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U.P-222001



Syllabus of Pre Ph.D. Course Work in Botany for University and Affiliated Colleges

(As Per Guidelines of U.P Government in Accordance with
National Education Policy-2020 with Effect from the session 2022-2023)

Syllabus of Pre Ph.D. course work

Botany

(IN Accordance with the Guidelines of NEP-2020)

Effective from the academic session:2022-2023

Programme Outcomes (POs)

PO1.The Ph.D. course work in Botany is framed to inculcate the research scholars with basic,applied and instrumental knowledge associated with plant science.

PO2.Students will be equipped with background status and innovation in research work and future perspectives of the selected topics of research.

PO3.Students would be taught different aspects about the importance of literature review,accessing scientific databases, laboratory safety and code of conduct with the view of preparing them for taking up research problems.

PO4.Students would be made aware of the research ethics, scientific temper, intellectual property rights and code of conduct for pursuing career in research and development.

PO5.Students would be taught about the different instrumentation techniques, statistical tools and bioinformatics tools, so that they could apply theses in their field of research depending upon their requirements.

Programme specific outcomes (PSOs)

PSO1. Students after completing the six month course will have an elementary knowledge about the different disciplines of the subject.

PSO2.Students will be able to utilize their knowledge of using instruments and other analytical techniques for solving their research problems.

PSO3.Students will be aware of the consequences of deviating from the standard code of conduct in research laboratories, plagiarism, and paraphrasing, ethical aspects and so on.

PSO4.Students will be able to access and extract the desired information from the different scientific databases and resources.

PSO5.Students will be able to read and write good scientific papers.

PSO6.The programme will motivate the students to take up the challenges of the Ph.D course and make them mentally prepare to excel in the respective field of their research work.

PSO7.After completion of the course, students will gain the capacity to serve the various higher academic

institutions like Colleges, Universities, National Research Institutes in various fields of apex academic research.

SUBJECT: Botany Titles and code of the Papers in Pre Ph.D. (Botany)

Course Code	Paper	Paper title	Theory/Research	Credits	Hours	Total marks
B041101T	Paper 1	Tools & Techniques in Plant Sciences	Theory	06	60	100 25(CIE)+75(UE)
B041102T	Paper 2	Advances in Plant Sciences	Theory	06	60	100 25(CIE)+75(UE)
B041103T	Paper 3	Research Methodology & Computer Applications	Theory	04	60	100 25(CIE)+75(UE)
B041104R	Paper4	Research project	Research	-	-	100 25(CIE)+75(UE)

Credit system:

- A four (4) credit theory course/paper will have four Lectures/periods (of one hour) in a week. In one full semester the course will be covered in 60 Lectures.
- Similarly, a six (6) credit theory course/paper will have six Lectures/periods (of one hour) in a week. In one full semester the course will be covered in 90 Lectures.

Continuous Internal Evaluation (CIE) of 25 marks:

- Continuous internal evaluation will be performed by the teacher/ course coordinator concerned.
- CIE shall be 25% of total assessment in a Theory paper and research project.
- 25 marks shall be distributed as 5 marks for attendance, 5 marks for presentation and assignment and remaining 15 marks for class test.

Marking system:

- All papers will have a total maximum mark of 100, including both CIE and University Examination (UE).Maximum marks of 25 will be allotted to CIE and 75 to UE in a theory paper/ research project.
- The CIE of the research project shall be evaluated by the research supervisor and co-supervisor (if any).
- 75 marks of **research project** shall be distributed as 50 marks (project work and presentation) and a viva voce of 25 marks.
- The evaluation (Max Marks 75 UE) of the research project shall be done by internal examiner/s (Supervisor and Co-supervisor (if any)) and one external examiner appointed by the University.

Research Project Submission:

- The evaluated research project report in two sets of hard copy (spiral binding) must be prepared. One copy of it shall be submitted to the university if it demands. A second copy of the evaluated research project report must be in the records of the college/research centre.
- The format of university Ph.D. thesis writing guidelines can be used as format of Research project writing guidelines.

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI
Subject-Botany		
Course Code: B041101T	Course Title: Tools & Techniques in Plant Sciences	
Course Outcomes (COs) CO1: With the help of this course, students will be able to understand separation techniques & electrophoresis . CO2: The student will be able to understand the Microscopy & Microtomy. CO3: The course will enable the students to understand spectroscopic techniques. CO4: With the help of this course, students will be able to learn about Computational biology Techniques and Tools. CO5: After this course, the students will be able to learn how to use techniques of Molecular Biology & Sequencing and Whole genome sequencing.		
Credits: 6	Core Compulsory	
Max. Marks: 25 (CIE) + 75(UE)	Min. Passing marks: 55	
Total number of lectures: Lectures-Tutorial-Practical (4 hours in a week) L-T-P: 4-0-0 (60 hr)		
Unit	Topics	No. of Lecture Hrs.
I	Separation Techniques & Electrophoresis Chromatographic Technique: Paper chromatography, Thin Layer Chromatography	12

	<p>(TLC), High Performance Liquid Chromatography (HPLC), HPTLC, Gas - Liquid chromatography (GLC), Isoelectric Focussing.</p> <p>Electrophoresis: PAGE, SDS PAGE, 1-D and 2-D gel electrophoresis, DIGE (Differential in Gel Electrophoresis). Separation of proteins through electrophoresis. Gel electrophoresis (AGE, 2D etc), ChIP, EMSA, Co-Immunoprecipitation</p> <p>Fabrication, Plagiarism(FFP), Biosafety regulations in biological research and bioethics.</p>	
II	<p>Microscopy & Microtomy</p> <p>Microscopy: Principles of Microscopy, Confocal microscopy, Fluorescence Microscopy, Electron Microscopy, Phase Contrast microscopy; Atomic Force Microscopy, Camera Lucida.</p> <p>Microtomy: Microtomy/Microtome & it types: dehydration, clearing and embedding of material, section cutting, dewaxing. Different types of stains, their preparation and uses: Safranin, fast green, hematoxylin, iodine, cotton blue, crystal violet, ruthenium red, Janus green, Gram's stains, Acetocarmine.</p>	12
III	<p>Spectroscopic Techniques:</p> <p>General principles; Basic laws of light absorption; Types of spectra and their biological usefulness. Principle, application and instrumentation of UV-VIS spectrophotometry; FTIR, Atomic Absorption spectrophotometry; Raman Spectroscopy, MALDI-TOF; GCMS.</p>	12
IV	<p>Bioinformatics</p> <p>Computational biology Techniques and Tools: Techniques and tools for Sequences Alignment (Pairwise and multiple alignment), Phylogenetic analysis- Methods and Tools, gene prediction, ORF finding. Homology: Orthology & paralogy. Databases: NCBI,</p>	12

	EMBL, DDBJ, Gene bank Pubmed; Ensembl, Phytozome etc Online tools - BLAST, ORF finder, Primer3, protein motif and structure prediction tools. Generation and analysis of whole genome data, Whole genome annotation taking examples of major plant genomes.	
V	<p>Techniques of Molecular Biology & Sequencing Whole genome sequencing: Whole genome shotgun sequencing; clone-by-clone or ‘hierarchicalshotgun’ sequencing; pan genomes and metagenome.</p> <p>Next generation Sequencing Technologies: 454 Pyrosequencing, Reversible Terminator Sequencing, Single-Molecule Real-Time (SMRT) Sequencing and Nanopore Sequencing; microbial genomes (including yeast); plant genomes (<i>Arabidopsis</i>, rice). Application of NGS. Genome editing tools ZFN, TALEN and CRISPR, Anti CRISPR; Genome annotation.</p>	12

Suggested Readings:

1. A Biology Guide to Principles and Techniques of Practical Biochemistry. 2000. Wilson, & Goulding, KH. ELBS edition.
2. Cooper Robert and Hausman. The Cell: A Molecular Approach; 2013. Sinauer Associates, Inc.; 6 edition
3. Introduction to Instrumental Analysis. Robert Brown. Mc Graw Hill Internatiuonal Edition.
4. Introduction to Practical Molecular Biology. Dabre, PG. John Wiley & Sons Ltd.
5. Kuby Immunology (sixth edition).2006. Golds, RA. Thomas J. Kintz, Barbara, A. Osborne, Freeman & Co., New York.
6. Microbiological Applications: A Laboratory Manual in General Microbiology. Benson, HJ. WCG; WnC Brown Publishers.
7. Microbiology, a Laboratory Manual. 2013. Cappuccino, JG and Sherman, N. Addison Wesley.

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI
Subject-Botany		
Course Code: B041102T	Course Title: Advances in Plant Sciences	
<p>Course Outcomes (COs)</p> <p>CO1:With the help of this course, students will be able to study of Taxonomy & Nomenclature Taxonomic & Nomenclatural products .</p> <p>CO2: The student will be able to understand Biodiversity & Environment Biodiversity.</p> <p>CO3: The course will enable the students to understand the ecology of plant invasion .</p> <p>CO4: With the help of this course, students will be able to learn about taxonomic advancement in various groups of algae and their molecular phylogeny .</p> <p>CO5: After this course, the students will be able to learn about Fungi & Diseases.</p>		
Credits: 6	Core Compulsory	
Max. Marks: 25 (CIE) + 75(UE)	Min. Passing marks: 55	
Total number of lectures: Lectures-Tutorial-Practical (4 hours in a week) L-T-P: 4-0-0 (60 hr)		
Unit	Topics	No. of Lecture Hrs.
I	<p>Taxonomy & Nomenclature Taxonomic & Nomenclatural products: Botanical Congress and Plant nomenclature; Taxonomic products: Floras, Revisions, Keys, Monographs & synopses, Conspectus. Taxonomic website for: Names & Nomenclature, Literature and Herbarium Specimens. Circumscription of genus & species, Description of new genus & species.</p>	12

II	<p>Biodiversity & Environment Biodiversity: Global environmental change & Biodiversity in India, Valuing biodiversity, Extinction & De-extinction, Vulnerability to extinction, Endemism. RET & IUCN criteria & Subcriteria, Concept of Rarity & NatureServe Conservation status assessment. Hot & cold spots; Biodiversity act.</p>	12
III	<p>Ecology: Ecology of Plant Invasion: Invasion, invasion processes, hypothesis regarding invasion, success of invaders, Species invasiveness, invasive species in India, Management of invasive species, Seed bank studies. Restoration Ecology: Phyto-sociological technique, Concept and strategies of ecological restoration, Ecology of disturbed ecosystems, Degradation and restoration of natural ecosystems. Soil sampling, Physico-chemical characteristics (Soil pH, Moisture, field capacity, bulk density, organic carbon, total nitrogen, available phosphorus, exchangeable Na, K, Ca).</p>	12
IV	<p>Phycology: Taxonomic advancement in various groups of algae and their molecular phylogeny. Features of model organisms from cyanobacteria (<i>Synechocystis</i> sp. PCC 6803, <i>Nostoc</i> sp. PCC7120 and algae (<i>Chlamydomonas reinhardtii</i>). Retrieval of data and their bioinformatic analysis. Metabolic engineering in microalgae: Algal cell as a bio-factory, Concept of transcriptome and metabolome.</p>	12
V	<p>Fungi & Diseases Molecular systematics of Fungi; modern tools for identification. Plant- microbe interactions: molecular basis of plant-fungal, and bacterial pathogen- plant interactions, virulence factor, host resistance and plant immunity; pattern triggered and effector triggered immunity, ISR and SAR. Yeast as a eukaryotic model organism: mutant creation and characterization, yeast vectors, yeast two hybrid system, genetic and physical interactions studies in yeast, SGA analysis, functional genomics and proteomics studies in yeast.</p>	12

Suggested Readings:

1. Chapman, V.J. and Chapman D.J., (1975). The algae. 2nd Edition, Mac. Millan Publ. Inc. New York.

2. Desikachary, T.V., (1959). Cyanophyta. ICAR, New Delhi.
3. Hoek, C. van den, Mann, D. G. and Jahns, H. M., (1995). Algae: An introduction to Phycology. Cambridge University Press, UK.
4. Prescott, G. W., (1969). The algae: A review. Nelson, London.
5. Round, F.E., (1981). The Ecology of Algae. Cambridge University Press, Cambridge.
6. Barry G. Hall. (2007). Phylogenetic Trees Made Easy: A How-To Manual, Third Edition. Sinauer Associates, Inc., Publishers, Sunderland, USA.
7. Christenhusz, M. J. M., Chase, M. W. and Michael F. F. (2017). Plants of the World: An Illustrated Encyclopedia of Vascular Plants. University of Chicago Press.
8. 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 Linnaean Society, 181: 1-20.
9. Cronquist, A. (1968). The Evolution and Classification of Flowering Plants. Houghton Mifflin. Boston.
10. Davis, P.H., & Heywood V. H. (1965). Principles of Angiosperm Taxonomy. Oliver & Boyd. Edinburgh.
11. Hutchinson, J. (1973). The Families of Flowering Plants. 3rd Edition. Oxford University Press. Oxford.
12. Jain, S.K. & Rao R. R. (1977). A Handbook of Field and Herbarium Methods. Today and Tomorrow's Printers and Publishers, New Delhi.
13. Jones, S.B., & Luchsinger, A.E. (1987). Plant Systematics. 2nd Edition. McGraw-Hill Book Company. New York.
14. Alexopoulos, C.J., Mims, C.W. and Blacwell, M., (2007). Introductory Mycology. Fourth Edition, Wiley India Pvt. Limited.
15. Mehrotra, R.S., (2017). Plant Pathology. 3rd Edition, McGraw-Hill Education, New Delhi.
16. Okafor, N. and Okeke, B.C., (2018). Modern Industrial Microbiology and Biotechnology. 2nd Edition, CRC Press, Boca Raton
17. Ethi, I.K. and Walia, S.K., (2018). Text book of Fungi & Their Allies, Second Edition. MacMillan Publishers Pvt. Ltd., Delhi, India
18. Webster, J. and Weber, R., (2007). Introduction to Fungi. Third Edition, Cambridge University Press, Cambridge and New York.

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI
Subject-Botany		
Course Code: B041103T	Course Title: Research Methodology, Research Publication Ethics and Computer Applications	
Course Outcomes (COs)		
<p>CO1:With the help of this course, students will be able to decide the research field, topic, design, and pros and cons of research, sampling, and data collection techniques.</p> <p>CO2: The student will be able to understand the research process and acquire the skill of writing research articles.</p> <p>CO3: The course will enable you to execute the best practices, morals, and ethical values in scientific conduct and avoid publication misconduct.</p> <p>CO4: With the help of this course, students will be able to learn about the standards of journals for good-quality publications of their research work.</p> <p>CO5: After this course, the students will be able to learn how to use computers and different application software for manuscript writing.</p> <p>CO6: This course will enable the students to learn about reference management and the maintenance of academic integrity using scientific tools. They will be familiar with the protection of the machines from computer hazards.</p>		
Credits: 6	Core Compulsory	
Max. Marks: 25 (CIE) + 75(UE)	Min. Passing marks: 55	

Total number of lectures: Lectures-Tutorial-Practical (4 hours in a week) L-T-P: 4-0-0 (60 hr)		
Unit	Topics	No. of Lecture Hrs.
I	<p>Research Methodology</p> <p>Definition, and Objectives, Motivation and Significance of Research, Types of Research, Truth and Facts of Research, Similarity and Contrast in Literary Research and Scientific Research, Research and Criticism, Research Problem and Research Design, Sampling Design and Methods of Data Collection.</p>	12
II	<p>Research standards:</p> <p>Layout of the Research Report, Research Process: subject Selection, Outline of the Research, Review of Literature, Material Collection; Testing and Classification, Analysis, Discussion and Conclusions, Precautions in Writing Synopsis/Research Paper/Thesis/Research Report.</p>	12
III	<p>Philosophy, Ethics, Scientific Conducts and misconducts</p> <p>Moral Philosophy, Nature of Moral Judgments and Reactions, Publication Ethics, Best Practices/Standards Setting Initiatives and Guidelines: Committee on Publication Ethics</p>	08

	(COPE), World Association of Medical Editors (WAME) etc., Intellectual Honesty and Research Integrity: Falsification, Fabrication and Plagiarism (FFP), Open Access Publishing, and Publication Misconduct.	
IV	Databases and Research Metrics Databases: Indexing Databases, Citation Databases: Web of Science, Scopus etc., Research Metrics: Impact Factor of Journal as Per Journal Citation Report, SNIP, SJR, IPP, Cite Score; Metrics: h-Index, g-Index, i-10 Index, and Altimetric.	08
V	Fundamentals of Computers and application Softwares Types Of Computers, Computer Peripherals and internal component, Types of Operating Systems, Web Browser, Web Search Engine, Spreadsheet Processing, Presentation (MS PowerPoints Preparation or Beamer or Libre Office (Optional), Project/Thesis/Report writing, Using MS-Word or LaTeX or LibreOffice documentation style Labelling, References Style, Footnotes etc.	12
VI	Scientific Softwares Use of Reference Management Software Like Mendeley, Zotero, Reference Manager, Endnote, Authorea Etc. Anti-Plagiarism Software Like Turnitin, iAuthenticate, Urkund, Ebooks and	08

	Virtual Library, UGC-Infonet, Computer Hazards and Security	
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Suggested Readings:

1. C.R. Kothari, *Research methodology Methods and Techniques*, 4th Edition, New Age International (P) Ltd. Publisher, 2014.
2. W. Creswell, *Research Design, Qualitative, Quantitative and mixed method approaches*, 3rd Edition, Sage Publications, Inc.
3. D.B. Resnik, (2011) What is ethics in research & Why is it important. National institute of Environmental Health Science, 1-10 Retrieved from <https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm>
4. Indian National Science Academy (INSA), *Ethics in Science Education, Research and Governance* (2019), ISBN:978-81-939482-1-7. https://www.insaindia.res.in/pdf/Ethics_Book.pdf
5. Reema Thareja (2019) *Fundamentals Of Computers* (2nd Edition), Oxford University Press
6. *Microsoft Office 365 : A complete Guide to Master Word, Excel, and PowerPoint 365 for Beginners*, Matt Vic
7. Leslie Lamport, *LaTeX, A Document Preparation System*, 2nd Edition, Addison-Wesley Professional Publisher, July, 1994.
8. Latex tutorials <https://www.tug.org/twg/mactex/tutorials/ltxprimer-1.0.pdf>
9. Libre Office tutorial: www.documentation.libreoffice.org/en/english-documentation

Suggested equivalent online courses: <https://epgp.inflibnet.ac.in/>

Programme: Post graduate diploma in Research (PGDR)	Year: six (6)	Semester: XI
Subject-Botany		
Course Code: B041104R	Course Title: Research Project	
<p>Course Outcomes (COs) -With the help of this course, students will be able to:</p> <p>CO1:how to write review of literature and bibliography.</p> <p>CO2: The student will be able to the different types of indexing of journals.</p> <p>CO3: The course will enable the students to understand basic idea of research.</p> <p>CO4: With the help of this course, students will be able to learn about biostatistical analysis of data.</p> <p>CO5: After this course, the students will be able to learn how to use citation and published their papers in national and international journalals.</p>		
Credits: 6	Core Compulsory	
Max. Marks: 25 (CIE) + 75(UE)	Min. Passing marks: 55	

Suggested readings:

- 1.Internet sources of elsewhere journals.
- 2.lib.gen.res.
- 3.Scopus indexing and ugc care journals.
- 4.science direct.com.