Syllabus for Ph.D. Preliminary Qualifying Examination

Name of Research Centre : Department of Botany, University of Calicut

Paper II-Specialization Subject: Angiosperm Taxonomy

Name of the Candidate: Shinoj K.

1. Taxonomic structure, taxonomic hierarchy, taxonomic categories- supra specific and infraspecific categories; concept of species, genus and family.
2. Methods of plant exploration: collection and herbarium preparation; management of herbaria; major herbaria in India and the World; role of herbaria in taxonomy.
3. Taxonomic literatures: Floras, Revisions, Manuals, Monographs, Journals, etc.
4. Procedure involved in the recognition and publication of new plant species.
5. Preparation of taxonomic articles for publication: main components of scientific article; preparation and presentation of botanical illustrations.
6. Floristic studies in India: Major centers of taxonomic and floristic studies in India; Organization and functions of Botanical Survey of India.
7. Taxonomic Keys: indented and bracketed keys.
8. Concept of character, character variations, sources of taxonomic characters.
9. Plant Nomenclature: International code of Botanical Nomenclature (ICBN); ICBN Rules, Effective and valid publication, Rule of Priority and its limitations, Typification, Author citation, rejection and retention of names, conserved names.
10. Modern trends in Plant taxonomy: Biosystematics, Numerical taxonomy, Cladistics, Molecular Taxonomy and Phylogenetics.
11. A comparative account of major systems of classification; detailed account of APG system of classification.
12. Taxonomic research projects: plan and presentation of research proposals.
13. An overview and detailed classification of family Lamiaceae according to classical workers and APG.
14. Distribution of Lamiaceae, world checklist of Lamiaceae.

Approved

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

Syllabus for Ph.D. Preliminary Qualifying Examination

Name of Research Centre : Department of Botany, University of Calicut

Paper I: Research Methodology

Name of the candidate: Shinoj K

1. Photography: Principle and methods of digital photography, photomicrography, and image analysis.
2. Microscopy and micrometry: Resolving power, numerical aperture, lens aberration and their corrections, sources of contrast, amplitude change and phase shift, bright field microscopy, dark field microscopy, UV microscopy, fluorescence microscopy, polarized light microscopy, phase contrast microscopy, interference contrast microscopy, inverted microscopes and stereomicroscopes. Tools and techniques of micrometry.
3. Electron microscopy: Principles and methods of TEM and SEM, parts of electron microscope, resolving power, electromagnetic lenses and their aberrations, Specimen preparation for TEM and SEM.
4. Photometry: colorimetry and spectrophotometry, Electromagnetic spectrum- Extinction coefficient. Chromatography- Principles and types. Molecular sieving. Electrophoresis- theory and types, isoelectric focusing.
5. Sedimentation techniques- Theory of velocity of sedimentation- instruments- application.
6. Methods of molecular biology: Extraction of DNA and RNA, Estimation of G+C content, nucleic acid hybridization, blotting techniques. Sequencing- principles and methods. Fingerprinting, biochips, genomic and cDNA libraries- gene banks.
7. Autoradiography, immunofluorescense and ELISA.
8. Bioinformatics- analysis of molecular data.
9. Tissue culture- Principles and methods. Different types of cultures- applications.
10. Histochemical techniques- Tissue processing, localization of metabolites and quantification.
11. Methods in microbiology- types of culture media, their preparation, maintenance of microbial cultures and their analysis.
12. Designing and analysis of quantitative experiments- experimental designs and analysis of numerical data- central tendencies, dispersion, testing significance of variation, analyzing correlation of variables, regression analysis, study of factor loading and its implication, cluster analysis and its use in biological research.
13. Domestic and industrial pollution- toxic and hazardous agents of pollution- their identification, quantification, and analysis.
14. Collection and compilation of scientific literature- presentation of scientific data- preparation of scientific reports, papers, and dissertations.

Approved

Prof. (Dr.) V.V. Radhakrishnan
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University of Calicut, Kerala - 673 635

Syllabus for PhD Preliminary Qualifying Examination

~~M. Phil. Botany Course~~
~~1st semester Examinations~~
Special Paper – Fungal Systematics (for Greeshma Gangadharan K.G)

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, currant 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 – objective 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.

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

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UNIVERSITY OF CALICUT
DEPARTMENT OF BOTANY
Ph.D. (BOTANY) PRELIMINARY QUALIFYING EXAMINATION
Paper II. Resource Conservation and Management (Syllabus)

1. Sustainable development
   Concept and definition; dimensions; Role of planning and management in sustainable development.

2. Bio resources and management
   Biotic components and Ecosystem stability.
   Culture and value of biodiversity; Methods in biodiversity assessment; Biodiversity decline and strategies of biodiversity conservation; use of bio resources in eco restoration and pollution control.

3. Land resources and Management
   Soil formation and development, soil characteristics and classification.
   Physico- chemical and biological methods of assessment soil characteristics.
   soil erosion and management.
   Waste disposal and soil pollution management; bio resources in soil conservation and management.

4. Water resources and Management
   Significance of water as a vital resource; classification of water and water resources; hydrological cycle.
   Surface water sources : streams, rivers lakes and their management.
   Ground water resources and management : wells, tube wells, springs, geysers and artesian wells; water table; aquifiers ; factors effecting infiltration, permeability of hydraulic conductivity; factors effecting water logging and skinning of fresh waters; over drawing of water resources; recharge and methods of natural and artificial recharge; ground water conservation strategies and water budgeting.
   Water quality monitoring : sampling and analysis, quality assessment, water quality standards.
   Water pollution : source, type and effects; management of water pollution.
   Water and health.

5. Atmospheric resources and Management
   Constituents of air ; atmospheric stratification, cycling of gaseous elements.
   Methods of air quality assessment and quality standards.
   Air pollution : source, type and effects; bio resource utilization in air pollution management, sequestration of atmospheric carbon dioxide; air pollution management.

6. Energy resources and Management
   Types of energy resources and their present status; energy crisis; energy conservation and management; alternative sources of energy; bio resource utilization in energy management.

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References:

- Abbasi, S.A. Wetlands of India – Ecology and Threats. Discovery publishing house, New Delhi.
- Rand, M.C., Greenberg, A.E. and Taras, M.J., (Eds.). Standard methods for the examination of water and waste water. American Public Health Association (APHA). 19th edition.
- Gangstad, E.O. Natural Resource Management of water and land. Van Nostrand Teinhold, New York.
- Mitchell, B. Resource and Environment Management. Addison Wesley Longman Ltd, Edinburgh.

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Approved

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UNIVERSITY OF CALICUT
DEPARMENT OF BOTANY

Ph. D. (ENVIRONMENTAL SCIENCES) COURSE WORK
(SYLLABUS)

Paper II. Environmental sciences

Unit 1:
Earth processes: Primary differentiations of the earth and its core formation, mantle and crust. Plate tectonics and the formation of oceans, continents and mountains

Unit 2:
Lithosphere and soil pollution: Soil formation, physico-chemical and biological characteristics of soil. Soil pollution: sources of solid and liquid wastes; their characterisation and classification effect of soil pollution, effects of soil pollution, methods of disposal and management of solid and liquid wastes recycling of waste materials

Unit 3:
Atmosphere and air pollution: Structure and composition of atmosphere, climate change and its effect, ozone depletion, photochemical smog and sea level increase, air pollution management.

Unit 4:
Hydrosphere and water pollution: Vertical distribution of ground water, zone of saturation, geological formation of aquifers, types of aquifers and ground water basin. Physico-chemical and biological properties of water.
Types, sources and effects of water pollution. Wastewater and its treatment, water quality criteria and standards. Environmental impact on water borne disease cycles, disease vectors and their control

Unit 5:
Bio resources conservation and management: Terrestrial, fresh water and marine, biodiversity: concept, origin, values, measurement and loss of biodiversity; needs for conservation of biodiversity; hot spots of biodiversity and key stone species

Unit 6:
Energy resources and management: Types of renewable energy. Scope of solar, wind, tidal and geothermal energy resources

References

- Abbasi, S. A. (1998). Environmental pollution and its control. cogent international, Pondicherry.
- Clarke, J. R. (1995). Coastal zone management a hand book .CRC-Lewis publishers.
- Cralley, L. V. (1995). Industrial environmental health-the worker and the community.

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- Freedman, B (ed). Environmental ecology-the ecological effects of pollution-disturbances and other stresses. Academic press.
- Gangsted, E.O. (1990). Natural resources management of water and land. Van Nostrand Reinhold, New York.
- Kale, V. S. and Gupta, A. (2001). Introduction to geomorphology, Orient Longman Ltd. Hyderabad.
- Mitchel, B. (1997). Resources and environmental management, Addison Westland Longman Ltd. Edinburgh.
- Richard, T. Wright and Dorothy, F. Boorse. Environmental Science-towards a sustainable future (11 ed), Pearson education Inc., USA.
- Ryding, S. O. (1994). Environmental management. IOS press, Amsterdam.
- Standard method for the examination of water and waste water (APHA, AWWA), Washington.

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Syllabus for Ph. D. Qualifying Examination: Paper II

Cell and Molecular Biology

Name of the Research Centre: Department of Botany, University of Calicut

1. Basic and modern cytogenetic techniques: Cytological stains, fluorochromes, cytological markers, FISH, cell sorters, cytochemical techniques, cytophotometry & micro-densitometry.
2. Isolation & study o fcells: Somatic cell hybridization, preparation of protoplasts from plant tissues for organelle isolation; extraction of giant plant protoplast, electrofusion of plant protoplasts, protoplast fusion and cybridisation.
3. Cellular kinetics and cell signaling: Mechanism of cellular movements inside the cell, microtubule dynamics and vesicular movements, translocation of proteins into mitochondria and chloroplast, signal transduction and plant signals.
4. Study of nuclei and nuclear components: Isolation of nuclei & nuclear specific staining techniques, extraction of nucleoli and techniques for staining nucleoli.
5. Chromosome analysis: Karyotype analysis, chromosome banding techniques, study of polytene chromosomes and their characterization, image cytometry, cytological map construction, flow cytometry, electrophoretic karyotyping and chromosome library, chromosome painting, Harlequin staining and spectral karyotyping, chromosome engineering, chromosome uptake, centromere activation, centromere mapping in eukaryotes.
6. Mutation studies: detection of chromosomal aberrations, methods to detect apoptosis and necrosis, site directed mutagenesis, human genetic syndromes, genetic disease diagnosis, gene therapy, radiation therapy and pre-natal diagnosis in man- amniocentesis and chorionic biopsy.
7. Methods of characterization of genome: Detection of repeated DNA sequences, DNA renaturation kinetics, restriction kinetics, restriction mapping, genetic markers(SSR, AFLP and SNPs). Transcript profiling: EST sequencing, SAGE, cDNA fragment analysis methods, array-based

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hybridization approaches, DNA footprinting, chromosome walking and jumping, DNA amplification, micro-array technologies, DNA microchips, SHOM, protein and amino acid sequencing, exon connection and reverse3d genetics; human gene transfer, trans-splicing, construction of genomic library and c-DNA library.

8. Molecular techniques for the improvement of organisms: cloning of plastid and mitochondrial genes by biolistics, gene editing and gene therapy, gene transfer techniques, organelle sequence transfer, bioluminescence, sperm typing, strategies for GMO's, transgenic plants and anti- sense technology.

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SYLLABUS

Ph.D. in Botany - Preliminary Qualifying Examination

Paper II - Specialization Subject - GENETICS AND 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.

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Chairman, Board of Studies in Botany (PG)
University of Calicut, Kerala - 673 635

Syllabus for Ph.D. Preliminary Qualifying Examination

Name of the Research Centre: Department of Botany, University of Calicut

Paper II – Specialization Subject: Angiosperm Taxonomy

Name of the candidate: NIKHIL KRISHNA

1. Taxonomic structure: Taxonomic hierarchy – Different taxonomic categories– supra specific and infra specific categories. Concept of species, genus and family.
2. Conceptual basis of the classification of APG system (latest).
3. Concepts of characters– analytic and synthetic characters, good and bad characters, qualitative and quantitative characters, character variation, isolation, isolating mechanisms and speciation.
4. International Code of Nomenclature for Algae, Fungi and Plants (ICN) – Melbourne code- key decisions, principles of ICN, major rules, effective and valid publications, rules of priority, limitations of priority, typification, author citation, choice and rejection of names and epithets, reasons for name changes.
5. Plant diversity – Keystone species, Umbrella species, threats to biodiversity, Red data book, *insitu* and *exsitu* conservation.
6. Computer applications in systematics: data bases, floras, monographs, checklists, dichotomous keys – information retrieval related to herbarium, museum specimens– phylogenetic analysis, preparation of manuscripts– references, libraries.
7. Procedure involved in the recognition and publication of new plant species. Preparation of taxonomic articles for publication: main components of a scientific article; preparation and presentation of scientific illustrations. Taxonomic research projects: plan and presentation of project proposals.
8. Systematics of *Begonia*: Diagnostic characters of the family *Begoniaceae*, global distribution of *Begonia*. Habit and habitat requirements, vegetative and floral characters used for classification and identification of *Begonia*. Brief outline of the recent sectional classification on *Begonia*. Studies on Indian begonias- the present status.

Approved

Prof. (Dr.) V.V. Radhakrishnan
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University of Calicut, Kerala - 673 635

References

1. Burkill, I.H. 1865. *Chapters in the history of Botany in India*. Delhi.
2. Doorenbos, J., Sosef, M.S.M & de Wilde, J.J.F.E. 1998. *The sections of Begonia including descriptions, keys and species lists. (Studies in Begoniaceae VI)*, The Netherlands.
3. Heywood, V.H. (Edn) 1968. *Modern Methods in Plant Taxonomy*, London.
4. Heywood, V.H. & P.H. Davis. 1963. *Principles of Angiosperm Taxonomy*, New York.
5. Jeffrey, C. 1968. *An introduction to Principles of Plant Taxonomy*, London.
6. Judd, W.S., Campbell C.S., Kellogg E.A., Stevens P.A. and Donoghue M.J. 2002. *Plant Systematics*: A Phylogenetic Approach. Sinauer Associates, Inc.,Massachusetts.
7. Layman B. Smith, Dieter C. Wasshausen, Jack Golding and Carrie E. Karegeannes. 1986. *BEGONIACEAE*, City of Washington.
8. McNeill, J., Barrie, F.R., Buck, W.R., Demoulin, V., Greuter, W., Hawksworth, D.L., Herendeen, P.S., Knapp, S., Marhold, K., Prado, J. and Prud'homme Van Reine, W.F., 2012. *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code). Regnum vegetabile, 154*(1). Koeltz Scientific Books. Germany
9. Naik.V.V.1984. *Taxonomy of Angiosperms*, New Delhi.
10. Sharma, B.D., P.K. Hajra., M. Sanjappa & A.R.K. Sastry. 1996. *Flora of India: Introductory Volume, Part I*, BSI.
11. Simpson M.G. 2006. *Plant Systematics*. Elsevier, Amsterdam.
12. Sivarajan, V.V. 1984. *Introduction to Principles of Plant Taxonomy*. Cambridge University Press, Cambridge.
13. Stace, C.A. 1989. Plant *Taxonomy & Biosystematics. University of Cambridge*, New York.
14. Stuessy, T.F. 2008. Plant Taxonomy: *The Systematic Evaluation of Comparative Data*. Columbia University Press, New York.
15. Turland, N. 2013. *The Code Decoded: A User's Guide to the International Code of Nomenclature for Algae, Fungi, and Plants. Regnum vegetabile*. 155. Koeltz Scientific Books, Germany.
16. Vogel, E.F. (Ed.) 1987. *Manual of Herbarium Taxonomy*, Leiden.

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UNIVERSITY OF CALICUT

SYLLABUS FOR Ph.D (Botany) QUALIFYING EXAMINATION

Name of the Candidate: **Jeomol K. K.**

Special paper II: Angiosperm Taxonomy

1. Plant Nomenclature: International code of Botanical Nomenclature (ICBN); ICBN Rules, Effective and valid publication, Rule of Priority and its limitations, Typification, Author citation, rejection and retention of names, conserved names, orthography and gender of names.
2. Taxonomic structure, taxonomic hierarchy, taxonomic categories- supra specific and infraspecific categories; concept of species, genus and family.
3. Taxonomic literatures: Floras, Revisions, Manuals, Monographs, Journals, etc.
4. Taxonomic Keys: indented and bracketed keys.
5. Concept of character, character variations, sources of taxonomic characters.
6. Variation and Speciation: Types of variation, variance analysis, isolating mechanism and speciation.
7. Methods of plant exploration: collection and herbarium preparation; management of herbaria: major herbaria in India and the World; role of herbaria in taxonomy.
8. Modern trends in Plant taxonomy: Biosystematics, Numerical taxonomy, Cladistics, Molecular Taxonomy and Phylogenetics.
9. A comparative account of major systems of classification; detailed account of APG system of classification.
10. Threatened taxa: IUCN categories, conservation of biodiversity, insitu and exsitu conservation.
11. Floristic studies in India: Major centers of taxonomic and floristic studies in India; Organization and functions of Botanical Survey of India.
12. Procedure involved in the recognition and publication of new plant species.
13. Preparation of taxonomic articles for publication: main components of scientific article; preparation and presentation of botanical illustrations
14. Taxonomic research projects: plan and presentation of research proposals.
15. An overview and detailed classification of family Urticaceae according to classical workers and APG.
16. Distribution of Urticaceae.

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

SYLLABUS FOR Ph. D.(PRELIMINARY QUALIFYING) EXAMINATIONIN BOTANY - 2017

Special paper: Plant physiology & Biochemistry

Name of the candidate – Dhanya Thomas T. T.

1. **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.
2. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternateoxidase; photorespiratory pathway.
3. **Nitrogen metabolism**: Nitrate and ammonium assimilation; amino acid biosynthesis.
4. **Sensory photobiology**: structure, function and mechanisms of actions of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
5. **Solute transport and photoassimilate translocation**: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
6. **Stress physiology**: Responses of plants to biotic (pathogen and insects) and abiotic (Low and high temperature, drought, heavy metals and salt) stresses; mechanisms of tolerance to biotic and abiotic stress.
7. **Highlight and UV stress**- stress effects to plants, changes in structure and function of photosynthetic apparatus; stress tolerance mechanisms.
8. **Effect of seed priming in stress tolerance**- Different types of priming-abiotic priming-osmopriming, hydropriming, halopriming, chemical priming, UV-priming (seeds and seedling). Biotic priming with microorganisms. Molecular and Metabolic changes in seed/seedlings subjected to priming.

References

1. Orcutt, D.M. and Nilsen, E.T. 2000. Physiology of Plants Under stress: Soil and Biotic Factors. John Wiley & Sons.Inc.

2. Prasad, M.N.V. and Strazalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants.Kluwer Academic Publishers.

3. Taiz, L. and Zeiger, E. 2002. Plant Physiology.The Benjamin Cummings Publishing Corporation Inc.

4. P J Lumsden. 1997. Plants and UV-B: responses to environmental change. Cambridge [U.K.], Cambridge University Press.

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Syllabus for Ph.D. Preliminary Qualifying Examination - 2017

Name of the Research Centre: Department of Botany, University of Calicut

Paper II – Specialization Subject: Industrial Biotechnology

Name of the candidate: JANEESHMA, E.

Module I

Biomolecules: Amino acids and peptides – classification, proteins – classification, hierarchy in structure; sugars – classification, polysaccharides types, structural features; lipids – classification, structure & functions, glycerophospholipids, sphingolipids; nucleic acids, biosynthesis and metabolism of proteins, lipids and nucleic acids.

Module II

Introduction to industrial enzymes: Production and isolation of extracellular and intracellular enzymes, purification and characterization, structure, specificities, molecular and biochemical properties carbohydrases, proteases, lipases, estimating their kinetic constants, use of linear plots, allosteric kinetics, Ramachandran plot and its applications.

Module III

Protein engineering in basic and applied biotechnology: Protein engineering for affinity purification, structure - function analyses of industrially significant enzymes, stabilization of industrial enzymes by protein engineering, protein modifying enzymes, designer enzymes and pectins, enhancement and recovery of folding and recombinant proteins using fusion protein strategies, biosensors.Site - directed mutagenesis and its importance.

Module IV

Culture strategy: Genes,Mutation and Mutagenesis – Mutagens – Radiation and chemical;Types of mutation. Ames test for mutagenesis, bacterial genetic system-recombination-transformation, conjugation, transduction, plasmids and transposons.

Module V

Bioprospecting: Isolation & screening of industrially important microbes, primary &secondary detection assay of fermentation products, improvement of increased yield & other desirable characteristics, advantages of bioprocess over chemical process. Media formulation, sterilization, fermentation – submerged, solid-state and immobilization. Bioreactor designing and upstream and downstream processings.

Module VI

Biotechnology in action: **Production of Primary Metabolites:** A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid etc.,); amino acids (glutamic acid, phenyalanine, aspartic acid etc.,) and alcohols (ethanol, butanol etc.; **Production of Secondary Metabolites:** Study of production processes for various classes of secondary

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metabolites: antibiotics: beta-lactams (penicillin, cephalosporin etc.), aminoglycosides (streptomycin etc.,) macrolides (erythromycin), vitamins and steroids; **Production of bioproducts:** Production of biopesticides, biofertilisers, biopreservatives (Nisin), biopolymers (xanthan gum, PHB), single cell protein; **Production of Modern Biotechnology Products:** Production of recombinant proteins having therapeutic and diagnostic applications; production of vaccines and monoclonal antibodies. Products of plant and animal cell culture..

References

Latest edition of

- Basic Biotechnology. Ratledge C & Kristiansen B (eds). *Cambridge University Press.*
- Biosafety and Bioethics. Josh RM. *Isha Books, ND.*
- Biosensors. Josh RM. *Isha Books ND.*
- Concepts in Biotechnology. Achrekar J. *Dominant Publishers and Distributors, ND.*
- Environmental Biotechnology. Vashisth P. *Dominant Publishers and Distributors, ND.*
- Enzyme Technology. Pandey A, Webb C, Soccol C, Larnche C. *Springer.*
- Fundamentals of Molecular Biology Genetic engineering Biotechnology. Khan IA & Khanum (eds). *Ukaaz Publications, Hyserabad.*
- Genes. Lewin B. *Pearson Educational International.*
- Lehninger Principles of Biochemistry, Nelson DL & Cox MM. *WH Freeman and Company New York.*
- Molecular Cloning. Sambrook J & Russel DW. *Cold Springer Harbor Lab Press NY.*
- New Horizons in Biotechnology. Roussos S, Soccol CR, Pandey A, Angur C. *Kluwer Academic Publications.*
- Protein Engineering in Industrial Biotechnology. Alberghina C (ed). *Harwood Academic Pbublications.*
- Text Book of Biotechnology. Das HK. *Wiley Dreamtech India P.Ltd.*

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UNIVERSITY OF CALICUT

SYLLABUS FOR Ph.D (Botany) QUALIFYING EXAMINATION

Name of the Candidate: Amrutha A

Special paper: Angiosperm Taxonomy

1. Plant Nomenclature: International code of Botanical Nomenclature (ICBN); ICBN Rules, Effective and valid publication, Rule of Priority and its limitations, Typification, Author citation, rejection and retention of names, conserved names, orthography and gender of names.
2. Taxonomic structure, taxonomic hierarchy, taxonomic categories- supra specific and infraspecific categories; concept of species, genus and family.
3. Taxonomic literatures: Floras, Revisions, Manuals, Monographs, Journals, etc.
4. Taxonomic Keys: indented and bracketed keys.
5. Concept of character, character variations, sources of taxonomic characters.
6. Variation and Speciation: Types of variation, variance analysis, isolating mechanism and speciation.
7. Methods of plant exploration: collection and herbarium preparation; management of herbaria: major herbaria in India and the World; role of herbaria in taxonomy.
8. Modern trends in Plant taxonomy: Biosystematics, Numerical taxonomy, Cladistics, Molecular Taxonomy and Phylogenetics.
9. A comparative account of major systems of classification; detailed account of APG system of classification.
10. Threatened taxa: IUCN categories, conservation of biodiversity, insitu and exsitu conservation.
11. Floristic studies in India: Major centers of taxonomic and floristic studies in India: Organization and functions of Botanical Survey of India.
12. Procedure involved in the recognition and publication of new plant species.
13. Preparation of taxonomic articles for publication: main components of scientific article; preparation and presentation of botanical illustrations
14. Taxonomic research projects: plan and presentation of research proposals
15. Circumscription and delimitation of the Family Leeaceae; floral morphology, pollination, ecology and distribution of the Genus *Leea*
16. Modern trends in Plant Taxonomy: Biosystematics, Numerical Taxonomy (Taximetrics), Cladistics.

Approved

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

SYLLABUS FOR Ph. D. (PRELIMINARY QUALIFYING) EXAMINATION IN BOTANY - 2018

Special paper: Plant Physiology & Biochemistry

Name of the candidate – Sameena P. P.

1. **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.
2. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.
3. **Nitrogen metabolism**: Nitrate and ammonium assimilation; amino acid biosynthesis.
4. **Sensory photobiology:** structure, function and mechanisms of actions of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
5. **Solute transport and photoassimilate translocation**: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
6. **Stress physiology:** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.
7. **Heavy metal stress:** sources of heavy metals (Natural, agricultural, industrial and municipal sources); Metallophytes (accumulators, indicators & excluders), avoidance and amelioration mechanisms. Synthesis of phytochelatins: Biosynthesis of glutathione, characterisation.
8. **Physiology and biochemistry of metal toxicity:** Metal binding to organic ligand; metal antagonisms and synergisms; metal uptake, toxicity, detoxification (Heat shock proteins, metallothioneins, phytochelatins, Plasma membrane-vacuolar compartmentation, antioxidants & enzymes); tolerance mechanisms.

References

1. Orcutt, D.M. and Nilsen, E.T. 2000. Physiology of Plants Under stress: Soil and Biotic Factors. John Wiley & Sons.Inc.

2. Prasad, M.N.V. and Strazalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants. Kluwer Academic Publishers.

3. Taiz, L. and Zeiger, E. 2002. Plant Physiology. The Benjamin Cummings Publishing Corporation Inc.

Approved

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

SYLLABUS FOR Ph. D.(PRELIMINARY QUALIFYING) EXAMINATIONIN BOTANY - 2018

Special paper: Plant physiology & Biochemistry

Name of the candidate – Akhila sen.

1. **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.
2. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternateoxidase; photorespiratory pathway.
3. **Nitrogen metabolism:** Nitrate and ammonium assimilation; amino acid biosynthesis.
4. **Sensory photobiology**: structure, function and mechanisms of actions of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
5. **Solute transport and photoassimilate translocation**: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
6. **Stress physiology**: Responses of plants to biotic (pathogen and insects) and abiotic (light, drought, heavy metals and salt) stresses; mechanisms of tolerance to biotic and abiotic stress.
7. **UV stress, drought and salt-** stress effects to plants, changes in structure and function of photosynthetic apparatus; stress tolerance mechanisms.
8. **Effect of seed priming in stress tolerance-** Different types of priming-abiotic priming-osmopriming, hydropriming, halopriming, chemical priming, UV-priming. Biotic priming with microorganisms.
9. **Gene expression changes in relation to different abiotic stresses-** Alterations in gene expression in response to water deficit, salt tolerance, regulation of heat shock gene expression.

References

Approved

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

1. Orcutt, D. M. and Nilsen, E.T. 2000. Physiology of Plants Under stress: Soil and Biotic Factors. John Wiley & Sons.Inc.

2. Prasad, M. N. V. and Strazalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants.Kluwer Academic Publishers.

3. Taiz, L. and Zeiger, E. 2015. Plant Physiology. Sixth edition. Sinauer Associates. Inc Publishers, Massacheusetts.

4. Lumsden P. J. 1997. Plants and UV-B: responses to environmental change. Cambridge [U.K.], Cambridge University Press.

5. Barsa, A. S. 1996.Stress induced gene expression in plants. Harwood Academic Publisher.

Approved

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

UNIVERSITY OF CALICUT

SYLLABUS FOR Ph.D (Botany) QUALIFYING EXAMINATION 2018

Special paper: Angiosperm Taxonomy

Ph. D Topic: Molecular phylogeny of Musaceae in India.

Name of the Candidate: **Rajeesh E P**

1. Plant Nomenclature: International code of Botanical Nomenclature (ICBN); ICBN Rules, Effective and valid publication, Rule of Priority and its limitations, Typification, Author citation, rejection and retention of names, conserved names, orthography and gender of names.
2. Taxonomic structure, taxonomic hierarchy, taxonomic categories- supra specific and infraspecific categories; concept of species, genus and family.
3. Taxonomic literatures: Floras, Revisions, Manuals, Monographs, Journals, etc.
4. Taxonomic Keys: indented and bracketed keys.
5. Concept of character, character variations, sources of taxonomic characters.
6. Variation and Speciation: Types of variation, variance analysis, isolating mechanism and speciation.
7. Modern trends in Plant taxonomy: Biosystematics, Numerical taxonomy, Cladistics, Molecular Taxonomy and Phylogenetics.
8. A comparative account of major systems of classification; detailed account of APG system of classification.
9. Threatened taxa: IUCN categories, conservation of biodiversity, insitu and exsitu conservation.
10. Floristic studies in India: Major centres of taxonomic and floristic studies in India; Organization and functions of Botanical Survey of India.
11. Procedure involved in the recognition and publication of new plant species.
12. Preparation of taxonomic articles for publication: main components of scientific article; preparation and presentation of botanical illustrations
13. Taxonomic research projects: plan and presentation of research proposals.
14. An overview and detailed classification of family Musaceae according to classical workers and APG.
15. Recent advancements in the family Musaceae: Molecular phylogenetics.

Approved

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

16. Molecular systematic and evolution: Different types of molecular markers- nuclear versus chloroplast, methods of DNA isolation, amplification, and sequencing.
17. Phylogenetics: Applications of molecular phylogenetics, Methods of tree building using DNA sequence data: (a) Distance approach: NJ, UPGMA, Least square, Minimum Evolution; (b) Character state approach : Parsimony, Maximum likelihood, Bayesian approach.
18. Databases, Blast, primer designing, primer design software, Acquiring molecular data NCBI (Gene Bank), principles of multiple sequence alignment (Clustal W), Software for phylogenic and biogeographic analysis - PAUP. BEAST, S-DIVA, TRACER, Mesquite, MEGA, Raxml.

Approved

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

Syllabus for Ph.D. Preliminary Qualifying Examination 2018

Name of Research Centre: Department of Botany, University of Calicut

Paper II- Special paper: Angiosperm Taxonomy

Name of the Candidate: **Sreekutty T.K.**

Supervising Teacher: **Prof. Santhosh Nampy**

Topic: **Molecular phylogeny and character evolution in *Murdannia* Royle (Commelinaceae) in India supplemented with morphological and cytological data.**

1. Taxonomic structure and concept of taxa: Taxonomic hierarchy, purpose of hierarchy, concept of species, genus and family.

2. Plant nomenclature: International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code- 2018); Outline of the code. Principles- major rules, rule of priority, effective and valid publication, author citation.

3. Commelinaceae: General characters with special emphasis on *Murdannia* Royle and its diversity in India.

4. Recent systems of plant classifications: APG IV.

5. Molecular taxonomy, cladistics, Phylogenetics: Application of molecular phylogenetics; method of tree building using DNA sequence data. a). distance approach: NJ, UPGMA, Least square, minimum evolution. b). Character state approach: Parsimony, Maximum likelihood, Bayesian approach. Boot strap, likelihood ratio test and application, test for monophyly- parametric bootstrapping, S-H test.

6. Techniques in Molecular biology: Spectrophotometry; gel electrophoresis: different types- 1D and 2D, application, PCR & types of PCR; molecular markers- nuclear versus chloroplast; method of DNA isolation, amplification and sequencing. RFLP, RAPD, AFLP, SSR, ISSR.

7. Bioinformatics: Data bases, BLAST; Multiple sequence alignment, software for phylogenic and biogeographic analysis- MEGA, RAxML, PAUP, BEAST, Mesquite.

8. Cytotaxonomy: Cell division; mitosis, meiosis and their significance; Chromosome-morphology, counting, ploidy; karyotyping.

9. Cytological techniques: Pre-treatment, Fixation, staining, squash preparation and slide preparation.

Approved

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

Ph.D. PRELIMINARY QUALIFYING EXAMINATION - 2021

Name of Research Centre: Department of Botany, University of Calicut

Paper II(special paper)–Plant Physiology and Biochemistry (Syllabus)

Name of the candidate- Aswathi Raj K P

1. **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO_2 fixation-C3, C4 and CAM pathways.
2. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternateoxidase; photorespiratory pathway.
3. **Nitrogen metabolism**: Nitrogenase enzyme, Nitrate and ammonium assimilation; amino acid biosynthesis.
4. **Sensory photobiology**: Structure, function and mechanisms of actions of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
5. **Solute transport and photoassimilate translocation**: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
6. **Stress physiology**: Responses of plants to biotic (pathogen and insects) and abiotic (light, drought, heavy metals and salt) stresses; mechanisms of tolerance to biotic and abiotic stress.
7. **Effect of seed priming in stress tolerance-** Different types of priming-abiotic priming- osmopriming, hydropriming, halopriming, chemical priming, UV-priming. Biotic priming with microorganisms.
8. **Relevance of drought stress tolerance and recovery in plants-** Morphological, physio-chemical and molecular alterations during drought and recovery.
9. **Gene expression changes in relation to different abiotic stresses-** Alterations in gene expression in response to water deficit, salt tolerance,regulation of heat shock gene expression.

Approved.

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

References

1. Orcutt, D. M. and Nilsen, E.T. 2000. Physiology of Plants Under stress: Soil and Biotic Factors. John Wiley &Sons.Inc.

2. Prasad, M. N. V. and Strazalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants.Kluwer Academic Publishers.

3. Taiz, L. and Zeiger, E. 2015. Plant Physiology.Sixth edition. Sinauer Associates. Inc Publishers, Massacheusetts.

4. Lumsden P. J. 1997. Plants and UV-B: responses to environmental change. Cambridge [U.K.], Cambridge University Press.

5. Barsa, A. S. 1996.Stress induced gene expression in plants. Harwood Academic Publisher.

Approved

Prof. (Dr.) V.V. Radhakrishnan
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Ph.D. PRELIMINARY QUALIFYING EXAMINATION - 2021

Name of Research Centre: Department of Botany, University of Calicut

Paper II (special paper) – Plant Physiology and Biochemistry (Syllabus)

Name of the candidate- Noble Louis

1. **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.
2. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.
3. **Nitrogen metabolism**: Nitrogenase enzyme, Nitrate and ammonium assimilation; amino acid biosynthesis.
4. **Sensory photobiology**: Structure, function and mechanisms of actions of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
5. **Solute transport and photoassimilate translocation**: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
6. **Stress physiology**: Responses of plants to biotic (pathogen and insects) and abiotic (light, drought, heavy metals and salt) stresses; mechanisms of tolerance to biotic and abiotic stress, stress signalling.
7. **Different types of seed priming and its effects in stress tolerance-** Different types of priming-abiotic priming: - osmo-priming, hydropriming, halopriming, chemical priming, nano-priming and biotic priming with microorganisms.UV-priming and application of UV-priming. Priming induced molecular changes.
8. **Stress/priming and epigenetic change –** DNA methylation, histone acetylation, enzymes evolved in epigenetic changes, sulfur sequencing, ChIP sequencing.
9. **Gene expression changes in relation to different abiotic stresses-** Alterations in gene expression in response to water deficit, salt tolerance, regulation of heat shock gene expression.

Approved

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

References

1. Orcutt, D. M. and Nilsen, E.T. 2000. Physiology of Plants Under stress: Soil and Biotic Factors. John Wiley &Sons.Inc.

2. Prasad, M. N. V. and Strazalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants.Kluwer Academic Publishers.

3. Taiz, L. and Zeiger, E. 2015. Plant Physiology. Sixth edition. Sinauer Associates. Inc Publishers, Massacheusetts.

4. Lumsden P. J. 1997. Plants and UV-B: responses to environmental change. Cambridge [U.K.], Cambridge University Press.

5. Barsa, A. S. 1996.Stress induced gene expression in plants. Harwood Academic Publisher.

6. Jisha, K. C., Vijayakumari, K., & Puthur, J. T. (2013). Seed priming for abiotic stress tolerance: an overview. *Acta Physiologiae Plantarum*, *35*(5), 1381-1396.

7. Hossain, M. A., Bhattacharjee, S., Armin, S. M., Qian, P., Xin, W., Li, H. Y., ... & Tran, L. S. P. (2015). Hydrogen peroxide priming modulates abiotic oxidative stress tolerance: insights from ROS detoxification and scavenging. *Frontiers in plant science*, *6*, 420.

8. Grant-Downton, R., & Dickinson, H. G. (2005). Epigenetics and its implications for plant biology. 1. The epigenetic network in plants. *Annals of botany*, *96*(7), 1143-1164.

9. Woodward, C., Hansen, L., Beckwith, F., Redman, R. S., and Rodriguez, R. J. 2012. Symbiogenics: an epigenetic approach to mitigating impacts of climate change on plants. *HortScience*, *47*(6), 699-703.

Approved

Prof. (Dr.) V.V. Radhakrishnan
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University of Calicut, Kerala - 673 635

Ph.D. PRELIMINARY QUALIFYING EXAMINATION - 2021

Name of Research Centre: Department of Botany, University of Calicut

Paper II (special paper) – Plant Physiology and Biochemistry (Syllabus)

Name of the candidate- Amritha M. S.

1. **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.
2. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.
3. **Nitrogen metabolism**: Nitrogenase enzyme, Nitrate and ammonium assimilation; amino acid biosynthesis.
4. **Sensory photobiology**: Structure, function and mechanisms of actions of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
5. **Solute transport and photoassimilate translocation:** Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
6. **Stress physiology**: Responses of plants to biotic (pathogen and insects) and abiotic (light, drought, heavy metals and salt) stresses; mechanisms of tolerance to biotic and abiotic stress, stress signalling.
7. **Different types of seed priming and its effects in stress tolerance-** Different types of priming-abiotic priming: - osmo-priming, hydropriming, halopriming, chemical priming, UV-priming and biotic priming with microorganisms. Nanopriming; application of nanopriming agents over bulk materials, different types of nanomaterials used in priming. Priming induced molecular changes.
8. **Stress/priming and epigenetic change –** DNA methylation, histone acetylation, enzymes evolved in epigenetic changes, sulfur sequencing, ChIP sequencing.
9. **Gene expression changes in relation to different abiotic stresses-** Alterations in gene expression in response to water deficit, salt tolerance, regulation of heat shock gene expression.

Approved

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

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University of Calicut, Kerala - 673 635

References

1. Orcutt, D. M. and Nilsen, E.T. 2000. Physiology of Plants Under stress: Soil and Biotic Factors. John Wiley & Sons.Inc.

2. Prasad, M. N. V. and Strazalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants.Kluwer Academic Publishers.

3. Taiz, L. and Zeiger, E. 2015. Plant Physiology. Sixth edition. Sinauer Associates. Inc Publishers, Massacheusetts.

4. Lumsden P. J. 1997. Plants and UV-B: responses to environmental change. Cambridge [U.K.], Cambridge University Press.

5. Barsa, A. S. 1996.Stress induced gene expression in plants. Harwood Academic Publisher.

6. Jisha, K. C., Vijayakumari, K., & Puthur, J. T. (2013). Seed priming for abiotic stress tolerance: an overview. *Acta Physiologiae Plantarum*, *35*(5), 1381-1396.

7. Hossain, M. A., Bhattacharjee, S., Armin, S. M., Qian, P., Xin, W., Li, H. Y., ... & Tran, L. S. P. (2015). Hydrogen peroxide priming modulates abiotic oxidative stress tolerance: insights from ROS detoxification and scavenging. *Frontiers in plant science*, *6*, 420.

8. Shukla, P., Chaurasia, P., Younis, K., Qadri, O. S., Faridi, S. A., & Srivastava, G. (2019). Nanotechnology in sustainable agriculture: studies from seed priming to post-harvest management. *Nanotechnology for Environmental Engineering*, *4*(1), 11.

9. Waqas, M., Korres, N. E., Khan, M. D., Nizami, A. S., Deeba, F., Ali, I., & Hussain, H. (2019). Advances in the concept and methods of seed priming. In *Priming and pretreatment of seeds and seedlings* (pp. 11-41). Springer, Singapore.

10. Woodward, C., Hansen, L., Beckwith, F., Redman, R. S., and Rodriguez, R. J. 2012. Symbiogenics: an epigenetic approach to mitigating impacts of climate change on plants. *HortScience*, *47*(6), 699-703.

Approved

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

Ph.D. PRELIMINARY QUALIFYING EXAMINATION - 2021

Name of Research Centre: Department of Botany, University of Calicut

Paper II(special paper)–Plant Physiology and Biochemistry (Syllabus)

Name of the candidate- Veena Mathew

1. **Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways.
2. **Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternateoxidase; photorespiratory pathway.
3. **Nitrogen metabolism**: Nitrogenase enzyme, Nitrate and ammonium assimilation; amino acid biosynthesis.
4. **Sensory photobiology**: Structure, function and mechanisms of actions of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.
5. **Solute transport and photoassimilate translocation**: Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.
6. **Stress physiology**: Responses of plants to biotic (pathogen and insects) and abiotic (light, drought, heavy metals and salt) stresses; mechanisms of tolerance to biotic and abiotic stress.
7. **Effect of seed priming in stress tolerance-** Different types of priming-abiotic priming- osmopriming, hydropriming, halopriming, chemical priming, UV-priming. Biotic priming with microorganisms.
8. **Effect of nutripriming in Biofortification-**Micronutrient malnutrition, biofortification approaches- agronomic, genetic- breeding, rDNA technology.
9. **Gene expression changes in relation to different abiotic stresses-** Alterations in gene expression in response to water deficit, salt tolerance,regulation of heat shock gene expression.

References

Approved

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

1. Orcutt, D. M. and Nilsen, E.T. 2000. Physiology of Plants Under stress: Soil and Biotic Factors. John Wiley &Sons.Inc.

2. Prasad, M. N. V. and Strazalka, K. 2002. Physiology and Biochemistry of Metal Toxicity and Tolerance in Plants.Kluwer Academic Publishers.

3. Taiz, L. and Zeiger, E. 2015. Plant Physiology.Sixth edition. Sinauer Associates. Inc Publishers, Massacheusetts.

4. Lumsden P. J. 1997. Plants and UV-B: responses to environmental change. Cambridge [U.K.], Cambridge University Press.

5. Barsa, A. S. 1996.Stress induced gene expression in plants. Harwood Academic Publisher.

Approved.

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

Ph.D. PRELIMINARY QUALIFYING EXAMINATION 2021 (Syllabus)

Name of Research Centre: Department of Botany, University of Calicut

Paper II (Special paper) - ANGIOSPERM TAXONOMY

Name of the candidate: Akhil M.K.

Topic: **Taxonomy and molecular phylogeny of the genus *Aeschynanthus* Jack (Gesneriaceae) in India**

1. Taxonomic structure, taxonomic hierarchy, taxonomic categories- supra specific and infraspecific categories; concept of species, genus and family.
2. International code of Nomenclature of algae, fungi and plants (Schenzen Code, 2018); Principles –Rules & recommendations - Effective and valid publication - Rule of Priority and its limitations – Typification - Author citation - rejection of names - conserved names - orthography and gender of names – names of hybrids.
3. Taxonomic literatures: Floras, Revisions, Manuals, Monographs, Journals, etc.
4. Concept of character, character variations, sources of taxonomic characters.
5. Variation and Speciation: Types of variation, variance analysis, isolating mechanism and speciation.
6. Modern trends in Plant taxonomy: Biosystematics, Numerical taxonomy, Cladistics, Molecular Taxonomy and Phylogenetics.
7. A comparative account of major systems of classification; detailed account of APG system of classification.
8. IUCN Red list Categories and Criteria (2012, 2019 versions), conservation of biodiversity, insitu and exsitu conservation.
9. Floristic studies in India: Major centres of taxonomic and floristic studies in India; Organization and functions of Botanical Survey of India.
10. Family Gesneriaceae: an overview and detailed classification - diversity, distribution and endemism of Indian Gesneriaceae.
11. Genus *Aeschynanthus* Jack: general characteristics - review of the status in world context - diversity, distribution and endemism.
12. Procedure involved in the recognition and publication of new plant species.
13. Palynology in relation to taxonomy and recent advances in palynology.

Approved

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

14. Molecular systematic and evolution: Different types of molecular markers- nuclear versus chloroplast, methods of DNA isolation, amplification, and sequencing.
15. Techniques in Molecular biology: Spectrophotometry; gel electrophoresis; different types- 1D and 2D, application. PCR & types of PCR; molecular markers- nuclear versus chloroplast; method of DNA isolation, amplification and sequencing. RFLP, RAPD, AFLP, SSR, ISSR.
16. Phylogenetics: Applications of molecular phylogenetics. Methods of tree building using DNA sequence data: (a) Distance approach: NJ, UPGMA, Least square, Minimum Evolution; (b) Character state approach : Parsimony, Maximum likelihood, Bayesian approach.
17. Bioinformatics: Data bases, BLAST; Multiple sequence alignment, software for phylogenic and biogeographic analysis- MEGA, RAxML, PAUP, BEAST, Mesquite.

Approved

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

Ph.D. PRELIMINARY QUALIFYING EXAMINATION 2021 (Syllabus)

Name of Research Centre: Department of Botany, University of Calicut

Paper II (Special paper) - ANGIOSPERM TAXONOMY

Name of the candidate: Harishma K.H.

Topic: **Taxonomic revision of the genus *Ixora* L. (Rubiaceae) in India based on Morphological, Palynological and Molecular studies**

1. Taxonomic structure, taxonomic hierarchy, taxonomic categories- supra specific and infraspecific categories; concept of species, genus and family.
2. International code of Nomenclature of algae, fungi and plants (Schenzen Code, 2018); Principles –Rules & recommendations - Effective and valid publication - Rule of Priority and its limitations – Typification - Author citation - rejection of names - conserved names - orthography and gender of names – names of hybrids.
3. Taxonomic literatures: Floras, Revisions, Manuals, Monographs, Journals, etc.
4. Concept of character, character variations, sources of taxonomic characters.
5. Modern trends in Plant taxonomy: Biosystematics, Numerical taxonomy, Cladistics, Molecular Taxonomy and Phylogenetics.
6. Variation and Speciation: Types of variation, variance analysis, isolating mechanism and speciation.
7. A comparative account of major systems of classification; detailed account of APG system of classification.
8. IUCN Red list Categories and Criteria (2012, 2019 versions), conservation of biodiversity, insitu and exsitu conservation.
9. Procedure involved in the recognition and publication of new plant species.
10. Floristic studies in India: Major centres of taxonomic and floristic studies in India; Organization and functions of Botanical Survey of India.
11. Family Rubiaceae: an overview and detailed classification - diversity, distribution and endemism of Indian Rubiaceae.
12. Genus *Ixora* L.: general characteristics - review of the status in world context - diversity, distribution and endemism.
13. Palynology in relation to taxonomy and recent advances in palynology.

Approved

Prof. (Dr.) V.V. Radhakrishnan
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University of Calicut, Kerala - 673 635

14. Molecular systematic and evolution: Different types of molecular markers- nuclear versus chloroplast, methods of DNA isolation, amplification, and sequencing.
15. Techniques in Molecular biology: Spectrophotometry; gel electrophoresis: different types- 1D and 2D, application, PCR & types of PCR; molecular markers- nuclear versus chloroplast; method of DNA isolation, amplification and sequencing. RFLP, RAPD, AFLP, SSR, ISSR.
16. Phylogenetics: Applications of molecular phylogenetics. Methods of tree building using DNA sequence data: (a) Distance approach: NJ, UPGMA, Least square, Minimum Evolution; (b) Character state approach : Parsimony, Maximum likelihood, Bayesian approach.
17. Bioinformatics: Databases, BLAST; Multiple sequence alignment, software for phylogenic and biogeographic analysis- MEGA, RAxML, PAUP, BEAST, Mesquite.

Approved

Prof. (Dr.) V.V. Radhakrishnan
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