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PhD Entrance Syllabus Biotechnology (2018)

PART-A

Research methodology:

Hypothesis and Research Design: Defining, formulating and development of research hypothesis. Testing and development of working hypothesis. Types of research (descriptive, analytical, applied, fundamental, qualitative, conceptual and empirical) and research methods. Importance of literature review in defining a problem. Thrust area and innovation.

Computer Applications in Biological Research: Basics, Programmes (microsoft excel, word, power point) and software (SPSS) used in research. Networking and modelling. Data mining and interpretation by use of computer. Data respository in knowledge bank (Gene Bank, Shodh Ganga, INFLIBNET etc.)

Scientific Presentation and Writing: Structure and components of scientific reports, Types of scientific reports and their preparation, review, paper and thesis writing. Bibliography, referencing and citation for scientific writing.

Biosafety and Good Laboratory Practices: International standards and concepts of biosafety, bio safety levels and biohazards. Chemical and radiological hazards. Removal and disposal of biohazards. Concepts of good laboratory practices, safety related with genetically modified organisms.

Bioinstrumentation and Bioinformatics: Principle, theory and instrumentation: Centrifugation, Chromatography, Spectroscopy (Visible, UV, Fluorescence, Atomic absorption, NMR), Microscopy (simple, compound, phase contrast, confocal, Electron). Basic of computers, MS office tools, Internet and search engines, Sequence alignment tools, Primer designing, Gene analysis and prediction methods. Microbiological techniques: Growth media, types of media, nutrition and growth, control of microbial growth, isolation of pure culture techniques, enumerating bacteria.

PART-B

Cell Biology: Structure and function of cell and cell organelles of prokaryotic and Eukaryotic cells. Visualization of cells and cell organelles using various microscopic technique. Cell signaling: Basics of signal transduction, types of receptors and receptor mediated processes. Cell division: Mitosis and Meiosis, cell cycle regulation, cancer and cell cycle. Protein trafficking, spatial and temporal gene regulation during development.

Biochemistry: Structure and metabolism of biomolecules: Carbohydrates, Proteins, Lipids and Nucleic acids. Enzymology: Classification, Mechanisms of action, inhibition, kinetics. Proteins: Structure, function and folding. Photosynthesis: Light and dark reactions.

Microbiology: Microbial genetics: Structure of gene, Recombination, Horizontal gene transfer: Transformation, Conjugation, Transduction and Transposons. Microbial pathogens: HIV,

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Malaria, Tuberculosis, Antibiotics, Antifungal, Antiviral and Antiprotozoal drugs. Applied Microbiology: Food microbiology, probiotics and industrial microbiology.

Molecular Biology: DNA replication: Prokaryotic and Eukaryotic, DNA repair mechanisms, Transcription, RNA processing and regulation: Prokaryotic and Eukaryotic, Translation: Prokaryotic and eukaryotic, initiation, elongation and termination, regulation, co and post-translational modifications, Gene regulation: Prokaryotic and eukaryotic, epigenetic regulation, posttranscriptional control, RNA interference.

Immunology: Innate Immunity: Properties and components, physical and chemical barriers, cells involved in innate immunity, compliment system, recognition of pathogens. Major histocompatibility complex (MHC): Classification, antigen processing, binding and presentation. Antibody structure, types and functions, T cell receptors (TCR) structure and function, diversity generation of antibodies and TCR, T and B cell activation and maturation, Functions of Helper, Cytotoxic and regulatory T cells, T cell dependent antibody response, Antibody mediated effector functions. Immune regulation: T and B cell tolerance, Autoimmunity: Pathogenesis, genetic factors and role of infection and environment.

Animal Biotechnology: Cell and tissue culture: Equipments, cell culture media, Primary and Secondary culture, isolation of cell lines and characterization, immortalization, viability, cytotoxicity, micromanipulation, synchronization, subculturing, adherent and suspension cultures. Clone isolation and cell sorting. Three dimensional cell culture and tissue engineering. Stem cells: characteristic and isolation. Scale up and application of animal cell cultures.

Genetic Engineering: Tools: Restriction enzymes, DNA modifying enzymes, ligases. DNA sequencing, Vectors: Plasmids, phagemids, cosmids, YAC, BAC etc. Microinjection, Transformation, transduction, transfection, Electroporation. Plasmid vector types and applications. Cloning strategies: Genomic libraries, cDNA libraries, Screening and selection methods. Introduction of plant tissue culture and cell suspension culture, physico-chemical conditions for propagation of plant cells and tissues, composition of media, nutrient and hormone requirement. Single cell culture mechanism. Concept of artificial seeds. Somatic hybridization. Methods for the plant genetic transformation, Particle bombardment method, Mechanism of Agrobacterium mediated gene transformation, Promoters and genetic markers, Methods of molecular analysis of GMO.

Bioprocess Engineering and Technology: Isolation and preservation of industrially important microorgansims, Growth and death kinetics of microorganisms, Media components and design for fermentation, Fermentor/biorectors design and types, Downstream processing: Centrifugation, filtration, precipitation, extraction, crystallization, drying, etc., Enzyme immobilization, Protein engineering, Industrial production of ethanol, citric acid, amino acids, Amino acids, antibiotics, etc. Effluent treatment: Physical, chemical and biological methods, Plant design and economics.

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