RAMAKRISHNA MISSIONVIVEKANANDA CENTENARY COLLEGE

RAHARA, KOLKATA, WEST BENGAL
www.rkmvccrahara.org

SWAMI VIVEKANANDA CENTRE FOR MULTIDISCIPLINARY RESEARCH IN BASIC SCIENCE AND SOCIAL SCIENCE

DEPARTMENT OF BOTANY

PROGRAMME OFFERED: Ph.D.

PROGRAMME CODE: PHDBOT

DURATION: 6 Months

TOTAL CREDIT: 16

The Ph.D. course work curriculum in Botany is introduced from 2018 - 2019 onwards

with 100% change vide BOS resolution dated 17.05.2018

2018

R.K. Mission Vivekananda Centenary College Dept. of Botany Rahara

SYLLABUS FOR Ph.D. COURSE WORKS IN BOTANY

PROGRAMME STRUCTURE

The Ph.D coursework Programme consists one part as under:

The coursework would consist of **16 credit courses.** There would be Core Units to be studied compulsorily by all students of the Ph.D. Botany programme, and Elective Units from which each student would have to select **one unit** of his choice. There would be a confirmation viva-voce after the successful completion of the course work which do not have any credits as it is a mandatory requirement. The schedule of papers prescribed for various semesters shall be as follows:

Course No.	Course Title	Credits
Core Units		
PHDBOT 01	Research Methodology	4
PHDBOT 02	Computer Applications	4
PHDBOT 03	Literature Survey and Related Topic	4
Elective Unit		
PHDBOT 04	Advance Level Elective Course	4

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PROGRAM OUTCOMES (PO):

After completion of the Ph.D. Degree program, the students will be able to

PO No.	Program Outcomes	Cognitive Level
PO1	Understands and apply theories, methodologies, and knowledge to address fundamental questions in their primary area of study.	U, Ap
PO2	Demonstrate the gained knowledge and skills in oral and written and hence communicate them to publish and present work in their field.	E, C
PO3	Develop a mastery of analysing skills and knowledge at a level required for college and university undergraduate teaching in their discipline and assessment of student learning.	An
PO4	Develop the intellectual independence that epitomizes true scholarship and Pursue research of significance in the discipline under the guidance of an advisor.	C

R= remembering, U = understanding, Ap = applying, An = analysing, E = evaluating, and C = creating

PROGRAMME SPECIFIC OUTCOMES (PSO):

After the successful completion of this course, the student will be able to:

PSO No.	Program Specific Outcomes	Cognitive Level
PSO1	Develop specialization in a particular area of biological research.	U, Ap
PSO2	Inculcate logical reasoning among students and help them develop ability to solve problems modern biological techniques.	E, C
PSO3	Train the students a wide range of analytical and/or experimental and/or computational techniques that can be applied in biological research.	An, C
PSO4	Design and formulate experiments to conduct independent research.	C

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Course Name: **Research Methodology**	
Course Code: **PHDBOT01**	
FullMarks:100	Credit: 4
Number of classes: 60	

Course Objectives (PHDBOT01)

The prime objectives of the course are:

- Develop the ability to choose methods appropriate to research aims and objectives.
- Understand the advantages and disadvantages of particular research method.
- Develop skill of critical thinking and the skill of qualitative and quantitative data analysis and presentation.
- Prepare students for organizing and conducting research in a more appropriate manner.

Course Content

(a) Introduction, Overview, and Research Misconduct, rules and regulations in India
(b) Data Management
(c) Mentoring, mentor-mentee responsibilities
(d) Authorship Guidelines, Publication and Peer Review
(e) Intellectual property, plagiarism, patents
(f) Collaboration
(g) Reporting and representing research, representing images.
(h) Bias, Conflicts of Interest
(i) Ethical use of animal subjects
(j) Protection of Human subjects
(k) Stem Cell Ethics
(l) The Ethics of Plant Use, transgenic crops
(m)Agricultural Ethics
(n) Ecosourcing-code of practice
(o) Radioactive, chemical and biohazard safety, waste management and disposal
(p) Social Responsibility and Whistle blowing
(q)Definition of problem: Necessity of defining problem, Technique involved in defining a problem.
(r) Techniques involved in solving the problem: Different methods used to solve a problem.
(s) Research Design: Subject of study; Place of study; Reason of such study; Type of data required; Method of data collection; Periods of study; Style of data presentation.
(q) Developing a research plan: Research objective; Informations required for solving the problem; Each major concept should be defined in operational terms; An overall description

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of the approach should be given and assumption if considered should be clearly mentioned in research plan; The details of techniques to be adopted.
(r) Methods of data collection: Experimental methods.

B: Statistical Methods: Numerical and graphical presentation of data; Measures of central tendency; Measures of dispersion; Testing of significance of hypothesis by student's t-test, paired t-test and Fisher's t-test; Determination of correlation coefficient between two variables; Regression analysis; Theories of probability; Analysis of variance; Post-hoc test; Statistical distributions (Normal, binomial and Poisson distributions); Basic statistical modelling.

C: Techniques in Plant Sciences: Algal cell culture - Algal culture, Fungal culture - Fungal culture media, Protoplast and Spore culture, Plant cell Culture- Cellular totipotency, cytodifferentiation, Somatic embryogenesis, Preservation techniques- Histochemical and cytochemical preservation, Herbarium, Molecular biological Techniques- Gene amplification and PCR, Molecular Probes, DNA fingerprinting

D: Analytical Methods: Microscopic Techniques: Light microscope: Resolving power and magnification, Phase Microscope, Fluorescence Microscope, Confocal Microscope, Micrometry. Electron Microscope: Transmission and scanning techniques for E.M. Spectrophotometry: Electromagnetic spectrum, construction of calorimeter and spectrophotometer, Applications. Analytical techniques: GC-MS, HPLC, FT-IR, Maldi, Raman, Etc.

Course Outcomes

On successful completion of the course students will be able to:

CO. No.	Course Outcome	Cognitive Level	POs Addressed	PSOs Addressed
CO1	Understand the objectives, motivation and types of research	U	PO1	PSO1
CO2	Define and formulate a research problem	R, C	PO4	PSO2
CO3	Collect data (primary or secondary) based on the formulated problem and analyse the data.	An	PO2	PSO3
CO4	Analyse the data with hypothesis testing, generalization and interpretation.	An, C	PO3	PSO3
CO5	Discuss the application of results and write the thesis.	Ap, E	PO3	PSO4

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Name of the Course: **Computer Applications**	
Course Code: **PHDBOT02**	
Full Marks: 100	Credit: 4
Number of classes: 60	

Course Objectives (PHDBOT02)

The prime objectives of the course are:

- To develop competency in technical writing.
- To master the fundamentals of writing LaTeX and Python scripts.
- To acquire Object Oriented Skills in Python.
- To develop the skill of designing Graphical user Interfaces in Python and LaTeX.
- To develop the ability to write database applications in Python.

Course Content

LaTex: Credit – 2; Lecture Hours– 30

Introduction to LaTeX, Installation of LaTeX, Layout Design, LaTeX input files, Input file structure, document classes, packages, environments, page styles, Typesetting texts, Fancy Header, tables.

Inline math formulas and displayed equations, Math symbols and fonts, Delimeters, matrices, arrays, Typesetting Mathematical formulae: fractions, Integrals, sums, products, etc. Producing Mathematical Graphics.

Document classes for paper writing, thesis, books, etc. Table of contents, index, bibliography management, hypertext, pdf pages, geometry, fancy header and footer, Verbatim, itemize, enumerate, boxes, equation number.

Beamer class, beamer theme, frames, slides, pause, overlay, transparent, handouts and presentation mode

Biopython: Credit – 2; Lecture Hours– 30

What is Biopython? What can I find in the Biopython package. Installing Biopython. What can you do with Biopython? General overview of what Biopython provides. Working with sequences. Parsing sequence file formats. Simple FASTA parsing example. Simple GenBank parsing example. Connecting with biological databases. Sequence objects. Sequence annotation objects. Sequence Input/Output. Multiple Sequence Alignment objects. BLAST. BLAST and other sequence search tools. Accessing NCBI's Entrez databases. Going 3D: The PDB module.

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Course Outcomes (PHDBOT02)

On successful completion of the course students will be able to:

CO. No.	Course Outcome	Cognitive Level	POs Addressed	PSOs Addressed
CO1	Explain and use TeX and LaTeX.	An	PO2	PSO2
CO2	Understand the advantages of LaTeX over other more traditional software's.	U	PO1	PSO1
CO3	Prepare handouts and presentations using LaTeX.	C	PO4	PSO3
CO4	Understand the core BioPython scripting elements such as variables and flow control structures.	U, Ap	PO1	PSO1
CO5	Use BioPython to analyze biological data files.	E, C	PO3	PSO3

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Name of the Course: **Literature Review**	
Course Code: **PHDBOT03**	
Full Marks: 100	Credit: 4
Number of classes: 60	

Course Objectives (PHDBOT03)

The prime objectives of the course are:

- To learn to review and assess scientific literature critically.
- To write and present an overview of the relevant literature for a specific research topic.
- To develop knowledge, insight, and academic skills.
- To develop transferable skills & interpersonal skills.

Course Content

Unit 1: Searching of Literature **5 hours**

- Formulation of key questions for a literature review.
- Identification of literature through generating a definite search string using relevant keywords.
- How to use Publication Databases: Web of Science, Scopus, PubMed, Google Scholar

Unit 2: Quantitative Evaluation of Literature **5 hours**

- Quantification of the research performance and research trends analysis.
- Identification of important bibliometric parameters namely Countries, Organizations, Authors, Research areas, funding agencies.
- Identification of important Journals for designing and communicating the research.

Unit3: Qualitative Evaluation of Literature **5 hours**

- Citation analysis: Average citation, h-index, G-index, i-10 index, self-citation, citation half-life.
- Mapping of science: Collaboration, Co-citation, co-occurrence network map analysis.
- Journal's impact: Impact factor, 5-year impact factor, Ranking, JCR and SNIP.
- Patent citation analysis.

Unit 4: Content Analysis **7 hours**

- Identification of "Trending Issues" of a particular research topic.
- Analysis of thematic evolving trends of a particular research field to identify "Emerging themes".
- Applications of various bibliometric software: Sci2, SciMat, Bibliometrix, VOSviewer.
- Basic introduction about meta data analysis.

Unit 5: How to Write a Review Literature **8 hours**

- Types of literature review: Critical Review, Systematic Review and Computational Review.

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- Identification of the most important works, trends and debates within a certain field.
- Evaluation and presentation of the important research findings in a systematic way.

Unit 6: Assignments **30 hours**

- Independently defining, designing and writing of a literature review.

Course Outcomes

On successful completion of the course students will be able to:

CO. No.	Course Outcome	Cognitive Level	POs Addressed	PSOs Addressed
CO1	Identify and retrieve relevant publications within a field of research and write a literature review by searching the literature systematically.	An, E	PO2	PSO4
CO2	Select representative scientific sources from several perspectives relevant to the assignment.	E	PO2	PSO3
CO3	Write a research proposal for obtaining Financial assistance from national funding agencies.	C	PO4	PSO4
CO4	Draw conclusions related to the research problem and give recommendations towards new research opportunities.	C	PO4	PSO4
CO 5	Represent and systematically structure a discussion on the theories and experimental results and define, design and write a literature review independently	An, C	PO3	PSO2

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Name of the Course: **Advance Level Elective Course**	
Course Code: **PHDBOT04**	
Full Marks: 100	Credit: 4
Number of classes: 60	

List of Advance Level Elective Courses (Select one from the below courses)

Course No.	Course Title	Credits
PHDBOT04.1	Breeding Methods and Seed Technology	4
PHDBOT04.2	Phytochemical extraction and analysis	4
PHDBOT04.3	Plant Tissue Culture	4
PHDBOT04.4	Cloning Vectors and Plant Transformation Techniques	4
PHDBOT04.5	Genetic Markers and Mapping	4
PHDBOT04.6	Transgenic Plants	4
PHDBOT04.7	Modern Application of Fungi or Applied Mycology	4

PHDBOT04.1: Breeding Methods and Seed Technology

Breeding methods of self and cross pollinated crops. Pure lines, inbred lines and hybrids. Sexual incompatibility, male sterility and their importance in hybrid seed production. Production of hybrid seeds in self and cross pollinated crops. Seed production and certification. Plant genetic resources and conservation. Barstar and Barnase system for production of hybrid seeds.

PHDBOT04.2: Phytochemical extraction and Analysis

Organic Solvent Extraction (Maceration, Percolation, Cold Percolation, Counter current Extraction) Extraction with Supercritical Gases, Steam Distillation, Extraction of Essential Oil, Soxhlet Extractor, Accelerated Solvent Extractor, Purification and Concentration of Miscella, Schemes ofProcedure for Extracting Plant Tissues.

Chromatographic techniques and applications. Paper and classical column (Preparative and analytical) chromatography, TLC, liquid chromatography: HPLC, gas chromatography. Electromagnetic spectrum. Applications of UV, IR, NMR and Mass spectrometry in the structural elucidation of phytoconstituents. Interpretation spectral data of IR, HNMR, 13CNMR, mass spectroscopy in the characterization of organic medicinal compounds.

PHDBOT04.3: Plant Tissue Culture:

Different areas and applications of plant tissue culture. Micro propagation (Organogenesis, Somatic Embryogenesis, Shoot tip culture, Rapid clonal propagation), Somaclonal variation of medicinal plants. Haploid culture of crop plants. Selection of cell lines for bioactive compound production.Production and processes for enhancing secondarymetabolites from cell suspension

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cultures and hairy root cultures. Mass multiplication ofcommercially important crops. Virus indexing and genetic fidelity of micropropagated crops.

PHDBOT04.4: Cloning Vectors and Plant Transformation Techniques:

General characteristics of vectors, plasmids, phage vectors, cosmids, phagemids, gateway vectors and artificial chromosomes. Concepts of Genome editing. Binary and co integration vectors, viral vectors and their applications. Methods of plant transformation: Particle bombardment, electroporation, microinjection and *Agrobacterium* mediated transformation. Transformation of chloroplasts. Screening and selection of transformants. Transgene stability. Generation and maintenance of transgenic plants.

PHDBOT04.5: Genetic Markers and Mapping:

Recent developments in molecular markers: Approaches for developing high throughput marker systems with emphasis on RFLP, RAPD, SSR, ISSR, AFLP, SNP and SCAR. Considerations for developing markers. Methods for genotyping.

Maps and their relation to genome: Establishing relationships between physical maps, genetic maps and genome sequences.

Analyzing marker trait association: Methods to analyze marker trait association with emphasis on association mapping and genomic selection.

PHDBOT04.6: Transgenic Plants:

Concept of transgene, Transgenic plants for disease and Insect resistance,abiotic stress tolerance, Modification of wood quality, herbicide resistance; Approaches to marker-free transgenics.Transgenic Crops: Status, Potential, and Challenges

Bio-safety – Regulations, Bioethics, Handling of recombinants in the Laboratory and field experiments. Objectives, risk assessment, regulation, Biosafety during industrial, Production, Biosafety guidelines in India, Guidelines and regulation Biotechnology for environment: Bioenergy, Biofuel, Bioremediation and Climate change.

PHDBOT04.7: Modern Application of Fungi / Applied Mycology Fungi:

Habit, habitat, vegetative and reproductive structure, ecology and classification in brief. Isolation techniques for fungi from different habitat in media. Characterization and identification of fungi - phenotypical (colony morphology, macro/microscopic structure) and molecular (PCR based techniques) identification. Fungi in bioremediation of environmental pollution including plastic waste management. Mushroom: a brief idea of structures, types and cultivation techniques.

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Mushroomsas antioxidant, anticancerous and immunomodulatory agents. Fungi as biopesticides including mosquitocides and biofertilizers.

Course Outcomes (PHDBOT04)

On successful completion of the course students will be able to:

CO No.	Course Outcome	Cognitive Level	POs Addressed	PSOs Addressed
CO1	Understand the objectives, motivation and types of molecular biology research.	An	PO1	PSO1
CO2	Explain and use advanced molecular biology and biochemical techniques.	U	PO2	PSO2
CO3	Prepare handouts and presentations using LaTeX.	C	PO4	PSO3
CO4	Analyse the research data with advanced statistical softwares.	U, Ap	PO1	PSO1
CO5	Discuss the application of advanced biological techniques and applied botany.	E, C	PO3	PSO3

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