

**VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY, BALLARI****DEPARTMENT OF P.G. STUDIES AND RESEARCH IN BIOTECHNOLOGY****Ph. D Entrance Test Syllabus (2019-2020)****Part A: Research Methodology****Unit-1: Research methods and Foundation of research**

Fundamentals of Research Methodology: Definition and Objectives of Research. Types (Descriptive, Analytical, Applied, Fundamental, Qualitative, Quantitative, Conceptual and Empirical) and Significance of Research. Research Approaches. Research Methods versus Methodology. Criteria of a Good Research. Problems encountered by Researchers in India. Research Problem. Definition of Research Problem. Necessity of defining Research Problem. Techniques involved in Defining a Research Problem. Methods of selecting a Research Problem.

**Unit-2: Experiment design and Statistics**

Research Design: Meaning and Need of Research Design. Important concepts related to Research Design. Features of a Good Design. Different Research Designs. Basic Principles of Experimental Designs. Processing and Analysis of Data; processing operations, problems in processing. Types of analysis, statistics in research, importance of statistical analysis. Measure of relationship- simple regression, multiple correlation and regression analysis. T-test: application of this test. Analysis of variation and co-variations; what is ANOVA, basic principle of ANOVA.

**Unit-3: Biological databases**

Database browsing and Data retrieval, Database mining tools. Sequence database and genome database: GeneBank; EMBL; DDBJ; Swissprot; PIR; MIPS; TIGR; Hovergen; TAIR; PlasmODB; ECDC; Searching for sequence database like FASTA and Blast algorithm. Biological background for sequence analysis; Identification of protein sequence from DNA sequence. Use of CLUSTAL W and CLUSTAL X for the multiple sequence alignment; Phylogenetic analysis, Primer designing and DNA microarray or Biochips

**Unit-4: Ethical issues and Patent filling**

Ethical, legal, social and scientific issues in Biological Research. A brief idea about the funding agencies such as DST, DBT, ICMR, CSIR and UGC. Role of IPR in Research and Development. Types of IP: Patents, Trademarks, Copyright & Related Rights. Patent filing procedures :National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting –disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies

**Part B: Biotechnology (Core subject)****Unit-1: Biomolecules, metabolism and Bioanalytical methods**

Composition, Structure and function of - carbohydrates, lipids, nucleic acids and amino acids. Cellular Metabolism: Anabolic and catabolic pathways of carbohydrates, lipids, amino acids and nucleic acids, Regulatory strategies and integration of metabolism.

Enzyme catalysis: general principles of catalysis; Quantization of enzyme activity and efficiency; Enzyme characterization and Michaelis-Menten kinetics.

Methods of cell disintegration-Enzyme assays and controls; Detergents and membrane proteins; Dialysis, Ultrafiltration and other membrane techniques.

Chromatography: Principle, instrumentation and applications of separation techniques– paper, TLC, Gel filtration, ion exchange, affinity, HPLC, FPLC and GC.

Electrophoresis: Principle and instrumentation- gel, agarose-gel, PAGE, SDS-PAGE, Iso-electric focusing. Immuno-electrophoresis and electroblotting and applications.

Spectroscopy: principle, instrumentation and application of UV-visible, fluorescent, CD, NMR, ESR spectroscopy, Atomic absorption spectroscopy, Plasma emission spectroscopy, X-ray diffraction, Mass spectroscopy.

**Unit-2: Molecular biology, Genetics and Microbiology**

Structure of DNA - A-,B-, Z- and triplex DNA; Replication: initiation, elongation and termination in prokaryotes and eukaryotes; Enzymes and accessory proteins; Fidelity; Replication of single stranded circular DNA; Gene stability and DNA repair- enzymes; Photoreactivation; Nucleotide excision repair; Mismatch correction; SOS repair; Recombination: Homologous and non-homologous; Site specific recombination; Chi sequences in prokaryotes;

Gene targeting; Gene disruption; FLP/FRT and Cre/Lox recombination. Transcription and Translation: Mechanism of Transcription in prokaryotes & Eukaryotes, Processing of RNA Genetic code and translation machinery, Mechanism of translation, Post translational modification of proteins such as phosphorylation, adenylation, acylation and glycosylation. Inhibitors of translation. Types of mutation, Oncogenes and Tumor suppressor genes, Transposition - Transposable genetic elements in prokaryotes and eukaryotes; Mechanisms of transposition; Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins. Microbiology: Soil Microbiology, Food microbiology, Biofertilizers and Dairy microbiology. Bacterial diseases, Fungal diseases and Viral diseases.

### **Unit-3: Cell biology, Immunology and Immunotechnology**

Structure of typical bacterial, plant and animal cells and functions of cell organelles, Mechanism of cell division. Transport processes - active transport, ionophores and ion channels. Exo and endocytosis. Phago and pinocytosis. Structure, organization and types of eukaryotic chromosomes, types of chromosomes, polytene chromosomes and lampbrush chromosomes. Cell cycle – Molecular events including cell cycle check points and Cdk–cyclin complexes and their role in cell cycle regulation. Apoptosis.

Immunology: Antibodies/Immunoglobulins, Complement pathways, Hypersensitivity, Tumor Immunology, Genetic basis of antibody diversity, MHC pathway.

Immunological techniques: ELISA, RIA, Western Blot, Immunoblot and Immuno fluorescent techniques. FACS. Hybridoma technology - production and applications of monoclonal antibodies. Antibody engineering, chimeric antibodies.

### **Unit-4: Plant Biotechnology and Animal Biotechnology**

Plant Biotechnology: Introduction and scope, culture media, Organ culture – types, method and applications; Organogenesis – direct and indirect, Somatic embryogenesis; Androgenesis, significance of homozygous diploids; Protoplast culture and its applications. Cell suspension culture and secondary metabolite production in vitro; Secondary Metabolites: classification, isolation, characterization and pharmacological evaluation. Abiotic and biotic methods of gene transformation; Transgenic plants- Golden Rice, Saline Rice, BT Cotton and BT brinjal. Germplasm conservation- Ex situ & in situ. Cyto-differentiation, Transposons, Plant genome project. Animal Biotechnology - Culture media – Types and Composition, Biology of in vitro cells, Cell separation methods; Scaling-up methods – Physico-chemical parameters, Bioreactors – types, design and applications. Stem cells – Characteristics, Types and Applications; Cell Transformation- characteristics and alterations. Organ Culture – Methods and applications; Assisted Reproductive Techniques, Transgenic Animals- Methods, Types and Applications. Animal Cloning- Technique and Applications.

**Unit-5: rDNA technology, Bioinformatics, Environmental Biotechnology**

Molecular tools; Cloning vectors, Enzymes used in genetic engineering, Molecular cloning methods, screening of r-DNA, DNA/RNA probes, DNA libraries, Polymerase Chain Reaction, Blotting techniques, DNA markers-RAPD, RFLP, AFLP and SNP, DNA fingerprinting and DNA sequencing. Marker assisted breeding, reverse transcription, cDNA library construction. Techniques of gene transfer: transformation, transfection, micro injection, electroporation, lipofection and biolistics. DNA microarray, chromosome walking and jumping. Classification of Biological databases, Biological Sequence Retrieval systems, Pair wise alignment, BLAST and FASTA, multiple sequence alignment and applications. Protein modeling: homology modeling, model refinement, evaluation of the model. Molecular dynamics, simulation methods, drug designing and molecular docking and evaluation. Environmental pollution and monitoring; Bioremediation- Types and importance, Bioventing and Biomineralization. Bioleaching of metals; Biodegradable plastics. IPR: TRIPs and its provisions. Bioethics - International codes and Declarations, Biotechnology and Society – Social, Legal, Economic and Ethical issues. GMOs. Biopiracy, Human genome project.

**Unit-6: Bioprocess, Microbial technology and Nanobiotechnology**

Batch fermentation, feed-batch fermentation – continuous fermentation, Bioreactors – Large scale fermentation system. Down stream processing: Harvesting microbial cells – Membrane filtration system, high speed semi continuous centrifugation – disrupting microbial cells. Microbial metabolites - Organic solvent, Organic acids, Wines and beers, Antibiotics, Vitamins, Amino acids. Production of single cell proteins. Large scale production of proteins from recombinant microorganisms. Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles; Microbial communication system; Quorum sensing; Microbial fuel cells; Prebiotics and Probiotics; Vaccines. Types of nanomaterials and their classifications, Nanocrystal, Nanoparticle, Quantum dot, Quantum Wire and Quantum Well etc. Synthetic methods, Biological Methods of synthesis. Applications of Nano-Materials in Biosystems. Nanomaterial-Cell interactions-Manifestations of Surface Modification, Nanomaterials and Diagnostics/Drug Delivery and Therapeutics, Nanomaterials and Toxicity Evaluation.

**Note:**

1. Ph.D. Entrance test is for 100 Marks (1 mark each) and MCQ type.
2. Research methodology (Part A) carries 40 marks and core subject (Part B) carries 60 marks.