

Syllabus for PhD Entrance Exam

January -2025

DEPARTMENT: BOTANY

Part I – RESEARCH METHODOLOGY

Unit 1 **Fundamentals of Research**:

Introduction to Research- Definition, objectives, and significance of research. Types of research: Basic vs. Applied, Qualitative vs. Quantitative, Exploratory, Descriptive, and Experimental research.

Research process: Steps in the research process, formulating a research problem;

Literature Review- Importance of literature review, sources of literature, Reviewing research articles, systematic literature review, and meta-analysis, Identifying research gaps

Unit 2 Research Design and Sampling :

Research Design- Concept and types of research design: Experimental, Quasiexperimental, Descriptive, and Exploratory;

Variables- Independent, dependent, control, extraneous variables; Hypothesis formulation-Null and alternative hypotheses, characteristics of a good hypothesis.

Sampling Techniques-

Population vs. sample, sampling frame. Probability sampling: Simple random, stratified, cluster sampling. Non-probability sampling: Convenience, judgmental, quota, snowball sampling. Determining sample size.

Unit 3 Data Collection and Measurement :

Data Collection Methods-Primary data: Surveys, interviews, observations, and experiments. Secondary data: Sources, advantages, and limitations. Questionnaire design: Types of questions, scaling techniques (Likert scale, Semantic differential scale).

Measurement and Scaling Techniques-

Types of scales:-Nominal, ordinal, interval, and ratio scales.

Reliability and validity- Concepts, types, and techniques for assessing reliability and validity.

Unit 4 Data Analysis and Interpretation

Statistical Tools for Data Analysis-

Descriptive statistics:- Mean, median, mode, standard deviation, variance. Inferential statistics:- Hypothesis testing (t-test, chi-square test, ANOVA), correlation and regression analysis.

Multivariate analysis:-x Factor analysis, cluster analysis, discriminant analysis. Qualitative Data Analysis:

Content analysis, thematic analysis, narrative analysis, grounded theory. Use of software tools for qualitative analysis. Interpretation of Data and Report Drawing conclusions, implications of findings. Avoiding common errors in data interpretation.

Unit 5 **Ethics in Research and Report Writing:**

Research Ethics-

Ethical issues in research:- Plagiarism, data fabrication, falsification, and informed consent. Institutional Review Boards (IRB) and ethical guidelines. Data privacy and confidentiality.

Report Writing and Presentation:-

Structure of a research report:- Title, abstract, introduction, methodology, results, discussion, conclusion, references.

Citation and referencing styles:- APA, MLA, Chicago, Harvard.

Publishing research:- Peer-reviewed journals, conference papers, and thesis submission guidelines.

References:

- 1. Research Methodology: Methods and Techniques by C.R. Kothari and Gaurav Garg
- 2. Business Research Methods by Donald R. Cooper and Pamela S. Schindler
- 3. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W. Creswell
- 4. Statistics for Research by George Argyrous

Part II - DOMAIN SPECIFIC

Unit 1 **Plant Systematics and Taxonomy:**

Plant Taxonomy-Principles of plant classification; systems of classification (Linnaean, Engler & Prantl, APG system).

Nomenclature: ICBN rules, species concept, and typification.

Molecular Taxonomy- DNA barcoding and phylogenetics.

Recent trends in taxonomy using molecular markers (RAPD, RFLP, AFLP).

Unit 2 **Plant Physiology and Biochemistry:**

Plant Physiology-

Photosynthesis:- Light reactions, Calvin cycle, CAM and C4 pathways.

Respiration: Glycolysis, TCA cycle, electron transport chain.

Plant hormones and growth regulators (Auxins, Gibberellins, Cytokinins, Ethylene, Abscisic acid).

Biochemistry-Structure and function of carbohydrates, proteins, lipids, and nucleic acids.

Enzymes:- Mechanism, kinetics, and regulation.

Secondary metabolites:- Types, biosynthesis, and roles.

Unit 3 Genetics and Plant Breeding:

Mendelian Genetics-

Laws of inheritance, linkage, recombination, and gene mapping, Molecular Genetics: Gene structure and function, transcription, and translation. Mutations and DNA repair mechanisms.

Plant Breeding-

Principles of plant breeding- Hybridization, mutation breeding, and polyploidy, Molecular breeding- Use of genetic markers in crop improvement.

Unit 4 Plant Ecology and Environmental Botany:

Plant Ecology- Ecosystem structure and function, energy flow, biogeochemical cycles. Plant interactions- Competition, allelopathy, symbiosis, and plant-animal interactions.

Environmental Botany- Global environmental issues: Climate change, deforestation, and desertification.

Conservation strategies- In-situ and ex-situ conservation, biodiversity hotspots.

Unit 5 Plant Anatomy and Developmental Biology:

Plant Anatomy- Meristematic tissue, secondary growth, xylem and phloem differentiation. Structure of wood, leaf, root, and stem.

Developmental Biology- Embryogenesis, organogenesis, and morphogenesis. Apical dominance, photoperiodism, and vernalization.

Unit 6 **Plant Pathology:**

Plant Diseases- Classification of plant diseases:- Fungal, bacterial, viral, and nematode diseases, Symptoms, causes, and control measures of major plant diseases.

Disease Management- Integrated Disease Management (IDM), Biological control and use of biopesticides.

Unit 7 Plant Biotechnology:

Techniques in Plant Biotechnology-

Plant tissue culture:- Micropropagation, callus culture, somatic embryogenesis,

Genetic engineering- Gene cloning, CRISPR-Cas9, Agrobacterium-mediated transformation.

Applications of Plant Biotechnology-

Transgenic plants:- GM crops, biofortification, and edible vaccines.

Industrial applications: Production of biofuels, secondary metabolites.

Unit 8 **Economic Botany and Ethnobotany:**

Economic Botany-Importance of plants in agriculture, medicine, and industry, Plants as sources of food, fiber, oil, and medicinal compounds.

Ethnobotany-Role of plants in traditional medicine and cultural practices. Conservation of indigenous plant knowledge.

Unit 9 **Paleobotany and Palynology:**

Paleobotany- Fossil plants, methods of fossilization, and importance of fossil records. Evolutionary history of plants: Major plant fossils, Paleozoic to Cenozoic era.

Palynology- Pollen morphology, applications in plant taxonomy, forensic science, and climate studies.

Unit 10 Plant Molecular Biology and Genomics:

Molecular Biology- DNA replication, RNA processing, gene expression regulation, Signal transduction pathways in plants.

Genomics-Plant genome organization, whole-genome sequencing, and comparative genomics, Functional genomics:-Transcriptomics, proteomics, and metabolomics.

References:

- 1. Plant Physiology by Taiz and Zeiger
- 2. Introduction to Plant Biotechnology by H.S. Chawla
- 3. Plant Systematics by Michael G. Simpson
- 4. Molecular Biology of the Cell by Alberts et al.
- 5. Genetics: Analysis & Principles by Robert Brooker