

# **MAA SHAKUMBHARI UNIVERSITY**

SAHARANPUR, UTTAR PRADESH



**Syllabus of:**

**Pre Ph.D. (Botany)**

**(As per guidelines of U.P. Government in accordance with**

**National Education Policy-2020)**

### Members from the Board of Studies

S.No.	Name	Signature
1.	<b>Prof. Sanjeev Kumar</b> , Department of Botany, D.A.V. (P.G.) College, Muzaffarnagar ( <b>Convener</b> )	
2.	<b>Prof. Ritu Agarwal</b> , Department of Botany, M.S. College, Saharanpur ( <b>Member</b> )	
3.	<b>Dr. Rakesh Kumar</b> , Department of Botany, VSP Govt. (P.G.) College, Kairana, Shamli ( <b>Member</b> )	
4.	<b>Dr. Yogendra Kumar</b> , Department of Botany, GDC, Saharanpur ( <b>Member</b> )	
5.	<b>Prof. Rupnarayan</b> , Department of Botany, CCSU, Meerut ( <b>Member</b> )	
6.	<b>Prof. Alok Srivastav</b> , Department of Plant Science, MJPRU, Bareilly ( <b>External Expert</b> )	

**Eligibility for Admission to Pre PhD (Botany):** Students must have passes Master of Science in Botany/Plant Sciences/BioSciences/Life Sciences (excluding Zoology & Microbiology) from any recognized University equivalent with 55% aggregate.

**Courses of Pre PhD (Botany):** In Pre PhD there shall be three compulsory papers (16 credits=6+6+4) and one project work. The three papers will be as

1. Two papers will be related to the concern subject. Each paper will be of 6 credits (6+6 credits =12 credits).

2. One paper will be of Research Methodology and computer application. This paper will be of 4 credits.

A minimum 55% marks or its equivalent CGPA will be the passing marks.

Those students, who will qualify in all the papers separately, will be given post graduate diploma in research.

- a. Apropos semester rules of the University, if a candidate fails to secure qualifying marks in a paper, may be given another chance, but the registration process will remain standby for such candidate.
- b. If a candidate secures 16 credits but fails to appear in the examinations or even filling up of the exam form, may be given an opportunity to appear in the next ensuing examinations, till then the process of registration will remain standby.
- c. The period of research apart from course work will be considered from the date of registration.

### **SUBJECT: Botany**

#### **Titles and code of the Papers in Pre PhD (Botany)**

<b>Course Code</b>	<b>Paper</b>	<b>Paper Title</b>	<b>Credits</b>
PPh 01	Paper 1	Research Methodology & Computer Applications	04
PPh 02	Paper 2	Tools & Techniques in Plant Sciences	06
PPh 03	Paper 3	Advances in Plant Sciences	06

## **Paper1**

### **Research Methodology & Computer Applications**

**Course code:** PPh. 01

**Total duration:** 60 hours

#### **Objectives:**

**This course is common for doctoral research students of all the subjects in Science faculty. The objective of the course is to acquaint research student with scientific research methods and approaches.**

**UNIT 1:** Basic principles of research, objectives of research, importance, types of research: basic and applied, Selection of a research topic and problem, assessment of current status of topic chosen, literature survey and reference collection, formulation of hypothesis, research designs, sampling designs, ethics in research, code of ethics fabrication of data, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP), Biosafety regulations in biological research and bioethics

**12 hours**

**UNIT 2:** Types and sources of data, data collection methods, primary data, secondary data, analysis for specific type of data, tabulation and graphical representation, central tendency, dispersion, skewness, correlation, regression, chi-square test, t- and F-tests, ANOVA- One way and two-way, Important non-parametric tests- Sign, Run, Kendall's coefficient.

**12 hours**

**UNIT 3:** Significance of report writing, different steps in writing report and research papers, layout of the research report, oral and written presentation of research (Abstract/Synopsis), mechanics of writing research reports, Precautions in writing research reports, conclusions, Impact factor and Citation index.

**12 hours**

**UNIT 4:** Computer and Internet: Networking, different WAN and LAN connections, Connection to a network, Web Browsers, Internet security, Web Search Engine, MS Word, Handling graphics, tables and charts, Converting a word document to various formats like- text, rich text, word perfect, html, pdf, etc. MS Power Point: creating slide show with animations, creating a blank presentation, auto layout with power point screen, screen lay out and views, insert a new slide, applying design template, changing slide layout, reordering and hiding slides, slide show and editing, custom slides.

**12 hours**

**UNIT 5: Publication ethics:** 1. Definition, introduction and importance 2. Best practices/ standards setting initiatives and guidelines: COPE, WAME, etc. 3. Conflicts of interest 4. Publication misconduct: Definition, concept, problems that lead to unethical behaviour and vice versa, types 5. Violation of publication ethics, authorship and contributorship 6. Identification of publication misconduct, complaints and appeals 7. Predatory publishers and journals

Electronic journals, e-books, digital libraries, searching research information using Jgate and SCOPUS, Science Direct.

### **Research Metrics**

1. Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score

2. Metrics: h-index, g-index, i10 index, altmetrics. **12 hours**

### **References:**

Research Methodology: Methods and Techniques by C.R. Kothari, Second revised edition

Research Methodology: A step by step guide for beginners by Ranjit Kumar

Research methodology: Methods and Statistical techniques, by Santosh Gupta

Statistical Methods, by S.P. Gupta

Research Design, Qualitative, Quantitative and mixed method approaches, by W. Creswell, 3rd edition.

Information Communication Technology, by Tim Shorts Handbook of Communication and Social Interaction Skills, by John O. Green, Brant Raney Burleson

**Paper 2**  
**Tools & Techniques in Plant Sciences**  
**Course code: PPh 02**

**Total duration: 60 hours**

**Unit I. Microscopy & Microtomy: 12 hours**

**Microscopy:** Principles of Microscopy, Confocal microscopy, Fluorescence Microscopy, Electron Microscopy, Phase Contrast microscopy; Atomic Force Microscopy, Camera Lucida.

**Microtomy:** Microtomy/Microtome & its types: dehydration, clearing and embedding of material, section cutting, dewaxing. Different types of stains, their preparation and uses: Safranin, fast green, hematoxylin, iodine, cotton blue, crystal violet, ruthenium red, Janus green, Gram's stains, Acetocarmine.

**Unit II Spectroscopic Techniques: 12 hours**

General principles; Basic laws of light absorption; Types of spectra and their biological usefulness. Principle, application and instrumentation of UV-VIS spectrophotometry; FTIR, Atomic Absorption spectrophotometry; Raman Spectroscopy, MALDI-TOF; GCMS.

**Unit III Separation Techniques & Electrophoresis 12 hours**

**Chromatographic Technique:** Paper chromatography, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC), HPTLC, Gas-Liquid chromatography (GLC), Isoelectric Focusing.

**Electrophoresis:** PAGE, SDS PAGE, 1-D and 2-D gel electrophoresis, DIGE (Differential in Gel Electrophoresis). Separation of proteins through electrophoresis. Gel electrophoresis (AGE, 2D etc.), ChIP, EMSA, Co-Immunoprecipitation.

**Unit IV: Techniques of Molecular Biology & Sequencing 12 hours**

**Whole genome sequencing:** Whole genome shotgun sequencing; clone-by-clone or 'hierarchical shotgun' sequencing; pan genomes and metagenome.

**Next generation Sequencing Technologies:** 454 Pyrosequencing, Reversible Terminator Sequencing, Single-Molecule Real-Time (SMRT) Sequencing and Nanopore Sequencing; microbial genomes (including yeast); plant genomes (*Arabidopsis*, rice). Application of NGS. Genome editing tools ZFN, TALEN and CRISPR, Anti CRISPR; Genome annotation.

**Unit V Bioinformatics 12 hours**

**Computational biology Techniques and Tools:** Techniques and tools for Sequences Alignment (Pairwise and multiple alignment), Phylogenetic analysis- Methods and Tools, gene prediction, ORF finding. **Homology:** Orthology & paralogy. **Databases:** NCBI, EMBL, DDBJ, Gene bank, Pubmed; Ensembl, Phytozome etc Online tools - BLAST, ORF finder, Primer3, protein motif and structure prediction tools. Generation and analysis of whole genome data, Whole genome annotation taking examples of major plant genomes.

## Paper 3

### Advances in Plant Sciences

Course code: PPh 03

Total duration: 60 hours

#### Unit 1. Phycology

10 hours

Taxonomic advancement in various groups of algae and their molecular phylogeny.

Features of model organisms from cyanobacteria (*Synechocystis* sp. PCC 6803, *Nostoc* sp. PCC 7120) and algae (*Chlamydomonas reinhardtii*). Retrieval of data and their bioinformatic analysis.

Metabolic engineering in microalgae: Algal cell as a bio-factory, Concept of transcriptome and metabolome.

#### Unit II. Fungi & Diseases

13 hours

Molecular systematics of Fungi; modern tools for identification.

Plant- microbe interactions: molecular basis of plant-fungal, and bacterial pathogen- plant interactions, virulence factor, host resistance and plant immunity; pattern triggered and effector triggered immunity, ISR and SAR.

Yeast as a eukaryotic model organism: mutant creation and characterization, yeast vectors, yeast two hybrid system, genetic and physical interactions studies in yeast, SGA analysis, functional genomics and proteomics studies in yeast.

#### Unit III. Taxonomy & Nomenclature

12 hours

**Taxonomic & Nomenclatural products:** Botanical Congress and Plant nomenclature;

**Taxonomic products:** Floras, Revisions, Keys, Monographs & synopses, Conspectus.

**Taxonomic website for:** Names & Nomenclature, Literature and Herbarium Specimens. Circumscription of genus & species, Description of new genus & species.

#### Unit IV. Biodiversity & Environment

12 hours

**Biodiversity:** Global environmental change & Biodiversity in India, Valuing biodiversity, Extinction & De-extinction, Vulnerability to extinction, Endemism. RET & IUCN criteria & Subcriteria, Concept of Rarity & NatureServe Conservation status assessment. Hot & cold spots; Biodiversity act.

#### Unit V Ecology

13 hours

**Ecology of Plant Invasion:** Invasion, invasion processes, hypothesis regarding invasion, success of invaders, Species invasiveness, invasive species in India, Management of invasive species, Seed bank studies.

**Restoration Ecology:** Phyto-sociological technique, Concept and strategies of ecological restoration, Ecology of disturbed ecosystems, Degradation and restoration of natural ecosystems.

Soil sampling, Physico-chemical characteristics (Soil pH, Moisture, field capacity, bulk density, organic carbon, total nitrogen, available phosphorus, exchangeable Na, K, Ca).

### References:

1. Chapman, V.J. and Chapman D.J., (1975). The algae. 2nd Edition, Mac. Millan Publ. Inc. New York.
2. Desikachary, T.V., (1959). Cyanophyta. ICAR, New Delhi.
3. Hoek, C. van den, Mann, D. G. and Jahns, H. M., (1995). Algae: An introduction to Phycology. Cambridge University Press, UK.
4. Prescott, G. W., (1969). The algae: A review. Nelson, London.
5. Round, F.E., (1981). The Ecology of Algae. Cambridge University Press, Cambridge.
6. Barry G. Hall. (2007). Phylogenetic Trees Made Easy: A How-To Manual, Third Edition. Sinauer Associates, Inc., Publishers, Sunderland, USA.
7. Christenhusz, M. J. M., Chase, M. W. and Michael F. F. (2017). Plants of the World: An Illustrated Encyclopedia of Vascular Plants. University of Chicago Press.
8. Angiosperm Phylogeny Group, (2016). An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG IV. Botanical Journal of the Linnaean Society, 181: 1-20.
9. Cronquist, A. (1968). The Evolution and Classification of Flowering Plants. Houghton Mifflin. Boston.
10. Davis, P.H., & Heywood V. H. (1965). Principles of Angiosperm Taxonomy. Oliver & Boyd. Edinburgh.
11. Hutchinson, J. (1973). The Families of Flowering Plants. 3rd Edition. Oxford University Press. Oxford.
12. Jain, S.K. & Rao R. R. (1977). A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.
13. Jones, S.B., & Luchsinger, A.E. (1987). Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.
14. Alexopoulos, C.J., Mims, C.W. and Blackwell, M., (2007). Introductory Mycology. Fourth Edition, Wiley India Pvt. Limited.
15. Mehrotra, R.S., (2017). Plant Pathology. 3rd Edition, McGraw-Hill Education, New Delhi.
16. Okafor, N. and Okeke, B.C., (2018). Modern Industrial Microbiology and Biotechnology. 2<sup>nd</sup> Edition, CRC Press, Boca Raton
17. Ethi, I.K. and Walia, S.K., (2018). Text book of Fungi & Their Allies, Second Edition. MacMillan Publishers Pvt. Ltd., Delhi, India
18. Webster, J. and Weber, R., (2007). Introduction to Fungi. Third Edition, Cambridge University Press, Cambridge and New York.