M. Phil. Botany Course

1st semester Examinations

Special Paper – Fungal Systematics

1. An overview of true fungi (Kingdom Fungi), straminipilan fungi (Kingdom Stramenopila) and protistan fungi (Kingdom Amoebozoa): biodiversity, significance and conservation. Phylogeny of fungi and pseudofungi based on ultra structure and nucleic acid analysis.

2. Taxonomic ranks. The concept of 'Domains' in biological classification. Ranks above family, families, subfamilies and tribes, genera, species, subspecies, varieties, form, special form, morphotype, chemotype, ecotype, strain and race, teratological forms, concepts of anamorph, teleomorph and holomorph. Sources of taxonomic characters.

3. International Code of Nomenclature for algae, fungi, and plants (Melbourne Code): detailed study of the rules and its application. Major changes in the Melbourne Code that will affect fungal nomenclature. Registration of new fungal names and repositories for the registration of fungal names.

4. DNA barcoding in fungi: aim, advantages, methods, DNA regions evaluated as potential DNA barcodes for fungi, current status.

5. Modern techniques available for fungal taxonomy: chemotaxonomy, cytogenetics, electrophoresis, serology and ultrastructure.

6. Molecular methods employed in fungal taxonomy: DNA regions commonly used in fungal taxonomy, isolation of genomic DNA, PCR protocol, agarose gel electrophoresis, automated sequencing, BLAST search and interpretation of search results.

7. Phylogenetic Analysis – objectives of molecular phylogenetic studies, structure of phylogenetic trees, terminology used for describing various aspects of phylogenetic trees: bootstrap support value, branch, branch length, clade, cladogram, consensus tree, node, phylogram, polytomy, root, rooted tree, scale bar, distance scale, scaled branches, topology, unrooted trees, unscaled branches, monophyletic, paraphyletic and polyphyletic groups, homologs, paralogs or orthologs. Steps in phylogenetic analysis: assembling and aligning datasets, building phylogenetic trees from sequences using computational methods and stochastic models, and statistically testing and assessing the estimated trees, popular software packages used for building and testing trees. Tree-estimation techniques such as maximum parsimony, maximum likelihood and tree assessing techniques such as bootstrap analysis.

8. Principles of numerical taxonomy.

9. Collection, examination, and preservation of different groups of fungi with particular reference to agarics, techniques, and methods used to maintain fungal herbaria and culture collections, major fungal culture collections and herbaria of the world.

10. Naming, describing, illustrating, and publishing, monographs and revisions, keys, floras, maps.

11. Fungal taxonomic literature, sources of references, catalogues of names, tracing incomplete and incorrect references, dates of publication, major mycological libraries, citation of literature.

12. Classification of true fungi according to the current 'AFTOL' scheme (Hibbett et al. 2007); current taxonomic concepts regarding straminipilan fungi and protistan fungi.

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

13. A taxonomic overview of the Class Agaricomycetes. Characters used in the classification of gilled-mushrooms. Phylogeny of gilled mushrooms.

Model Question Paper

MPhil (Botany) Course, 2017
1st SEMESTER EXAMINATION
Special Paper- Fungal Systematics

Time: 3hours Marks: 80

SECTION A: *Two* 10-mark question to be answered out of *three* questions
(2 x10 =20 marks)

1. Give an overview of the characters used in the classification of agarics.
2. Discuss in detail the molecular techniques available to fungal taxonomists.
3. Discuss in detail the steps involved in constructing a phylogenetic tree.

SECTION B: *Eight* 5-mark questions to be answered out of *ten* questions
(4 x 5 =20 marks)

4. Describe the different methods of maintaining fungal cultures.
5. Give an account of typification in botanical nomenclature.
6. Explain the major changes in the Melbourne Code that will affect fungal nomenclature.
7. Give an outline of numerical taxonomy.
8. Explain the concept of 'domains' in biological classification.
9. Give an account of the current ideas in fungal phylogeny.
10. Briefly explain the position of myxomycetes in the current biological classification.
11. Explain the differences between oomycetes and true fungi.
12. Briefly explain the currant status of barcoding in fungi.
13. Briefly explain the significance of ultrastructural characters in fungal taxonomy.

SECTION C: *Ten* 2-mark questions to be answered out of *twelve* questions
(10 x 2 =20 marks)

14. Differentiate between dendrogram and phenogram.
15. Differentiate between gene trees and species trees.
16. Differentiate between a monograph and a revision.
17. Differentiate between bracketed keys and indented keys.
18. Name the three repositories for registering new fungal names.
19. What is 'Systema Ascomycetum'?
20. What is Rolf Singer's contribution to agaricology?
21. What is an ecotype?
22. What is the most important diagnostic feature of Kingdom Stramenopila?
23. Explain any one chemical spot test used in the identification of agarics.
24. Explain the value of lamellar tramal structure as a taxonomic character.
25. What is *forma specialis*? Give an example.

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

M.Phil. Botany - Syllabus

Paper III : Special Paper: Genetics & Plant Breeding

1. Genetic resources – conservation and utilization. Centres of origin of cultivated plants – primary and secondary centres of diversity. Gene banks – international and national networks of gene banks.
2. Biological foundations of plant breeding – heredity and variations – hereditary factors, Inheritance of characters – different types of character expression, different types of control of characters in organisms, mechanisms of inheritance of characters, Character variations – nature and types of mutations, the role of environment.
3. Plant breeding – history and scope.
4. Systems of reproduction in plants – sexual reproduction, pseudosexual reproduction, asexual reproduction, tissueculture.
5. Mating systems in sexually reproducing plants – random mating, inbreeding, outbreeding.
6. Conventional methods of plant breeding – domestication, introduction, selection, hybridization.
7. Modern methods of plant breeding – mutation breeding, polyploidy breeding, distant hybridization, biotechnological approaches in crop improvement.
8. Breeding for special purposes – breeding for disease and pest resistance, Breeding for drought and salinity resistance, Breeding for quality, Breeding hybrid varieties, Breeding synthetic varieties, Breeding composite varieties, Ideotype breeding.
9. Variety release, Seed multiplication, Seed certification.
10. Intellectual property rights and plant breeding – plant breeders' rights, farmers' rights, forms of IPR.
11. Farming systems – intensive, organic, integrated – merits and demerits, sustainable agriculture.
12. Major cereals and plantation crops and their improved varieties.
13. Biometrical genetics and plant breeding – Factors involved in an experiment – replication, randomization, local control, Experimental designs – screening designs, evaluation designs (CRD, RBD, LSD).
14. Analysis of numerical data – analysis of central tendencies, measures of dispersion, tests of hypothesis, analysis of variance.
15. Correlation and regression analysis.
16. Factor and cluster analysis.

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

MPhil Special Paper syllabus

Cell & Molecular Biology

1. Basic & modern cytogenetic techniques: Common stains used for cytological studies, flurochromes, cytological markers, cell sorters, cytochemical techniques, cytophotometry & micro-densitometry.

2. Isolation & study of cells: Somatic Cell Hybridisation, Preparation of protoplasts from plant tissues for organelle isolation; extraction of giant plant protoplasts, electrofusion of plant protoplasts, interspecific transfer of partial nuclear genomic information by protoplast fusion & cybridization.

3. Characterization of sub-cellular components and organelles: Cell wall characterization using MAB & by Fourier Transform Infra-red and Near Infra-red Spectroscopy; Study of plasma membrane from cell homogenates; isolation of vacuoles and tonoplast from plant protoplasts, organelle extraction & analysis kits, isolation of intact chloroplasts & plant mitochondria.

4. Study of nuclei & nuclear components: Isolation of nuclei & nuclear specific staining techniques, extraction of nucleoli & techniques for staining nucleoli.

5. Chromosome analysis: Karyotype analysis, chromosome banding techniques, study of polytene chromosomes & their characterization, image cytometry, cytological map construction, flow cytometry, electrophoretic karyotyping & chromosome library, chromosome painting, Harlequin staining & spectral karyotyping, chromosome engineering, chromosome uptake, centromere activation, centromere mapping in eukaryotes & micro-cinematography.

6. Mutation studies: Detection of chromosomal aberrations, methods to detect apoptosis & necrosis, site directed mutagenesis, genetic disease diagnosis, gene therapy, radiation therapy, cancer gene therapy & prenatal diagnosis in man - amniocentesis & chorionic biopsy,

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

7. Methods for the characterization of genome: Genomic analysis tools: large scale genetic mapping, Detection of repeated DNA sequences, DNA renaturation kinetics, restriction mapping, genetic markers (SSR, AFLP and SNP's). Transcript profiling: EST sequencing, SAGE, cDNA fragment analysis methods, array-based hybridisation approaches, DNA footprinting, chromosome walking & jumping, DNA amplification, micro-array technologies, DNA microchips, SHOM, robotics & construction of genomic library.

8. Molecular techniques for the improvement of organisms: Cloning of plastid & mitochondrial genes by biolistics, gene editing, gene transfer techniques, bioluminescence, sperm typing, strategies for GMO's, transgenic plants & antisense technology.

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

Special Paper - Angiosperm Taxonomy

1. Taxonomy: Definitions, Objectives, Importance, Scope.

2 Historical development of theories and concepts of biological classification and classificatory systems.

3 Conceptual bases of the classifications of the following: Bentham & Hooker, Engler & Prantl, Hutchinson, and Takhtajan.

4 Taxonomic characters: Concept of character, character variations and their taxonomic implications.

5 Sources of taxonomic characters: Morphology, Anatomy, Embryology, Cytology and Palynology.

6 Problems in Evolutionary taxonomy: Concept of primitive and advanced characters/groups, monophyly and polyphyly, parallelism and convergence, homology and analogy.

7 Modern trends in Plant Taxonomy: Biosystematics, Numerical Taxonomy (Taximetrics), Cladistics, Molecular Taxonomy.

8 Plant Nomenclature: Brief History on the origin and development of nomenclature; detailed study of the major provisions of the International Code of Botanical Nomenclature (ICBN) - Effective and Valid Publication, Rule of Priority and its limitations, Typification, Different kinds of types, Author citation, Rejection and retention of names, Conserved names; Common technical terms used in Plant nomenclature

9 Practical identification of plants: Different kinds of Identification keys, Construction of Dichotomous keys – Indented and Bracketed keys.

10 Various kinds of Taxomonic literature: Floras, Revisions, Manuals, Monographs, Periodicals, Journals, etc.

11 Methods of plant exploration; Collection and herbarium preparation; Management of Herbaria; Major herbaria in India and the World

12 Floristic studies in India; Major centers of taxonomic and floristic studies in India; Organization and functions of the Botanical Survey of India.

13 Botanical Gardens: Role in taxonomy and biodiversity conservation.

14 Preparation of Taxonomic articles for publication: main components of a scientific article; preparation and presentation of botanical illustrations.

15. Procedure involved in the recognition and publication of new plant species

16. Taxonomic research projects; plan and presentation of project proposals

17. A comparative account of major systems of plant classification. Detailed account on APG system of classification

18. General concepts on pollination biology, pollen morphology and pollen count.

19. Pollen pistil interaction; types of stigma, self incompatibility.

20 Staining techniques in pollination biology.

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

SYLLABUS FOR M.Phil.SPECIALIZATION SUBJECT-2018

PAPER III -PLANT PHYSIOLOGY

Chapter 1-Genome Organization and Gene Expression

(i) Nuclear Genome Organization
(ii) Plant Cytoplasmic Genomes:Mitochondria and Chloroplasts
(iii) Transcriptional Regulation of Nuclear Gene Expression

Chapter 2-Photosynthesis

(i) General Concepts
(ii) Key Experiments in Understanding Photosynthesis
(iii) Repair and Regulation of the Photosynthetic Machinery
(iv) Genetics,Assembly, and Evolution of Photosynthetic Systems
(v) Accumulation and Partitioning of Photosynthates-Starch and Sucrose
(vi) Formation and Mobilization of Chloroplast Starch
(vii) Sucrose Biosynthesis and Signaling

Chapter 3-Photosynthesis: Physiological and Ecological Considerations

(i) Photosynthesis Is the Primary Function of Leaves
(ii) Photosynthetic Responses to Light by the Intact Leaf
(iii) Photosynthetic Responses to Temperature
(iv) Photosynthetic Responses to Carbon Dioxide
(v) Identifying Different Photosynthetic Pathways

Chapter 4- Secondary Metabolites and Plant Defense

(i) Secondary Metabolites
(ii) Terpenes
(iii) Phenolic Compounds
(iv) Nitrogen Containing Compounds
(v) Induced Plant Defenses against Insect Herbivores
(vi) Plant Defenses against Pathogens

Chapter 5-Cell Walls: Structure,Biogenesis, and Expansion

(i) The Structure and Synthesis of Plant Cell Walls
(ii) Patterns of Cell Expansion
(iii) The Rate of Cell Elongation

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

Chapter 6- Growth and Development

(i) Overview of Plant Growth and Development
(ii) Embryogenesis: The Origins of Polarity
(iii) Meristematic Tissues:Foundations for Indeterminate Growth
(iv) The Root Apical Meristem
(v) The Shoot Apical Meristem
(vi) Vegetative Organogenesis
(vii) Senescence and Programmed Cell Death

Chapter 8- Brassinosteroids: Regulators of Cell Expansion and Development

(i) BrassinosteroidStructure,Occurrence,Genetic Analysis
(ii) The BrassinosteroidSignalling Pathway
(iii) Biosynthesis,Metabolism, and Transport of Brassinosteroids
(iv) Brassinosteroids: Effects on Growth and Development
(v) Prospective Uses of Brassinosteroids in Agriculture

Chapter 9- Responses and Adaptations to Abiotic Stress

(i) Adaptation and Phenotypic Plasticity
(ii) The Abiotic Environment and its Biological Impact on Plants
(iii) Water Deficit and Flooding
(iv) Imbalances in Soil Minerals
(v) Temperature Stress
(vi) High Light Stress
(vii) Developmental and Physiological Mechanisms that Protect Plants against Environmental Extremes

Chapter 10-Plant Heavy metal Stress

(i) Heavy metal tolerance and toxicity at cellular level
(ii) Impact of Heavy metals on the cellular redox environment
(iii) Relation between toxicity and tolerance-mechanisms of tolerance
(iv) Signals generated by heavy metal exposure
Signal perception
Cellular secondary signal molecules
Stress signal transduction by plant hormones
Signaling by transcription factors
Redox signaling induced by heavymetals

Approved

Prof. (Dr.) V.V. Radhakrishnan
Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635