

## **Ph.D Botany (Course work) syllabus-2020**

### **Core course paper-I: Research Methodology**

**Credits: 4**

**External Exam: 70M**

**Duration: 4 Hrs/wk**

**Internal Exams: 30**

#### **Unit-I:**

1. Research problem-It's importance, aims and objectives, Literature survey, Planning of research, Methodology( Methods of Data, collection) design of experiments, Data presentation and statistical analyzing data drawing conclusion/Report writing.
2. Scientific paper writing, preparing manuscript for publications and paper presentation.
3. Research Journals, Impact factor and Paper citation index, Different bibliographic styles.
4. Funding opportunities DST, DBT, DRDO, UGC, CSIR, ICAR, Ministry of Environment and Forest, Drugs and Pharmaceutical Research (DST), Ministry of Food Processing Industries.

#### **Unit-II:**

5. Isolation and Culture of Algae
6. Isolation and culture of Fungi from air, water and Soil
7. Tissue culture techniques: Explant preparation, sterilization, media preparation, cell culture, cell suspension culture, Isolation of protoplast, protoplast culture, Protoplast fusion, haploid production, Anther and Pollen culture, Somatic embryogenesis, callus induction and micro propagation.
8. Field and Herbarium methods: Plant collection, documentation, drying and preservation, Role of Herbaria in teaching and research. Importance of National and International Herbaria and Pest control in Herbaria.

#### **Unit-III:**

9. Cytological Techniques: pre-treatment, fixation, staining (single and double), Mounting, making of permanent slides of Microtome.
10. Preparation of cytological slides for study of Mitosis by root tip squash and Meiosis from smear of anthers.
11. Micrometry: Stage and Ocular micrometers, Haemocytometer, Camera lucida and Microphotography.

12. Microscope: Light microscope, Fluorescence microscope(SEM,TEM and STEM)

**Unit-IV:**

13. Centrifugation Techniques: Basic principles of sedimentation, uses, separation methods, differential and Density gradient centrifugation, High speed and, Ultracentrifugation.

14. Extraction and Estimation: Carbohydrates, Amino acids, Proteins, Lipids, Nucleic acids and Pigments (Chlorophyll and Carotenoids)

15. Plant breeding: concept of hybridization techniques, anthesis, selection of floral buds for crossing. Knowledge of micro and mega sporogenesis. Analysis of F1 hybrids and assessment of F1 hybrids with their respective parents.

16. Biodiversity and Conservation techniques, legal issues, Intellectual Property Rights Issues.

17. Bio statistics: Data analysis-variables, numerical, categorical central measures (mean, median, mode); dispersion measures (range, standard deviation), Parametric and non parametric tests t-test, f-test, chi-square test, ANOVA.

## **Reference Books:**

1. Dwivedi, J.N and Singh R.B 1990. Essentials of plant techniques. Scientific Publishers, Jodhpur.
2. Sharma V.K. 1991 Techniques in Microscopy and Cell Biology. Tata Mc Graw-Hill publishing company Ltd. Delhi.\
3. Wilson k and John Walker, 2000 Principles and Techniaues of practical Biochemeistry , Cambridge Universtiy Press.
4. N Gurumani 2006 Research Methodology for biological sciences. MJP Publishing, Chennai
5. C.R.Kothari 2004 Research Methodology-Methods and Techniques, New Age Publ. Wiley Eastern, 1985.
6. Dawson, Catherina 2002 Practical Res. Methods New Delhi, UBS Publ.
7. Kumar,N.C 1993 An Introduction to Plant tissue and Cell culture. Emkay pubnlications, New Delhi.
8. Plummer, D.T 1998 An Introduction to Practical Biochemistry. Tata Mc Graw-hill publishing company Limited, Delhi.
9. Sadasivam, s and A.Manikam 1992 Biochemical Methds, Wiely Eastern Ltd.

## **Ph.D Botany (Course work) syllabus-2020**

### **Core course paper-II: Advances in Botany**

**Credits: 4**

**External Exam: 70M**

**Duration: 4 Hrs/wk**

**Internal Exam: 30M**

#### **Unit-I: Ecology & Biodiversity**

Concept of Ecology, Ecological factors, concept of Biome and Biosphere, Ecosystem, types of Ecosystems, Plant succession, Plant indicators, Forest types, Environment (Protection) Act, Endangered species(plants), Endemism, IUCN categories, Red Data Book, Biodiversity and its conservation, Hotspots of Biodiversity, Conventions on Biodiversity, Indian Biodiversity Act (2002), Global warming and Climate change, Environmental Impact Assessment(EIA) and Introduction to Ethnobotany.

#### **Unit-II: Secondary metabolites**

Secondary metabolites-Terpenoids, Phenolics, Alkaloids.

Major secondary metabolite synthesis pathways in plants, Acetate Pathway (Fatty acid and polypeptides), Mevalonate and deoxyxylulose phosphate pathway (for production of Terpenoids and steroids), Shikimate pathway(Phenols, Amino acids etc) and role of Secondary metabolites.

#### **Unit-III: Plant Systematics**

Plant Classifications: Artificial, Natural, Phonetic, Phylogenetic and APG IV

Computational phylogenetics:Theoretical framework of phylogenetic, Distance Vs. Discrete methods, Minimum Evolution, UPGMA, Neighbor Joining, Maximum Likelihood, Maximum Parsimony, Bayesian Inference, reconstruction of phylogeny from morphological data, Gene Tree Vs. Species tree, and lineage sorting.

#### **Unit-IV: Genomics & Proteomics**

Genome structure & Organization, Eukaryotic genome, Organelle genome, Genomics of Microbes and Microbiomes, Genome sequencing technologies.

Proteome-Structural and functional features, Qualitative proteome technology (Gel based and Gel free), Quantitative proteome technology, Functional proteome technology, Application of Proteomics in Agricultural biotechnology.

## Reference Books:

1. Krishnamurthy K.V. 2004 An advanced text book of Biodiversity. Oxford & IBH, New Delhi.
2. Odum E.P Gary W. Barrelet. 2004 Fundamentals of Ecology-15th edition. Thomson Asia Pvt.Ltd.
3. L. Taiz and E. Zeiger 2002 Plant physiology (second edition) Simauer Associates Inc Publishers Sunderland, Massachusetts.
4. W.G. Hopkins 1985 Introduction to plant Physiology John Wiley and Sons, Inc. New York.
5. Coombs, Hall, Long and Scurlik. 1985 Techniques in bioproductivity and Photosynthesis, Pergamon Press, Oxford
6. Hall, Scurlik, Bolhar, Norden Kamf, Leagood and Long 1993 Photosynthesis and productin in a changing Environment. A Field and Laboratory Mannual, Chapman and Hall Publication.
7. Glick, B.r. and Pasternak, J.J 1994 Molecular Biotechnology: Principles and Application of r-RNA Press, Washington.
8. Singh Gurucharan 2010 Plant systematic : An Integrated fapproach. Science Pblsher, USA
9. Judd, W.S Campbell, C.S., Kollogg, E.A., Stevens, P.F and Donoghue M.J. 2008 Plant systematic: Phylogenetic approach. Sinauer Associates, Inc.
10. Krishnamoorthy, K.V 2003 Text Book of Biodiversity, Science Publishers Inc, United States of America.
11. Wison E.O and Frances M. Peter 1988 Biodiversity, National Academy Press, Washington
12. Kelvin J Gaston and John I Spicer 2005 Biodiversity an Introduction. Blackwell publishing company, Australia.
13. Negi. S.S. 1993 Biodiversity and Conservation in India, Indus Publishing, New Delhi.
14. Chapman, V.J and D.J Champan. 198 Seaweed and their uses, 3<sup>rd</sup> Edition, Chapman & Hall, New York, 63-85
15. Cole, K.M and Sheath, R.G. 1990. Biology of Red Algae. Cambridge University press 517pp
16. Fritsch F.E 1972 Structure and Reproduction of Algae VI. I and II Cambridge University press
17. Sambamurthy A.V.S.S 2005 A Textbkook of Algae. I.K. International Pvt.Ltd. New Delhi.
18. Sharma O.P 2007 Text book of Algae: Tata Mc Graw-Hill Publications Pvt., New Delhi
19. Suresh kumar 2009 An Introduction to Algae: Campus Books International Publications, New Delhi
20. Vijayaraghavan M.R and Bela Bhatia 1997 Studies in Cryptogamic botany of Red Algae
21. Manivasagam 1997 Industrial Effluents, First Edition. Sakthi Publications, Coimbatore
22. Prasad, M.N.V 2004. Heavy metal stress in plants from Biomolecules to ecosystem. Narosa Publishing House, New Delhi.
23. Trivedi, P.C 2008. Pollution and bioremediation, Aavishkar Publication, Jaipur.
24. Rajendran P. Gunasekaran 2007 Microbial Bioremediation MJP Publication, Geneva.

25. Brown TA, Genomes (2nd Ed), BIOS Scientific Publishers, Oxford,UK, 2002.
26. Sensen CW, Essentials of Genomics and Bioinformatics,Wiley-VCH, 2002. 27. Sensen CW, Hand book of Genome Research, Wiley-VCH Verlag GmBh & Co, Weinheim, 2005.
27. Pennigton SR and Dunn MJ, Proteomics, Viva Books Pvt. Ltd, NewDelhi, 2002.
28. Sándor Suhai, Genomics and Proteomics: Functional and Computational Aspects, Kluwer AcademicPublishers, 2002.
29. Phylogenetic Analysis of Morphological Data (Smithsonian Series in Comparative Evolutionary Biology), John J. Wiens. Smithsonian Books, 978-1560988168
30. Phylogenetics: Theory and Practice of Phylogenetic Systematics, E. O. Wiley & Bruce S. Lieberman, Wiley-Blackwell, 978-0470905968
31. Phylogenetic Trees Made Easy: A How To Manual, Fourth Edition, Barry G. Hall, Sinauer Associates, Inc. 978-0878936069
32. Inferring Phylogenies, Joseph Felsenstein, Sinauer Associates, 978-0878931774
33. Phylogenetics (Oxford Lecture Series in Mathematics and Its Applications), Charles Semple & Mike Steel, Oxford University Press, 978-0198509424

## **Ph.D Botany (Course work) syllabus-2020**

### **Core course paper-III (Research Area): Allelopathy and Weed Science**

**Credits: 4**

**External Exam: 70M**

**Duration: 4 Hrs/wk**

**Internal Exam: 30M**

#### **Unit-I: Allelopathy & Allelochemical**

Allelopathy definition, brief history of allelopathy, Terminology, Allelopathic research in India and world. Allelochemical release, volatilization, leaching, root exudates, decomposition of residues. Origin and nature of allelochemical

#### **Unit 2 Interaction between Plant Communities:**

Allelopathy between plant communities, Interaction between crop-crop, Crop-weed, Weed-Crop, Weed-Weed interaction. Crop residue, Cropping system, crop rotation, weed residues, root exudates, volatiles. Tree allelopathy in Agro forestry.

#### **Unit 3 Secondary metabolites**

Types -source production pathway of secondary metabolites in plants-

Alkaloids, Flavonoids, Terpenoids, Saponins, Phenols and tannins -their types and biological function.

#### **Unit 4 Weeds & Weeds control:**

Introduction to weed science, weeds as host plants, classification of weed, Grass species and broad leaf species, aquatic, Forest and crop field weeds and their distribution. Weeds effect on quality and quantity of crop plants. Invasive alien weeds, methods of weed control, cultural weed control, mechanical, Biological and Chemicals weed control methods.

## **Ph.D Botany (Course work) syllabus-2020**

**Core course paper-III (Research Area): Stress Physiology/Abiotic stresses in Plants**

**Credits: 4**

**External Exam: 70M**

**Duration: 4 Hrs/wk**

**Internal Exam: 30M**

### **Unit I**

Biotic and abiotic factors of the environment. Abiotic factors, global warming, pollution and temperature effects on plants. Response of plants to abiotic stresses. Abiotic stresses affecting plant productivity. Interactions between biotic and abiotic stresses.

### **Unit II**

Soil and soil water relations. Mechanism of water uptake by roots, transport in roots, movement of water in plants. Water loss from plants and energy balance. Stomata structure, function and stomatal movement. Transpiration and plant factors influencing transpiration rate.

### **Unit III**

Plant water relations. Physiology of water stress in plants. Influence of water stress at cell, organ plant and canopy levels. Drought characteristics features. Indices for assessment of drought resistance. Physiological processes affected by drought. Drought avoidance, dehydration tolerance and characteristics of resurrection plants. Osmotic adjustment and osmoprotectants, stress proteins. Water use efficiency as drought resistant trait.

### **Unit IV**

Salinity: species variation in salt tolerance. Cellular and whole plant level, tolerance mechanisms. Salt tolerance in different types of plants. Heavy metal stress: Aluminium and cadmium toxicity in acid soils. Heavy metals binding proteins.

Basic principles of a crop improvement program under stress. Breeding for stress resistance (salt and drought resistance)



## Ph.D. Botany (Course Work) Syllabus 2020

**Core Course Paper-III (Research Area): Nano-Particles and Soil borne Fungal Diseases.**

**Credits: 4**  
**70 Marks**

**External Exam:**

**Duration: 4hrs/wk**  
**30 Marks**

**Internal Exam:**

### Unit I

**Parasitism, Disease development and Defence mechanisms in plants:** Parasitism and Pathogenicity; Host range of pathogens; Development of disease in Plants. Pre-existing defence structures; Pre-existing Biochemical defence; histological defence mechanism.

### Unit II

**Fungal Plant Diseases:** Clubroot of Crucifers; Seedling damping off by *Pythium*, *Fusarium* wilt disease; Late blight of potato.

### Unit III

**Biological Synthesis and Characterization Techniques of Nanomaterials:** Biological synthesis of nanoparticles using bacteria, fungi, plants, purified enzymes and biological templates. Silver nanoparticles, gold nanoparticles, cerium oxide nanoparticles, titanium oxide and zinc oxide nanoparticles. Structural characterization: X-ray diffraction, Electron microscopy- Scanning Electron Microscopy (SEM), Transmission Electron Microscopy-(TEM) including high-resolution imaging, FTIR- XPS. Surface characterization: atomic force microscopy (AFM).

### Unit IV

**Nanobiotechnology:** Characteristics of CuO and Ag<sub>2</sub>O Nanoparticles; Effects of nanoparticles on fungi; Nanoparticles as disease managing agents.

**Ph.D Botany (Course work) syllabus-2020**

**Compulsory paper: Research & Publication Ethics (RPE)**

**Credits: 2**

**External Exam: 35M**

**Duration: 2 Hrs/wk**

**Internal Exam: 15M**

**Course Structure:**

**The Course comprise of six modules. Listed in table below. Each module has 4-5 Units.**

Modules	Unit Title	No of credits
Theory		
RPE-01	Philosophy and Ethics	4 credits
RPE-02	Scientific Conduct	4 credits
RPE-03	Publication Ethics	7 credits
Practice		
RPE-04	Open Access Publication	4 credits
RPE-05	Publication Misconduct	4 credits
RPE-06	Data Bases and Research Metrics	7 credits

**Note: As per University Grants Commission letter D.O No F.1-1/2018(Journal/Care) and in its 543 meeting held on 9<sup>th</sup> August, 2019 had made compulsory paper for all Ph.D students.**