ST ALOYSIUS
(DEEMED TO BE UNIVERSITY)
MANGALURU 575003 - INDIA

Syllabus for PhD Entrance Exam

January -2025

Department: BIOCHEMISTRY

Part I – RESEARCH METHODOLOGY

Unit 1 **Research and Types of Research**

Meaning of Research: Definition, scope, and significance.

Types of Research: Primary, secondary, qualitative, quantitative, basic, applied, fundamental, and empirical research.

Research Problem Identification: Approaches to identify and frame research problems.

Objectives of Research: Formulating objectives and understanding criteria for good research.

Unit 2 **Data Collection and Interpretation**

Sources of Data: Primary and secondary data sources.

Types of Data: Categorical (nominal, ordinal) and numerical (discrete, continuous, ratio, interval).

Data Collection Methods: Surveys, in-depth interviews, focus group discussions (FGDs), observational methods, experimental records.

Sampling and Errors: Sampling techniques, sampling errors, statistical errors.

Statistical Methods and Tools: Central tendency, variation, hypothesis testing (z-test, t-test, F-test, ANOVA, Chi-square), correlation and regression analysis, error estimation.

Statistical Graphics: Histograms, frequency polygons, ogives, dot plots, stem plots, bar graphs, Pareto charts, pie charts, scatterplots, boxplots.

Unit 3 **Scientific Writing**

Project Proposal Preparation: Structuring titles, abstracts, rationales, objectives, methodology, timelines, work plans, budgeting, and referencing.

Scientific Report Components: Structure and significance of technical reports and theses, components of research reports.

Research Metrics: Understanding impact factor, h-index, i10-index, and other parameters.

Unit 4 **Research Ethics**

Ethics in Research: Plagiarism types, ethical misconduct (self-plagiarism, ghost-writing, salami publications, undue benefits), publishing ethics.

Unit 5 **Intellectual Property Rights**

Introduction to IPR: Basics of patents, trademarks, copyrights, industrial designs, geographical indications, and traditional knowledge.

References:

1. Marder M.P. (2011). *Research Methods for Science*. Cambridge University Press.
2. Rosner B. (2010). *Fundamentals of Biostatistics*, 7th Edition. Brooks/Cole Cengage Learning.
3. Dunleavy P. (2003). *Authoring a PhD*. Palgrave Macmillan.
4. Kothari, C. (2017). *Research Methodology: Methods and Techniques*. New Age International.

Part II – DOMAIN SPECIFIC

Unit 1 **Fundamentals of Biochemistry**

Principles of Life: Supramolecular structures, importance of weak noncovalent interactions.

Water and pH: Structure, ionization, acid-base concept, pH, and buffers.

Thermodynamics in Biology: Laws of thermodynamics, ATP and energy coupling, Gibbs free energy in biological systems.

Unit 2 **Biomolecules**

Carbohydrates, Amino Acids, Proteins, Lipids, and Nucleic Acids: Structure, classification, properties, and functions.

Immunoglobulins: Structure, formation, and various forms and functions.

Unit 3 **Enzymology**

Enzyme Kinetics: Basic principles, Michaelis-Menten kinetics.

Catalysis and Regulation: Mechanisms of catalysis, enzyme regulation, and inhibition.

Unit 4 **Metabolic Pathways**

Carbohydrate Metabolism: Glycolysis, Gluconeogenesis, Glycogen metabolism.

Central Energy Pathways: TCA cycle, Oxidative phosphorylation.

Unit 5 **Macromolecule Metabolism**

Amino Acid Metabolism: Pathways and regulatory mechanisms.

Nucleotide and Lipid Metabolism: Synthesis, degradation, and regulation.

Unit 6 **Molecular Biology of Genes**

Genome Organization: Complexity, organization in prokaryotes and eukaryotes, chromatin structure.

DNA Structure and Replication: Semi-conservative replication, DNA polymerases, topoisomerases, ligases, and replication inhibitors.

Unit 7 **Gene Expression and Regulation**

Transcription: Basic principles, stages (initiation, elongation, termination), RNA processing, RNA interference.

Translation: Ribosome structure, genetic code, aminoacyl tRNA synthetases,

translation stages, inhibitors.

Gene Regulation: Mechanisms in prokaryotes and eukaryotes, post-translational modifications.

Unit 8 **Techniques in Biochemistry and Molecular Biology**

Chromatography: Principles and applications of paper, thin-layer, column, gel filtration, ion exchange, affinity, HPLC, FPLC.

Electrophoresis: Techniques including native PAGE, SDS-PAGE, 2D-PAGE, and capillary electrophoresis.

Unit 9 **Analytical Techniques**

Centrifugation: Types, applications, preparative and analytical ultracentrifugation.

Spectroscopy: UV-VIS, fluorescence, FTIR, NMR, ESR, X-ray spectroscopy.

Mass Spectrometry: MS/MS, LC-MS, GC-MS, MALDI-TOF, and applications in biochemistry.

Unit 10 **Immunological and Molecular Techniques**

Immunological Methods: Antibody production, immunoprecipitation, immunoblotting, RIA, ELISA.

Molecular Biology Techniques: PCR, cloning, restriction enzymes, gel electrophoresis, molecular markers, blotting, DNA/protein arrays.

Cell Culture: Plant tissue culture, Animal cell line culture techniques, and cryopreservation.

References:

1. Nelson, D. L., & Cox, M. M. (2020). *Lehninger Principles of Biochemistry*. W.H. Freeman.
2. Wilson, K., & Walker, J. M. (2010). *Principles and Techniques of Biochemistry and Molecular Biology*. Cambridge University Press.
3. Alberts, B. et al. (2019). *Molecular Biology of the Cell*. Garland Science.
4. Goldsby, R. A., Kindt, T. J., & Osborne, B. A. (2013). *Kuby Immunology*. W.H. Freeman.

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