COURSES OF STUDY (Syllabus)

M.Phil. & Pre-Ph.D. in BOTANY

(Effective from the session 2020-2021)

BERHAMPUR UNIVERSITY
BHANJA BIHAR, BERHAMPUR – 760 007
GANJAM, ODISHA, INDIA
2020

GLIMPSE OF THE DEPARTMENT:

The Department of Botany was established in 1969 and founded by late Prof. Harihar Patanaik, a renowned algologist. Since its inception the department has grown appreciably, not only in terms of students and faculty strength but also in terms of introduction of new courses, specializations and broadening of research activities. The Department is sponsored by different Government agencies such as CSIR, UGC, DBT, DAE, MoEF and CC, Government of India, OFSD, Govt. of Odisha, S & T Department, Government of Odisha for different research projects. Total 25 research projects have been completed successfully by the faculties of the Department and presently 6 major research projects are ongoing by the present faculties. The student achievers of this department are absorbed in different Sectors (Govt. /Private.) in India and Abroad. Some of them have taken up positions as scientists and faculties in prestigious institutions like IIT, Mandi; BARC, Mumbai; ILS, Bhubaneswar; NBRI, Lucknow; BSI, Kolkata; AIS, Pune; Viswa Bharati, Shantiniketan; Central University, Jharkhand; DST, New Delhi; Reliance Industries Limited, Mumbai etc. Products of this department were working in different companies and universities of USA i.e. Celgene, San Diego; Ohio State University, Columbus; Stanford University, Stanford etc. Also a few have entered into Indian Forest Services, Banking, Administration, Education and Economics service in Odisha State and outside of the State. Many of them have joined as Lecturers/Assistant Professors in Govt. Colleges of Odisha and India. An appreciable number of our students have been qualifying in the joint NET (UGC-CSIR), GATE, UGC etc from 1997 to till date (2020).

Objectives: To motivate our students to achieve their goals in different competitive examinations i.e. UPSC, CSIR (NET), UGC (NET), GATE, ICMR (NET) and OPSC *etc*. and also to expose them into the exciting and innovative Research & Teaching line.

Facilities: Students are being provided with free access to internet facilities, study materials and text books through department/seminar library. Department has a well-furnished Seminar hall with electronic systems. We have five specialized laboratories (Algal Biotechnology, Ethnobiology and Biochemistry, Microbiology, Computational Biology and Bioinformatics, Molecular Biology, Ecology etc.) along with a Common Instrumentation laboratory, which is well equipped with modern Instruments. All the facilities are being used by the students for their experiments during routine practical works.

Core Research Areas.

The faculty members of the department are working on different disciplines of Botany, i.e. Phycology and Algal Biotechnology, Environmental Sciences, Microbiology, Bioinformatics & Computational Biology, Molecular Biology, Biochemistry and Ethnobiology etc.

Faculties: There are five regular faculties and four guest professors (with >30 years of teaching and research experience in Botany).

CURRENT FACULTY MEMBERS

Name of the Faculty	Designation	Specialized Subject
Dr. Mrutyunjay Jena, Ph.D.	Assistant Professor	Phycology and Algal Biotechnology
Dr. A. Leelaveni, Ph.D.	Assistant Professor & Coordinator	Ethnobiology & Biochemistry
Dr. Sarita Das, Ph.D.	Assistant Professor	Pathology & Pharmaceutical Microbiology
Dr. Biswa Ranjan Meher, Ph.D.	Assistant Professor	Computational Biology & Bioinformatics
Dr. Padmalochan Hembram, Ph.D.	Assistant Professor	Molecular Biology & Plant Biotechnology

COURSES OF STUDIES
Pre-Ph. D. Course Work and M. Phil. in Botany

Total Credit: 16 (Pre Ph.D.); 32 (M.Phil.); Core course: 05, Elective course :05 & Dissertation

SEMESTER-I				
Core/elective course	**Course no.**	**Name of the Course**	**Credit**	**Marks**
Core course 1	BOTA MPC1	Research Methodology and Instrumentations	04	100
Core course 2	BOTA MPC2	Advanced Plant Sciences	04	100
Core course 3	BOTA MPC3	Research and Publication Ethics	02	50
Core course 4	BOTA MPC4	Review of Literature and Seminar Presentations	02	50
Elective course 1 (Any one to be opted by the students)	BOTA MPE1 BOTA MPE2 BOTA MPE3 BOTA MPE4 BOTA MPE5	Applied Phycology Advanced Medicinal Botany Pharmaceutical Microbiology and Phytopathology Molecular Modelling & Drug Design Plant molecular biology and Biotechnology	04	100
		Total	**16**	**400**
SEMESTER-II				
Core Course-5	BOTA MPC5	Review of Research Progress & Seminar Presentations	04	100
Dissertation	BOTA MPD6	Dissertation	12	300
		Total	**16**	**400**
		Total Credit	**32**	800

Pre-Ph.D. course work consists of 16 credits of 400 marks (Only Semester I). **M.Phil.** course consists of 32 credits and 800 marks of two Semesters (Semester I: 16 credits and Semester II: 16 Credits). In the first semester of the programme, there are 4 compulsory core papers and one elective paper. In the second semester, there is one core paper (Review of Research Progress & Seminar Presentations) of 4 credits and dissertation of 12 credits.
In the 1st semester all the 4 core courses are mandatory for both M.Phil. and Pre-Ph.D. students and in addition, students have to choose one elective course out of five elective courses (BOTA MPE1, BOTA MPE2, BOTA MPE3, BOTA MPE4, BOTA MPE5).

DETAILS OF SYLLABUS

SEMESTER-I

Course No: BOTA MPC1
Course Name: Research Methodology and Instrumentations

Credits: 4 **Core/Elective: Core course**

Course details

Chapter	Contents	Hours
Unit- I	Analytical approaches: Principles and operation of UV-Visible spectrophotometer, Atomic Absorption spectrophotometry. Community analysis: value index, diversity index and dominance index. Dose response and determination of threshold values: EC_{50}, non-toxic and toxic doses, hormesis. Microbial techniques: Preparation of solid and liquid media for algae, fungi and bacteria, mass culture of algae, fungi, bacteria. Plant Tissue culture and Micro-propagation techniques.	**15**
Unit- II	Phase Contrast and Fluorescent Microscopy, Electron Microscopy, Centrifugation technique for separation of Biological samples, Purification and identification of biomolecules by chromatography: Paper Chromatography, Thin Layer Chromatography, adsorption chromatography (Gel, Ion-exchange), HPLC and Gas-liquid Chromatography, Principles of electrophoresis, Agarose gel electrophoresis, SDS-PAGE, Native PAGE, 2D gel electrophoresis PCR techniques, real time PCR	**15**
Unit- III	Research paper reading, writing: Searching literature, structuring and writing a research paper (review of literature, citing references, peer review). Online tools for citation, correct usage of technical language and scientific peer network and presentations.	**15**
Unit- IV	Data processing and statistical analysis: Analysis of variance (ANOVA), Chi square test, LSD test, Simple correlation and linear regression analyses. Software for statistical analysis, data organization and presentation (Microsoft excel and SPSS).	**15**
Total		**60**

Suggested References:

1. Instrumental methods of analysis by Willard et al.
2. Practical Biochemistry: Principles and Techniques by Wilson and Walker
3. Principles and Techniques of Biochemistry and Molecular Biology by Wilson and Walker
4. Laboratory Manual of Biotechnology by S. K. Bhatnagar and Deepika Abrol, S. Chand & Co
5. Fundamentals of Biostatistics by Veer Bala Rastogi.
6. Fundamentals of Biostatistics by Bernard Roser
7. Misra, B.N. and M.K. Misra. 1983. Introductory Practical Biostatistics
8. Seboyar, G.E., Manual for Report and Thesis Writing, New York: F.S. Crofts & Co., 1929

9. Noether, G.E., Elements of Nonparametric Statistics, New York: John Wiley & Sons, Inc., 1967.
10. Leki, I. (1995). Academic writing: Exploring processes and strategies (2nd ed.) New York: St. Martins Press, pp. 185-211.
11. Spatt, B. (1999). Writing from sources (5th ed.) New York: St. Martin's Press, pp. 98-119; 364-371.
12. Levine, S. and Elzey, Freeman F., A Programmed Introduction to Research, California: Wods Worth Publishing Co., 1968.

Course No: BOTA MPC2

Course Name: Advanced Plant Science

Credits: 4 **Core/Elective: Core**

Course details

Chapter	Contents	Hours
Unit- I	Biodiversity and Plant resources: biodiversity conservation and sustainable utilization, Non-conventional energy from biomass of higher plants, algae and bacteria. Ethno-botany: Forest plant resources, traditional medicinal plant knowledge.	**15**
Unit- II	Concept of environmental toxicology and eco-toxicology, environmental hazards: pesticides, metals, UV and ionizing radiations, Nano-materials, toxicity evaluation in plants and ecosystems, ecological impact and consequence of global climate change. Waste management, phytoremediation of environmental pollution.	**15**
Unit- III	Sources of environmental stress - biotic and abiotic stress - oxidative stress, reactive oxygen species, plant adaptation to drought, salinity, temperature, and pathogen. Homeostasis. Molecular markers of plant responses to stress biotic and abiotic stress: oxidative metabolism, stress proteins, heat shock proteins, pathogen related proteins. Plant hormones (salicylic acid, jasmonic acid, abscisic acid), signal transduction and pathways.	**15**
Unit- IV	Plant transformation: Agrobacterium mediated gene transfer, process of T-DNA transfers and integration, practical applications of Agrobacterium-mediated gene transfer, Direct gene transfer methods. Genetically modified plants: Classical mutational approaches, transgenic approaches, CRISPR-CAS technology for genome editing approaches used for herbicide tolerance, pest tolerance, disease resistance, Risk and benefits associated with transgenic crops, regulations.	**15**
Total		**60**

Suggested References:

1. Understanding Biodiversity: Life sustainability and Equity by Kothari, A, Orient Longman, New York.
2. Biodiversity and its Conservation in India by Negi, S. S. Indus Publishing Company, New Delhi.

3. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Glick, B. R. and Pasternak, ASM Press, Washington, D. C., USA.
4. Plants from Test Tube: An Introduction to Micropropagation by Kyte, L. and Kleyn, J.3rd Ed. Timber press, Port land, USA.
5. Plant Cell and Tissue Culture Vol VI by Pollard, W. J. and Walker, Humana press Clifton, USA.
6. Practical Applications of Plant Molecular Biology by Henry, R. J., Chapman & Hall, London, UK
7. Wilson, E. O. (1988). Biodiversity. National Academy Press.
8. Truhaut, René (September 1977). "Ecotoxicology: Objectives, principles and perspectives". Ecotoxicology and Environmental Safety. 1 (2): 151–173
9. Connell, Des; et al. (1999). Introduction to Ecotoxicology. Blackwell.

Course No: BOTA MPC3

Course Name: Research and Publication Ethics

Credits: 2 **Core/Elective: Core**

Chapter	Contents	Hours
Unit- I	**Philosophy and Publication ethics:** Philosophy: definition, nature and scope, concept, branches Publication ethics: definition, moral philosophy, nature of moral judgements and reactions, importance Best practices/standards setting initiatives and guidelines: COPE, WAME etc. Conflicts of interest. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types Violation of publication ethics, authorship and contributorship Identification of publication misconduct, complaints and appeals Predatory publishers and journals	**15**
Unit- II	**Scientific conduct** Ethics with respect to science and research Intellectual honesty and research integrity Scientific misconducts: falsification, fabrication and plagiarism (FFP) Redundant publications: duplicate and overlapping publications, salami slicing Selective reporting and misrepresentation of data Use of plagiarism software like Turnitin, Urkund and other open source software tools	**15**
Unit- III	**Open access publishing** Open access publications and initiatives SHERPA/RoMEO online resources to check publisher copyright & self-archiving policies Software tool to identify predatory publications developed by SPPU Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester etc.	**15**
Unit- IV	**Databases and research metrics** Publication Databases, Indexing databases	**15**

	Citation databases: Web of Science, Scopus etc. Research metrics: Impact factor of journal as per journal citation report, SNIP, SJR, IPP, Cite score etc. Metrics: h-index, g index, i10 index, altmetrics	
Total		**60**

Course No: BOTA MPC4

Course Name: Review of Literature and Seminar Presentations

Credits: 2 **Core/Elective: Core**

Course details

Contents	**Hours**
Review of Literature: meaning, significance and techniques of reviewing the literature for the specific topic/research paper. • Developing guidelines for review of literature. • Selecting five research papers on any topic of Botany/Bioscience and reviewing all. • Preparing a report on the reviewed papers- at least 05 research papers. • Presenting the research reviewed papers through PPT.	-
Evaluation: The candidate has to present his/her paper through PPT before the Department RAC and submit a report after the presentation. The department RAC will evaluate the candidate based on the presentation and the review report.	-

Course No: BOTA MPE1
Course Name: APPLIED PHYCOLOGY

Credits: 4 **Core/Elective: Elective**

Course details

Chapter	**Contents**	**Hours**
Unit- I	Algae in diversified habitats (terrestrial, freshwater, and marine). Distribution of economically important algae in India. Sampling techniques of phytoplankton, assessment of primary production of water. Identification of some important micro algae like, *Chlorella, Scenedesmus, Tetrasilmis, Dunaliella, Ceratium, Peridinium, Cyclotella* and *Skeletonema*. Identification of some macro-algae like *Ulva, Enteromorpha, Codium, Caulerpa, Ectocarpus, Padina, Sargassum, Porphyra, Gelidium, Eucheuma, Hypnea, Gracilaria.*	**15**
Unit- II	Mass culture techniques for yield of biomass of micro algae (*Chlorella, Scenedesmus, Spirulina*) and Commercial utility of micro algae for food and feed, pigments, pharmaceuticals and neutraceuticals, fine chemicals, biofuel and biofertilizers.	**15**
Unit- III	Seaweed farming in India, with emphasis on the methods of seaweed cultivation of *Sargassum, Porphyra, Gelidiella, Gracilaria.* Methods of extraction of Agar-agar and Algin, Seaweeds liquid biofertilizers (SLF).	**15**

Unit- IV	Algae and water pollution; Algae as indicators of pollution, algal bloom and control Biofouling, Phytoremediation, use of algae for sewage treatment.	**15**
Total		**60**

Suggested Readings:

1. Phycology by R.E. Lee, Cambridge University Press.
2. Algae by L.E. Graham and L. W. Wilcox Prentice Hall.
3. Introductory Phycology by Kumar, H. D. (1988), East-West Press, New Delhi**.**

Course No: BOTA MPE2

Course Name: ADVANCED MEDICINAL BOTANY

Credits: 4 **Core/Elective: Elective**

Course details

Chapter	Contents	Hours
Unit- I	**Floristic Survey:** Field collections and preservations of specimens in herbarium; phytography, Identification and formulation of diagnostic keys; documentation of data; analysis of flora, Flora of Odisha; its past present and future; flora of India.	**15**
Unit- II	**Herbarium Management:** Concept and definition; historical development; role of herbarium; famous herbaria of the world; Present state of herbarium; changing nature of herbarium and its future; Arrangement of specimens in the herbarium; operation and maintenance.	**15**
Unit- III	**Plant Nomenclature:** Historical development and critical evolution of various facets of International Code of Botanical Nomenclature; Typification and guide for the determination of types; priority and limitations of the principle of priority; Retention, choice and rejection of names and epithets; concept of epithets.	**15**
Unit- IV	**Structural Studies of Macromolecules and micro-molecules:** Macro molecules (Starch, polypeptides, proteins, Enzymes and Nucleic acid) Micro molecules (phenols, flavonoids, steroids, wax). Antioxidants	**15**
Total		**60**

Suggested Readings:

1. Majid, Husain (1 January 2014). Geography of India. McGraw- Hill Education.
2. Nag, Prithvish; Sengupta, Smita (1 January1992). Geography of India. Concept Publishing company.
3. ICBN (1983) International code of Botanical Nomenclature.
4. Joshi, K.I. (1994). Floristic, phyto sociological and ethno botanical study of Cambay taluka, Cambay.
5. Müller- Wille, Staffan (2006-0601)."Linnaeus 'herbarium cabinet: a piece of furniture and its function".

6. Chater, Arthur O. "Collecting and Pressing of Specimens".www.bsbi.org.uk. Botanical Society of Britain and Ireland. Retrieved2February2016.
7. Edinburgh Royal Botanic Garden. "Royal Botanic Garden Edinburgh-What is a herbarium". www.rbge.org.uk.
8. Bunge,M.(1979).Treatise on Basic Philosophy, vol. 4. Ontology II: A World of Systems, p.61-8.
9. Slabaugh, Michael R. & Seager, Spencer L. (2007). Organic and Biochemistry for Today (6th ed.). Pacific Grove: Brooks Cole.

Course No: BOTA MPE3

Course Name: PHARMACEUTICAL MICROBIOLOGY AND PHYTOPATHOLOGY

Credits: 4 **Core/Elective: Elective**

Course details

Chapter	Contents	Hours
Unit- I	**Bacterial pathophysiology:** Normal flora in human, Host-pathogen interaction, molecular mechanism of pathogenesis. Food and water borne diseases, Pathophysiology of Infectious diseases – diseases of respiratory tract, urinary tract, digestive system, skin and soft tissues.	**15**
Unit- II	**Antibiotics:** Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactams, tetracyclines, cephalosporins, flouroquinolones, macrolid antibiotics) Antifungal antibiotics (polyenes, azole drugs). Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis).	**15**
Unit- III	**Natural therapeutics**: Isolation, purification and characterization of secondary metabolites from plants (polyphenols, glycosides, steroids, flavonoids, coumarins tannins, terpenes, saponins etc), Mechanism of action of natural antimicrobial agents.	**15**
Unit- IV	**Phytopathology:** Plant diseases, altered metabolism of plants under biotic and abiotic stresses, host-parasite relationship, molecular mechanism of pathogenesis, recognition phenomenon, penetration, invasion and dissemination. Mechanism of resistance; phytoalexins, PR proteins, antiviral proteins, SAR, HR and active oxygen radicals. Endophytes and their role in plant immunity.	**15**
Total		**60**

Suggested Readings:

1. Hugo and Russell's Pharmaceutical Microbiology by Stephen P. Denyer (Author), Norman Hodges (Author), Sean P. Gorman (Author), Brendan F. Gilmore (Author) Publisher: Wiley India Pvt Ltd.
2. Microbiology by Prescott, L. M., Harley, J. P. and Klen, D. A, Tata McGraw-Hill, New York.
3. Microbiology by Tortora/Funke/Case, Publisher: Pearson Education India; Eleventh Edition.
4. General Microbiology by Stanier, R.Y., Ingraham, J.L., Wheelis, M.L., and Painter, P.R. The McMillan Press Ltd.

5. Plant Pathology by George N. Agrios Publisher: Academic Press; 5 edition (25 January 2005)
6. Plant Pathology by Mehrotra, R. S. and Aggarwal, A., Mc Graw Hill Education
7. Plant Diseases by R.S. Singh Publisher: Medtech; 10th edition (6 July 2017)
8. Trease and Evans Pharmacognosy 16th Edition by William C Evans Publisher: Elsevier (2019)

Course No: BOTA MPE4

Course Name: MOLECULAR MODELLING AND DRUG DESIGN

Credits: 4 **Core/Elective: Elective**

Course details

Chapter	Contents	Hours
Unit- I	**Molecular Modelling**: Introduction to Molecular Modeling and its applications, Biomolecular modeling problems: protein folding and misfolding, nucleic acid/ protein interactions. Basic concepts of quantum mechanics, *ab initio*. Molecular mechanisms, energy calculations, Bond stretch, Angle bending, torsional terms, Electrostatic interaction- van der Waals interactions.	**15**
Unit- II	**Molecular simulations**: Introduction to molecular dynamics and simulations, Molecular Dynamics using simple models; Dynamics with continuous potentials, Constant temperature and constant dynamics; Monte-Carlo simulation of biomolecules and bio-polymers. Comparative modeling of protein: by homology- the alignment, validation of protein models – Ramachandran plot, threading and *ab initio* modeling.	**15**
Unit- III	**Drug Design & Discovery**: Analog based drug designing, Introduction to QSAR. Lead module, linear and nonlinear modeled equations, Biological activities, physicochemical parameter and molecular descriptors, molecular modeling in drug discovery.	**15**
Unit- IV	**Structure based Drug Design**: Pharmacophores, molecular docking, De novo Ligand design, Free energies and solvation, electrostatic and non-electrostatic contribution to free energies. 3D data base searching and virtual screening, molecular similarity and dissimilarity searching, combinatorial libraries – generation and utility.	**15**
Total		**60**

Suggested Readings-

1. Molecular Modelling: Principles & Applications. By Andrew R. Leach, Pearson (Prentice Hall) 2nd Edition 2001.
2. Guidebook on Molecular Modeling in Drug Design- N. Claude Cohen, 1996. Elsevier
3. Molecular Modeling Basics- Jan H. Jensen, 2010. CRC Press

4. Computational Chemistry and Molecular Modeling, Principles and Applications- K. I. Ramachandran, G. Deepa, K. Namboori, 2008
5. Textbook of Drug Design and Discovery, 5th Edition- Kristian Stromgaard, Povl Krogsgaard-Larsen, Ulf Madsen, 2016. CRC Press.

Course No: BOTA MPE5

Course Name: PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY

Credits: 4 **Core/Elective: Elective**

Course details

Chapter	Contents	Hours
Unit- I	**Plant Biotechnology and genetic engineering:** Plant microbe interaction; Functional genomics, Transcriptomics and Proteomics; Biotic and abiotic stress in Crop plants; Generation of DNA fragments; Different types of vectors and cloning strategies; Construction of genomic library.	**15**
Unit- II	**Plant molecular biology:** Organization of genetic material; DNA Repair and recombination, DNA sequencing methods; Transcription of information; Different types of RNA: structure and function; Post transcriptional processing of different RNAs; Artificial RNA technology; RNA–interference; Mechanisms of translation.	**15**
Unit- III	**Concepts of signal transduction in Plants:** General principles of signal transduction; Evolution and diversification of signaling molecules; Mechanisms; Signals and sensors; Secondary messenger and protein modification; Signaling pathways; Cell death signaling.	**15**
Unit- IV	**Molecular breeding:** History and objective of molecular breeding; Molecular marker, Molecular Breeding and transgenic technology; Marker-assisted breeding (MAB) and molecular-assisted selection; Pure line theory; Breeding methods in crop plants; Hybrid breeding.	**15**
Total		**60**

Suggested Readings:

1. Biochemistry & Molecular Biology of Plants. By Buchanan, Gruissem, Jones
2. The Biochemistry of Cell Signaling. By Ernst J.M. Helmreich
3. Principles of Plant Breeding. By Robert W. Allard
4. Principles of Biochemistry. By Lehninger, Nelson & M. Cox.

SEMESTER-II

Course No: BOTA MPC5

Course Name: Review of Research Progress & Seminar Presentations,Credits: 4
Core/Elective: Core course 5

This paper includes total three (03) presentations periodically from 2nd month onwards of the admission. The students/scholars have to present 1st presentation (Proposed research proposal, including Review of Literature on the proposed topic for dissertation work, methodology and plan of research work and expected outcome) and 2nd presentation (Progress of research work/dissertation work), 3rd Presentation (Dissertation/thesis pre submission presentation) in the department through PPT before the department RAC. The department RAC will evaluate the candidate based on the presentation and the progress report.

Course No: BOTA MPD6

Course Name: DISSERTATION

Credits: 12 (300 Marks) **Core/Elective: Core course 6**

The M.Phil. Dissertation will be evaluated, based on a PPT presentation and viva-voce examination on dissertation work for 100 marks and the dissertation component will be evaluated for 200 marks jointly by the supervisor and the external examiner.