Savitribai Phule Pune University

(Formerly University of Pune)

Syllabus for M.Phil./Ph.D. (PET) Entrance Exam : Botany

Research Methodology

1) **Foundation of Research:** Meaning, Objectives, Motivation, Utility, Characteristics and Types. Characteristics of scientific methods - understanding the language of research - Concept, Construct, definition, Variable. Scientific Research Process. Steps of research, methods of research, research ethics.

2) **Problem Identification & Formulation:** definition and formulating the research problem, Necessity of defining the problem, Importance of literature review in defining a problem. Literature survey: primary and secondary; web sources; critical literature review. Research Question - Investigation Question - Hypothesis testing - Qualities of a good hypothesis - Null hypothesis & Alternative Hypothesis

3) **Research Design:** Concept and Importance in Research - Features of a good research design - Exploratory Research Design - Concept, Types and uses, Descriptive Research Design - concept, types and uses. Experimental Design - Concept of Independent & Dependent variables. Biased and unbiased research design

4) **Qualitative and Quantitative Research:** Qualitative - Quantitative Research - Concept of measurement, causality, generalization, replication. Merging the two approaches. **Biological data:** Types of data - Qualitative data, Quantitative data

5) **Data Collection and analysis:** Execution of the research - Observation and Collection of data - Methods of data collection, hypothesis-testing - Generalization and Interpretation.

6) **Measurement:** Concept of measurement - what is measured? Problem in measurement in research - Validity and Reliability. Levels of measurement - Nominal, Ordinal, Interval, Ratio.

7) **Sampling, data collection and analysis:** Concept of Statistical population, Sample, Sampling Frame, Sampling Error, Sample size, Non Response. Characteristics of a good sample, sample distribution, Probability and Probability distributions. Determining size of the sample - Practical considerations in sampling and sample size. Data analysis - Univariate analysis (frequency tables, bar charts, pie charts, percentages), Bivariate analysis - Cross tabulations and Chi-square test including testing hypothesis of association including Chi test, correlation and regression analysis.

8) **Interpretation of Data and Paper Writing:** Graphical interpretation of data, Layout of a Research Paper, Journals, Ethical issues related to publishing, Plagiarism and Self-Plagiarism.

9) **Use of tools / techniques for referencing and writing:** methods to search required information effectively, PubMed, effective literature search using Entrez, Google Scholar. Software for paper formating like MSOffice, software for detection of Plagiarism. Basics of internet and e-mailing. Reporting and Thesis writing - Structure and components of scientific reports - Types of report - Technical reports and thesis - Significance - Different steps in the preparation - Layout, Structure and Language of typical reports - Illustrations and tables - Bibliography, referencing and footnotes - Reproduction of published material - citation and acknowledgement - Oral presentation - Planning - Preparation - Practice - Making presentation - Use of visual aids - Importance of effective communication.

10) **Application of results and ethics:** Environmental impacts - Ethical issues - ethical committees - Commercialization - Copy right - royalty - Intellectual property rights and patent law - Falsification and verification.

11) **Reasoning and Mental ability**: Analogy, Logical reasoning and aptitude, Classification, Series, Coding-Decoding, Direction Sense, Representation Through Venn Diagrams, Mathematical Operations, Arithmetical Reasoning, Inserting the Missing Character, Number, Ranking and Time Sequence Test, Eligibility Test**,** Representation through Venn-diagrams, Number & symbols ordering, Comprehension questions, Statement & assumptions, Statement & conclusions, Statement & actions.

Books recommended

1. Research Methodology-C R Kothari
2. Research Methodology: An Introduction-Stuart Melville and Wayne
3. Practical Research Methodology-Catherine Dawson
4. Research Methods for Science Michael P Marder
5. Research Methodology: Principle, Methods and Practices-Joshua O.Miluwi and Hina Rashid
6. Research Methodology: A Step By Step Guide for beginners- Ranjeet Kumar
7. How to Write and publish a Research Paper- Seventh Edition-Robert Day And Barbara Gastle
8. Introduction to Biostatistics and Research Methods- P S S Sunder Rao
9. Research Methodology and Scientific Writings- C George Thomas

References:

1) Garg, B. L.Karadia R. Agrawal, F. and Agrawal U. K., 2002. An Introduction to Research Methodology, RBSA Publishers
2) Kothati C. R.,1990. Research Methodology: Methods And Techniques New Age International 418p.
3) Sinha S. C. and Dhiman A. K., 2002. Research Methodology Ess Ess Publications 2 Columes.
4) Trochim W. M. K., 2005. Research Methods: The Concise Knowledge Base Atomic Dog Publishing. 270P
5) Wadehra B. L., 2000. Law Relating to Patents, Trade Marks, Copyright Design and Geographical Indications, Universal Law Publishing

Additional reading

1) Anthony M. Graziano A. M. And Raulin M. L., 2009. Research Methods: A Process Of Inquiry Allyn And Bacon
2) Carlos C. M., 2000. Intellectual Property Rights The WTO and Developing Countries: The Trips Agreement and Policy Options, Zed Books New Yorks
3) Coley S. M., and Scheinberg C.A., 1990, "Proposal Writing", Sage Publications
4) Fink A., 2009. Conduction Research Literature Reviews: From the Internet to Paper. Sage Publications
5) Leedy, P. D. and Ormrod J. E., 2004 Practical Research: Planning and Design, Prentice Hall
6) Satarkar S. V., 2000. Intellectual Property Rights and Copy Rights Ess Ess Publications
7) Website for guidelines on experimentation animals (Institutional Animal Ethics Committee as per CPCSEA) : http://cpcsea.nic.in
8) Website for guidelines on Indian Biosafety Safety Rules & Regulations : http://dbtbiosafety.nic.in/
9) Website for guidelines on research using human subjects (Institutional Human Ethics Committee as per ICMR) : http://www.icmr.nic.in/ethical_guidelines.pdf

Subject Concerned Syllabus
Botany (M.Phil./Ph.D.)

1. **Systematics:**Aims, objectives and scope of taxonomy, Nomenclature and classification. Taxonomic literature**,** Evolutionary trends and variations, ICN, phylogenetic classifications, APG system of classification, species concepts, speciation, Biosystematics, biosystematic categories, Paleobotany.

2. **Biochemistry:**Structures of Carbohydrates, Lipids, Proteins, Nucleic acid, Enzymes, Enzyme kinetics;Metabolism of carbohydrates, Lipids, Proteins.

3. **Molecular Biology:**Chromosome organization, DNA replication and repair, Chromatin organization, protein synthesis, transcriptional and translational regulation,Protein targeting.

4. **Cell Biology:** Organization of plant cell and chloroplast, mitochondria, Golgi complex, Nucleus, Ribosomes, ER,Cell wall, Cell membrane, vacuoles, cytoskeleton, Totipotency differentiation and cell death,cell cycle, apoptosis, , signal transduction in cells.

5. **Genetics:** Mendelian genetics, concept of gene, Linkage and recombination, genetic mapping, extra chromosomal inheritance, chromosome banding, FISH and GISH , Microbial genetics, phage genetics, linkage and crossing over, recombination, homologous and non-homologous linkage maps, 3 point test cross, tetrad analysis in yeast and *Neurospora*.

6. **Plant Breeding:** Selection – Mass and Pure line selection, hybridisation – Backcross and Test cross, Heterosis breeding, Mutation breeding, role of polyploidy in plant breeding, genetically engineered plants.

7. **Plant Physiology:** Water relations and membrane transport, photosynthesis and respiration, nitrogen metabolism, hormones, Stress physiologyand tolerance mechanisms, strategies used for development of stress resistant / tolerant plants.

8. **Development:** Vegetative and reproductive development in plants, organization of plant structures, Regulation of plant development by intrinsic and extrinsic factors(light, Hormones). Molecular aspects of development.

9. **Ecology:** Ecosystem- structure, types and functions, Ecological succession, habitat, biomes, Biomes, population ecology, plant interactions, phytogeography, endemism, RET species, IUCN categories, Ecological modelling Niche, evolution and co-evolution, Diversity types.

10. **Environmental Biology:** Pollution ecology, Pollution indicator organisms, restoration ecology with reference to plants and microbes, Environmental Impact Assessment, Ecotoxicology, sewage treatment, carbon sequestration. National and International conventions and laws for protection and conservation of biological resources.

11. **Plant Biotechnology:** Plant tissue culture techniques, Micropropagation, cell, tissue andorgan culture, Elicitation and secondary metabolites production. Enzymes in genetic engineering, cloning vectors, *Agrobacterium*mediated gene transfer, characterization of transformants, Gene libraries, DNA sequencing.

12. **Bioprospecting:** Ethnobotany, types of Bioprospecting, Phytochemicals used in aroma, flavour and medicines, plant resources and natural products, Exploration of lower and higher plant forstandardization of herbal medicines as per US-FDA.

13. **Tools and Techniques:** Microtomy, Chromatography, Electrophoresis, Centrifugation, Radioactive techniques, Microscopy, Chromatographic techniques – column, HPLC, GC-MS, Immunological and Electrophoretic techniques, Spectroscopy. Fluorescence and confocal microscopy, SEM and TEM.

14. **Biostatistics and Bioinformatics:** Experimental Design – Completely Randomized Block and Factorial Experimental Design. Analysis of variance, Populations and samples, Graphical representation of data, frequency distribution, central tendency and dispersion, Introduction to databases and retrieving information from databases, Molecular tools in protein and nucleotide sequence analysis.