Department of Studies and Research in Biotechnology

Tumkur University, Tumkuru

Syllabus for PhD Entrance Examination

Part A

Research Methodology

Unit 1: Statistics- biostatistics: Methods of sampling, Random sample, sample size, study designs, types of data, measures of central tendency (mean, median and mode), measures of dispersion (range, standard deviation, variance, coefficient of variation, standard error), graphical representation (bar graph, histogram, frequency curve, box plot, etc.), Probability and distribution (Binomial, Poisson and Normal distributions), hypothesis testing, Z test, t- test, Chi-square test, F test, correlation and regression, ANOVA. QC and QA, Handling of Hazardous Materials, Bioentrepreneurship.

Unit 2: Ethics: definition, nature of moral judgements and reactions, Ethics in science and research, Intellectual honesty and research integrity, Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP) Redundant publications: duplicate and overlapping publications, salami slicing, Selective reporting and misrepresentation of data. Publication ethics: definition and importance, best practices/standards setting initiatives and guidelines: COPE, WAME, etc., Conflict of interest, Publication misconduct definition, concept, problems that lead to unethical behavior and vice versa, types, Violation of publication ethics, authorship and contributorship, complaints and appeals, Predatory publishers and journals.

Unit 3: Open access publications and initiatives, SHERPA/ROMEO online resource to check publisher copyright & self-archiving, Software tool to identify predatory publications developed by SPPU, Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc., plagiarism software-Tunitin, Urkund and other open source software tools, Databases And Research Metrics, Indexing databases, Impact Factor of Journal as per Journal Citation Report, Cite Score Metrics: h-index, g index, i10 index, altmetries, References and its formats.

Dr. DWARAKANATH V
ASSOCIATE PROFESSOR & CHAIRMAN
DOS & R in Biotechnology
Tumkur University, Tumakuru

Part B

Cognate subject: Biotechnology

Unit 1: CELL BIOLOGY AND MICROBIOLOGY

Morphology and Ultra structure of prokaryotic and Eukaryotic cell (intracellular organelles). Cell wall chemical composition and characteristics (Gram positive & gram-negative bacteria: lipoproteins, lipopolysaccharides, matrix proteins), cytoplasmic inclusions, endospores (formation and genetics) and Exospores. Membrane Transport (Prokaryotes and Eukaryotes) The composition and architecture of membranes, Membrane dynamics, transport across membranes, biochemical shuttles across mitochondrial membranes, Protein trafficking; cell cycle, regulation of cell cycle.

Introduction, morphology, bacterial genetics: mutation and recombination in bacteria, plasmids, transformation, transduction and conjugation; antimicrobial resistance. Microbial taxonomy and evolution of diversity, classification of microorganisms, classification of bacteria. Classification and general characteristics of algae, fungi, slime molds and protozoa; Community studies on unculturable microbes. viroid's and Prions. Microscopy and its types, microbiological Techniques, Hemocytometer and micrometry. Sterilization methods, nutrition of bacteria, Bacterial growth curve, Staining Techniques: Simple and differential, Preservation of cultures.

Unit 2: BIOCHEMISTRY AND BIOENERGETICS

Law of thermodynamics, Biological oxidation, free energy changes, Entropy, Gibbs free energy, and energy of activation, Composition, structure and function of carbohydrates, lipids, proteins, nucleic acids and vitamins, Metabolism of carbohydrates, proteins, lipids and nucleic acids: Glycolytic Pathway, TCA Cycle, Oxidative Phosphorylation, Photophosphorylation, Electron Transport Chain. Glyoxylate Cycle, Pentose Phosphate Pathway, Gluconeogenesis, Photosynthesis-Photosystems - Light and Dark Phases - C3 and C4 and CAM PathwaysBioluminescence. Fatty acid Metabolism - β - Oxidation of fatty acid. Nomenclature,

Dr. DWARAKANATH V
ASSOCIATE PROFESSOR & CHAIRMAN
DOS & R in Biotechnology
Tumkur University, Tumakuru

classification and properties of enzyme, isolation methods and purifications. Metals and cofactors, Catalytic RNA, Activate substrate, catalytic efficiency, enzyme regulation, allosteric and cooperative interactions. Factors affecting the rate of the reaction, Michaelis-Menton equation and kinetics. Analytical Techniques.

UNIT 3: GENETICS AND MOLECULAR BIOLOGY

DNA and RNA as genetic material, prokaryotic and eukaryotic genome organization, C-value paradox. kinetics of DNA re-association, Gene families, Organization of mitochondrial and chloroplast genomes, Enzymes involved in the replication of DNA and their features, replication of circular and linear DNA, regulation of eukaryotic genome replication, Mutagens and Molecular mechanisms of mutagenesis, Repair mechanisms, recombination, Transposon and rearrangements; prokaryotic and eukaryotic genes, genetic code, transcription, translation and regulation in prokaryotes and eukaryotes. Mendel's Laws, Incomplete dominance, Co-dominance, Penetrance and Expressivity, Pleiotropism, Phenocopy, Epistasis, Multiple Allelism, Pseudo allelism. Inheritance of quantitative traits, Sex determination in Drosophila, Man, Pedigree analysis. X-linked inheritance, Y-linked inheritance, Chromosome morphology, Karyotyping, Autosomal and allosomal disorder,Linkage and crossing over, recombination, Tetrad analysis, Genetic mapping.

Unit 4: GENETIC ENGINEERING AND BIOINFORMATICS

Restriction endonucleases, cloning and expression vectors, cloning and selection of recombinant clones, Genomic and cDNA libraries, jumping genes, Blotting and Hybridization techniques, DNA Sequencing- types, PCR – types and applications, Site directed mutagenesis, RNA interference. Knock out technology, Genome editing technologies. Bioinformatics data and Databases – primary and secondary databases: Basics of sequence alignment; Pair wise alignment algorithms, database searching algorithms (Blast/Fasta), multiple sequence alignment, phylogenetic analysis; Bioinformatics for genome sequencing, genome variation studies,

Dr. DWARAKANATH V
ASSOCIATE PROFESSOR & CHAIRMAN
DOS & R in Biotechnology
Tumkur University, Tumakuru

proteomic research and transcript profiling; Structural Bioinformatics: Medical application of Bioinformatics. IPR , Patent, copyright.

Unit 5: IMMUNOLOGY

Immune system, immunity and its types: Innate and acquired immunity, structure and functions of immune cells. Organs of immune system, Primary and secondary immune response, Structure and types of immunoglobulins, Antigens, Epitopes, Immunogens, Haptens, opsonin's, Clonal selection theory. Hypersensitivity Reactions, immunodiagnostic techniques. Lymphokines, chemokines and cytokines: Interleukins and Interferons, Graft rejection, auto immune disorders, immunodeficiency. Immunological Techniques, Production of antibodies, RID and EID, T-cell cloning. Immunization: Active and passive immunization, recombinant antibodies, vaccines, types of vaccines.

Unit 6: PLANT AND ANIMAL BIOTECHNOLOGY

Sterilization methods, Media preparation, Plant Growth Regulators, Micropropagation & Somatic embryogenesis ,Synthetic seeds, Endosperm culture, meristem, shoot-tip culture; Cell Suspension cultures; protoplast culture, somatic hybridization and cybridization; protoclonal, somaclonal and gametoclonal variation. Cryopreservation, Ti and Ri plasmids; opines and their significance; Agrobacterium-mediated gene delivery, direct gene transfer - PEG-mediated, electroporation, particle bombardment and alternative methods; screenable and selectable markers. Gene constructs for tissue-specific expression. Molecular analysis of transformants. Bt crops & golden crops.

Cell culture techniques: Monolayer and suspension culture, cell lines, organ culture- techniques, Somatic cell fusion and its applications. Primary and immortalized cells, Cell transformation and malignancy. Cell Synchronization and cell cycle Analysis, Gene transformation methods, Immuno-techniques . Applications of Animal Biotechnology: Medicine: diagnosis of diseases, detection of genetic disorders. Treatment: vaccines, gene and cell therapy, tissue transplantations.

Dr. DWARAKANATH V
ASSOCIATE PROFESSOR & CHAIRMAN
DOS & R in Biotechnology
Tumkur University, Tumakuru

Production of pharmaceutical chemicals, interferons, interleukins, stem cell factors and hormones. Industrial applications: metabolites production, bio control agents, industrially important enzymes. Application in virus isolation and in vitro testing of drugs, testing of toxicity, production of viral vaccines and pharmaceutical proteins.Transfection and transformation of cells: Commercial scale production of animal cells, stem cells and their application, storage of animal cells.

Unit 7: ENVIRONMENTAL AND INDUSTRIAL BIOTECHNOLOGY

pollution and its control; pollution indicators; waste management; domestic, industrial, solid and hazardous wastes; strain improvement; Biodiversity and its conservation; Host-pathogen interaction, ecological impact of microbes; symbiosis (Nitrogen fixation and ruminant symbiosis); microbes and nutrient cycles; microbial communication system; bacterial quorum sensing; microbial fuel cells; prebiotics and probiotics. Bioremediation; Role of microorganisms in bioremediation; applications (bio stimulation, bioaugmentation)-examples, bioremediation of metals (Cr, As, Se, Hg), radionuclides (U, Te), organic pollutants (PAHs, PCBs, Pesticides, TNT etc.), technological aspects of bioremediation (in situ, ex situ). Phytoremediation. Biofuels- types and production, modern fuels, microbiologically enhanced oil recovery (MEOR): Bioleaching, bioplastics. solid waste management; Composting; Vermiculture, treatment of municipal and industrial waste Water. Metagenomics, applications, metagenomic library. Isolation, screening and maintenance of industrially important microbes, strain improvement. Fermentation- process and types, Bioreactor- designs and Types, Fermentation media, upstream and downstream process. Principles of food processing, preservation and its types, Application of enzymes in food processing. Fermented food materials.

V. D

Dr. DWARAKANATH V
ASSOCIATE PROFESSOR & CHAIRMAN
DOS & R in Biotechnology
Tumkur University, Tumakuru