University of Kalyani

Ph.D. Course Work

[Reg.6 (D.D.)]

Syllabus

(2013 – onwards)

Department of Botany

Kalyani - 741235

PREAMBLE

Course-work and Course-end Examination

(1) Each Ph.D. student will have to undergo one Semester course work of six-month duration. Number of papers; breakup of marks and credits of the said course work shall be as follows:–

Sl. No.	Course	Marks	Credits
1.	Computer Applications	50	2
2.	Research Methodology	50	2
3.	Review of Literature	50	2
4.	Subject Upgradation (on recent developments)	50	2
	Total	200	8

(2) However; a student with M.Phil./M.Tech. Degree; who has undergone coursework to obtain such degree; or a student who has carried out doctoral course -work in other university/institute and moves to this university for Ph.D. degree; shall be exempted from coursework as approved by the Departmental Research Committee.

(3) A student shall complete the coursework before submission of his/her thesis.

(4) There shall be a course-end examination conducted by the University at the end of the semester; as per the programme announced by the Controller of Examinations. A student shall be given three consecutive chances to qualify the examination.

(5) A student shall be allowed to appear at the course-end examination if he/she has attended 75% or above of the total theoretical/practical classes held during the semester. If the attendance of any student falls short of 75% but not below 60%; he/she will be allowed to appear at the examination as non-collegiate candidate on payment of requisite fees. Candidates attending less than 60% classes will be treated as discollegiate and will be debarred from appearing at the examination.

(6) The course-end examination shall be as per the curricula and syllabi prescribed by the respective Departmental Research Committee and approved by the concerned Faculty

Council for Post Graduate Studies and the Executive Council. The Paper setters; Examiners; Moderators; Coordinators etc. for each course -end examination will be appointed by the Controller of Examinations on the recommendation of the concerned Departmental Research Committee and as approved by the Vice -Chancellor.

(7) A seven-point grading system shall be followed for calculating grade point average.

Categorization of these grades and their correlation with marks obtained and points to be assigned are given below:

Qualification	Grade	% of Marks Obtained	Points
Outstanding	'O'	100 to 95	10
Excellent	'E'	94 to 85	09
Very Good	'A'	84 to 75	08
Good	'B'	74 to 65	07
Fair	'C'	64 to 55	06
Pass	'D'	54 to 50	05
Fail	'F'	Below 50	
Incomplete	'I'	-	

(8) In order to qualify in the course -end examination; a student must obtain at least 'D' grade in each paper; and a SGPA of 5.0.

(9) A student who fails to qualify or fails to appear in not more than two papers shall be entitled to appear in back papers in the next regular course -end examination(s); and there shall be no separate supplementary examination. A student who fails to qualify or fails to appear in more than two papers shall have to appear in all the papers in the next regular course-end examination(s).

(10) A student's level of competence shall be categorized by Semester Grade Point

Average (SGPA).

$$\text{Semester Grade Point Average (SGPA)} = \frac{\text{CREDIT INDEX}}{\Sigma \text{ CREDITS}}$$

The terms to be used for calculation of such SGPA are defined below:

1. Point – Integer qualifying each letter grade as obtained by individual student.
2. Credit – Integer signifying the relative weightage of individual course item in a semester as indicated by the course structure and syllabus.
3. Credit Point – (1) × (2) for each course items obtained by individual student.
4. Credit Index- Σ Credit Points of course items in a semester.

DETAILED SYLLABUS

1. Computer Applications: 50 marks 2 Credits

Exercises in MS Word

Preparation of research proposal; Representation of a methodology in a flow chart form; Use of other applications; Use of Paint/Draw programs

Exercises in MS Excel

Input of experimental data; Application of different formulae; Transformation of data; Preparation of graphs; charts etc.; Use of different applications – statistical; error bars etc.

Exercises in Power Point

Each candidates must make a presentation of his/her research project/or any topic of interest (minimum of 10 slides using different applications)

Exercises in Adobe Photoshop

Preparation of at least one plate containing 5-6 photograph complete with legends and title Use of SPSS software; preparation of Dendogram / Phylogenetic tree.

Use of image analysis software for measurement of any specimen with bar

Internet Use

2. Research Methodology: 50 marks 2 Credits

2.1 Microscopy

Light and Phase Contrast microscopy – working principle and applications.

Fluorescence microscopy – principle and application. Knowledge on different staining techniques; including fluorescent stains like – Acridine Orange; Hoechst-261; DAPI; FDA; etc. A brief idea of Scanning and Transmission Electron Microscopy.

2.2 Cytogenetical techniques

Mitotic and meiotic chromosome preparations; Knowledge on pretreating; fixative and other potential chemicals and their use in cytogenetical techniques;

Analysis of chromosomal associations from meiotic plates and predicting ancestral basic chromosome number and secondary polyploidy nature of the species;

Analysis of desynaptic plants meiotically/as well as other aberrant translocation and inversion heterozygotes; Chromosomal behaviour of hybrids.

2.3 Colorimetry and Spectrophotometry

UV and visible light spectroscopy: principle, instrumentation and application; Infrared and Raman spectroscopy, resonance Raman's spectroscopy; Nuclear Magnetic Resonance (NMR): principle; instrumentation; application; Electron Spin Resonance spectroscopy (ESR): magnetic phenomenon; resonance condition; principle; instrumentation; Mass spectroscopy: principle; instrumentation; application.

2.4. Centrifugation Techniques

Basic principle of sedimentation; uses, separation methods: differential centrifugation; ultracentrifugation.

2.5. Chromatography

General Principle; types; application: Partition and adsorption chromatography; paper chromatography; TLC; GLC; Gel ; TLCGl; Ion exchange; Affinity and HPLC.

2.6 Electrophoretic Techniques

Effect of agarose concentration on gelling and migration of DNA; separation of protein by SDS-PAGE; extraction and estimation of soluble protein fraction; estimation of molecular weight of unknown polypeptide; estimation of similarity index using electrogram; concept of Protein Data Bank (PDB).

2.7 Nucleic Acids (Isolation; purification) and molecular marker (RFLP; RAPD; ISSR)

Isolation of Plant genomic DNA and estimation of yield and quality; Estimation of melting temperature of DNA; restriction digestion of plasmid DNA; electrophoresis and molecular weight determination of DNA fragments; Polymerase chain reaction; analysis of genetic diversty (Jaccard's coefficient) using RAPD & ISSR. BLAST analysis.

2.8 Plant Breeding

Concept of hybridization technique; anthesis; selection of floral buds for crossing. Knowledge of micro and mega sporogenesis. Analysis of F_1 hybrids and assessment of F_1 hybrids with their respective parents.

2.9 Biometry

Analysis of mean; median; mode; standard deviation; standard error and normal distribution. CV and its significance. Measures of dispersion; mean shift and analysis of micromutation. χ^2-test analysis and its significance in genetics. t-test and f-test – test of significance and their applications. Phenotypic correlation and its utility in plant breeding. Regression analysis. Analysis of data following the use of relevant software's by computer.

2.10 Palaeobotanical Techniques

Excavation of fossils,Extraction Techniques; Study of Morphology, Anatomy and Geochemistry;

Conservation: database and protocols; sedimentology, taphonomy and stratigraphy; Palaeoclimatology; Palaeoecology; Palaeoethnobotanical approach;

International laws for collecting fossils.

2.11 Palynological Techniques

Palynological processing; Contamination; Acetolysis technique: Residue mounting, embedding and storage.

2.12. Microbial Culture techniques

Preparation of culture media: complex and defined media; Selective and differential growth media; Establishing pure culture: streak plate; pour plate; Preservation of cultures: establishment of stock culture; subculturing; Techniques for the cultivation of anaerobes; Microbial staining procedures: Gram; Acid-fast; spore and capsule staining; Identification of Prokaryotes: conventional and molecular technique.

2.13. Immunological techniques

Demonstration of agglutination reaction by known antigen; Demonstration of agglutination reaction by unknown bacterial culture by slide agglutination technique. Demonstration of precipitating reaction based on immune-diffusion test. Identification of Blood group and Rh typing by an Antigen-Antibody complex formation; Identification of an Antigen-Antibody complex by complement fixation; Identification of an Antigen-

Antibody complex by fluorescent antibody technique; Detection of specific antigen by ELISA technique.

2.14. Phytochemical Techniques:

General protocol for Extraction; Separation; Purification and Identification of some phytochemicals; Clarification of plant extract for quantification and separation of sugar and amino acids; Modern techniques for quantitative analysis of plant hormones; Analysis of pathogen related protein; Alkaloids – Estimation and separation; separation of protein by ion exchange chromatography; Systematic identification of flavonoids; TLC of lipids; terpene derivatives; essential oils; vitamins; steroids; alkaloids; sugars.

2.15. Mycology and Plant Pathological techniques

Isolation of pathogenic microorganisms– methods and biochemical characterization. Isolation of soil fungi and degraded wood; Culturing of macrofungi; Screening techniques for antimicrobial activity; metal tolerant/accumulating fungal species; Assay of lignolytic enzyme activity; Long-term storage of plant pathogens; Techniques used in mycorrhizal study; Molecular techniques for studying systematics and phylogeny of plant pathogens & plant pathogen interaction; Induced resistance and analysis of its markers; Post harvest technology.

2.16. Plant tissue culture techniques

Plant tissue culture media preparation and culture of explants (embryo; shoot tips and nodal segments); Micropropagation via organogenesis and somatic embryogenesis; cell suspension culture; anther and embryo culture; determination of genetic fidelity (chromosome and molecular level) from plant tissue culture derived plantlets; analysis of secondary metabolites from plant tissue culture derived plantlets; encapsulation technique for artificial seed production; plant transformation system (demonstration).

2.17. Techniques in Phycology

Algal sampling: Phytoplankton, benthos and periphyton; preservation, processing and analysis of phytoplankton; diatoms; cyanobacteria; estuarine and marine forms; freshwater forms; soft bodied algal composites and crust forming algal composites; algal ecology: community structure and population dynamics; culture and mass cultivation of algae; techniques for extraction, estimation and analysis of different algal components; algal bioprocess techniques.

2.18. Biodiversity Techniques for Assessment and Conservation

Biodiversity assessment techniques: Baseline studies and site specific studies; Monitoring & Modeling Techniques; New approaches to biodiversity assessment;
Biodiversity assessment tools; Biodiversity Assessment and Approaches in Conservation; Conservation Techniques; Biodiversity: Legal issues; Intellectual Property Rights Issues**.**

2.19. Field and Herbarium Methods

Botanical Collections or Field work: Purpose of plant collection; kinds of field work; collection work: documentation, drying and preservation; collection of special groups/ kinds of plants: succulents; minute plants; ferns; aquatic plants; plants having mucilage; gums resins; aroids; large plants like bamboos; palms and bananas; collection of special groups of plants and sampling for molecular studies; pressing of bulky specimens; living collections; liquid- preserved collections; collection of seeds.

Herbarium Methods: Function and importance of a herbarium; herbaria as conservatory of materials and data; Role of herbaria in teaching and research, different kinds of Herbaria and Botanic Gardens ; precautions for using herbarium; Selection and steps for specimens for collection; processing of specimens, loan and exchange of specimens; data information system; important National and International Herbaria.

Plant preservation care/ Pest control in Herbarium: Pest and fungus killing and repelling; identification of specimens; filing of specimens; removing and handling of specimens.

2.20. Microtomy; Histochemical and Organoleptic Technique:

Types of microtomes and microtome knives; softening of woody tissues; paraffin sectioning; types of sections; difficulties in paraffin sectioning; dehydration; infiltration & embedding; mounting; application of microtome; Histochemical techniques: types of fixatives; factors affecting fixation; composition of fixatives & methods of fixation. techniques for the study of wood anatomy; techniques for study of foliar and floral anatomy; techniques for the pollen slide preparation;

Organoleptic techniques (including methods for evaluation of drug); methods of the measurements of leaf drugs of closely related species.

3. Review of Literature 50 marks 2 Credits

Each candidate will review the literature of the research problem assigned for his/her Ph.D. work.

4. Subject upgradation : 50 marks 2 Credits

Each topic is of 25 marks. Each candidate will opt for two topics as assignment after consultation with his/her Supervisor

4.1. Biodiversity Assessment and Conservation

1. Origin and types of biodiversity/ levels of biodiversity
2. Agricultural diversity including crop related non-conventional species/ medicinal plant wealth/forest resources/ marine diversity/ aquatic diversity/ microbial diversity
3. Importance of documentation/ use of information technology
4. *Ex situ* conservation techniques
5. Biodiversity and food security
6. Biodiversity: source of new chemical entities
7. Conservation of biodiversity and sustainable development
8. Bioprospecting *vs*. biopiracy
9. Changing scenario in access to plant genetic resources
10. People's Biodiversity Register exercise
11. Intellectual Property Rights issues in respect of: Conservation/ indigenous and traditional knowledge/ biotechnology/ technology transfer/ environmental sustainability
12. Biodiversity and legal issues

4.2. Cytogenetics & Plant Breeding; Tissue Culture

1. Advances in molecular marker techniques and their application in plant science.
2. Bioreactor technology for plant micropropagation.
3. Understanding biochemical and molecular aspects of salt tolerance in mangroves.
4. Modern biotech as an integral supplement to conventional plant breeding: The prospects and challenges.
5. Molecular markers and its application in marker assisted selection in breeding.
6. Metabolite profiling and genetic manipulating of medicinal aromatic plants.
7. Gel electrophoresis for the identification of plant varieties.
8. Photoautotrophic micropropagation.
9. Mutagenesis – treatments and consequences.
10. Mutation Breeding.
11. Macromutants – Screening; identification and inheritance patterns.
12. Biostatistics.
13. Breeding – Conventional and Modern for improvement of crop plants.

4.3. Microbiology

1. Recent advances in Identification and Characterization of Economically important Bacteria.
2. Nomenclature and classification of Actinomycetes.
3. Application of Recombinant DNA Technology for the potentiation of their activity.
4. Metagenomics and the study of the economically important bacteria.
5. Studies on the genes responsible for their economically important characteristics.
6. Characterisation of culturable economically important bacteria.
7. Application strategy of economically important bacteria.
8. Phosphate solubilizing and growth hormone producing bacteria.
9. Overview of immune system and immune deficiency.
10. Role of microorganisms in food industries.
11. Molecular basis of plant virus transmission and its management.
12. Lichen ecology.
13. Lichen Bioprospecting.
14. Water Pollution.

4.4 Mycology & Plant Pathology

1. Fungal diversity study.
2. Genetic markers for fungal population studies.
3. Fungal Polysaccharides.
4. Diversity of chitinases and their industrial potential.
5. Biodegradation & Bioremediation by fungi.
6. Recognition in Plant-Microbe interaction.
7. Molecular mechanisms of plant defence.
8. Induced resistance in plants.
9. Ecology of mycorrhiza- classical and molecular approaches.
10. Protein secretion systems in bacterial pathogens of plants.

11. Nomenclature and classification of Actinomycetes.
12. Fundamentals of plant protection.

4.6. Plant Physiology; Biochemistry and Plant Molecular Biology

1. Allelopathy.
2. Chemistry and bioactivity of flavonoids.
3. Pathogen related proteins.
4. Seed physiology and its relation to plant growth regulations.
5. Bioremediation.
6. Use of phytochemicals as antimicrobial agents.
7. Chemistry and bioactivity of terpenoids.
8. Isolation of stress responsive genes from plants.
9. Characterization of stress induced metabolic profiles of plants.
10. Signal transduction cascade for stress responsive proteins in plants.
11. Functional genomics for oxidative stress and its modulation.
12. Transgenic approaches for abiotic stress tolerance in plants.

4.7. Pteridology and Palaeobotany

1. Trends and patterns in plant evolution.
2. Palaeobiology and taphonomy.
3. Plant fossils as proxy data for mass extinction events.
4. Plant fossils and climate change.
5. Palaeogenetics.
6. Palaeoethnobotany.
7. Archaeobotany.
8. Ancient plant/animal interactions and their environments.
9. Pollination biology.
10. Palynology in hydrocarbon exploration.
11. Forensic palynology.
12. Aeropalynology.
13. Melissopalynology.
14. Entomopalynology.
15. Spore/pollen bank as conservation and regeneration.

4.8. Phycology

1. Phylogeny and evolutionary trends of different algal groups.
2. Algal diversity in different habitats.
3. Life history strategies of different algal groups.
4. Symbiotic algae.
5. Algal toxins.
6. Algal biotechnology.
7. Fossil algae.
8. Use of algae as paleoecological proxies in climate change studies.
9. Nanoparticle synthesis using algae.
10. Role of algae in fisheries development.

4.9. Taxonomy & Biosystematics

1. Modern systems of plant classification.
2. Origin and evolution of angiosperms.
3. Taxonomic revisions.
4. Literatures in systematic botany.
5. Morpho-anatomical studies of plants.
6. Floristic studies of plants.
7. Studies of microcharacters with the aid of electron microscope.
8. Herbarium preparation and maintenance.
9. Ethnobotanical studies of plants.
10. E-Herbarium.