

Syllabus fors PhD Entrance Exam

January -2025

Department: Biotechnology

Part I – Research Methodology

- Unit 1 **Foundations of research:** Concepts of research: Definition of research, the need for research. Types of research -purpose driven and method based.
- Unit 2 **Research Methodology:** Selecting and defining a research problem: Criteria for selecting a problem, techniques involved. Research design –Need for Research design, features of a good design, important experimental designs.
- Unit 3 **Research Ethics:** Scientific conduct ethics with respect to science and research, intellectual honesty and research integrity. Scientific misconduct falsification, fabrication and plagiarism.
- Unit 4 **Intellectual Property Rights:** Basics of patents, trademarks, copyrights, industrial designs, geographical indications, and traditional knowledge.
- Unit 5 Scientific communication: Scientific presentations- scientific poster preparation; PowerPoint presentation.
 Types of reports- Abstract, research articles/ thesis. Elements of a scientific paper, Styles for citing references, Impact Factor of Journals.

References:

- 1. Hochberg, M. (2019). An Editor's Guide to Writing and Publishing Science, United Kingdom: Oxford University Press.
- Johnson, S., & Scott, J. (2019). Study and Communication Skills for the Biosciences, 3rd ed., United Kingdom: Oxford University Press.
- 3. Kothari, S. R. (2012). Research Methodology Methods and Techniques, New Age: New Age International (P) Ltd.
- Matthews, J. R., & Matthews, R. W. (2021). Successful Scientific Writing (A Step-by-Step Guide for the Biological and Medical Sciences), 4th ed., United Kingdom: Cambridge University Press.
- 5. Muralidhar, K., Ghosh, A., & Singhvi, A. K. (2019). Ethics in Science Education, Research and Governance, India: Indian National Science Academy (INSA).

Part II – Domain Specific

- Unit 1 **Molecules and their interaction relevant to Biology:** Structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins), Principles of biophysical chemistry (pH, buffer, reaction kinetics, Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, Conformation of proteins and nucleic acids; Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.
- Unit 2 **Cellular Organization:** Membrane structure and function, Structural organization and function of intracellular organelles, Organization of genes and chromosomes, Cell division and cell cycle.
- Unit 3 **Fundamental Processes of Molecular Biology:** DNA replication, repair and recombination, RNA synthesis and processing, Protein synthesis and processing, Control of gene expression at transcription and translation level.
- Unit 4 **Cell communication and cell signalling:** Host parasite interaction, virusinduced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells. Cell signaling Hormones and their receptors, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, Innate and adaptive immune system.
- Unit 5 **Developmental Biology:** Basic concept of plant and animal developmental biology.
- Unit 6 Plant System Physiology Photosynthesis, CO2 fixation-C3, C4 and CAM pathways. B. Respiration and photorespiration; Nitrogen metabolism Nitrate and ammonium assimilation; amino acid biosynthesis; Plant hormones ; Secondary metabolites, Stress physiology Responses of plants to biotic and abiotic stresses.
- Unit 7 Animal System Physiology: Cardiovascular System, Respiratory system, Nervous system, Sense organs, Excretory system, Digestive system, Endocrinology and reproduction
- Unit 8 Environmental Biotechnology: Biodiversity, its threats, and conservation,
 Values and types of Biodiversity. *Conservation: In-situ* and *Ex-situ* Conservation. Pollution of air, water and soil, and the control measures.
- Unit 9 **Food Microbiology and Preservation:** Biochemical changes in food (rancidity, enzymic browning, nutritional changes, flavor changes, Maillard reactions). Mechanism of action of

exotoxins (enterotoxins) and endotoxins. Microbial food poisoning. Natural preservatives, pasteurization, dehydration, canning, irradiation, refrigeration, canning, pickling of food.

Unit 10 Applied Biology: Microbial fermentation and production of small and macro molecules; Application of immunological principles- vaccines, diagnostics. Tissue and cell culture methods for plants and animals; Transgenic animals and plants, molecular approaches to diagnosis and strain identification. Genomics and its application to health and agriculture, including gene therapy; Bioresource and uses of biodiversity. Breeding in plants and animals, including marker – assisted selection; Bioremediation and phytoremediation; Biosensors

References:

- Alberts, B., Hopkin, K., Johnson, A., Morgan, D., Lewis J., Raff M., Roberts, K., & Walter, P., (2019). Essential Cell Biology, International student edition, 5th ed., New York: W. W. Norton & Co.
- 2. Buchanan, B. B., Gruissem, W., & Jones, R. L. (2015). Biochemistry and Molecular Biology of Plants, 2nd ed, United States: Wiley Blackwell.
- 3. De, A. K., (2019). Environmental Chemistry, 9th ed., New Delhi: New Age International Pvt. Limited.
- Freshney, R. I. (2016). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 7th ed., United States:Wiley-Blackwell.
- 5. Lee, B. H. (2015). Fundamentals of Food Biotechnology, 2nd ed., United Kingdom: Wiley- Blackwell Publishers.
- Owen, J., Jenni P. J., & Stranford, S. (2018). Kuby Immunology, 8th ed., New York: W. H. Freeman.
- Stanburry, P. F., Whitaker, A., & Hall, S. (2016). Principles of Fermentation Technology, 2nd ed., United Kingdom: Butterworth Heinemann.
- 8. Tropp, B. E. (2020). Molecular Biology: Genes to Proteins, 5th ed., New York: Jones & Bartlett Learning.
- 9. Voet, D., & Voet, J. G. (2016). Biochemistry, 5th ed., Hoboken, New Jersey: J. Wiley & Sons.
- 10. Wolpert, L. (2011). Developmental Biology: A Very Short Introduction, 1st ed., United Kingdom: Oxford University Press.
