DEPARTMENT OF BOTANY

Syllabus and Scheme of Examination

Ph.D. (Botany)

Maharshi Dayanand University

Rohtak 124001

DEPARTMENT OF BOTANY

PROGRAM ARCHITECTURE, DURATION, SCHEME OF EXAMINATION, WORKLOAD/WEEK AND CREDITS FOR Ph.D. PROGRAM IN BOTANY

Program Specific Objectives (PSOs)

Students who obtain degree in Ph.D. (Botany) will be able to:

PSO1 Articulate and apply basic principles related to techniques and equipment used in botanical investigation.

PSO2 Critically analyze data and use results to evaluate hypotheses in the context of primary literature.

PSO3 Formulate hypotheses informed by primary literature and test them using appropriate experimental and observational approaches.

PSO4 Prepare and give a written or oral presentation, using data that synthesizes information from multiple sources including primary scientific literature.

Duration: One Semester (Six months)

Total Credit requirement: 14 credits

Program Structure: Ph.D. course work in Botany

	SEMESTER 1					
Course Code	**Nomenclature of Course**	**Theory marks (end semester examination)**	**Internal Assessment Marks**	**Maximum marks**	**Hours /Week**	**Credits**
20BOTPH11C1	Research methodology	80	20*	100	4	4
20MPCC1	Research and Publication Ethics	40	10**	50	2	2
20BOTPH11C3	Techniques in Plant Sciences	80	20*	100	4	4
20BOTPH11C4	Advances in Plant Sciences	80	20*	100	4	4
Total Marks/Credits				350		14

Note: The compulsory course on 'Research and Publication Ethics' shall be offered by Ch. Ranbir Singh Institute of Social and Economic Change for all UTDs/Centres/Institutes passed vide Resolution No. 27 of the 271st meeting of EC held on 29.7.2020.

***Internal Assessment:**

Two assignments of 5 marks each

Two presentations of 5 marks each

****Internal Assessment**

One assignment of 5 marks

One presentation of 5 marks

Pass percentage will be 50% in each paper.

Name of the Program	Ph.D. Course work in Botany	**Program Code**	BOTPH
Name of the Course	Research Methodology	**Course Code**	20BOTPH11C1
Hours/Week	4	**Credits**	4
Max. Marks	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along with the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To train the students in formulation of the hypothesis and research objectives.
2. To prepare researchers to design experiment and apply sound methods and tools to conduct their research.
3. To develop a comprehensive knowledge of previous and current research in their field of expertise and be able to demonstrate clearly such knowledge
4. To train researchers to communicate their research clearly and professionally in both written and oral forms
5. To apprise about statistical techniques required in research.

Course Outcomes:

1. Students will be able to identify the research problem and to design their experiments.
2. Students will be able to formulate and test their research hypothesis.
3. Students will be able to use various statistical tools and analyze their data.
4. Students will be able to write their research articles and reports.
5. Students will be able to present their research work at various platforms.

Unit-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;

Unit-II

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, brief idea about government research agencies such as DBT, DST, ICMR, CSIR and UGC.

Unit-III

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; Designing of e-posters; Effective oral scientific communication to specialized audiences, including peer groups, as well as general audiences such as students, the general population and policy makers.

Unit-IV

Statistical applications: Standard deviation, Standard error, Co-efficient of variation, probability distributions: Binomial, Poisson and Normal Distributions (areas method only) include 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.

References:

1. G.R. Basotia and K.K. Sharma (2002) Research Methodology, Mangal Deep Publications, Jaipur (India).
2. C.H. Chaudhary (2009) Research Methodology, RBSA Publication, New Delhi
3. Wayne Goddard & Stuart Melville (2004) Research Methodology: An Introduction, Juta and Company Ltd
4. Ranjit Kumar (2011) Research Methodology, SAGE Publication, New Delhi
5. Kothari, C.R. and Gaurav Garg (2019) Research Methodology: Methods & Techniques, New Age Publication, New Delhi

Name of the Program	Ph.D. Course work in Botany	**Program Code**	BOTPH
Name of the Course	Research and Publication Ethics	**Course Code**	20MPCC1
Hours/Week	2	**Credits**	2
Max. Marks.	40	**Time**	3 Hours
Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)			
Course Objectives:			
Course Outcomes:			
Unit – I			
Unit – II			
Unit – III			
Unit-IV			

Name of the Program	Ph.D. Course work in Botany	**Program Code**	BOTPH
Name of the Course	Techniques in Plant Sciences	**Course Code**	20BOT11C3
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To promote the understanding of various tools & techniques employed in botanical research
2. To expose the students to various biochemical techniques viz. spectroscopy, Crystallography Chromatography and Electrophoresis
3. To expose the students to various molecular techniques viz. PCR, cloning, protein sequencing
4. To train the student to conduct floristic and ethnobotanical research work
5. To familiarize the students about the use of scientific literature databases

Course Outcomes:

1. Students will be able to use GC, HPLC, PCR, FTIR and other instruments for their scientific work.
2. Students will know practical and working knowledge of various laboratory and field botanical methods.
3. Students will be able to collect the plant specimens and identify them with the help of floras and manuals.
4. Students will be able to acquire technical competency and will be able to get employment in different sectors of research and development.
5. Students will be able to use computer programs for preparing & presenting their work

Unit – I

Biochemical Techniques: Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, Crystallography, Structure determination using X-ray diffraction and NMR, Different types of mass spectrometry and surface plasma resonance methods, Gel and affinity chromatography, gas chromatography; High pressure liquid chromatography (HPLC), Fast Protein Liquid Chromatography, Electrophoresis (agarose and page); Isoelectric-focussing (IEF); Ultracentrifugation (Velocity and buoyant density).

Unit – II

Molecular Techniques: Isolation and Purification of DNA from living cells, Plasmid DNAs, Polymerase Chain Reaction for DNA amplification, RT-PCR, cloning PCR, AFLP product after electrophoresis, pulse field electrophoresis for separation of large DNA molecules, Introduction of DNA in to the host cells and selection, Principles & technique of nucleic acid hybridization & cot curve, sequencing of nucleic acid, Southern, Northern, & Western blotting techniques, Protein sequencing, RNA interference, CRISPR.

Unit – III

Techniques in Field Botany: Basic principles and methods of plant collection and identification; Importance of Herbarium and field studies in botanical research; Techniques for survey and assessment of endangered and threatened plant species, Sampling designs and analytical methods for determining ecological status of plant species; Ethnobotanical survey techniques: Designing questionnaire; Conducting different types of interviews; Participatory rural appraisal workshops; Calculation of Informant Consensus Factor and Use Value

Unit – IV

Computer applications: Text document preparation, MS Word, MS-EXCEL, MS-Power Point, Scientific editing tools, Popular image formats. Scientific literature databases: Science direct, google scholar and Pubmed. Primary databases: Gene bank, EMBL, DDBJ, Swiss Prot, PIR and MIPS. Sequence comparison with BLAST, FASTA and CLUSTAL-W; Motif

analysis and presentation with PROSITE and PRINTS.

References:

1. Molecular cloning A Laboratory Manual 3rd edition Vol. 1, 2, 3- Sambrook and Russell, Churchill press, 2007
2. Principals and Techniques of Biochemistry and Molecular Biology, Edited by Keith Wilson and John Walker, Sixth Edition, Cambridge University Press.
3. Brown. T. A. (1995). Gene Cloning an Introduction. (3rd edition).Chapman Hall, 2-6 Bundary Row, U.K.
4. Albuquerque, U.P., Ramos, M.A., Ferreira Júnior, W.S., de Medeiros, P.M. (2017) Ethnobotany for Beginners. Springer International Publishing.
5. S K Jain and Vartika Jain (2017) Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects. Deep Publication, New Delhi
6. Jain, Sudhanshu Kumar (2010). Manual of Ethnobotany. Scientific Publishers, Jodhpur, India.

Name of the Program	Ph.D. Course work in Botany	**Program Code**	BOTPH
Name of the Course	Advances in Plant Sciences	**Course Code**	20BOT11C4
Hours/Week	4	**Credits**	4
Max. Marks.	80	**Time**	3 Hours

Note: The examiner has to set a total of nine questions (two from each unit and one compulsory question consisting of short answer from all units. The candidate has to attempt one question each from each unit along the compulsory question (5 x 16 = 80 marks)

Course Objectives:

1. To ensure that you can achieve an up-to-date level of understanding of plant science
2. To provide sound knowledge with understanding of status and significance of biodiversity
3. To familiarize the students about various concepts and techniques of molecular biology
4. To understand the mechanism of stress tolerance in plants and various approaches for stress protection.
5. To provide an overview of plant nanotechnology viz. synthesis, characterization and application of nanoparticles

Course Outcomes:

1. Students will get in-depth knowledge about the current status of biodiversity, IPR and biopiracy.
2. Students will be able to understanding of genetic engineering, transgenic crops and molecular markers.
3. Students will be able to identify biotic and abiotic stress in plants and assess their physiological effects.
4. Students will be able to use of different protein and molecular markers in stress tolerance mechanism.

Unit – I

Biodiversity Conservation: Introduction to the dynamics of biodiversity; latitudinal and altitudinal gradients of biodiversity; Importance of biological resources for ecological integrity and human welfare; Major threats and conservation strategies for biodiversity conservation; National and international organizations and programmes associated with biodiversity; Indian Biodiversity Act (2002); Biodiversity Management Committees, People's Biodiversity Register; National Biodiversity Strategy and Action Plan; National Mission on Biodiversity and Human Well-Being

Unit – II

Molecular Biology: Kinds of Molecular markers- Proteins markers, Isozyme markers and DNA markers, advantages, disadvantages & applications of molecular markers in the field of molecular biology biotechnology, Relationship among different molecular markers. Cry genes- classification and properties, *Bacillus thuringenesis* endotoxin and their mode of action. Advantages of molecular markers in transgenic crops. Biotechnological approaches for stress tolerance in plants.

Unit – III

Stress Physiology: Plant responses to abiotic and biotic stress at physiological, biochemical and molecular level: drought and flooding, salinity stress, elevated temperature and freezing stress, hypoxia and anoxia, nutrient excess ad deficiency, heavy metals and metalloids, herbivory, insectivory, viral, bacterial and fungal interactions. Stress tolerance mechanism and approaches for stress protection. Physiological Effects and Mechanism of action of brassinosteroids, jasmonates, melatonin, strigolactones and polyamines.

Unit – IV

Nanobiotechnology: Physical and chemical nature of nanoparticles, methods of nanoparticle synthesis and characterization, Nanosupports for enzyme immobilization, methods of immobilization and properties of immobilized enzymes. Applications of immobilized enzyme in agriculture, environment and industry. Nanobiosensors: current status and future prospects. An overview of plant nanotechnology: opportunities as plant

growth stimulators, controlled release delivery vehicles and antimicrobial agents. Nanotoxicological implications.

References:

1. Enzyme Technology by Martin Chaplin and Christopher Bucke (1990) Cambridge University Press.
2. Biocatalysts and Enzyme Technology by Klaus Buchholz , Volker Kasche, Uwe Theo Bornscheuer (2005), 1 edition, Wiley-VCH.
4. Enzyme Technology, edited by Ashok Pandey, Colin Webb and Carlos icardo Soccol (2006), Springer US.
5. Introduction to plant physiology by W.G. Hopkins and NPA Huner, Wiley Int.3rd Ed.
6. Old and Primrose (1984).Principles of gene manipulation. Blackwell
7. Patterson, 1996. Genome mapping in plants, Academic Press.330p
8. Weising, K., H. Nybom, K. Wolff, W. Meyere.1995. DNA Fingerprinting.CRL Press