Draft of M.Sc Botany Syllabus : Course Structure

M.Sc Part –I (To be Implemented from June 2008)

First Semester

Course No.	Course Titles	Lectures/Practicals
BO 1.1	Systematics of non-vascular plants	48 Lectures
BO 1.2	Plant Physiology and Biochemistry	48 Lectures
BO 1.3	Genetics and Plant Breeding	48 Lectures
BO 1.4	Practicals based on BO 1.1	24 Practicals
BO 1.5	Practicals based on BO 1.2 and BO 1.3	24 Practicals

Second Semester

Course No.	Course Titles	Lectures/Practicals
BO 2.1	Systematics of Vascular Plants	48 Lectures
BO 2.2	Cell Biology and Instrumentation	48 Lectures
BO 2.3	Molecular Biology and Genetic Engineering	48 Lectures
BO 2.4	Practicals based on BO 2.1	24 Practicals
BO 2.5	Practicals based on BO 2.2 and BO 2.3	24 Practicals

M.Sc. Part – II (To be Implemented from June 2009)

Third Semester

Course No.	Course Titles	Lectures/Practicals
BO 3.1	Developmental Botany and Plant Tissue Culture	48 Lectures
BO 3.2	Environmental Botany and Palaeobotany	48 Lectures
BO 3.31 to BO 3.39	Elective Paper – I	48 Lectures
BO 3.31	Algology	
BO 3.32	Mycology	
BO 3.33	Angiosperms	
BO 3.34	Plant Physiology	

BO 3.35	Pharmacognosy	
BO 3.36	Cytogenetics and Plant Breeding	
BO 3.37	Plant Ecology	
BO 3.38	Plant Biotechnology	
BO 3.39	Plant Diversity	
BO 3.4	Practicals based on BO 3.1 and BO 3.2	24 Practicals
BO 3.5	Practicals based on Elective paper I (60 Marks) + Project Review of 5 Research papers from Reputed journal (10 Marks) + Seminar based on project reviews – (10 Marks)	18 Practicals + 06 Practicals (based on review)

Fourth Semester

Course No.	Course Titles	Lectures/Practicals
BO 4.1	Plant diversity, resource utilization and conservation	48 Lectures
BO 4.21 to 4.28	Elective Papers - II	48 Lectures
BO 4.21	Seed Technology	48 Lectures
BO 4.22	Post harvest Technology	
BO 4.23	Natural Plant Products	
BO 4.24	Plant Biomass Production	
BO 4.25	Plant Pathology	
BO 4.26	Plant Protection	
BO 4.27	Restoration Ecology	
BO 4.28	Plant Improvement	
BO 4.3	Bio-statistics and Bioinformatics	48 Lectures
BO 4.4	Practicals based on BO 4.1 and BO 4.3	24 Practicals
BO 4.5	Practicals based on Elective papers – II BO 4.21 to BO 4.28 (50 Marks) + Project Work (20 Marks) + Seminar based on project work (10 Marks)	12 Practicals 10 Practicals 02 Practicals

BO 1.1 Systematics of Non-Vascular Plants (48 Lectures)

1. **INTRODUCTION: - (4 Lectures)**

   Difference in Systematics and Taxonomy, Systematics – Concept, structural, Biochemical and Molecular systematics, Principles and Procedures of plant systematics, Sources of data for plant systematics.

2. **ALGAE: - (12 Lectures)**

   a. **Introduction: - (3 Lectures)**

      Position of algae in eight kingdom system, algal habitats, reserve food, thallus organization, pigments, evolutionary trends among algae, algal classification as per Smith, Fritsch, Bold and Wyne and Christensen.

   b. **Cyanophyta: - (2 Lectures)**

      Cell organization, thallus type, asexual reproduction, heterocyst interrelationships.

   c. **Chlorophyta and Charophyta: - (6 Lectures)**

      Range of thallus, asexual reproduction, life cycle pattern with respect to orders.

   d. **Phaeophyta and Rhodophyta: - (4 Lectures)**

      Thallus organization, asexual and sexual reproduction, interrelationship.

   e. **Minor groups: - (1 Lecture)**

      Chrysophyta, Pyrrophyta.

3. **FUNGI: - (16 Lectures)**

   a. **Introduction: - (2 Lectures)**

      Present status of fungi, habit or modes of life, Thallus organization, Nutrition-Saprotrophs, Biotrophs, Necrotrophs, Symbiotrophs, Evolutionary trends among fungi.

b. Reproduction: - (3 Lectures)

Asexual, Sexual methods, Evolution of sex in fungi, Heterothallism, Parasexuality and compatibility, fungal sex hormones.

c. Classification: - (1 Lecture)

Outline classification of fungi as per Smith, Ainsworth et.al, Alexopoulos, Mims and Blackwell.

d. Comparative account of thallus structure and spore producing organs, interrelationship, life cycle pattern and phylogeny of the following groups Myxomycotina, Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. **(10 Lectures)**

4. BRYOPHYTA: - (12 Lectures)

a. Introduction: - (2 Lectures)

Habit and Habitat, Distribution, Outline classification of Bryophytes as per Smith and Watson, Indian Bryology.

b. Morphology and anatomy of vegetative and reproductive structures of the following – (9 Lectures)

Sphaerocarples, Marchantiales, Jungermanniales (Acrogynae, Unacrogynae), Calobryales, Takakiales, Anthocerotales, Sphagnales, Andracales, Polytrichales, Funariales, Dawsoniales.

c. Ecological significance of Bryophytes. **(1 Lectures)**

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BO – 1.2 Plant Physiology and Biochemistry

(48 Lectures)

PLANT PHYSIOLOGY: - (24 Lectures)

1. **Plant Water Relation: - (3 Lectures)**

   Regulation of water supply, Aquaporins and facilitated water Transport, Soil plant atmosphere continuum (SPAC), Recent concept in stomatal physiology, Signal transdution in guard cell.

2. **Solute Transport: - (3 Lectures)**

   Diffusion, Nerst equation, Uniport, Symport, Antiportion channels, ATP driven active transport (Phloem loading and unloading)

3. **Photochemistry and Photosynthesis: - (5 Lectures)**

   Photosynthetic pigments, absorption and transformation of radiant energy, Light harvesting complexes, Kok curve, Kautsky curve, ETS, photo inhibition O_2 and H_2 evolution, Regulation of Calvin cycle, RUBISCO activity, Photorespiration, CAM, C4 Pathway.

4. **Respiration: - (4 Lectures)**

   Overview of plant Respiration, EMP pathway, TCA cycle, PPP, Glyoxylate cycle, Mitochondrial ETS, Cyanide resistance pathway, Gluconeogenesis, High energy compounds: Synthesis and utilization, ATP synthesis.

5. **Plant growth regulators:** - **(3 Lectures)**

   Biosynthesis and action mechanism of : Auxins Gibberellins, (GA), Cytokinins, Ethylene, Abscicsic Acid, Introduction of other hormones.

6. **Seed Germination, Flowering and Fruit ripening: - (4 Lectures)**

   Metabolic changes during seed germination, flowering initiation, maturity and fruiting, fruit ripening.

7. **Stress Physiology: - (2 Lectures)**

   Biotic and abiotic stresses.

BIOCHEMISTRY: - (24 Lectures)

1. **Energy Dynamics: - (2 Lectures)**

   Structure of atoms, molecules and chemical bonds, principles of physical chemistry, principles of thermodynamics, free energy, Redox potentials, Dissociation and associations constants, Activation energy, Binding energy.

2. **Enzymology: - (4 Lectures)**

   General classification of Allosteric mechanism, Isozymes, Factors affecting enzyme activity, Enzyme Kinetics, Michaelis – Menton equation, Competitive, uncompetitive and non competitive inhibition.

3. **Carbohydrates: - (4 Lectures)**

   General classification, Synthesis and breakdown of carbohydrates (starch, glycogen, pectin, Glucose)

4. **Amino acids and proteins: - (4 Lectures)**

   General classification of amino acids and proteins, Structure, synthesis and properties of amino acids, protein structure (Primary, secondary, tertiary and quaternary), Ramchandran plot.

5. **Nitrogen metabolism: - (2 Lectures)**

   Nitrogen uptake, NOD factor, root nodulation and nitrogen fixation.

6. **Secondary metabolites: - (5 Lectures)**

   General classification of Major pathways, Phenolics (Lignins, tannins) Flavonoids, terpenoids (steroids), Alkaloids, pigments (Carotenoids, Anthocynins)

7. **Lipid metabolism: - (3 Lectures)**

   General classification of Phospho, Spingo, Glyco Lipid biosynthesis and oxidation.

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BO – 1.3 PRINCIPLES OF GENETICS AND PLANT BREEDING (48 Lectures)

1. **Principles of Mendelian inheritance and Interaction of genes: - (4 Lectures)**

   Introduction to pre Mendelian, Mendelian and Post Mendelian genetics. Complementary, epitasis, inhibitory, Duplicate, Polymeric, Lethal and additive interaction of genes.

2. **Cytoplasmic inheritance: - (6 Lectures)**

   Cytoplasmic inheritance involving chloroplast (*Mirabilis jalapa, Zea mays*) and Mitochondria (petite yeasts and cytoplasmic male sterility in higher plants), mitochondrial and chloroplast genomes, interaction between nuclear and cytoplasmic genes. (*Rubisco and Cytochrome oxidase*)

3. **Quantitative Inheritance : - (4 Lectures)**

   Qualitative and Quantitative traits, Continuous variation, Inheritance of quantitative traits, (corolla length in *Nicotiana,* cob length in *Zea mays*), multiple factors hypothesis and heritability.

4. **Recombination and Linkage: - (5 Lectures)**

   Concept of Linkage, Types and Applications, Concept and Types of Recombination, estimation of recombination percentages and map distances, Gene mapping in Fungi using ordered and unordered tetrads of *Neurospora* and yeast. Three point test crosses and estimation of linkage distances in plants. Gene maps and physical maps.

5. **Population genetics: - (3 Lectures)**

   Gene and genotype frequencies, Hardy-Weinberg law, Factors affecting Hardy-Weinberg equilibrium (selection, mutation, migration and genetic drift) C value paradox, B chromosomes.

6. **Cytogenetics: - (5 Lectures)**

   Karyoptype, chromosome markers, Variation in chromosome structure – Detection, Duplication, Inversion and Translocation. Cytological consequences of crossing over in Inversion and translocation heterozygotes.

7. **Polyploidy: - (4 Lectures)**

   Classification, Aneuploidy and its importance, Methods of inducing Auto and allopolyploidy, Role of polyploidy in crop improvement.

8. **Plant Breeding: - (2 Lectures)**

   Pre and post Mendelian development, objectives, Genetic basis of breeding, Plant breeding in India.

9. **Plant Genetic resources: - (2 Lectures)**

   Genetic diversity in plants, Importance of genetic diversity in crop improvement and its erosion, Concepts of biodiversity conservation and regulation.

10. **Reproductive systems and Pollination control mechanisms: - (6 Lectures)**

    Sexual reproduction (Cross and self pollination), asexual reproduction, Imcompatibility and Male sterility, their types, mechanisms and applications in plant breeding.

11. **Hybridization: - (3 Lectures)**

    Hybridization and its role, Inter-varietal and wide crosses. Principles of combination breeding and its application. Hybrid breeding in self and cross pollinated crops. Heterosis, Inbreeding depression.

12. **Mutations: - (4 Lectures)**

    Concepts, classification of mutation, physical and chemical mutagens, their mechanism of action, molecular basis of gene mutations, Role of mutations in Plant Breeding.

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BO 1.4 Practicals [based on BO 1.1 (Algae, Fungi and Bryophytes)]

1. **ALGAE: -**
    a. **Cyanophyta: - (2 Practicals)**

        Range of thallus organization and reproductive structures, types showing unicellular, gonical, conical, filamentous, branched (pseudo and true branched)

    b. **Chlorophyta: - (4 Practicals)**

        Chlamydomonas, Gonium, Pandorina, Eudorina, Volvox, Chlorella, Pediastrum, Hydrodictyon, Scenedesmus, Ulothrix, Stigeoclonium, Cladophora, Draparnaldia, Draparnaldiopsis, Fristschiella, Chara, Nitella, Coleochaete, Ulva, Schizomeris, Caulerpa, Oedogonium, Zygnema, Spirogyra, Desmids.

    c. **Phaeophyta: - (1 Practical)**

        Ectocarpus, Sphacelaria, Dictyota, Padina, Sargassum.

    d. **Rhodophyta: - (1 Practical)**

        Porphyra, Batrachospermum, Gelidium, Gracillaria, Champia, Polysiphonia.

    e. **Other: - (1 Practical)**

        Centric and Pinnate Diatoms, *Vaucheria, Dinobrion, Euglena, Phacus.*

2. **FUNGI: - (12 Practicals)**

    Thallus organization, Spore producing organs, Tissue differentiation and accessory structures of following –

    a. **Myxomycotino: - (1 Practicals)**

        Stemonites, Arcyria, Physarum, Didymium, Hemitrichea.

b. Mastigomycotina: - (2 Practicals)

Synchytrium, Physoderma, Saprolegnia, Achlya, Peronospora, Plasmopara, Albugo, Sclerospora.

Zygomycotina: -

Mucor, Rhizopus, Pilobolus.

c. Ascomycotina: - (3 Practicals)

Taphrina, Protomyces, Erotium, Phyllachora, Diatrype, Elsinoe, Bagnisiella, Tryblidiella, Trichoglossum, Meliola, Meliolina, Erysiphe, Phyllactinia, Uncinula.

d. Lichens: - (1 Practicals)

Usnea, Anaptychia, Lecanora, Graphis, Parmelia.

e. Basidiomycotina: - (3 Practicals)

Uromyces, Ravenelia, Haphalophragmium, Monosporidium, Dasturella, Melampsora, Ustilago, Sphacelotheca, Entyloma, Agaricus, Pleurotus, Coprinus, Marasmius, Ganoderma, Polyporus, Cyathus, Lycoperdon, Phallus, Geaster.

f. Deuteromycotina: - (1 Practical)

Aspergillus, Penicillium, Fusarium, Cercospora, Colletotrichum, Ascochyta, Alternaria.

3. Bryophyta: - (5 Practicals)

a. Hepaticopsida: - (2 Practicals)

Riccia, Marehantia, Targionia, Astrella, Porella, Frullania, Cyathodium, Plagiochasma, Riccardia.

b. Anthocerotopsida: - (1 Practical)

Anthoceros, Notothyllus.

c. Bryopsida: - (2 Practicals)

Sphagnum, Funaria, Polytrichum, Bryum, Macrometrium.

BO 1.5 – Practicals based on BO 1.2 and BO 1.3

Plant Physiology Practicals: -

1. Principles of pH metre, colorimetry, spectrophotometry and fluorimetry.
   (1 Practical)
2. To determine the chlorophyll a / chlophyll b ratio in C_3 and C_4 plants.
   (1 Practical)
3. Preparation of the absorption spectra of chlorophyll **a** and estimation of total chlorophyll **a**. **(1 Practical)**
4. Survey of C_4 plants and CAM plants. Find out C4 pathways from the given plants by titration method. (TAN) **(1 Practical)**
5. To determine the activity of enzyme amylose in germinating seeds and its induction by GA. **(1 Practical)**
6. Hill Reaction. **(1 Practical)**
7. Effect of salt stress on accumulation of proline and its estimation. **(1 Practical)**
8. Estimation of Vitamin 'C' from suitable plant material. **(1 Practical)**

Biochemistry Practicals: - (Any eight practicals)

1. Preparation of i) solutions of different molarity and normality.
   ii) Buffers of different molarity and pH. **(1 Practical)**
2. Comparative estimation of proteins by using Lowery, Bradford and Biuret methods. **(1 Practical)**
3. To determine the units of activity and specific activity of β- amylase enzyme. **(1 Practical)**
4. Effect of substrate concentration on β- amylase activity and determination of its Km value by Michalis – Menton Curve. **(1 Practical)**
5. Separation of isozymes of peroxidases by native polyacrylamide gel electrophoresis. **(1 Practical)**

6. To study biochemical changes during leaf senescesnce. **(1 Practical)**
7. Desalting of proteins by get filtration chromatography employing sephadix G – 25. **(1 Practical)**
8. Separation of pigments by paper chromatography and TLC **(1 Practical)**

Genetics: -

1. Mathematical problems based on Mendelian genetics (Test of goodness of fit), Interaction of genes and Linkage and gene mapping. **(2 Practicals)**
2. Induction of polyploidy using colchicine; preparation of C-metaphase and karyotyping **(2 Practicals)**
3. Effect of physical/chemical mutagens on early seedling growth (Germination) and isolation of chlorophyll mutants following irradiation and treatment with chemical mutagens. **(2 Practicals)**
4. Study of meiosis in complex translocation heterozygotes *(Rhoeo discolor)* **(1 Practical)**.
5. Study of quantitative inheritance in suitable plant material. **(1 Practical)**

BO 2.1 Systematics of Vascular Plants (48 Lectures)

Pteridophytes: - (12 Lectures)

1. **Introduction: - (2 Lectures)**

   Habit and habitat, Plant body organization, Gametophyte and Sporophyte - evolution, Life cycle pattern, Comparative account of systems of classification with examples, Evolutionary significance of heteroporous Pteridophytes, Indian pteridology.

2. Comparative account of morphology, anatomy of gametophyte and sporophyte of – Psilotales, Lycopodiales, Isoetales, Equisetales, Ophioglossales, Maratiales, Osmundales, Filicales**. (8 Lectures)**
3. Alternation of generations, Apogamy, Apospory**. (2 Lectures)**

Gymnosperms: - (12 Lectures)

1. **Introduction: - (2 Lectures)**

   Habit, Habitat, Distribution, Plant body organization, Life cycle pattern,

   Comparative account of systems of classification with examples –

   Sporne's system, Sahni and Bhatnagar system.

2. Comparative account of structure of sporophyte and gametophyte of –
   Cycadales, Ginkgoales, Coniferales, Gnetales, Ephedrales, Welwitschiales. **(9 Lectures)**

3. Gymnosperm as prospective ancestor of angiosperms. **(1 Lecture)**

Angiosperms: - (24 Lectures)

1. **Introduction: - (1 Lecture)**

   Angiosperms as highly evolved, dominant and successful group of plants.

2. **Systems of angiosperm classification: - (6 Lectures)**

   Phenetic in taxonomy, Cladistics in taxonomy, Merits and limitations of systems of classification like –

Takhtajan system, Cronquists system, Dahlgrens system, Reference of systematics to assessment, Conservation and utilization of Angiosperm diversity.

3. Discussion of classes and subclasses of angiosperms by Cronquist (1989) : - **(7 Lectures)**

   Magnoliopsida and Liliopsida.

4. **Synthetic approach to the systematic of Angiosperms : - (3 Lectures)**

   Palynology, Phytochemistry, Genome analysis.

5. **Tools of Taxanomy : -**

   Laboratory, Field and Library tools.

6. **Origin of intrapopulation variation**: - **(3 Lectures)**

   Population and environment , Ecads and ecotypes, Evolution and differentiation of species – Various models.

7. **The Species Concept: - (4 Lectures)**

   Taxonomic hierarchy, Species, Genus, Family and other categories, Principles used in assessing relationship, Delimitation of taxa and attribution of rank

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BO 2.2 Cell Biology and Instrumentation (48 Lectures)

1. **Introduction: - (1 Lecture)**

   Evolution of eukaryotic cell from prokaryotic cells.

2. **The Dynamic Cell: - (3 Lectures)**

   Structural organization of plant cell, sub cellular organization, Totipotency and cell differentiation, cytoplasmic matrix (Properties and organization)

3. **Biogenesis, Ultra structure and functions of: - (18 Lectures)**

   i. Cell wall **(2 Lectures)**
   ii. Plasma membrane **(2 Lectures)**
   iii. Plastids **(2 Lectures)**
   iv. Endoplasmic reticulum **(2 Lectures)**
   v. Mitochondria **(2 Lectures)**
   vi. Golgi apparatus **(1 Lecture)**
   vii. Plasmodesmata **(1 Lecture)**
   viii. Plant Vacuole **(1 Lecture)**
   ix. Nucleus **(2 Lectures)**
   x. Ribosome **(1 Lecture)**
   xi. Lysosomes, Peroxisomes and Glyoxysomes **(2 Lectures)**

4. **Chromosomes: - (2 Lectures)**

   Structure, Types, packing of DNA, Nucleosome organization, molecular organization of centromere and Telomere, Giant chromosomes.

5. **Cell cycle and apoptosis: - (4 Lectures)**

   Mechanism of cell division, mitosis and meiosis, cell differentiation, control mechanisms, role of cyclins and cyclin dependent kinases cell-cell interaction, malignant growth, immune response, dosage compensation.

6. **Cell signaling in Plants: - (6 Lectures)**

   Concept, Photoproteins-light responsive proteins, Receptor/threonine kinase, Ethylene activated two component signaling pathway, plant wound signaling pathway.

7. **Instrumentation: - (13 Lectures)**

   Microscopy: - Simple, Compound, Phase contrast, Flurosence, Electron (SEM and TEM) microscopy, Micrometry **(2 Lectures)**

   Centrifugation: - Rotors, Bench top, Low speed, High speed, Cooling, Ultracentrifuge**. (1 Lectures)**

   Electrophoresis: - Native, Denaturing, Isoelectric focusing, 2 D Electrophorses. **(2 Lectures)**

   Spectroscopy: - UV, Visible, IR, Raman, Spectroflurometry, Mass, AAS, NMR, ESR**. (2 Lectures)**

   Radioactivity: - GM counting, Scitillation counting, Autoradiography. **(1 Lectures)**

   Immunology:-Antigen-Antibody interaction. Immunodiffusion, Immunoprecipitation, Immunoelectrophoresis, RIA, ELISA. **(2 Lectures)**

   Chromatography: - Paper, TLC, Column, Gel Filtration, Affinity, Ion Exchange, HPLC, GC**. (2 Lectures)**

   Microtomy (2 Lectures)

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8. **Roy S.C and KKDe** 2005 (Second Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
9. **Verma P.S and Agarwal V.K** 2006 Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
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BO 2.3 – Molecular Biology and Genetic Engineering (48 Lectures)

1. **Structure and Properties of Nucleic acids: - (5 Lectures)**

   Structure, Chemical, Physical, Spectroscopic and thermal properties of nucleic acids. (Buoyant density, Melting temperature, Effect of acid and alkali, UV absorption, hypo and hyperchromicity), Dissociation and reassociation kinetics of DNA, Cot curves, Cot ½ values and its significance. Unique, moderately repetitive and highly repetitive DNA, forms of DNA. (A, B, C, Z) RNA as a genetic material.

2. **Gene Structure: - (3 Lectures)**

   Organization and Structure of prokaryotic and eukaryotic genes; structure and role of promoters, exons, introns, terminators and enhancers.

3. **DNA Replication: - (3 Lectures)**

   Mechanism of prokaryotic and eukaryotic DNA replication, replication apparatus, Origins of replication, priming and DNA polymerases. Rolling circle and theta (θ) models.

4. **DNA damage and repair: - (3 Lectures)**

   Types of DNA damage, enzymes involving in repairing of DNA, excision repair, recombination repair and mismatch repair systems.

5. **Transcription: - (6 Lectures)**

   RNA polymerases and their role, Transcription apparatus, Transcription in prokaryotes and eukaryotes, Initiation, elongation and termination, RNA processing, reverse transcription and cDNA synthesis, Ribonucleoproteins, Structure of mRNA.

6. **Regulation of Transcription in prokaryotes and eukaryotes: - (4 Lectures)**

   Operon concept (Lac, Tryptophan, Arabinose) positive and negative regulation of prokaryotic genes, eukaryotic transcription factors.

7. **Protein synthesis: - (4 Lectures)**

   Structure of rRNA, tRNA and Ribosomal assembly. Mechanism of protein synthesis in prokaryotes and eukaryotes, initiation, elongation and termination. Translational and post translational control. Targeting of organelle proteins, protein folding and processing. Chaperones.

8. **Genetic Engineering: - (6 Lectures)**

   Machinery used in genetic engineering –

   i. Cloning vectors (plasmid and bacteriophage vectors, cosmids BAC and YACs.
   ii. Enzyme (restriction endonucleases, polymerases, reverse transcriptase, alkaline phosphatase, polynucleotide kinase, Ligases, terminal transferases)
   iii. DNA cloning, preparation of plasmid DNA, Restriction and electrophoresis, ligation, transformation and analysis of recombinants.

9. **Plant Genetic Engineering: - (5 Lectures)**

   Methods of direct and indirect gene transfer in plants, *Agrobacterium*, Ti and Ri plasmids, application of genetic engineering, transgenic plants for insect, fungal, bacterial disease resistance, lignin, modification, abiotic stress tolerance, production of useful products.

10. **Techniques of Genetic Engineering: - (6 Lectures)**

    Principles and methods of Genetic Engineering, Gene libraries and cDNA libraries, Polymerase chain reaction, DNA fingerprinting, DNA Synthesis, DNA Sequencing, Southern blotting, RAPD, RFLP, Restriction mapping.

    Introduction to Genomics, Proteomics and Bioinformatics.

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BO 2.4 Practicals Based on 2.1

(Pteridophytes, Gymnosperms and Angiosperms Systematics)

Pteridophytes: - (6 Practicals)

1. **Study of the following members to observe arrangement of Sori on a receptacle : - (2 Practicals)**

   Isoetes, Osmunda, Angiopteris, Ceratopteris, Achrostichum.

2. **Morphology, Anatomy and reproductive structures of : - (4 Practicals)**

   Psilotum, Selaginella, Lycopodium, Equisetum, Ophioglossum, Lygodium, Pteris, Pteridium, Atheurium, Actionopteris, Salvinia, Adiantum, Azolla.

Gymnosperms: - (6 Practicals)

Morphology, Anatomy and reproductive structures of –

Cycas, Zamia, Ginkgo, Pinus, Araucaria, Taxus, Cedrus Picea, Thuja, Podocarpus, Callitri's, Gnetum, Ephedra.

Angiosperms: - (12 Practicals)

1. *Methods of non-destructive field collection and documentation.* ***(1 Practicals)***
2. *Techniques of herbaria preparation.* ***(1 Practical)***
3. *Morphological characterization of selected families of dicots (10 families) and monocots (5 families) and identification upto families.* ***(5 Practicals)***
4. *Preparation of artificial key (at least five) based on appropriate character combination.* ***(2 Practicals)***
5. *Identification of genus and species from – (at least ten)*

   Monocots ***(1 Practical)***

   Dicots ***(2 Practicals)***
6. *Identification of given plant (at least six) up to species with the help of modern flora keys.*

   (2 Practicals)

BO 2.5 Practicals [based on BO 2.2 and BO 2.3]

(Cell Biology, Instrumentation, Molecular Biology and Genetic Engineering)

Molecular Biology (8 Practicals): -

1. Isolation of plant genomic DNA and its quantification by UV- spectrophotometric method. **(2 Practicals)**
2. Isolation of plasmid DNA and demonstration of nicked, super coiled forms on Agarose gel electrophoresis and visualization by ethidium bromide staining.
   (2 Practicals)
3. Restriction digestion of DNA and its analysis by Agarose gel electrophoresis
   (1 Practical)
4. SDS-PAGE analysis of seed storage proteins (globulins) from legumes.
   (2 Practicals)
5. Isolation of RNA and its quantification by UV - spectrophotometric method.
   (1 Practical)

Cell Biology (8 Practicals): -

1. Identification of different stages of mitosis and study of morphology of metaphase chromosomes from Onion root meristems. **(1 Practical)**
2. Identification of different stages of meiosis from suitable plant material. (Onion Buds).
   (1 Practical)
3. Orcein staining of salivary gland chromosomes of *Chironomas* or *Drosophila*.
   (1 Practicals)

4. Isolation of cell organelles: Mitochondria, Chloroplast, Nucleus, Lysosomes and there assay by succinate dehydrogenase activity(Mitochondria), acid phosphatase activity (Lysosomes), acetocarmine staining (Nucleus) and Microscopic observation (Chloroplast). **(3 Practicals)**
5. Study of mitotic index from suitable plant material**. (1 Practical)**
6. Techniques of preparation of permanent and semi permanent slides. **(1 Practical)**

Instrumentation: - (8 Practicals)

1. Demostration of microscopes (phase contrast, fluorescence, SEM, TEM) **(1 Practical)**
2. Micrometry of pollen grains. **(1 Practical)**
3. Camera Lucida sketching of suitable stages and karyotyping. (**1 Practical)**
4. Microtome techniques **(4 Practicals)**
5. Immunodiffusion and Immunoprecipitation. **(1 Practical)**