Savitribai Phule Pune University

(Formerly University of Pune)

Syllabus for Ph.D. (PET) Entrance Exam : Biotechnology

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
Biotechnology

Sr. No.	Name of the course	Topics
1	Biochemistry	Enzymology
		Metabolism
		Bioenergetics
		Thermodynamics
		Macromolecule chemistry
		Stereochemistry
		Plant hormone synthesis pathways
		Biochemical & Biophysical Techniques
2	Cell Biology	Organelles
		Cell cycle and apoptosis
		Cytoskeleton
		Cell Membrane and Signaling
		Differentiation
		Plant cell biology
3.	Molecular Biology	Central Dogma
		Replication
		Transcription
		Translation
		Post Translational Modifications
		DNA damage and repair
		Recombination and transposition

		Genome structure and organization
		Organelle genomes
		Genetic analyses; Cot curve
		Reverse transcription
4	Immunology	Innate & Acquired Immune system
		B cell, T cell ontogeny and trafficking
		Antibody structure and classification
		TCR and BCR gene rearrangement
		Antigen processing and presentation (MHC)
		Complement activation
		Hypersensitivity
		Autoimmunity
		Techniques in cellular Immunology
5	Microbiology	Classification of microbes
		Cellular Structure, growth and propagation
		Nutrition and cellular metabolism
		Antimicrobial agents
		Operon system
		Microbial metabolism
		Biofilm&Quorum sensing
		Plant and animal pathogens
		Multi Drug resistance
		Fungal Biotechnology
		Applied microbiology
		Techniques in Microbiology
6.	Virology	Classification of plant and animal viruses
		Propagation of bacteriophages
		Morphology and ultrastructure of viruses
		Replication of viruses
		Retroviruses
		Viral vectors
		Viral vaccines
7.	Genetics	Mendelian& non mendeliangenetics
		Mutation and chromosomal aberration
		Dosage compensation
		Linkage maps
		Population genetics
		Genotoxicity
		Plant and microbial genetics
8.	Bio-informatics	Introduction to biological databases
		Python , C++ languages
		Homology modelling
		Gene prediction & annotation
		Molecular Docking
		Phylogeny
9	Biostatistics	T-test
		Anova
		Correlation and regression
		Distribution

		Mean, median , mode, standard deviation, error
		Probability
Advanced courses (30%)		
10	Animal Tissue Culture	Establishment of cell lines
		Primary, transformed and non-transformed cells
		Cell-cell ; cell-matrix adhesion
		Adherent and Non adherent culture
		Cell synchronization and separation
		Transfection
		Media constituents
11	Plant Tissue Culture	Callus culture
		Suspension culture
		Protoplast culture
		Organ culture
		Embryo genesis
		Growth and development
		Contaminants and problems
12	Genetic Engineering	Vectors: Expression and cloning strategies
		DNA modifying enzymes
		Restriction endonucleases
		Induction of expression
		Library construction
		Shuttle and Phage vectors
		DNA markers
		miRNAs/siRNAs
13	Genomics and Proteomics	Sequencing
		Microarray
		Human genomics
		Structural genomics
		Functional Genomics
		Protein Technology
		Mass Spectrometry
14	Biochemical and Biophysical Techniques	IR
		NMR
		CD
		Fluorescence/Absorbance Spectroscopy
		Microscopy
		Separation techniques
		Radioactivity