

Department of Botany

Nagaland University

Lumami 798 627

Ph. D. Coursework Syllabus-2021

(Approved by 33rd Academic Council, 33:4:11 dated December 15, 2021 and 36th Academic Council, 36:5:16 held on May 17th, 2023)

The Ph. D. Coursework programme of the Department of Botany, Nagaland University is one semester course and it is an integral part of Ph. D. programme. Research Scholars is required to earn **16 credits (4 papers)** to complete the course. The course to be completed immediately after admission in Ph. D. programme and on successful completion, the scholar can submit the ‘Synopsis of Ph. D. Thesis’ for approval. The date of admission in Ph. D. programme is the date of registration.

There are **four papers**, of which **Paper I, III and IV** are compulsory papers while **Paper II is Elective Paper** and scholar need to select one of the elective papers from the syllabus.

Courses Distribution

Course No./ Code	Course Title	Max. Marks	Credits	Page No.
BOT-Ph.D. I	Research Methodology	100	4	2
BOT-Ph.D. II	Elective Paper	100	4	3-7
	E1: Applied Plant Science			3
	E2: Ecosystem Analysis, Biodiversity and Environment			4
	E3: Biosystematics			5
	E4: Microbial Studies			6
	E5: Plant Biotechnology			7
BOT-Ph.D. III	Research and Publication Ethics	100	4	8
BOT-Ph.D. IV	Literature Review, Report Writing and Seminar	100	4	9
	Total	400	16	

BOT-Ph.D.I: Research Methodology (4 Credits)**Unit I**

Basic Concept, Experimental Methods and Design: Preparation of solutions (normal, molar and molal solution) and buffers, Design of experiment, Importance of controls in experiments and types of controls.

Instrumentation and Techniques: Principle of centrifugation and spectrophotometer, Electrophoresis, PCRs, Conventional and e-herbarium, Plant tissue culture technique.

Unit II

Microbiology, Mycology and Plant Pathology: Various types of media, Isolation of microorganisms from soil, air and litter; mixed and pure culture; Inoculation techniques; sterilization and disinfection methods. Inoculums preparation.

Unit III

Techniques in Ecosystem and Biodiversity: Measurement of biodiversity indices; physico-chemical characteristics of water and soil and its analytical procedures; sampling methods; measurement of biomass and productivity; techniques used in ecological research.

Unit-IV**Statistics and Computer Application**

Standard deviation, Standard error, ANOVA, testing of significance, correlation and regression analysis; Knowledge of microsoft excel and word, Microsoft excel in data analysis; bioinformatic tools, genome analysis.

Suggested Readings

1. Alexander, M. 1979. Advances in Microbial Ecology. Plenum Press.
2. Becker, J.M., Caldwell, G.A. and Zachgo, EA. 1996. Biotechnology: A Laboratory Course, 2nd Edn. Academic Press Inc. San Diego, California.
3. Dubey, R.C. and Maheshwari, D.K. 2009 . A text book of Microbiology.
4. Gupta, S. P. (2011). Statistical Methods, 40th First edition, Sultan Chand and Sons, Darya Ganj, New Delhi-110002
5. Gurumani, N. 2007. Research Methodology for Biological Sciences. MJP Publishers, Chennai.
6. Harley and Smith, S.E. 1983. Microbial Symbiosis. Academic Press.
7. Jain, S.K. and Rao, R.R. 1977. A Hand Book of Field and Herbarium Methods.
8. Odum E.P (1971) Fundamentals of Ecology. W.B Saunders
9. Trivedy, R.K., Goel, P.K. and Trisal, C.L. 1998. Practical Methods in Ecology and Environmental science. Enviromedia Publication, Karad.
10. Wilson, K. and Walket, J. 1997. Practical Biochemistry: Principals and Techniques, Cambridge University Press, Cambridge.
11. Wittaker W.H (1975) Communities and Ecoystems, Mc Millan.

Elective Paper (4 Credits)
BOT-Ph.D.II (E1): Applied Plant Science

Unit-I

Concepts and principles in the isolation, separation and estimation of biomolecules (nucleic acids, proteins and secondary metabolites), Plant enzymes isolation and activity assay.

Unit-II

Plant tissue culture techniques, Types and application of molecular markers, Softwares used in DNA finger printing studies.

Unit-III

Recombinant DNA production, Bacterial transformation, Transgenic production, Gene expression studies (RNA isolation, cDNA construction and real-time PCR).

Unit-IV

Bioinformatics (nucleic acid sequence analysis: BLAST, Phylogenetic tree construction; protein domain search etc.),

Suggested Readings

1. Sambrook J., Russell D.W. 2001. Molecular Cloning- A Laboratory Manual, Vols I-III, Cold Spring Harbor Laboratory, USA.
2. Buchanan B., Gruissem G., Jones R. 2015. Biochemistry and Molecular Biology of Plants, 2nd Edition, American Society of Plant Physiologists, USA.
3. Smith R.H., 2000. Plant Tissue Culture: Techniques and Experiments (2nd edition). Academic Press.

Suggested Journals

1. Analytical Biochemistry
2. Annual Review of Plant Biology
3. Journal of Experimental Botany
4. Nature Plant
5. Nucleic Acid Research
6. Phytochemistry
7. PNAS, USA
8. Plant Biotechnology Journal
9. Plant Cell
10. Plant Cell Reports
11. Plant Journal
12. Plant Organ Tissue Culture
13. Plant Science
14. Journal of Biological Chemistry

BOT-Ph.D.II (E2): Ecosystem, Biodiversity Conservation and Environment

Unit - I

Ecosystem: Structure and function of ecosystem; Distribution and types of ecosystem; Population interaction; Mechanisms of plant succession; edges and ecotones; habitat and niche; Ecosystem stability- ecosystem resistance and resilience.

Unit – II Biodiversity: Status of biodiversity in India and the world; Biodiversity indices; values of biodiversity; Bioprospecting; Biodiversity hotspots; National and Global red data lists; Major drivers of biodiversity change; National Biodiversity Authority.

Unit- III Biodiversity Conservation: Principles of conservation; Threats : Habitat loss and Fragmentation; Invasive species; Global change and species extinctions; endangered & endemic species of plant conservation; Strategies for biodiversity conservation in India; Earth summit and follow up action; Convention on Biodiversity; Global protected area network.

Unit-IV Environment: Alteration of ecosystem function; air, water and soil pollution; effects of pollution on plants and ecosystems; Plant and metal interaction; Metal toxicity in crop plants; Pollution abatement; Overview of IPCC; Climate change scenario and vulnerability; Environmental Impact Assessment.

Suggested Readings

1. Pushparagadan, P., Ravi, K. and Santhosh, V. 1997. Conservation and Economic Evaluation of Biodiversity – Vol I and II. Oxford and IBH Publishing Company, New Delhi.
2. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity. Oxford & IBH, New Delhi.
3. Odum, E.P. and Gary, W.B. 2004. Fundamentals of Ecology – 15th edition, Thomson Asia Pvt., Ltd.,
4. Krishnamoorthy, K.V. 2003. Text Book of Biodiversity, Science Publishers Inc, United States of America.
5. Kelvin, J.G. and John, I.S. (2005). Biodiversity an Introduction, Blackwell publishing company, Australia.
6. Negi, S.S. 1993. Biodiversity and Conservation in India, Indus publishing, New Delhi.
7. Trivedy, R.K., Goel, P.K. and Trisal, C.L. 1998. Practical Methods in Ecology and Environmental science. Enviromedia Publication, Karad.
8. Prasad, M.N.V. 2004. Heavy Metal Stress in Plants from Biomolecules to Ecosystem. Narosa Publishing House, New Delhi.

BOT-Ph.D.II (E3): Biosystematics**Unit I**

Types of classification of plants: principles of APG system; Hierarchy of categories and units of classification; Concept of species, infra-specific categories; Concept of genus and family; Taxonomic characters.

Unit II

Taxonomic Documentations: Types of Botanical Keys, their use and construction; Digital Herbarium and eFlora; Steps in Ethnobotanical survey.

Unit III

Plant Nomenclature: Major roles of ICN; Taxonomic associations; BSI and its publications; Revisionary works and monographs; Protocols for publications of a floristic regions.

Unit IV

Molecular Systematics; Ecology in relation to taxonomy; Role of phytochemistry in taxonomy; Biosystematic categories and its limitations.

Suggested Readings

1. 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 Linnean Society, **181** (1): 1–20, doi:10.1111/boj.12385
2. Davis, P.H. and Heywood, V.H. 1973. Principles of Angiosperms Taxonomy. Robert E. Kreiger Pub. Co., New York.
3. Grant, W.F. 1984. Plant Biosystematics. Academic Press, London.
4. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Nieman Educational Books Ltd., London.
5. Heslop-Harrison, J. 1967. Plant Taxonomy. English Language Book Soc. & Edward Arnold Pub. Ltd., UK.
6. Heywood, V.H. and Moore, D.M. 1984. Current Concepts in Plant Taxonomy. Academic Press, London.
7. Jain, S.K. 1981. Glimpses of Indian Ethnobotany. Oxford and IPH.
8. Jain, S. K. and Rao, R.R. 1977. A Handbook of Field and Herbarium Methods. Today and Tomorrow.
9. Mondal, A. K. 2011. Advanced Plant Taxonomy. New Central Book Agency, Kolkotta.
10. Naik, V. N. 1990. Introductory Plant Taxonomy. Longman.
11. Radford, A.E. 1986. Fundamentals of Plant Systematics. Harper & Row Publications, USA.
12. Sivaranjan, V. V. 1990. Introduction to Principles of Plant Taxonomy. Oxford and IBH.
13. Stace, C.A. 1989. Plant Taxonomy and Biosystematics (2nd edition). Edward Arnold Ltd., London. Takhtajan, A.L. 1997.
14. Diversity and Classification of Flowering Plants. Columbia University Press, New York.

15. Verma, B. K. 2011. Introduction to Taxonomy of Angiosperms. PHI Learning Pvt. Ltd., New Delhi.
16. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall, New Jersey.

BOT-Ph.D.II (E4): Applied Microbiology**Unit I**

Microbial diversity: Species diversity, dispersal of microbes, ecological niche, nutrient regeneration in ecosystem;, microbial colonization, succession and climax,

Unit II

Methods in Microbiology: Microbial cultures, physical condition for growth, mixed cultures, isolation and maintenance of pure culture, isolation by exposing to air, types of media, preparation of medium.

Unit III

Microbes in relation to pollutants; Role of microbes in sewage treatment; biodegradation, bioremediation, biopesticides, tolerance range of microbes to extremes of environment

Unit IV

Agricultural microbiology: Beneficial and destructive associations viz. competition, parasitism, symbiosis, endophytes in its importance; biofertilizers, nitrogen fixation; mycorrhizae and their application in agriculture and forestry.

Suggested readings

1. Dubey, R.C and Maheswari, D.K. (2009). A text book of microbiology. S. Chand
2. Alexander, M. 1979. Advances in Microbial Ecology. Plenum Press.
3. Harley and Smith, S.E. 1983. Microbial Symbiosis. Academic Press.
4. Dubey, R.C. and Maheshwari, D.K. 2009 . A text book of Microbiology.

Elective Paper (4 Credits)
BOT-Ph.D.II (E5): Plant Biotechnology

Unit - I

Concept and scope of Biotechnology; Micropropagation techniques; Somatic embryogenesis and application; *In vitro* haploid production and application; Protoplast culture and application (somatic hybridization and cybridization).

Unit - II

In vitro production of commercially viable secondary metabolites; Conservation biotechnology; Fermentation technology; Recombinant DNA technology; Genomic library,

Unit - III

DNA barcoding; Transgenic plants and its application (nuclear and chloroplast); Nucleic acid hybridization, PCRs; DNA finger printing; Gene mapping techniques.

Unit - IV

Metagenomics; Nanobiotechnology; Environmental biotechnology; Biotechnology and biosafety; IPR.

Suggested Readings

1. Benson E. E., 1999. Plant Conservation Biotechnology (ed.). Taylor & Francis Ltd, USA.
2. Bhojwani S. S. and Razdan M. K., 2006. Plant Tissue Culture: Theory and Practice (Revised Edition). Elsevier Science B. V.
3. Bhojwani S. S. and Dantu P K. 2013. Plant Tissue Culture: An Introductory Text. Agritech Publications, P.O. Box 255, Shrub Oak, NY 10588, U.S.A.
4. Kurz W. G. W., 1989. Primary and Secondary Metabolism of Plant Cell Cultures II. Springer-Verlag.
5. Jain S. M., Gupta P. K. and Newton R. J. (eds.).2000. Somatic Embryogenesis in Woody Plants. Vol. 6. Kluwer Academic Publishers.
6. Brown T. A., 1999. Genomes. John Wiley and Sons (Asia) Pvt. Ltd., Singapore.
7. Primrose S. B. 2000. Principles of Genome Analysis. Blackwell Scientific Publications, Oxford, UK.
8. Kartha K. K., 2000. Cryopreservation of Plant cells and Organs. CRC Press, Boca Raton, Florida, USA.
9. Mitra S., 2000. Genetic Engineering. Mc Milam Publication.
10. Singh B. D., 2005. Biotechnology. Kalyani publishers, New Delhi, India.
11. Jolles, O. and Jornvall H. (eds), 2000. Proteomics in Functional Genomics. Birkhauser Verlag, Basel, Switzerland.
12. Nirmala C. B., 2009. Plant Biotechnology. MPJ Publishers, Chennai, India.
13. Kalaichelvan P. T., 2008. Microbiology and Biotechnology: A Laboratory Manual. MPJ Publishers, Chennai, India
14. Glicks B. R. and Pasternack J. J., 2004. Molecular Biotechnology. ASM Press.

15. Smith R. H., 2000. Plant Tissue Culture: Techniques and Experiments (2nd edition). Academic Press.

BOT-Ph.D.III: Research and Publication Ethics (2 Credits)**Unit I**

Introduction to philosophy: definition, nature and scope, concept, branches; Ethics: definition, moral philosophy, nature of moral judgments and reactions; Ethics in science and research; Intellectual honesty and research integrity.

Unit II

Scientific misconducts: Falsification, fabrication and plagiarism (FFP); Redundant publications: duplication and overlapping publications; Selective reporting and misrepresentation of data; Use of plagiarism software like Urkund, Plagiarism Checker X and other subscription based and open source software tools.

Unit III

Publication ethics: definition, introduction and importance; Best practices; Conflicts of interest; Publication misconduct: definition, concept, problems that lead to unethical behavior, violation of publication ethics, authorship and contributorship; Identification of publication misconduct, complaints and appeals; Predatory publishers and journals.

Unit:

A. Indexing databases, citation databases: Web of Science, Scopus, etc.; Impact factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-index, g index, i10 index etc.

B. Group Discussions: Subject specific ethical issues, FFP, authorship; Conflicts of interest; Complaints and appeals: examples and fraud from India and abroad.

Suggested Readings

1. Bird, A. 2006. Philosophy of Science. Routledge.
2. Mac Intyre, Alasdair 1967. A Short History of Ethics. London.
3. Chaddah, P. 2018. Ethics in Competitive Research: Do Not get scooped, do not get plagiarized.
4. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. 2009. On Being a Scientist: A Guide to Responsible Conduct in Research: 3rd edn. National Academies Press.
5. Beall, J. 2012. Predatory publishers are corrupting open access. Nature, 489(7415), 179-179. Doi: 10.1038/489179a
6. Indian National Science Academy (INSA). 2019. Ethics in Science Education, Research and Governance. www.insaindia.res.in/pdf/Ethics_Book.pdf

**BOT-Ph.D.IV: Review of Literatures, Report Writing and Seminar
(4 Credits)**

Every Scholar will be assigned a topic for literature search. Following review of literatures on the assigned topic, the Scholar will be preparing a scientific report and will present the report as PowerPoint Presentation.

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