit 3: Variation in chromosome number and structure (8 lectures)**

Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

**Unit 4: Gene mutations (6 lectures)**

Types of mutations; Molecular basis of Mutations; Mutagens – physical and chemical (Base

analogs, deaminating, alkylating and intercalating agents); Transposons.

**Unit 5: Fine structure of gene (6 lectures)**

Classical vs. molecular concepts of gene

**Unit 6. Population and Evolutionary Genetics (6 lectures)**

Genetic variation and Speciation.

**SEMESTER III**

**Skill Enhancement Course (SEC-1)**

**Plant Diversity and Human Welfare**

 **(Credits: Theory- 2, Project- 2) F.M.- 70**

**QUESTION PATTERN**: Question no. 1 will be compulsory, and ask for 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.), for 2 marks each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 15 marks each.

Unit 1: Plant diversity and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level. Values and uses of Biodiversity:Ethical and aesthetic values. Methodologies for valuation, Uses of plants, Uses of microbes. (8 lectures)

Unit 2:Loss of Biodiversity: Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Projected scenario for biodiversity loss, Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication. (8 lectures)

Unit 3:Conservation of Biodiversity: Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development. (8 lectures)

Unit 4: Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses. (6 lectures)

**SEMESTER III**

**Generic Elective (GE- 3)**

**Plant Anatomy and Embryology**

**(Credits: Theory-4, Practical-2) F.M.- 70**

**QUESTION PATTERN**: Question no. 1 will be compulsory, and ask for 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.), for 2 marks each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 15 marks each.

**Lectures: 60**

**Unit 1: Meristematic tissues (8 lectures)**

Apical, Intercalary and Lateral Meristems; simple and complex tissues

**Unit 2: Secondary Growth (8 lectures)**

Vascular cambium – structure and function, seasonal activity. Normal and Abnormal growth

Unit 3: Anomalous secondary growth

Boerhavia, Dracaena and Tinospora

**Unit 4: Structural organization of flower (8 lectures)**

Structure of anther and pollen; Structure and types of ovules; Types of embryo sacs,

organization

**Unit 5: Fertilization (8 lectures)**

Double fertilization

**Unit 6: Embryo and endosperm (8 lectures)**

Endosperm types, structure and functions; Dicot and monocot embryo; Embryo endosperm

Relationship

**SEMESTER IV**

**Core course VIII: Molecular Biology**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Nucleic acids : Carriers of genetic information (4 lectures)**

Historical perspective; DNA as the carrier of genetic information (Griffith’s, Hershey & Chase,Avery, McLeod & McCarty.

**Unit 2. The Structures of DNA and RNA / Genetic Material (10 lectures)**

DNA Structure: Miescher to Watson and Crick- historic perspective, DNA structure, Salient

features of double helix, Types of DNA, Types of genetic material, denaturation and

renaturation; Organization of DNA- Prokaryotes, Viruses, Eukaryotes.RNA

Structure\_Organelle DNA -- mitochondria and chloroplast DNA.TheNucleosome\_Chromatinstructure- Euchromatin, Heterochromatin- Constitutive and Facultative heterochromatin.

**Unit 3:The replication of DNA (10 lectures)**

Chemistry of DNA synthesis (Kornberg’s discovery); General principles – bidirectional, semiconservativeand semi discontinuous replication, RNA priming; Various models of DNA

replication, including rolling circle, θ (theta) mode of replication, replication of linear ds-DNA;Enzymes involved in DNA replication.

**Unit 4: Central dogma and genetic code (2 lectures)**

The Central Dogma; Genetic code (deciphering & salient features**)**

**Unit 5: Transcription (18 lectures)**

Transcription in prokaryotes and eukaryotes. Principles of transcriptional regulation;

Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E.coli.* Eukaryotes:transcription factors; Role of enzymes in trancription

**Unit 6: Processing and modification of RNA (8 lectures)**

Split genes-concept of introns and exons and splicing.

**Unit 7: Translation (8 lectures)**

Ribosome structure and assembly, mRNA; Charging of tRNA, aminoacyltRNAsynthetases;

Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides; Role of enzymes in translation; Inhibitors of protein synthesis.

**SEMESTER IV**

**Core course IX: Plant Ecology and Phytogeography**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Introduction, soil and water (15 lectures)**

Basic concepts; Levels of organization. Abiotic and biotic Components and their interrelationships and dynamism, homeostasis. **Soil:** Origin; Types and Formation; Composition; Physical, Chemical and Biological components; Soil profile. Types of soils in India. **Water:** States of water in the environment; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Atmospheric moisture; Water in soil; Ground water table. Water resources of India

**Unit 2: Ecological adaptations, Population ecology (15 lectures)**

Variations in adaptation of plants in relation to light, temperature, water, wind and fire. **Biotic interactions:** Competition: Inter- and intraspecific competition; Ammensalism, heterotrophy; mutualism, commensalism, parasitism; herbivory, carnivory, protocooperation, **Population ecology:** Characteristics and population growth, population regulation, life history strategies; *r* and *k* selection. Ecological Speciation.

**Unit 3: Plant Communities and Ecosystem (15 lectures)**

Community characteristics: analytical and synthetic; Concept of ecological amplitude; Habitat and niche; Ecotone and edge effect; Succession: processes, types; climax concept. Primary vs Secondary succession. **Ecosystem:** Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Ecosystems of India.

**Unit 4: Functional Aspects of Ecosystem and Phytogeography (15 lectures)**

Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles of carbon, nitrogen and phosphorus. **Phytogeography:** Principles;Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phyto-geographical division of India; Local Vegetation.

**SEMESTER IV**

**Core course X: Plant Systematics**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Significance of Plant systematics (12 lectures)**

Introduction to systematics; Plant identification, Classification, Nomenclature. Evidences from palynology, cytology, phytochemistry and molecular data. Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium.

**Unit 2: Taxonomic hierarchy (6 lectures)**

Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concept (taxonomic, biological, evolutionary).

**Unit 3: Botanical nomenclature (10 lectures)**

Principles and rules (ICN); Ranks and names; author citation

**Unit 4: Systems of classification (12 lectures)**

Major contributions of Hutchinson, Takhtajan and Cronquist; Classification systems of Bentham and Hooker(upto series)

**Unit 5: Phylogeny of Angiosperms (12 lectures)**

Terms and concepts (primitive and advanced, homology and analogy, parallelism and

convergence, monophyly, Paraphyly, polyphyly and clades). Origin and evolution of

angiosperms.

**SEMESTER IV**

**Skill Enhancement Course (SEC- 2)**

**Mushroom Culture Technology**

**(Credits: Theory- 2, Project- 2) F.M.- 70**

**QUESTION PATTERN**: Question no. 1 will be compulsory, and ask for 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.), for 2 marks each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 15 marks each.

 **Lectures: 30­**

Unit 1:Introduction, history. Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms.Types of edible mushrooms available in India - Volvariellavolvacea, Pleurotuscitrinopileatus, Agaricusbisporus. (5 Lectures)

 Unit 2:Cultivation Technology : Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation - paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation - Low cost technology, Composting technology in mushroom production. (12 Lectures)

 Unit 3:Storage and nutrition : Short-term storage (Refrigeration - upto 24 hours) Long term Storage (canning, pickels, papads), drying, storage in saltsolutions. Nutrition - Proteins - amino acids, mineral elements nutrition - Carbohydrates, Crude fibre content - Vitamins. (8 Lectures)

Unit 4:FoodPreparation­:Types of foods prepared from mushroom.ResearchCentres - National level and Regional level.­Cost benefit ratio - Marketing in India and abroad, Export Value. (5 lectures)

**SEMESTER IV**

**Generic Elective (GE- 4)**

**Plant Physiology, Cytogenetics and Biotechnology**

**(Credits: Theory-4, Practical-2) F.M.- 70**

**QUESTION PATTERN**: Question no. 1 will be compulsory, and ask for 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.), for 2 marks each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 15 marks each.

**Lectures: 60**

UNIT – 1 - 25

1. Transpiration - Mechanism & significance

2. Ascent of Sap – Root Pressure transpiration pull, theory

3. Photosynthesis – Photophosphorylation, C3, C4 Cycle

4. Respiration – Glycolysis, TCA Cycle.

5. Growth Hormone – Auxins, Gibberellins

UNIT – 2 - 25

1. Structure of Cytoplasmic Cell Organelles – Mitochondria, Chloroplast, Ribosome

2. Cell Division – Mitosis, Meiosis,

3. Principles of inheritance, Mendel’s Law

4. Complimentary Genes & Epistasis

5. Gene – Mutation & Polyploidy

UNIT – 3 - 5

Plant Tissue Culture – History, Requirement, Technique & Application

**SEMESTER V**

**Core course XI: Reproductive Biology of Angiosperms**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Reproductive development (6 lectures)**

Induction of flowering; flower as a modified determinate shoot. Flower development

**Unit 2: Anther and pollen biology (10 lectures)**

Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance.Microgametogenesis; Pollen wall structure, MGU (male germ unit) structure;

Palynology and scope (a brief account); Pollen wall proteins; Pollen viability and

germination.

**Unit 3: Ovule (10 lectures)**

Structure; Types; Special structures–endothelium, obturator, aril, caruncle and hypostase; Femalegametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis(details of *Polygonum*type); Organization and ultrastructure of mature embryo sac.

**Unit 4: Fertilization (6 lectures)**

Structure of stigma and style; path of pollen tube in pistil; double fertilization.

**Unit 5: Embryo, Endosperm and Seed (10 lectures)**

Structure and types; General pattern of development of dicot and monocot embryo and

endosperm; Suspensor: structure and functions; Embryo-endosperm relationship; Nutrition of

embryo; Unusual features; Seed structure

**Units 6: Polyembryony (6 lectures)**

Introduction; Classification; Causes and applications.

**SEMESTER V**

**Core course XII: Plant Physiology**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Plant-water relations (10 lectures)**

Water Potential, water absorption by roots, pathway of water

movement, symplast, apoplast, transmembrane pathways, root pressure, guttation. Ascent of sap–

cohesion-tensiontheory.Transpiration and factors affecting transpiration, mechanism of stomatal movement.

**Unit 2: Mineral nutrition (8 lectures)**

Essential and beneficial elements, macro and micronutrients, criteria for essentiality, mineral deficiency symptoms, roles of essential elements.

**Unit 3: Translocation in the phloem (8 lectures)**

Mass flow hypothesis of Munch

**Unit 4: Plant growth regulators (14 lectures)**

Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin,

Gibberellins, Cytokinin, Abscisic acid, Ethylene

**Unit 5: Physiology of flowering (6 lectures)**

Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy

**SEMESTER V**

**Discipline Specific Elective (DSE- 1)**

**Natural Resource Management**

**(Credits: Theory-4, Project-2) F.M.- 50**

**QUESTION PATTERN:** Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Natural resources (2 lectures)**

Definition and types.

**Unit 2: Sustainable utilization (8 lectures)**

Concept, approaches (economic, ecological and socio-cultural).

**Unit 3: Land (8 lectures)**

Utilization (agricultural, pastoral, horticultural, silvicultural); Soil degradation and management.

**Unit 4: Water (8 lectures)**

Fresh water (rivers, lakes, groundwater, aquifers, watershed); Marine; Estuarine; Wetlands;

Threats and management strategies.

**Unit 5: Biological Resources (12 lectures)**

Biodiversity-definition and types; Significance; Threats; Management strategies; Bioprospecting;

IPR; CBD; National Biodiversity Action Plan).

**Unit 6: Forests (6 lectures)**

Definition, Cover and its significance (with special reference to India); Major and minor

forestproducts; Depletion; Management.

**Unit 7: Energy (6 lectures)**

Renewable and non-renewable sources of energy

**Unit 8:** National and international efforts in resource management and conservation

(4 lectures)

**SEMESTER V**

**Discipline Specific Elective (DSE-2)**

 **Plant Breeding**

**(Credits: Theory-4, Project-2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Unit 1: Plant Breeding (10 lectures)**

Introduction and objectives. Breeding systems: modes of reproduction in crop plants. Important

achievements and undesirable consequences of plant breeding.

**Unit 2: Methods of crop improvement (20 lectures)**

Introduction: plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization: For self, cross and vegetatively propagated plants – Procedure, advantages and limitations.

**Unit 3: Quantitative inheritance (10 lectures)**

Concept, mechanism, examples of inheritance of Kernel colour in wheat, Skin colour in human

beings.Monogenicvs polygenic Inheritance.

**Unit 4: Inbreeding depression and heterosis (10 lectures)**

History, genetic basis of inbreeding depression and heterosis; Applications.

**Unit 5: Crop improvement and breeding (10 lectures)**

Role of mutations; Polyploidy; Distant hybridization and role of biotechnology in crop

improvement.

**SEMESTER VI**

**Core course XIII: Plant Metabolism**

**(credits: Theory- 4, Practical- 2) F.M.-50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Concept of metabolism (6 lectures)**

Introduction, anabolic and catabolic pathways, regulation of metabolism

**Unit 2: Carbon assimilation (14 lectures)**

Photosynthetic pigments, role of photosynthetic pigments (chlorophylls

and accessory pigments), antenna molecules and reaction centres, photochemical reactions,

photosynthetic electron transport, PSI, PSII, Q cycle, CO2 reduction, photorespiration, C4pathways.

**Unit 3: Carbohydrate metabolism (2 lectures)**

Synthesis and catabolism of sucrose and starch.

**Unit 4: Carbon Oxidation (10 lectures)**

Glycolysis, fate of pyruvate, regulation of glycolysis, oxidative pentose phosphate pathway,

TCA cycle,amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron

transport, oxidative phosphorylation.

**Unit 5: ATP-Synthesis (8 lectures)**

Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism

(oxidative and photophosphorylation), ATP synthase

**Unit 6: Lipid metabolism (8 lectures)**

Synthesis and breakdown of triglycerides, β-oxidation, glyoxylate cycle

**Unit 7: Nitrogen metabolism (8 lectures)**

Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes);

Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination

**SEMESTER VI**

**Core course XIV: Plant Biotechnology**

**(credits: Theory- 4, Practical- 2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Plant Tissue Culture** (**16 lectures)**

 Composition of media; Nutrient and hormone requirements (role of

vitamins and hormones); Totipotency; Organogenesis; Embryogenesis (somatic and zygotic);

Protoplast isolation, culture and fusion; Tissue culture applications (micropropagation,

androgenesis, virus elimination.

**Unit 2: Recombinant DNA technology (12 lectures)**

Restriction Endonucleases (History, Types I-IV, biological role and application); Cloning Vectors: Prokaryotic (pUC 18 and pUC19, pBR322, Ti plasmid, BAC); Genetic vectors (Transposons, Retroposons)

**Unit 3:Gene Cloning (10 lectures)**

Recombinant DNA, Bacterial Transformation and selection of recombinant clones, PCRmediated gene cloning

**Unit 4: Methods of gene transfer (8 lectures)**

*Agrobacterium*-mediated, Direct gene transfer by Electroporation, Microinjection,

Microprojectile bombardment

**Unit 5: Applications of Biotechnology (14 lectures)**

Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic cropswith improved quality traits (FlavrSavr tomato, Golden rice)

**SEMESTER VI**

**Discipline Specific Elective (DSE-3)**

 **Stress Biology**

**(Credits: Theory-4, Project-2) F.M.- 50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each.

**Lectures: 60**

**Unit 1: Defining plant stress (2 lectures)**

Acclimation and adaptation.

**Unit 2: Environmental factors (20 lectures)**

Water stress; Salinity stress, High light stress; Temperature stress; Hypersensitive reaction;

Pathogenesis; Systemic acquired resistance

**Unit 3: Stress sensing mechanisms in plants (20 lectures)**

Calcium modulation, Phospholipid signalling

**Unit 4: Developmental and physiological mechanisms that protect plants against**

**environmental stress (12 lectures)**

Adaptation in plants; Changes in root: shoot ratio; Aerenchyna development; Osmotic

adjustment; Compatible solute production.

**Unit 5: Reactive oxygen species–Production and scavenging mechanisms**. **(6 lectures)**

**SEMESTER VI**

**Discipline Specific Elective (DSE-4)**

 **Biostatistics**

**(Credits: Theory-4, Project-2) F.M.-50**

**QUESTION PATTERN**: Question no. 1 will be compulsory and have 10 objective type questions (MCQ/True-False/Fill in the Blanks etc.) of 1 mark each. Question no.s 2 to 6 will be short answer type questions of which 4 have to be answered for 5 marks each. Question no.s 7 to 10 will be long answer type questions of which 2 have to be answered for 10 marks each. The questions will also include mathematical problems.

**Lectures: 60**

**Unit 1:Biostatistics (12 lectures)**

Definition - statistical methods - basic principles. Variables - measurements, functions,

**Unit 2:Collection of data primary and secondary (12 lectures)**

Types and methods of data collection procedures - merits and demerits. Classification -

tabulation and presentation of data - sampling methods.

**Unit 3:Measures of central tendency (14 lectures)**

Mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range,

standard deviation; Co- efficient of variations.

**Unit 4:Correlation (12 lectures)**

Types and methods of correlation, regression, simple regression equation

**Unit 5:Statistical inference (10 lectures)**

Hypothesis - simple hypothesis - student 't' test - chi square test