DETAILED SYLLABUS FOR THE POST OF ASSISTANT PROFESSOR IN BIOTECHNOLOGY (CAT.NO.: 289/2021)

Total Marks 100

Module 1. Structural Biology (Questions of 3+5+5 Marks = 13 marks)

Biochemistry of Carbohydrates: Classification of Carbohydrates with examples; Detailed study on Polysaccharides - occurrence, structure, isolation, properties and functions of homoglycans- starch, glycogen, cellulose, dextrin, inulin, chitins, xylans, arabinans, galactans. Occurrence, structure, properties, and functions of heteroglycans – bacterial cell wall polysaccharides, glycoaminoglycans, agar, alginic acid, pectins, amino sugars and deoxv sugars, blood group substances and sialic acids. Glycoprotein and their biological applications. Lectins structure and functions.

Biochemistry of Lipids: Classification -saturated and unsaturated fatty acids, phospholipids -classification, structure and functions. Ceramides and sphingomyelins. Eicosanoids, structure and functions of prostaglandins, thromboxanes, leukotrienes Types and functions of plasma lipoproteins. Amphipathic lipids -membranes, micelles, emulsions and liposomes. Steroids -cholesterol structure and biological role -bile acids, bile salts. Sterols in Plant system: Phytohormones: Brassinosterroids (functions); Sterols in microbial system: mycosterols

Protein structure and function: Classification of proteins on the basis of solubility and shape, structure, and biological functions. Isolation, fractionation and purification of proteins. Denaturation and renaturation of proteins. Primary structure -determination of amino acid sequence of proteins. Detailed study onstructure and function with an example: Membrane protein (ATP synthase), Fibrous Protein (Collagen) Globular protein (Hemoglobin)

Nucleic Acid Structure: Watson -Crick model of DNA structure. A, B and Z DNA Cruciform structure in DNA, miscellaneous alternative conformation of DNA, Methods for nucleic acid sequence determination, isolation and purification of DNA, molecular hybridization, Cot value curve, ; Organization of the DNA Sequence: Genes, pseudogenes, extragenic regions (beta globin gene and gene family) duplicated genes; Reassociation kinetics, Repetitive DNA sequences: Tandem repeats (Satellites, minisatellites, and microsatellites), Interspersed repeats (LINE, SINEs) Single copy genes; RNA Structure: Types of RNA; structure of mRNA, tRNA and rRNA ,Si RNA, micro RNA with emphasis on importance of structure to its function

Biophysics: Laws of thermodynamics, enthalpy, entropy and free energy, thermodynamic equilibrium. Redox reactions, Redox potential and its calculation by Nernst equation, examples of redox reactions in biological system. Biological importance or redox reactions. Principle and biological importance of physical phenomena- osmosis, osmotic pressure, osmotic equilibrium diffusion, Fick's law, sedimentation, filtration, surface tension, dialysis, adsorption, Colloids- classification, properties and importances of colloids, Osmosis, Osmotic pressure, Osmotic equilibrium, Donnan equilibrium, Electroosmosis

DNA- protein interaction and RNA- protein interactions:. DNA-binding proteins: prokaryotic transcription factors, Helix-turn-Helix motif in DNA binding, Trp repressor, Eukaryotic transcription factors, Zn fingers, helix-turn helix motifs in homeodomain, Leucine zippers. Electromagnetic spectrum Ionizing and nonionizing radiation. Properties and biological effects of ultraviolet radiation, lasers, microwave radiations and ultrasonic waves. Radioactivity, Interaction of radiation with matter. Units of Radiation. Biological effects of radiation. Applications of ionizing and non-ionising

radiations in industry, agriculture and research. Radiation Hazards. Introduction to proteomics and Bioinformatics

Module 2. Microbiology and Immunology (Questions of 8 Marks = 8 Marks)

Microbial Diversity: Morphology and structure of bacteria. Surface structures and inclusions of bacteria; Viruses unique properties, morphology, structure and cultivation; Viroids and Prions.Viral replication.Viral diversity–bacterial, plant and animal viruses; Fungi - properties and classification. Microorganism in extreme environments. Microbial photosynthesis. Biosynthesis of cell wall

Microbial physiology: Factors influencing microbial growth. Environmental and nutritional factors. Nutritional types of bacteria. Microbial growth curve. Mathematical expression of growth- continuous and batch cultures. Diauxic and synchronous growth. Measurement of bacterial growth.Cultivation of bacteria- culture media and methods. . Aerobic and Anaerobic culture methods. Culture preservation techniques and Culture collection centers.. Microbial locomotion – flagellar motility, gliding motility and amoeboid motion. Chemotaxis, Phototaxis and other taxes.

Identification of bacteria and Sterilisation methods: Identification of bacteria. Staining reactions. Cultural, physiological and biochemical properties. Molecular methods for identification. Sterilisation – Principles and methods, physical and chemical methods. Disinfectants – modes of action. Testing of disinfectants. Antibiotics – mechanism of action. Drug resistance in bacteria. Antibiotic sensitivity tests

Immunology: Infection, Source and methods of transmission, Immunity, Types of immunity. Mechanisms of innate immunity, pattern recognition receptors, types, scavenger receptors and toll – like receptors, Phagocytes and Phagocytosis, Organs and cells with immune functions. Lymphocytes and lymphocyte maturation.Antigens, Epitopes and paratopes, B-cell and T-cell epitope, Antigenicity and Immunogenicity, Antibodies, Immunoglobulin – structure, classes and functions. Genetic basis of antibody diversity, Organization and Expression of Immunoglobulin Genes, V(D)J rearrangements; recombination signal sequences and their role, somatic hypermutation and affinity maturation Antigen-antibody reactions, Agglutination, Precipitation, Immunoflourescence, Complement fixation, Radioimmuno assay, ELISA, Western blotting

Immune response: Humoral and cell mediated, Receptors on T and B cells for antigens, MHC, TCR-mediated signaling, Signal transduction pathways associated with T-cell activation, Signal transduction by activated B- cell receptor, Antibody production, Primary and secondary immune modulation, Factors influencing antibody production, Clonal selection theory, Monoclonal antibodies – production and application, Antibody engineering. Complement system, Complement activation, Biological effects of complements, Antigen processing and presentation, Activation of T-cells, T-cell function, Cytokines.

Immunology of organ and tissue transplantation: Allograft reaction and GVH reaction, Factors influencing allograft survival, Immunology of malignancy, Tumor antigens, Immune response in malignancy, Immunotherapy of cancer, Immunohematology, ABO and Rh blood group system, Immunology of blood transfusion, Hemolytic disease of new born,Immunological Tolerance, Autoimmunity, Mechanisms of autoimmunization, Autoimmune diseases. Inflammation, Hypersensitivity – immediate and delayed reactions, Clinical types of hypersensitivity, Immunodeficiency diseases, Immunoprophylaxis, Vaccines –types of vaccines, DNA vaccine, recent trends in vaccine development

Module 3. Cellular organization, Genetics and cellular Processes

(Questions of 3+5+5 marks = 13marks)

Cell and its constituents: Cell constituents - Mitochondria , Chloroplast, Endoplasmic Reticulum Golgi complex, Peroxisomes, Lysosome, Ribosome, Nucleus, Nucleolus, Chromosomes, Nucleosomes, Histones, Genome, Genomics ,Proteomics.

Genetics: Genetics, the evolution of the subject through pre mendelian, Mendelian and post Mendelian Peroids. Mendelism – the basis principles of inheritance, gene interactions – allelic and no allelic. Environment and gene expression, penetrance and expressivity. Multiple alleles and polygenic inheritance, Heritability and genetic advance

Chromosome genetic mapping ,Organelle Genetics and Population Genetics: Linkage and linked genes with special reference to inheritance, Chromosome mapping with three - point test crosses. Organelle Genetics and cytoplasmic inheritance. Population Genetics – types of gene variations, Measuring genetic variations, Hardy Weinberg principle and its deviations. Medical genetics - an introduction

Genetic System in Microbe, Yeast and Neurospora: Plasmids & bacterial sex. Types of plasmids. Plasmids copy number and incompatibility, Replication of plasmid. Plasmid a cloning vector. Episomes. Transposable element-IS element and transposon, Integrons and Antibiotic resistance cassettes, Multiple antibiotic resistant bacteria, Mu-virus. Gene mapping in Bacteria. Bacteriophage genetics-Plaque formation & phage mutants, genetic recombination in lytic cycle. Genetic system in Yeast & Neurospora.

Cell cycle: Different stages, variations, checkpoints, regulations of cell cycle, maturation Promoting factor, cells, cyclins , ubiquitin, protein ligases, Anaphase Promoting complex, inhibitors of CdK, growth factors and D cyclins. Rb protein and E2F transcription factors.

Cancer: - Stages in cancer development, causes, properties of cancerous cells, tumor Viruses, oncogenes, functions of oncogene products, oncogene and signal Transduction , oncogene and G proteins, oncogene and cell survival, Tumor Suppressor gene, functions of tumor suppressor gene products, Diagnosis ,prevention and treatment of cancer

Cell Differentiation: Stages of development, regulation of development, cascade control/ Differentiation in Drosophila, maternal, Segmentation and homeotic Genes, Genetic control of embryonic development, Bi thorax mutant, Antennapediac mutant ,Hemeobox

Aging: Process of aging, theories of aging, Arking's contribution Oxidative stress, Telomere problem, DNA repair defects.

Cell Death: Necrosis and Apoptosis, Differences between necrosis and Apoptosis, stages in Apoptosis, mitochondrial damage DNA ladders, transglutaminase activity, programmed cell death in *Ceanorhabdtis elegans* CED 3, CED 4, CED 9 and their roles in Apoptosis Bax, Bid, Bcl2 protein

DNA Replication : Process of DNA replication, Semiconservative, discontinuous uni and bidirectional , Okazaki fragments, DNA polymerases in eukaryotes and prokaryotes , Klenov fragment, modes of replication, theta, rolling circle, d-loop replication, Primasome, SSB, Helicase, Ligase, methylation and control, repetitive DNA sequences, minisatellite, microsatellite, DNA protein interation DNA Linking number and topoisomerase, Inhibition of replication.

Transcription: Process of transcription, stages in transcription, RNA polymerases in prokaryotes and enkaryotes, sigmafactor in prokaryotes, Rho dependant and Rho independent termination. Enhancers, Transcription factors in Eukaryotes, Differences in transcription between prokaryotes and Eukaryotes, post transcriptional modifications-Polyadenylation, capping, r-RNA processing, Splicing-Spliceosome, lariat structure, Group 1, II and III Introns Rihozyme, Importance of ribozyme, properties, application,

RNase P, RNAse III, RNAse H. monocistonic and polysistronic m-RNA, Joint transcript of r-RNA and t-RNA in prokaryotes and their processing, Transplicing, alternate splicing, inhibitors of Transcription.

Molecular mechanism of gene regulation in prokaryotes : Transcriptional regulation in prokaryotes; Inducible & repressible system,+ & -ve regulation; Operon concept, structure of operon, Lac, Trp, Arc operon, Catabolic repression, Atteunation. Role of Hormones in gene regulation.

RNA World: RNA based technology- Molecular mechanism of Ribozyme, Antisense RNA, SiRNA, MicroRNA, Ribozwitches & their applications; Telomerase structure and function .Nucleic acid as therapeutic agent

Translation: Process of translation. Stages in translation, genetic code, properties, wobble hypothesis, eukaryotes and prokaryotes ribosomes, m-RNAs, t-RNAs, aminoacyl t-RNA synthatases, protein factors initiation complex, peptidyl transferase, releasing factors, differences between prokaryotic and eukaryotic systems, inhibition of translation. Post translation modification by cleavage, self-assembly assisted self-assembly chaperones, acylation, phosphorylation, acetylation and glycosylation, Histone acetylation and deacetylases, chromosome remodeling complex. Intein splicing. Protein targeting, cotranslational import, post translational import, SRP- structure and function, Blobel's concept, Lysosome targeting, M6P address Glycosylation core glycosylation terminal glycosylation, Dolichol phosphate.

Module 4. Bioinstrumentation and Biostatistics

(Questions of 5+3 marks = 8marks)

Spectroscopic techniques: Principle, Instrument Design, methods and Applications of UV-Visible spectroscopy, Infrared spectroscopy, Raman Spectra, Fluorescence spectra, Nuclear magnetic Resonance Spectroscopy.

Hydrodynamic techniques: Principle, Instrument Design, methods and Applications of all types of Adsorption and Partition Chromatography- Paper chromatography, Thin layer chromatography, Gel filtration chromatography, Affinity chromatography, Ion-exchange chromatography and HPLC. Reversed phase chromatography, hydrophobic interaction chromatography, chiral chromatography, counter current chromatography, Fast protein liquid chromatography, tw dimensional chromatography, Centrifugation – Principle, methods and application, Ultra centrifugation, Viscometry

Electro analytical techniques & Optical techniques: Principle, Instrument Design, methods and Applications of Free and zone Electrophoresis – Paper electrophoresis, Gel electrophoresis, Poly Acrylamide gel electrophoresis, SDS PAGE, Capillary electrophoresis, Isoelectric focusing, Potentiometry, pH meter, conductometry. Principle, Instrument Design, methods and Applications of Polarimetry, ORD, CD, Light scattering, Refractometry, Flowcytometry, Cytometry

Microscopic techniques: Principle and working of Compound microscope, Phase contrast microscope, Interference microscope, Fluorescence microscope, polarizing microscope, Scanning and Transmission Electron Microscopy, CCD camera, Introduction to Atomic force microscopy, Confocal microscopy

Introduction to Biostatistics: Scope of Biostatistics, probability and probability distribution analysis. Variables in biology- collection, classification and tabulation of data- graphical and diagrammatic representation- scatter diagrams, histograms- frequency polygon- frequency curve-logarithmic curves. Descriptive statistics- measures of central tendency, Arithmetic mean, median, mode, geometric mean, harmonic mean. Measures of dispersion, standard deviation, standard error, variance, coefficient of variation. Correlation and Regression

Test of significance: Basic idea of significance test- hypothesis testing, levels of significance. Testing of single mean, double mean, single proportion, double proportion in large sample. Testing of single mean, double mean and Paired- t in small sample. ANOVA- One way and Two way; Chi-square test of

goodness of fit and Chi-square test of independence, comparison of means of two samples, three or more samples. Fundamentals of field experiments- randomization, replication and local control. CRD and RBD. Statistical packages

Module 5. Recombinant DNA Technology (Questions of 5+5 marks =10marks)

Introduction to transgenic technology: Enzymes for *in vitro* DNA manipulation – site specific recombinases, thermophilic polymerases, topoisomerases – specialized uses. Advanced vector systems for E. coli – vector S.S DNA production, Expression vectors, vectors amenable for protein purification and export. Shuttle vectors with special emphasis on GateWay ® system. Vectors with combination features and artificial chromosomes and their usefulness.

Vectors: Vectors for bacteria other than E. coli, vectors for yeast and other fungi, Vectors for animal cell lines and animals. Genetic manipulation of animals – techniques usefulness and ethics of gene transfer with special emphasis on gene transfer to mice, chicken, frog and *Drosophila* Maximising protein expression in Bacteria, fungi and animal cells – Promoters, markers and reporter systems.

Inducible expression system: Control of transgene expression through naturally inducible promoters – lac and tet. Steroid hormones as heterologous inducers. Chemically induced dimerisaion (CID) as inducible transgene regulation. Site specific recombination for efficient gene targeting. Gene inactivation by methods other than gene knock out – Anti sense RNA, Ribozymes, Co suppression, RNA interference, Gene inhibition at protein level, Site directed mutagenesis

Applications of recombinant DNA technology: Applications of recombinant DNA technology, Nuclear transfer technology and animal Pharming- Production of Therapeutic proteins, Metabolic engineering, Animal models for human diseases, gene medicine, DNA vaccines and gene therapy. Genome Editing- CRISPR Cas 9, TALENS, ZFN and NHEJ for targeted knock ins and knock outs. Bio-safety and Ethics of gene transfer

Module 6. Bioprocess and Enzyme Technology

(Questions of 5+5 marks =10marks)

Isolation. Screening. Selection and Identification: Isolation of Industrially important microorganism, various methodologies of Isolation Screening. Primary and secondary screening methods. Identification of the organism. Improvement of the industrially important organism, methods of improvement. Preservation and maintenance. Industrially important microorganisms and their products.

Microbial growth and growth kinetics: Batch culture, specific growth rate, substrate saturation constant, yield coefficient, Monod kinetics, substrate affinity, Continuous culture, Dilution rate, Washing out, Fed batch culture maintenance coefficient, Product yield, growth depended products non growth linked products. industrial sterilization, Direct, indirect methods, Death Kinetics

Bioreactor and its control: Bioreactor Parts, function of each part, probes, values, agitators aerators, baffles, Types of bioreactors, Reactor performance, oxygen transfer in reactor system , Resistances against oxygen transfer, KLa, methods to estimate KLa. Heat transfer in Bioreactor systems. Overall heat transfer coefficient. Heat exchangers,Instrumentation of bioreactor online and offline control. pH probe, temperature probe, DO probe, Tacchometer, Load cells Control of Bioreactor, Types of control, Feed forward control, cascade control, adaptive control, complex control systems, PID control systems. Computer application on the control of Bioreactor

Fermentative production: Primary metabolites, secondary metabolites. Fermentative production of alcohol, acetone butanol, citric acid, acetic acid, lactic acid, amino acids, vitamins. Antibiotics-penicillin, streptomycin, cephalosporin, tetracycline. Microbial production of enzymes-amylase, protease, cellulose, pectinase, SCP production. Bread manufacturing, beer manufacturing, Cheese manufacturing, rennet preparation, fermented dairy products and production of distilled beverages

Enzyme Biotechnology: Enzyme structure, Classification of enzymes,.mechanism of enzymatic action Enzyme kinetics, Estimation of enzyme activity, enzyme assays. specific activity, Isolation and purification of enzymes, Allosteric enzyme, Characterization of enzymes, Application of enzymes in bioprocess-application of lactase in diary industry, use of proteases in food, leather and detergent industry. Diagnostic and therapeutic enzymes

Module 7.Agricultural Biotechnology (Questions of 5+5 marks = 10 marks)

Plant Breeding: Introduction to Conventional plant breeding principles and applications mutation breeding polyploidy and distant hybridisation in plant breeding male sterility and incompatibility mechanisms in plants.

Plant Tissue culture: Tissue culture as a technique to produce novel plants and hybrids. Tissue culture media (Composition and Preparation). Sterilization and agents of sterilization used in tissue culture labs. Initiation and maintenance of callus and suspension cultures; Single cell clones. Organogenesis; Somatic embryogenesis; Transfer and establishment of whole plants in soil. Shoot tip culture; Rapid clonal propagation and production of virus-free plants. Embryo culture and embryo rescue

Methods of invitro culture: Protoplast isolation, culture and fusion; Selection of hybrid cells and regeneration of hybrid plants; Symmetric and asymmetric hybrids, cybrids. Anther, pollen and ovary culture for production of haploid plants and homozygous lines. Somaclonal variation. In vitro mutation – Sexual incompatibility and male sterility. Cryopreservation; Slow growth and DNA banking for germplasm conservation

Plant transformation technology : Basis of tumour formation; Hairy root; Features of Ti and Ri plasmids; Mechanisms of DNA transfer; Role of virulence genes; Use of Ti andRi as vectors; Binary vectors; Use of 35S and other promoters; Genetic markers; Use ofreporter genes; Reporter gene with introns; Use of scaffold attachment regions; Methods of nuclear transformation; Viral vectors and their applications; Multiple gene transfers; Vector-less or direct DNA transfer; Particle bombardment, electroporation, microinjection; Transformation of monocots; Transgene stability and gene silencing

Application of plant transformation : Plant transformations for for productivity and performance Herbicide resistance, insect resistance, Bt genes, Non Bt like protease inhibitors, alpha amylase inhibitor, coat protein mediated viral disease resistance, disease resistance through RIP, antifungal proteins, thionins, PR proteins, nematode resistance, abiotic stress resistance Molecular marker aided breeding –an introduction. Chloroplast transformation – Advantages, Vectors, Success with tobacco and potato. Metabolic engineering for industrial products, Plant secondary metabolites, Control mechanisms and manipulation of phenyl propanoid pathway and shikimate pathway

Module 8.Medical Biotechnology (questions of 5+5 marks = 10 marks)

Animal cell Culture ; History of animal cell culture; Laboratory setup and equipments; Types of cell culture media; Ingredients of media; Physiochemical properties;Co2 & bicarbonate;Buffering; Oxygen;Osmolarity; Temperature ;Surface tension and foaming; Balance salt solution; Antibiotic; Growth supplements;Foetal bovine serum; Serum free media;Trypsin; Selection of media & serum; Conditioned media; Other cell culture reagents; Cell culture vessels; Preparation &sterilization of cell culture media, serum and other reagents

Different tissue culture techniques; Disaggregation of tissue and primary culture; Types of primary culture; Chicken embryo fibroblast culture; Chicken liver &kidney culture; Secondary culture; Trypsinization; cell separation; Continuous cell lines; Passaging number; Anchorage & Anchorage independent cells and cultures; Suspension culture; Organ culture and Histotypic cultures; Embrionic and Adult stem cell culture. Behavior and nature of cells in culture and Preservation

Division and Growth patterns; Measurement of viability & cytotoxicity; Charecterization of cultured cell; Cell cloning and selection; Cell synchronization; Transfection and Transformation of cell; Maintenance of cell Lines Cryopreservation&Germplasm storage;Common cell culture contaminants

Commercial scale production of animal cells : Stem cells & their applications; Application of animal cell culture for invitro testing of drugs and testing of toxicity of environmental pollutants; Application of cell culture technology in production of human and animal vaccines and pharmaceutical proteins. Hybridoma technology and its application; Three dimensional culture and tissue engineering

Cell culture reactors; Scale up in suspension; Mixing and aeration; Rotating chambers; Perfused suspension cultures; Fluidized bed reactors for suspension cultures.Scale up in monolayers; Multisurface propagators; Multiarray disks, spirals, and tubes; Roller culture; Micro carriers; Perfuse monolayer cultures; Membrane perfusion; Hollow fiber perfusion; Matrix perfusion. Immobilized cell culture

Module 9.Environmental Biotechnology (questions of 5+5 marks =10 marks)

Industrial pollution causes, problems: Air, Soil and Water pollutants, Types of pollutants characterization, Persistence and Biomagnification of Xenobiotics, recalcitrant molecules, nitroaromatic polychlorinated, biphenyls and dioxans, synthetic polymers, alkylbenzyl sulphonates, Hydrocarbons, Pesticides, Phenolics, Anilines, Inorganic pollutants, Heavy metals. Detection and Quantification of pollutants. Environmental laws

Biodegradation, Process and application: Microbial infallibility, types of biodegradation, factors affecting biodegradation, enzymes involved in biodegradation, catabolic plasmids, Molecular Approaches, Biogeochemical cycles, Bioleaching. Biodegradation of Hydrocarbons, cellulose, lignin, Phenoland pesticides. Application of TOC, FT/IR, GC-MS analysis in biodegradation studies

Industrial wastewater: Types of industrial effluents, characterization of the wastewater. Chemical Oxygen Demand, Biological Oxygen Demand, Total organic carbon, Nitrogen contents, Suspended solids. Total heterotrophic bacterial population. Bacteriological analysis of drinking water, Presumptive, completed, and confirmed test. Treatment strategies primary, Secondary and tertiary treatment Physical, Chemical and Biological treatment. Floc based and film based strategies, aerobic and anaerobic methods

Biological treatment of industrial wastewater: Activated sludge process, different stages, Types. Oxic/Anoxic, Extended aeration methods, Nitrification and denitrification. Trickling filter process, Different stages Types, Biofilm applications, Rotating Biological contactor,UASB, Submerged aerobic filters, Fluidized Bed Reactor, Packed bed reactor, Oxidation lagoons. Bioreactors for wastewater treatment. Advanced treatment strategies Teritiary treatment methods, Disinfection, Chlorination, Chlorination dosage chlorination derived byproducts

Solid waste management: Solid waste, Types, Problems, Characterization and sorting of wastes. Municipal and industrial waste management, Land fills composting, stages in composting, Types of composting vermicomposting. Methanogenesis, stages in anaerobic digestion, methanogens Anaerobic reactors Biogas generation, Household treatment strategies, Present problem and Possible remedies

Module 10.Bioinformatics, IPR and Patents (Questions of 8 Marks = 8marks)

Bioinformatics Concept of sequence alignment, scoring matrices, Alignment algorithms ,BLAST and FASTA programs, Multiple sequence alignment, Concept of molecular phylogeny, Types of trees, Distance based methods, Character based methods, Boot strapping ,Tree viewing software. Biological databases, Nucleic acid databases, Protein databases

Applications of Bioinformatics Application of bioinformatics in target identification and validation, binding site prediction, Structure based and ligand-based approaches, Molecular docking algorithms, Genomic data science, Galaxy, tools available to utilize genomic data, alignment and functional annotation

IPR TRIPS Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret, copyright and Geographical indications Requirement of patentability, Biotechnological examples of patents, trademark, trade secret and copy right

Patents Patent filing and Infringement Patent application- forms and guidelines, fee structure, time frames; Types of patent applications: provisional and complete specifications; PCT and convention patent applications; International patenting-requirement, procedures, and costs; financial assistance for patenting-introduction to existing schemes; Indian Patent Act, 1970 and recent amendments Publication of patents in India Status of patenting in Europe and US. Patenting by research students, lecturers, and scientists University/organizational rules in India and abroad, credit sharing by workers, financial incentives, Patent infringement- meaning, scope, litigation, case studies and examples

Biotechnology and Patents The patentability of microorganisms, legal protection for plants and other higher organisms, new plant varieties by rights, tissue culture protocols, transfer of technology. Patentability of vectors. Licensing - Flavr Savr™ tomato as a model case, Biopiracy and case studies on patents (Basmati rice, Turmeric, and Neem)

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.