

**Ph.D. Course Work  
Department of Botany  
Visva-Bharati**

**Ordinance**

**Paper I**

Research Methodology	8 credit points	Full Marks – 100
(a) Subject concerned	6 credit points	Marks- 75
(b) Computer Application	2 credit points	Marks- 25

**Paper II (Optional)**

Advanced fields of the subject	8 credit points	Full marks – 100
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**Paper III**

Review work in the relevant field and presentation	8 credit point	Full Marks- 100
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- (i) Report – 60 marks
- (ii) Presentation & Viva voce – 40 marks

**Ph.D. Course Work  
(Detailed syllabus)**

<b>Paper I (Research Methodologies)</b>	<b>8 Credit points</b>	<b>Full Marks 100</b>
Subject concerned:	6 credit points, marks 75	
Computer Applications:	2 credit points, marks 25	

A. Subject concerned: 75 marks

1. Microscopic techniques: light microscopy; electron microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy
2. Karyotype study; Micropropagation and *in vitro* tissue culture; Protoplast culture and protoplast fusion technology
3. Protein extraction and purification; Native and SDS-PAGE of proteins, isoelectric focusing; MALDI-TOF/TOF and peptide sequencing
4. Quantitative analysis of biomolecules- spectrophotometric, gravimetric and titrimetric estimation
5. Chromatographic separation of compounds- column chromatography, paper chromatography, affinity chromatography, HPLC
6. Genomic and plasmid DNA isolation; Identification of DNA binding region by Electrophoretic mobility shift assay; Real time PCR method
7. Pollen slide preparation by Acetolysis method, qualitative evaluation of honey, pollen viability and stigma receptivity tests
8. Quantification of aeroallergens by volumetric air samplers; Purification and identification of aeroallergens by *in vivo* test ( skin-prick test) and *in vitro* tests (ELISA, RIA, Dotblotting, Immunoblotting, Immuno-electrophoresis)
9. Alpha, beta & gamma biodiversity study, assessment of cladistics and phenetic classification, assessment of gene diversity by RFLP, RAPD, microsatellite, SNP analysis; Study of *in situ* & *ex-situ* conservation of natural resources
10. Isolation of organisms from natural sources (Algae, Fungi and Bacteria) and their culture; Bacterial fermentation
11. Crude drug analysis

B. Computer Applications: 25 marks  
[To be framed by the Department of Computer System & Science Department]

**Paper II (Optional)**

**8 credit points**

**Full marks – 100**

[Any **one** of the following papers has to be opted by the candidate]

**A. Plant Physiology and Biochemistry**

1. Plant survival under stress: Responses of plants/tissues to desiccation, salinity and heat; Reactive oxygen species (ROS) and their metabolism, antioxidants and scavenging enzymes; stress-induced proteins.
2. Molecular physiology of hormones: Receptors of phytohormones, signaling cascades leading to physiological responses; deficiency mutants and perception mutants.
3. Cell signaling: Receptors, second messengers, G-protein and phospholipid signaling, cyclic nucleotides, calcium and calmodulin, protein kinases and phosphatases.
4. Membrane transport: Membrane potential; electrogenic pumps, carriers, ion channels, aquaporins.
5. Cell morphogenesis and patterning: Cytoskeleton, role of actin filaments and microtubules in cell patterning; signaling and regulation.
6. Protein sorting and vesicle traffic: Protein sorting machinery, protein targeting; role of ER, endocytosis and vesicle trafficking.
7. Seed physiology: Seed development; deposition of storage reserves and its regulation, embryo maturation and desiccation tolerance; seed deterioration and longevity.
8. Senescence and programmed cell death: Senescence patterns, senescence-associated genes and senescence mutants; chlorophyll and protein catabolism; programmed cell death in plants- differentiation of traceary elements, formation of aerenchyma, regulation of PCD.

**B. Cytogenetics and Plant Biotechnology**

1. The dynamism and ultrastructure of the nuclear components; nuclear envelope, molecular traffic between nucleus and cytoplasm; nucleolus, chromatin
2. Ribosomal RNA genes, transcription and processing of rRNA, ribosome assembly
3. Recombinant DNA technology and its application in Agriculture
4. Chromosome changes and biodiversity
5. Chromosome behaviour in differentiation; nuclear DNA and plant evolution
6. Androgenesis and dihaploids: in vitro production of haploids and dihaploids, significance and uses of haploidy

7. Protoplast fusion technology and somatic hybridization, application
8. Current trends in forest tree biotechnology
9. Somaclonal variation: basis of somaclonal variation, scheme for obtaining somaclonal variation, application
10. Biodiversity conservation: Possible approaches, in vitro storage technology

### **C. Biosystematics, Palynology & Aerobiology**

1. Biosystematics and its categories: APG- II classification; Plant identification using different keys
2. Herbaria and Botanic gardens and their role in modern research; ICBN
3. Taxonomic evidences from Cytology, Phytochemistry, Molecular Taxonomy, Anatomy, Embryology & Palynology; Computer-aided Taxonomy
4. Conservation of bioresources
5. Polarity, symmetry and shape classes of pollen grains, NPC classification, Sporoderm stratification, Exine ornamentation, LO analysis
6. Sources, chemistry and function of sporopollenin
7. Pollen wall proteins: nature, origin & function, marker proteins
8. Aeroallergens: mechanism of Type-I allergy, Pollen calendar, important and well-characterized pollen/spore allergens
9. Melissopalynology: Physical & chemical characteristics of honey, Types of honey, assessment of honey quality, adulteration of honey, Geographical origin of honey
10. Pollen biotechnology: Use of pollen for genetic transformation, induction of haploids( pollen embryos) from pollen grains and their utilization, production of hybrid seeds using CMS, GMS, self-incompatibility and r-DNA technology

### **D. Pharmacognosy & Anatomy**

1. Complementary and alternative medicine with reference to Indian traditional systems of medicine
2. Ethnobotany- Introduction, multidisciplinary approaches, role of traditional and folkmedicine in development of new drug; bioprospecting

- 3 Diversity and conservation of Medicinal Plants (with reference to WHO guidelines)
- 4 Crude drugs-Classification, factors involved in preparation of crude drugs and it's quality control
- 5 Pharmacogenetics- Genetic improvements of medicinal plants; transgenic plant, secondary metabolism engineering
- 6 Medicinal Plant biotechnology- Production and improvement of bioactive compounds of medicinal plants through various biotechnological approaches
7. Anatomical knowledge in forensic science and animal food habit
8. Fibres- Controlling factors in fibre differentiation, extraxylary & xylary fibres, forage fibers and animal nutrition
9. Pollution anatomy- effects of air pollutants, ozone injury, acid rain on plants

#### **E. Molecular Biology**

1. Analysis of gene structure and function
2. Site-directed mutagenesis of a gene, improvement of the enzyme characteristics and determination of structure-function relationships
3. Cloning and purification of DNA-binding protein
4. Regulation of gene expression by signal transduction
5. DNA fingerprinting and its applications
6. Development of DNA markers and applications
7. DNA Microarrays and SAGE (Serial analysis of gene expression)

#### **F. General and Applied Phycology**

1. Taxonomy of algae: Collection, preservation of various algal groups
2. Algal culture: isolation, culture and preservation of algal strain
3. Algal pigment: Production and application of algal biocolorant
4. Algal response to stress: Ecophysiology of algae with response to various stresses like salinity, desiccation, temperature, light intensity, UV-B radiation

5. Algal Pollution: Algal bloom, algal toxins, ballast water and algal pollution, phytoplankton and climate change
6. Algal Biotechnology: Secondary metabolites of algae, algae as source of pharmaceutical, cosmetic, anti aging products, production and application of algal hydrocolloids.
7. Recent Advances in Algal technology: Algae in nanotechnology, Biodiesel and hydrogen production by algae, Algae and climate change

## **G. Mycology & Plant Pathology**

1. Uniqueness of fungi in the living world and its classification
2. Importance of fungal enzymes in industry; Importance of fungi as food and medicine
3. Mycorrhiza: Types and importance
4. Biotechnology in fungi through genetic transformation
5. Causes of plant diseases; Disease control- chemical and biological methods; Development of resistant variety
6. Appresorial development and host penetration by fungal pathogens
7. Fungal toxins: mycotoxins and phytoalexins, their types and mode of action
8. Host defence- pre-infective and post-infective
9. Mycoses and control fungal diseases
10. Fungal spoilage and its control

## **H. Fundamental and Applied Microbiology**

1. Bacterial classification: Classification & identification; Molecular Taxonomy: molecular chronometers, 16 S rDNA sequencing, DNA-DNA and G+C content
2. Culture condition and Growth: Bacterial culture medium, Enrichment culture Isolation of pure cultures; Batch culture and Continuous culture; Measurements of bacterial growth - Generation time, mathematical expression of growth; Synchronised growth; Diauxic growth
3. Metabolic classes of microorganisms: autotroph, phototroph, chemotroph, heterotrophy, auxotroph and prototroph

4. Microbial growth control: Heat, ionization and filter sterilization methods; Antiseptics, antimicrobial agents and disinfectants
5. Microbial genetics: Conjugation, Transformation and transduction recombinant DNA technology
6. Immunology: Humoral and cell mediated immunity hypersensitivity reaction, complement fixation, immunological techniques- Ouchterlony double diffusion test, ELISA, RIA

#### **1. Fundamental and Applied Pteridology**

1. Distribution of pteridophytes in diversified ecological conditions - A brief mention of climates and flora of the past geological era.
2. The contribution of pteridophytes to an understanding of the life history of vascular plants (sexuality in gametophytic growth; Significance of isolation in relation to cyclic alternation of generation, determination of femaleness in free homosporous plants; relationship between heterospory and anisospory; cyclical alternation in heterosporous plants).
3. Present status of distribution of pteridophytes in India. Endangered pteridophytes and their conservation.
4. Different systems of classification of major groups of Filicopsida.
5. Experimental approach in understanding ecology of pteridophytes – with special reference to introduction of new species.
6. Apospory, apogamy and apomixes; hybridization- An approach for rapid multiplication of economically important pteridophytes.
7. Culture of fern gametophytes, Photomorphogenesis in Fern gametophytes.
8. Phytochemical analysis of medicinally important pteridophytes (quantitative and qualitative analysis) - total chlorophyll, carbohydrate, protein; screening tests for alkaloid, flavonoid, glycoside, tannin, steroid, saponins, anthroquinone etc.

#### **Paper III (Review works)**

**8 Credit points**

**Full Marks 100**

A thorough review of literature has to be done by the candidate based on research area of his/her interest. The candidate will deliver a seminar of one hour duration before the external expert and faculty members for evaluation followed by viva-voce.

