

**EXAMINATION PATTERN**  
**and**  
**COURSE DESIGN**  
**For C.B.C.S. Ph.D. Coursework in BOTANY**

**To be implemented from the session 2017–2018 on wards**

## Ph. D. Coursework guidelines

- As per Bankura University Regulations Relating to Doctoral (Ph.D.) Degree 2017, after admission to PhD, a research scholar shall be required to undertake coursework for a minimum period of one semester. All candidates admitted to the Ph.D. programme shall be required to complete the coursework prescribed by the Department during the initial one or two semesters. Women candidates may be allowed a relaxation of two terms / semesters in case of maternity.
- Candidates already holding M. Phil. degree and admitted to the Ph.D. programme, or those who have already completed the course work in M.Phil. / Ph.D. and have been permitted to proceed to the Ph.D. in integrated course, may be exempted by the Department from the Ph.D. course work. All other candidates admitted to the Ph.D. programme shall be required to complete the Ph.D. course work prescribed by the Department.
- 75 % attendance for coursework classes is compulsory.
- Teaching work per credit is 16 hours. (This may include lectures, seminars, and tutorials).

### Course Structure:

Subject Code	Name of Module / Course	Paper Type	Credits	Total Marks
PhD/E-01	<b>Research Methodology</b> [Part A: Common, Part B: Subject related Research Methodology]	Theory	4	100 [ Part A: 70 + Part B: 30]
PhD/E-02	Subject specific topic ( <b>Assignment</b> )	Assignment	2	50
PhD/E-03	<b>Seminar</b> on Research topic or Literature Review or Research Paper	Seminar Presentation	2	50
<b>Total</b>			<b>08</b>	<b>200</b>

## Award of Grades:

- A Ph.D. scholar has to obtain a minimum of 55% of marks or its equivalent grade in the UGC 7-point scale (or an equivalent grade/CGPA in a point scale wherever grading system is followed) in the coursework in order to be eligible to continue in the programme and submit the dissertation/thesis.
- Maximum two chances shall be given to the scholar for clearing the coursework, failing which may lead to cancellation of admission.

## Coursework Assessment

Subject Code	Name of Module / Course	Total Marks
PHD/E-01	<b>Written Examination: 100 Marks</b>	
	Research Methodology	Part A 20 <i>Objective type questions</i> x 2 = 40 5 <i>Short answer type questions</i> (out of 7) x 6 = 30
		Part B 2 <i>Descriptive type questions</i> (out of 4) x 15 = 30
PHD/E-02	<b>Submission of Hardcopy: 50 Marks</b>	
	Subject specific topic (Assignment)	<ul style="list-style-type: none"> <li>• Topic for assignment should be related to scholar's Ph.D. subject / research area</li> <li>• Assignment shall be of a minimum of 5000 words</li> </ul>
PHD/E-03	<b>Submission of Hard copy with presentation: 50 Marks</b>	
	Seminar on Research topic or Literature Review or Research Paper	<ul style="list-style-type: none"> <li>• 3500-- 5000 words</li> <li>• Presentation and viva voce</li> </ul>
<b>Total</b>		<b>200</b>

## C.B.C.S. Syllabus for Ph.D. Coursework

**Name of Module/ Course: Research Methodology**

**Subject Code: PhD/E-01**

**Credit: 4 Credit Hours / week**

**(4 x 16 teaching weeks = 64 credit hours per semester)**

**Course Objectives and Outcomes:**

To identify and apply appropriate research methodology in order to plan, conduct and evaluate basic research. The Course will furthermore enable scholars to distinguish between the scientific method and common sense knowledge while laying the foundation for research skills at higher levels.

**Part A (Common for all faculties)**

1. **Basics of Research:**

Definition of research - Objectives of research - Scientific research - Social science research - Ethics in research, Plagiarism, How to write a research proposal

2. **Types and Methods of Research:**

Classification of Research- Pure and Applied Research - Exploring or Formulative Research - Descriptive Research - Diagnostic Research/Study - Evaluation Research/Studies - Action Research - Experimental Research - Analytical Study of Statistical Method - Historical Research - Surveys - Case Study - Field Studies

3. **Literature Review:**

Need for Reviewing Literature - What to Review and for What Purpose - Literature Search - Procedure - Sources of Literature

4. **The Planning Process of Research:**

Selection of a Problem for Research - Formulation of the Selected Problems - Hypothesis Formation - Measurement - Research Design/Plan, Research process

5. **Computer Application in Research:**

Introduction to MS Excel, Using Formulas and Functions, Hand on to SPSS, Features for Statistical Data Analysis, Generating Charts/Graphs, Introduction to MS Word, Features and Functions, Writing Report in MS Word, Introduction to Open Office or Latex, Creating Presentations in MS Power Point, Introduction to Internet Based Search, Use of Advanced Research Techniques

6. **Report Writing:**

Types of Reports - Planning of Report Writing - Research Report Format - Principles of Writing - Documentation - Data and Data Analysis in Thesis - Writing of Report - Typing of Report - Briefing - Preparation of Manuscript for Publication of Research

Paper - Pictures and Graphs, Citation styles, Writing a Review of Paper, Bibliography, Writing Synopsis & Thesis.

**7. Literary Concepts and Theory**

**8. Seminar about literature review or research paper by research scholar**

**Suggested Readings List:**

*Research Methodology: An Introduction* by CR Kothari, New Age International Publishers.

*Research Methodology: Methods and Techniques* by C. R. Kothari, New Age International Publishers.

*Research Methodology for Business: A Skill Based Approach* by Kumar, Shekaran (2009), New York, John Wiley Publishers.

*Research Methodology-A Step-by-Step Guide for Beginners*, Kumar, Ranjit. (2nd.ed), Pearson Education.

Sinha P.K., *Computer Fundamentals*, BPB Publishing.

Inderpal Singh, *Research Methodology and Statistical Methods*, Kalyani Publishers, Ludhiana.

Krishnaswamy, K.N., Sivakumar, A. and Mathirajan, M.: *Management Research Methodology: Integration of Principles, Methods and Techniques*, Pearson Education, New Delhi.

*A.S. Gaur & S.S. Gaur, Statistical Methods for Practice and Research (A Guide to Data Analysis using SPSS), Sage Publications*

**Part B: Subject related Research Methodology**

F.M-30

**Optional Paper (Select any one):**

1. **Microbiology, Microbial Culture and Advanced Microbial Techniques**
2. **Ecology**
3. **Plant Taxonomy, Systematics and Biodiversity**
4. **Mycology, phytopathology and Plant Pathological techniques**
5. **Phycology**
6. **Plant Physiology and Biochemistry**
7. **Pteridology**

**Microbiology, Microbial Culture and Advanced Microbial Techniques**

Transcription: Organization of transcriptional units Mechanism of transcription of prokaryotes-Structure and function of RNA polymerase, RNA processing (Capping, polyadenylation, splicing, introns and exons), Translation: Ribonucleoprotein, Salient features of genetic code, structure of mRNA, rRNA, tRNA. polycistronic mRNA in bacteria, translation mechanism in bacteria, Post-translational

modification, Regulation of gene expression in prokaryotes: Control of gene expression. Positive gene regulation, negative gene regulation and attenuation, using the lac, gal, trp, ara and tol operons, with emphasis on recent advances, Gene cloning: Plasmid biology (Types; Detection and purification; Replication); Genetic engineering (Splicing of DNA; Insertion of DNA into vector; Detection of recombinant molecules; Expression of cloned genes; PCR and Its variants, Genetic recombination: Genetic recombination processes: Role of rec proteins in homologous recombination. Conjugation: Discovery, F<sup>+</sup>, F<sup>-</sup> and Hfr cells, types of Hfr; F<sup>+</sup> and F<sup>-</sup> and Hfr and F<sup>-</sup> genetic crosses. Mechanism of conjugation. Sexduction, conjugational transfer of colicinogenic and resistance transfer factors. Genetic mapping.

Preparation of Media, Types of growth media, Techniques for pure culture establishment and maintenance, Preservation of pure culture, Techniques for cultivation of anaerobes, Different staining methods, Identification of Prokaryotes, Antigen-Antibody reaction, ELISA, RIA, RAST, RIST, Lyophiliser, sonicator, Cold centrifuge, Ultracentrifuge, Electron Microscopy, Fluorescence Microscopy, PCR, Gel-documentation system, HPLC, GC-MS, FPLC, Northern, Southern and Western Blotting, Use of Bioinformatic tools for study of gene and protein sequences, Basic idea about Pharmacogenomics and Drug designing.

## Ecology

**The environment:** Physical environment, biotic environment, biotic and abiotic interactions.

**Ecosystem :** Principle and concept of ecology, Structure and function , energy flow and mineral cycling ( CNP ) , primary production of some Indian ecosystems – terrestrial ( forest , grassland ) and aquatic ( fresh water, marine ).

**Population ecology :** Characteristics of a population, population regulation, life history strategies ( *r* and *k* selection ); concept of meta population – demes and dispersal, interdemec extinction, age structured populations.

**Synecology or community ecology:** Definitions, classification of vegetation, community composition, classification of community, study of plant community structure.

**Species interactions:** Types of species interactions; mathematical model/ Lotka- volterra model for interspecific competition; species coexistence and niche.

**Plant succession and productivity:** Plant succession – Definition, types, mechanisms and changes involved during succession, concept of climax; Productivity – Definition, types and measurements of primary productivity.

**Ecological genetics of population or gene ecology:** definition, concepts, characteristics, formation and origin of new ecotypes, significance of ecotypes, ecoclines.

**Biodiversity:** General concept, levels, importance, assessment of variation and isolation, conservation principles and strategies, Red Data Book and different categories of threatened plants (IUCN), hotspots.

**Ecology and environmental issues:** Food production, energy crisis, conservation of wastes to resources, salinity and water logging, reclamation of waste and mined lands, climatic changes, natural calamities, deforestation.

**Ecology and man:** International Biological Programme (IBP), Man and Biosphere Programme (MAB).

**Environmental pollution and standard parameters:** Air, water and soil pollution, effects on plants and ecosystems, methods/ techniques used in phytoremediation/ bioremediation.

**Practical :** To study physical characteristics of soil, To study chemical characteristics of soil, Determination of species area curve by quadrat method, Determination of density, frequency, basal cover and IVI of the species, Estimation of organic matter content of soil, Determination of total soluble salts of soil/ water, Colorimetric determination of nitrogen and phosphorus of soil, Determination of dissolved oxygen (D.O.) in unpolluted and polluted water, Determination of nutrient content of soil by kit method, Preparation of biological spectrum of a vegetation and comparison with Raunkiaer's normal biological spectrum.

## **Plant Taxonomy, Systematics and Biodiversity**

**Taxonomy and Systematics:** Concept, objectives and significance.

**Plant Nomenclature:** ICN/ICBN, Principles, rules, recommendations and appendices, type concept, rules of priority, effective and valid publication, rejection of names.

**Taxonomic Hierarchy:** Definition, concept of species, genus, and other categories.

**Taxonomic Literatures:** Types, definition and examples.

**Angiospermic Classifications:** Broad outline classification of Cronquist (1988) and

APG IV (2016) with merits and demerits, phenetic versus phylogenetic systems, cladistics in taxonomy.

**Data sources in Taxonomy:** Supportive evidences from morphology and micro morphology, palynology, cytology, chemotaxonomy, serology and molecular taxonomy; molecular markers in plant systematics (chloroplast DNA, mitochondrial DNA and nuclear ribosomal DNA), DNA barcoding, application of computer and GIS in taxonomy.

**Taxonomy and Phylogeny:** Salient features, floral diversity, diversity of families and phylogeny of the following orders: Ranales, Centrospermae, Amentiferae, Helobieae and Glumiflorae.

**Practical:** Work out of at least 10 wild taxa representing different plant families and identification to species level, Construction of taxonomic keys: Indented and Bracketed, Study of flora, Formation of Phenogram and Cladogram.

## **Mycology, phytopathology and Plant Pathological techniques**

Ultrastructure of fungal cell; Cell wall composition and biogenesis, Economic importance of Fungi (General account), Fungi as pathogen and biocontrol agents (general account), Human diseases of Fungi, Fungi in industry & medicine: Antibiotics- Penicillin; Organic acids – Citric acid; Plant growth regulator- Gibberellin, alcohol and Fungal enzymes (general account), Fungal toxins: Host non-selective toxins- cercosporin (Mode of action); Host specific toxins- structure, mode of action and concept of Vb gene, Mycotoxins- aflatoxin biosynthetic pathway with enzymatic and genetic informations, Mycorrhizae: interaction; Specific recognition in mycorrhizal association; Application as biofertilizer and bioprotector in forestry and agriculture, Structural and chemical decay of wood by decaying microorganisms, Details studies of fungal diseases: Damping off, powdery mildew, smut, rust, wilt, root rot, leaf spots, leaf blight and gall of economically important crops, Bacterial diseases: bacterial leaf blight of rice, bacterial wilt of potato, bacterial canker of tomato, crown gall of rose, Virus disease: Symptoms, carrier, transmission, interaction of virus and host; role of nucleic acid in virus infection; Control strategies, Plant disease control: chemical control, biological control of phytopathogens, integrated disease management practice. Resistance mechanisms in plants: Biosynthetic pathways for the main plant antimicrobials, PR proteins.

Study of mycoflora of air/soil, Preparation of media, Isolation of pathogen (Fungi and Bacteria) from diseased plant material, Study of Koch's postulates and pathogenicity test in whole plants/cut shoots/ leaves, Identification of fungi by molecular technique (by ITS region amplification and BLAST analysis) -Demonstration from an Identified organism.

Bioassay of antifungal compounds/fungicides by agar well/disc method, Artificial inoculation of plants with pathogen(s) and disease assessment, Comparison of soluble protein content between healthy and artificially inoculated plants, Comparison of total and orthodihydroxy phenol content between healthy and artificially inoculated plants, Extraction and assay of Phenylalanine ammonia lyase activity in plants following infection, Extraction and assay of peroxidase activity in plants following infection.

## **Phycology**

General overview Basic characteristics features and modern system of classification, Evolution of Algae and range of thallus structure among different groups, General features of the division Cyanophyta. Ultrastructure of cell and Heterocyst, Glaucophyta-General characteristics and primitive features, phylogenetic significance. Dinophyta- Cell structure; Heterotrophic nutrition; Chlorophyta -Ultra structure of flagella; classification and phylogeny. Bacillariophyta - Classification; Ultra structure and developmental patterns of Diatom frustules.

Algal sampling techniques, Phytoplankton, benthos, preservation techniques (both wet and dry), algal ecology, community structure and population dynamics, culture and mass cultivation of algae, techniques for extraction, estimation and analysis of different algal component

## **Plant Physiology and Biochemistry**

Unit I: Lipids and Amino Acids Biosynthesis

Lipids- structural and storage lipids and their functions; Amino acid biosynthesis and assimilation in plants

Unit II: Thermodynamic

Concept of free energy: Thermodynamic principles, energy-rich bonds, coupled reactions and oxidative phosphorylation, bioenergetics. Cellular oxidations: Pathways of ATP production, mitochondrial electron transport system, mitochondrial F<sub>0</sub>F<sub>1</sub>, ATPase and mechanism of ATP synthesis.

Unit III: Secondary Metabolites

Secondary metabolites- Role of natural products in plant defense, pharmaceuticals and cosmetics; Development of transgenic plants for abiotic stress tolerance; Stress Proteins in plants- HSP, osmotin, PR, BSIPS, Stress- induced proteins.

Unit IV: Stress physiology

Biotic and Abiotic stress; Physiological and Biochemical responses of plants to environmental stress; Plant responses to salinity and chilling stress; Abiotic stress and secondary metabolite production.

Unit V: Hormones & Signal Transduction

Hormonal regulation of plant growth and development, signal Transduction, Role of PGR in agriculture and horticulture, Status of Plant Physiology Research in India.

Practical

Quantitative estimation of Pigments in plant tissue.

Extraction and estimation of Chlorophyll, protein, Carbohydrate.

Evaluation of seed viability by reliable physiological and biochemical methods.

Quantitative estimation of proline in water-stressed leaf-tissues.

Effect of water stress on root metabolic activity.

Extraction and estimation of fat.

Separation of amino acids by paper chromatographic technique.

Extraction and estimation of the enzyme catalase, peroxidase and amylase from plant samples.

Separation of phenolic compounds by thin layer chromatography

Purification of protein by SDS-PAGE

## **Pteridology**

Introductory idea about pteridophytes, Characteristic features, geological distribution, evolutionary trends and interrelationships of Rhyniopsida, Zosterophyllopsida, Trinerophytopsida, Psilotopsida, Lycopsidea and Sphenopsida, An idea about the system of classifications of ferns, A comparative study of the members belonging to the following taxonomic groups and also their systematic treatments, evolutionary tendencies and affinities: Cladoxylales, Marratiales, Ophioglossales, Osmundales, Filicales ( Schizaeaceae, Gleicheniaceae, Cyatheaceae, Polypodiaceae), Salviniaceae, Marsileales, Stelar organization in pteridophytes and its evolution, Soral evolution in ferns, Mating systems in ferns, sexuality in homosporous ferns, apospory & apogamy ,Types of plant fossils according to their mode of preservation; Preparation of fossil slides through peeling technique, Spore-pollen symmetry, polarity, apertural pattern, exine stratification .