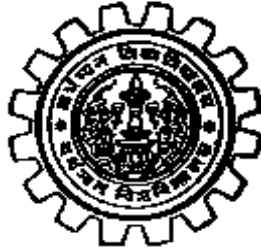


**Proposed curriculum and syllabus for M.Phil. in  
BOTANY**



**THE UNIVERSITY OF BURDWAN**

**(2020 on ward)**

## The University of Burdwan

### M. Phil. Syllabus of Botany

Year	Semester	Course Code	Course Title	Credit Value	Marks Distribution
<b>1<sup>st</sup></b>	Semester-I	MPHIL101	Research Methodology	4	50
		MPHIL102	Research and Publication Ethics (RPE)	2	25
		MPHIL103	Advanced Instrumentation for Research	4	50
		MPHIL104	Term Paper(s) & Related Seminar Presentation(s)	4	50(25+25)
		Sub Total		14	175
	Semester-II	MPHIL201	Compulsory/Optional Paper-I (Advanced Level)	4	50
		MPHIL202	Compulsory/Optional Paper-II (Advanced Level)	4	50
		MPHIL203	Term Paper(s) & Related Seminar Presentation(s)	4	50(25+25)
		Sub Total		12	150
	<b>2<sup>nd</sup></b>	Semester-III & IV	MPHIL301	Dissertation	12
Viva-Voce				4	50
Sub Total				16	200
Grand Total				42	525

## Semester I

### M.Phil. syllabus for Botany, BU

#### MPHIL101: Research Methodology

Credit -4

Total Marks-50

- 1. Research Methodology:** Meaning of Research in Biological Sciences; Characteristics of Research, Research student and research supervisor; Process of research; Identification and criteria of selecting a research problem (Hypothesis); Formulation of objectives; Research plan and its components; Methods of Research and Difficulties in Biological research;
- 2. Research Proposal and experimental design:** Key elements- Objective, Introduction, Design or Rationale of work, Guidelines for design of experiments, Material and methods, Designing biological experiments, Compilation and documentation of data; Major research institutes related to plant sciences in India. A brief idea about government research agencies such as DBT, DST, ICMR, CSIR and UGC.
- 3. Writing and presentation:** Format of research paper and report writing, Procedure of Reference Citation; Significance of writing research papers and review articles; Major scientific publishers; Impact factor and citation index; Ethical issues in research; Intellectual Property right and Plagiarism; Effective presentation of research findings.
- 4. Statistical applications:** Standard deviation, Standard error, Co-efficient of variation, probability distributions: Binomial, Poisson and Normal Distributions (areas method only) including problems. Sample statistics and parameters, population null hypothesis, level of significance. Definitions and applications of Chi-square test, 't' and 'f' test. Analysis of variance with linear models. Analysis of variance for one-way and two way classified data.
- 5. Computer application** – Exercise in MS word, MS excel, MS PowerPoint, Adobe photoshop, Introduction to SPSS, bioinformatics, databases and their application

#### Books Recommended

1. Research Methodology- G.R. Basotia and K.K. Sharma.
2. Research Methodology- C.H. Chaudhary, RBSA Publication
3. Research Methodology: An Introduction - Wayne Goddard & Stuart Melville
4. Research Methodology - Ranjit Kumar
5. Research Methodology: Methods & Techniques - Kothari, C.R.
6. Molecular cloning Laboratory Manuals: Sambrook, Russel and Maniatis
7. Principle Practices in Plant Biotechnology – Wilson and Walker

## **MPHIL102: Research and Publication Ethics (RPE)**

**Credit -2**

**Total Marks-25**

### **THEORY**

#### **RPE 01: PHILOSOPHY OF ETHICS (3hr)**

1. Introduction of philosophy: Definition, Nature and scope, concept, branches.
2. Ethics: Definition, moral philosophy, nature of moral judgements and reactions.

#### **RPE 02: SCIENTIFIC CONDUCT (5hr)**

1. Ethics with respect to science and research
2. Intellectual honesty and Research integrity
3. Scientific misconducts: falsification, fabrication and plagiarism
4. Redundant Publications: duplicate and overlapping Publications, Salami Slicing
5. Selective reporting and mispresentation of data

#### **RPE 03: PUBLICATIONS ETHICS (7hr)**

1. Publication ethics: definition, introduction and importance
2. Best practices/ standard settings 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 contributor ship
6. Identifications of Publication misconduct, complaints and appeals
7. Predatory publishers and journals

### **PRACTICAL**

#### **RPE 04: OPEN ACCESS PUBLISHING (4hr)**

1. Open access Publication and initiatives
2. SHERPA/ RoMEO online resource to check publisher copyright and self-achieving policies
3. Software tool identify predatory Publications developed by SPPU
4. Journal finder/ journal suggestion tool viz., ZAME, Elsevier journal Finder, Springer journal suggester, etc

#### **RPE 05: PUBLICATION MISCONDUCT (4hr)**

##### **A. Group discussion (2hr)**

1. Subject specific ethical issues, FFP, authorship
2. Conflicts of interest
3. Complaints and appeals: examples and fraud from India and abroad

##### **B. Software tools (2 hr)**

1. Use of plagiarism software like Turnitin, Urkund and other open source software tools

#### **RPE 06: DATABASES AND RESEARCH METRICS (7hr)**

##### **A. Databases (4hr)**

1. Indexing databases

2. Citation databases: Web of science, Scopus, etc.

**B. Research Metric (3hr)**

1. Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score
2. Metrics: h- index, g-index, i10-index, altmetrics

**MPHIL103: Advanced Instrumentation for Research**

**Credit -4**

**Total Marks-50**

**1. Microscopy** Light and Phase Contrast microscopy – working principle and applications.

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

**2. Centrifugation** - principles - instrumentation for centrifuges - bench top - high speed-ultracentrifuges- applications, dialysis and Lyophilization

**3. Colorimetry and Spectrophotometry:** Colorimetry, ultraviolet - visible spectrophotometry - principles, instrumentation - applications, Principles and methodology of spectrophotometer, Fluorescence spectrophotometry.

**4. Chromatography** – Thin layer chromatography - Gas chromatography – Column chromatography- Ion exchange chromatography - Gel exclusion chromatography - HPLC Affinity chromatography and Immunoabsorption.

**5. Electrophoresis:** Polyacrylamide gel electrophoresis (PAGE) – Nucleic acid and sequencing gels - Agarose gel electrophoresis Two dimensional electrophoresis -Pulse Field Gel Electrophoresis (PFGE), isoelectric focusing – Gel documentation. Blotting - Western, Southern and Northern blots.

**6. Nucleic Acids (Isolation; purification) and molecular marker (RFLP; RAPD; ISSR)**

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

**7. PCR Techniques:** Types, Conventional PCR, real Time PCR, qPCR

**8. Immunotechniques-** ELISA, RIA, RUST, RIST

**9. Nanotechnology** – Principles and applications of Nanotechnology in Biological Sciences.

**MPHIL104: Term paper and related seminar presentation  
(Under assigned Faculty-compulsory)**

**Credit -4**

**Total Marks-50(25+25)**

**Semester II**

**M. Phil. syllabus for Botany, BU**

**MPHIL201: Compulsory/ Optional paper-I (Advanced Level)**

**Credit -4**

**Total Marks-50**

**Unit-I**

1. **Microbiology:** Bioremediation, PGPR, Role of soil microbes in the degradation of pesticides, Bioinformatics, Sequencing, sequence analysis, extremophile, applications
2. **Phycology:** Bioremediation, Biofertilizers, commercial applications, Phycotoxins, Biofuel
3. **Mycology plant pathology:** Mechanism of plant disease development-it's molecular basis. plant disease resistance- it's genetical, biochemical and molecular understanding, host pathogen interactions- recognition, elicitors-receptor concept and plant defence responses; Plant Immunization. Fungal Endophytes and their roles in plant's secondary metabolites production.

**Unit-II**

4. Signal perception and transduction. Introduction, Receptors, G proteins, Phospholipid signaling, Cyclic nucleotides, Calcium calmodulin, protein kinases
5. Stress biology, plant response to drought, temp stress- role of signalling network and inducible proteins in stress acclimatization, redox regulation of drought and temperature stress, characterization of osmotin and HSPs through proteomic approaches
6. Isolation and characterization of certain enzymes (Rubisco, PEP Carboxylase, GS and GOGAT)
7. Regulation of photorespiration and its significance in crop, productivity
8. *In vitro* production of secondary metabolites. Significance of Hairy roots

**Unit-III**

9. The origin and early evolution of angiosperms, with reference to recent findings on fossil

pollen, flowers and leaf remains.

10. Pharmacognostic study of different types of plant drugs with special reference to Aromatic plants–Lemongrass and Palmarosa: Medicinal plants i) *Aloe vera*ii) Glory lily
11. Indigenous traditional drugs of India and their market Adulteration
- 12 **Taxonomy and Systematics:** Concept, objective and relevance to conservation. Plant Nomenclature–ICN, Principles, Rules, Recommendations and Appendices, Type concept, valid publication and Rejection of names. Taxonomy of special group plants like climber, Parasitic, Mycoheterotrophic and Insectivorous plants and their specializations.
13. Biosystematics principles, practice, limitations and scope; phenotypic plasticity, epigenetic phenomenon;
14. Biodiversity: general concept, values, isolation and assessment of Genetic Diversity. Distribution of endemic plant families in the southern hemisphere of the globe. Conservation: Principles, categories of threatened plants (IUCN), strategies of conservation, Red Data Book. Botanical Survey of India, its contribution and functions.
15. Molecular markers in Taxonomy and phylogenetic analysis: Nuclear ribosomal DNA, Chloroplast DNA and Mitochondrial DNA.

#### **Unit-IV**

16. Conventional plant breeding, mutation breeding, QTL mapping and Marker assisted selection for crop improvement.
17. Tissue culture of plants: Callus culture, plantlet regeneration, micro propagation, somaclonal variation and synthetic seeds.
18. Principles of genetic engineering and status of transgenic plants.
19. Molecular characterization of Elite medicinal plants and endangered plants and development of molecular markers (RAPD, SSR and AFLP).
20. Biodiversity-Types, hot spots, threats to Biodiversity and conservation.

#### **Unit-V**

21. Mechanism of plant disease development.
22. Plant disease control- Chemical, Biological and integrated disease management.
23. Plant disease resistances- plant defense responses- its biochemical and molecular basis, SAR, ISR, Phytoalexins, Phytoanticipins, PR-proteins and Ion-Flux cascade. Induced resistance and plant immunization.
24. Host-pathogen interactions –recognition, elicitor- receptor complex, molecular mechanism of appressoria formation.

25. Application of modern biotechnology and genetic engineering for development of disease resistant crop varieties.
26. Economic benevolence of fungi-medicinal and nutraceuticals and industrial applications of fungi. Application of fungi as a tool in genetic engineering.

**MPHIL202: Compulsory/ Optional paper-II (Advanced Level)**

**Credit -4**

**Total Marks-50**

**1. Plant Physiology and Biochemistry:**

(I) Plant cell signaling

Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulations of signaling pathways, bacterial and plant two component systems, light signaling in plants.

(II) Plant System Physiology

- A. Photosynthesis- Mol architecture of light harvesting complexes, mechanism of electron transport; photoprotective mechanism, CO<sub>2</sub> concentrating mechanisms and their regulation.
- B. Respiration and photorespiration-Regulation of glycolysis and Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorepiratory pathway, its regulations and significance.
- C. Nitrogen metabolism-Dinitrogen fixation, Nitrate and ammonium assimilation; amino acid biosynthesis.
- D. Plant hormones- biosynthesis, storage, breakdown and transport; physiological effects and molecular mechanism of action of IAA, CK, GA, ABA, JA.
- E. Sensory photobiology-Structure, function, and mechanism of action of phytochromes, cryptochromes and phototropins; blue light signaling and stomatal movement.
- F. Secondary metabolites-Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.
- G. Stress physiology-Responses of plants to biotic (pathogen and insect) and abiotic (water, temperature and salt) stresses, role of inducible proteins and genes.
- H. Senescence-molecular basis of monocarpic senescence, PCD, SAGs.
- I. Flowering- Origin of floral signal, multiple signaling pathway of flowering, ABC model of flowering.



### (III) Methods in Biology

Molecular analysis using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, molecular structure determination using X-ray diffraction and NMR, molecular analysis using light scattering, different types of mass spectroscopy and surface plasma resonance methods, detection and measurements of different types of radioisotope normally used in biology. Electrophoresis (1DE, 2DE), Chromatographic techniques (GC, HPLC).

#### **MPHIL202: Compulsory/ Optional paper-II (Advanced Level)**

**Credit -4**

**Total Marks-50**

#### **2. Approaches in Molecular Genetics:**

Genetic analysis- overview, forward and reverse genetics and their application. Molecular breeding; molecular marker types, applications, mapping of molecular loci-QTL mapping, marker assisted selection, assessment of germplasm fidelity-RAPD, RFLP, ISSR markers, gene pyramiding, transposon/exon tagging, cytological identification of molecular markers –in situ hybridization techniques.

#### **MPHIL202: Compulsory/ Optional paper-II (Advanced Level)**

**Credit -4**

**Total Marks-50**

#### **3. Applied Microbiology**

Unit I - Microarray techniques in Microbiology, analytical analysis (HPLC, GC-MS, LC-MS, MS-MS, MALDI-TOF)

Unit- II -Microbial polysaccharides, its role and applications

Unit III - Bioremediation using microbes, wastewater treatment using microbes,

Unit IV - Thermostable enzymes and industrial applications, Industrial alcohol Amino acids, Vitamins.Fermented foods, food spoilage and food preservation Microbial examination of Milk –MBRT, leather, wood.textiles

Unit IV- Biopesticides, Biofertilizers, Single cell proteins, Rhizobacteria in plant stress.

Unit V- Xenobiotics- cometabolism and detoxification reactions. Biochemistry of xenobiotic metabolism. Bioleaching- Recovery of metals from ores- oxidation of minerals- testing forbiodegradability- biomagnification.Bioaccumulation- removal of heavy metals from effluents.

Unit V – Bioinformatics tools used in Microbiology

## **Text Book**

Lansing, M. Prescott., John.P.Harley and Donald.A.Klein. 2002. Microbiology 5th edition.WCB. McGraw – Hill

### References:

Atlas,R.M.1997. .Principles of Microbiology.Secondedition.WCB.Mcgraw- Hill.

Atlas, R.M and Bartha, R. 1997. Microbial ecology Fundamentals and Applications.

Fourth edition.An Imprint of Adision Wesley Longman Inc.

Brown T.A. 1997.Gene cloning- An Introduction. 3rd ed.

Old R.W and Primrose S.B 1995.principles of gens manipulation- .An introduction to genetic engineering. 5th ed.

Jawetz, E, Melnic, J.K, and Adelberg, E, .A. 1998. Review of medical Microbiology, Lange Medical Publications, U.S. A.

## **MPHIL202: Compulsory/ Optional paper-II (Advanced Level)**

**Credit -4**

**Total Marks-50**

### **4. Floristic studies of angiosperms and plant ecology:**

Concept of taxonomic characters and character states.Taxonomic hierarchy.Plant nomenclature–basis, ICN rules and typification.Taxonomic key.Taxonomic literature–flora, monograph and revision. Comprehensive view of various approaches to plant classification–natural, artificial, phylogenetic, general and special purpose, their advantages and disadvantages. Phenetic and numerical taxonomy–OTU, weighting, cluster analysis. Digital taxonomy–need and application, various data base in taxonomy. Taxonomic evidences from morphology and micromorphology (SEM), anatomy, karyology, embryology, palynology, ecology and physiology. Phytogeography–definition, various geographic regions.Speciation.Plant genome as source of taxonomic evidence–gene mapping, sequencing, base ratio, hybridization.Application of PCR, RFLP, RAPD, AFLP, ISSR in plant systematics.Application of Proteins–amino acids sequencing, storage proteins, serology and isoenzymes in plant systematics. Application of secondary metabolites as sources of taxonomic evidence – alkaloids, flavonoids, terpenoids, sugars, polysaccharides, hydrocarbons, fatty acids, lipids and pigments–betalains, anthocyanins and betacyanin.

Plant Ecology:Concept of Ecology, Ecosystem, Population, Community; Community dynamics. Plant habitat relationship: Allelopathy; Mechanism of self regulation in ecological systems. Understanding rarity and monitoring rare plants population. Use of IUCN guidelines. Population Size: Conservation Dilemma, Concept of minimum viable population size, Concept of maximum tolerance population size. Restoration of degraded lands: Habitat restoration for

afforestation with any suitable example. Ecotoxicology in the context of contamination of food chains. Ecofriendly approach, Bioremediation, Green products. Plant interaction, co-evolution, pollination syndrome.

## **REFERENCES**

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3. Heywood V K. & Moore D M. (1984). Current Concepts in Plant Taxonomy, Academic Press, London.
4. Lawrence G H M. (1955). The Taxonomy of Vascular Plants, Central Book Depot, MacMillan, New York.
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6. Heywood V H., 1967, Plant Taxonomy. The English Language Book Society, London.
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8. Ray Samit and A.K.Ray (ed.) 2006. Biodiversity and Biotechnology. New Central Book Agenc(p.) Ltd.Kolkata; India.
9. Singh Gurucharan 2010. Plant systematic: An Integrated approach. Science publisher. USA.
10. Judd, W.S., Campbell, C.S.,Kollogg, E.A., Stevens, P.F. and Donoghue M.J.2008. Plant systematic: phylogenetic approach. Sircuier Associates, Inc.
11. Futuyma D.J. 2009. Evolution.Sinauer Associates, INC. Publishers, Sunderland. USA.
12. Groom, M.J., Meffe, G.K. and Carroll, C.R.2006. Principles of conservation biology.Sircuier Associates, Inc.
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15. David Briggs 2009. Plant microevolution and conservation in human influenced ecosystems.Cambridge University press. UK.
16. Braun Blanquest J. (1972). Plant Sociology
17. Davy, A.S. Hutchings, M.S. and Watkinson, A.R. (1988). Plant populatin Ecology, 28th Symposium of the British Ecological Society.
18. Greig Smith p. (1983).Quantitative Plant Ecology
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20. Haywood, V.H.(1973). Taxonomy and Ecology
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23. Osborne, P.L.(2000). Tropical ecosystems and ecological concepts.Cambridge University Press.
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25. Synge, H. (1981). The Biological aspects of rare plant conservations.
26. John Wiley and Sons. Willis, A.D. (1973) Introduction to plant Ecology.
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29. Michael G. Simpson, Plant Systematics, 2006, Elsevier Academic Press, Burlington.
30. Hills D.M., Mortiz C & Mable B K. (eds.), 1996, Molecular Systematics, Sinauer Associates, Sunderland, USA.
31. Gurucharan Singh, Plant Systematics (II Edn), 2004, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

32. Harborne J. B. & Turner B. L., 1984, Plant Chemosystematics, Academic Press, London.

**MPHIL202: Compulsory/ Optional paper-II (Advanced Level)**

**Credit -4**

**Total Marks-50**

**5. Advanced Phycology:**

Modern tools and techniques in modern systematics of algae (Molecular techniques and its applications in study of Diatoms and Dinoflagellates). Application of algae in forensics; biocosmetics; functional food and nutraceuticals; algal pigments, its analysis and potential applications; algal photosynthesis, field instruments: use and applications; types of photoreceptive systems, photoreceptor protein; photorespiration and photoaccumulation; Nitrogen and Sulfur metabolism in phytoplankton; Algal biofertilizers; BGA, marine; Biofuel and Biodiesel. H<sub>2</sub> production.

## MPHIL202: Compulsory/ Optional paper-II (Advanced Level)

Credit -4

Total Marks-50

### 6. Mycology and Plant Pathology

- Mycorrhizae- types, fungi involved in mycorrhiza formation, molecular mechanism for establishing mycorrhizal symbiosis in plants –signaling and signal transduction pathway, application of mycorrhiza as biofertilizer in agriculture and forestry, mass multiplication techniques for commercial production of mycorrhizal biofertilizers.
- Interactions of mycorrhizal fungi –PGPR bacteria and mycorrhizal helper bacteria (MHB) and their applications for betterment of crop production.
- Fungal endophytes other than mycorrhiza- DSE (dark septate endophytic fungi)-their significance and role in plant derived secondary metabolic production –augmented production of plants secondary novel metabolites by DSE fungi. Positive cooperation, interaction of DSE and endomycorrhizal fungi in host plant and related benefits to mankind.
- Plants under stress –stress proteins and stress management in plants under pathogenesis.
- PR-proteins –classes of PR-proteins, their role in plants defence, PR-genes and their regulations.

## MPHIL203. Terms paper and related seminar presentation

Credit -4

Total Marks-50(25+25)

### Semester III & IV

MPHIL301	Dissertation	12 Credits	150
	Viva voce	4 Credits	50
	Sub-Total	16 Credits	200



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