

## **SYLLABUS FOR PhD ENTRANCE EXAMINATION**

### **SCHOOL OF APPLIED SCIENCES (BIOTECHNOLOGY)**

CORE AREAS: Cell biology, Biochemistry, Genetics, Immunology, Animal cell culture, Basic Microbiology, Applied Microbiology, Molecular biology, Plant Tissue culture, Animal sciences, Plant sciences, Analytical Techniques, Environmental biology, IPR, Biostatistics.

#### Molecular & Cell Biology, Biochemistry, Genomics & Bioinformatics

Biomolecules, Metabolism, Membrane transport, Structure and regulation of prokaryotes and eukaryotes genes, post-transcriptional and translational modifications, molecular interaction, phylogenetics, molecular markers, genetic and physical mapping, Gene interaction; Population genetics; cloning and expression vectors, rDNA technology, gene cloning approaches, whole genome sequencing & annotation, high throughput gene expression and function elucidation technologies, PCR, blotting techniques, Gene transfer technologies, protein-protein interactions, Mass spectrophotometry, Signal transduction pathways and their elucidation, primary and secondary metabolic pathways, systems biology frameworks for metabolic engineering, Nanobiotechnology, Genomics and proteomics, Major bioinformatics resources (NCBI, EBI, ExPASy); Sequence and structure databases and analysis Comparative genomics; Molecular modeling and simulations.

#### Analytical Techniques

Chromatographic Techniques - General principles, TLC, column chromatography, HPLC, Adsorption chromatography, Partition chromatography, Ion exchange chromatography, Exclusion chromatography, GLC, Affinity chromatography. Electrophoretic Techniques: General principles, Native gels, SDS-PAGE, IEF, 2D gel electrophoresis, Agarose gel electrophoresis, Pulse field gel electrophoresis, Capillary electrophoresis. Spectroscopic techniques: UV/visible, fluorescence, circular dichroism, NMR, ESR spectroscopy, X-ray diffraction, mass spectrometry. Radiolabeling techniques: Detection and measurement of radioisotopes, molecular imaging of radioactive material, safety guidelines. Microscopic techniques: Light microscopy, scanning and transmission electron microscopy, fluorescent and confocal microscopy.

#### Immunology and Immunotechnology

Innate and adaptive immune system: Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules. Generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity. Immunological techniques: ODD, immunoelectrophoresis, RIA, ELISA, Immunofluorescence, Western blot. Tumor immunology: Neoplasms, tumor-associated antigens, immune response to tumor antigens, immunologic factors favouring tumor growth, immunotherapy.

### Gene Technology

Isolation, purification, analysis of RNA and DNA (genomic and plasmid). Molecular cloning of DNA and RNA fragments in cloning vectors and expression. Construction of genomic and cDNA libraries and screening. DNA sequencing methods, strategies for genome sequencing. Methods for analysis of gene expression at RNA and protein level, micro array, DNA chips. PCR, RFLP, Southern and Northern blotting, AFLP techniques, Real-time PCR. *In-situ* localization, FISH.

### Microbial and Medical Biotechnology

Microbial nutrition, growth and control, Microbial metabolism, Nitrogen fixation, Microbial genetics, Biodiversity, Viruses. infectious diseases, antigen antibody interactions, cancer biology, cell & developmental biology, immunotechnology, antibody engineering, vaccines and the associated manufacturing processes, molecular and immuno diagnostics methods and their applications, cell culture technologies, regenerative medicine & transplantation technology, hypersensitivity and autoimmune diseases, tolerance, animal biotechnology, Genetic engineering in animal cell culture, Animal cell preservation.

### Plant and Industrial Biotechnology, Fermentation Technology & Downstream Processing

Chemical and functional nature of enzymes, enzyme Kinetics and regulations, Process technology for production of primary metabolites, Microbial production of industrial enzymes, Production of secondary metabolites, Operation Batch, Fed-batch, packed bed reactor, Recovery and purification of fermentation products: effluent treatment, principle and large scale instrumentation requirement for downstream processing, Concept of animal and plant cell cultures, Environmental biotechnology, Bioremediation.

Intellectual Property Rights (IPR): IPRs and agricultural technology- implications for India, WTO, WIPO, GATT, TRIPS. Plant Breeder's Rights, legal implications. Ethical issues associated with consumption of GM food, labelling of GM crops and foods.

## Biostatistics

Statistical Methods: Measures of central tendency and dispersion; probability distributions (Binomial, Poisson and normal); Sampling distribution; parametric and non-parametric statistics; Confidence Interval; Errors; Levels of significance; Regression and Correlation; t-test; Analysis of variance and multiple range tests, chi-square test, experimental design, data transformation.

## **PART – B**

### **RESEARCH METHODOLOGY**

**Research and Types of research:** Meaning of Research- Objectives of Research- Motivation in Research. Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Research Process. Criteria of good Research.

**Research Formulation** – Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Literature review – Primary and secondary sources – reviews, treatise, monographs- patents – web as a source – searching the web - Critical literature review – Identifying gap areas from literature review - Development of working hypothesis.

**Data Collection** and analysis: Execution of the research - Observation and Collection of data - Methods of data collection – Modeling, Mathematical Models for research, Sampling Methods- Data processing and Analysis strategies. Data Analysis with Statistical Packages – Hypothesis-testing, Generalization-and-Interpretation.

**Interpretation and report writing** - Techniques of interpretation - Structure and components of scientific reports - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis

## Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. *An introduction to Research Methodology*, RBSA Publishers.
2. Kothari, 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 volumes.
4. Anderson, T. W., An Introduction to Multivariate Statistical Analysis, Wiley Eastern Pvt., Ltd., New Delhi
5. Sinha, S.C. and Dhiman, A.K., 2002. *Research Methodology*, Ess Ess Publications. 2 volumes.
6. Trochim, W.M.K., 2005. *Research Methods: the concise knowledge base*, Atomic Dog Publishing. 270p.
7. Fink, A., 2009. *Conducting Research Literature Reviews: From the Internet to Paper*. Sage Publications

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