Biotechnology II & IV Sem

201 - IInd semester

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UNIT I

1. Nature of Gene: Evolution of Gene Concept, Chemical Nature of Gene, Gene-cistron Relationship in prokaryotes and eukaryotes, Overlapping genes, Nested Genes, Gene families and pseudogenes. Proof of DNA as genetic material.
2. Denaturation and Renaturation of DNA. Molecular Basis of Gene Mutation:, Biological Repair Mechanisms, Repair Defects and Human Diseases
3. DNA Replication: General features of Chromosomal Replication. DNA Replication Machinery in Prokaryotes and its comparision with Eukaryotes.
4. Enzymology of DNA Replication : DNA Polymerases; Primases; Ligases; Helicases; Topoisomerases; Gyrases and Single stranded Binding Proteins. Regulation of DNA Replication ; Inhibitors of DNA Replication

UNIT II

1. Transcription in prokaryotes: Initiation, elongation and termination
2. Structure and Function of prokaryotic promoter
3. Control of transcriptional initiation in prokaryotes: Structure and function of RNA Polymerase: Sigma factors- Types and functions
4. Control of transcriptional termination: Attenuation and anti termination

UNIT III

1. Regulation of gene expression in prokaryotes: Operon concept, induction and repression, Structure and regulation of lactose, arabinose and tryptophan operons
2. Initiation of transcription in Eukaryotes: RNA Polymerases Types and properties
3. Transcription factors- Types and properties; Enhancers- Structure and properties; Response Elements
4. Post-transcriptional Modification Eukaryotes- 5' and 3' modification of mRNA .

UNIT IV

1. Post- transcriptional Processing of pre mRNA, pre rRNA and pre tRNA transcripts
2. Genetic Code: Evidence and properties; Wobble hypothesis; Transcriptional adaptors and amino acyl tRNA synthases
3. Translation: Successive stages of protein synthesis in prokaryotes and its comparison with eukaryotes
4. Post-translational Modification: Types and Significance

UNIT V

1. Regulation of Gene Expression in Eukaryotes: cis- acting DNA elements; Chromatin organization and regulation of gene expression; regulation at the level of processing of transcripts
2. Regulation of Gene Expression in Eukaryotes: RNA editing; Gene Alteration; DNA methylation and gene regulation; Regulation of gene expression by hormones: regulation of gene expression at translational level
3. Transposable elements in Prokaryotes and Eukaryotes: Types and Significance
4. Oncogenes and Tumor Suppressor Genes: Properties and Significance

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202 IMMUNOTECHNOLOGY

UNIT I

1. Immune response: Innate and adaptive immune system: Cells and molecules involved, characteristics and mechanism. hematopoiesis and differentiation of hematopoietic cells by cytokines. Toll-like receptor-component of innate immune system; clonal selection theory.
2. Anatomical organization of immune system: Primary lymphoid organ, secondary lymphoid organs. Ontogeny and phylogeny of lymphocytes, lymphocyte traffic.
3. Cell of immune system: Mononuclear cells and granulocyte, antigen presenting cells; APCs: professional and Nonprofessional;
   Lymphocytes and their subsets, lymphocyte surface molecules and receptors and flow cytometry.
   Artigens, Heptanes: factor effecting immunogenicity; super antigen, Antigenicity and immunogenicity.
4. Inflammation: its mediators and the process, cell-adhesion molecules and their role in inflammation, Leukocyte migration, lymphocyte homing, tissue injury and immune response leading to an inflammatory reaction, role of anaphylotoxins, granulocytes in inflammatory process.

UNIT II

1. Major histocompatibility systems: Structure of MHC I and II molecule, polymorphism, distribution variation and function. Organization of MHC with complex in Mouse and human. Association of MHC with disease.
2. Recognition of antigens by T and B Cells: Antigen processing, role of MHC molecules in antigen presentation and co stimulatory signals.
3. T-cell receptor complex, T-cell accessory membrane molecules, activation of T-cell, organization and arrangement of T-cell receptor genes.
4. B-cell receptor complex, activation and differentiation of B-cells, Immunoglobulin's (Class and subclass): Molecular Structures, type and function. Antigenic determinants of immunoglobulins (isotype. allotype and idiotype).

UNIT III

1. Molecular mechanism of antibody diversity organization of genes coding for constant and variable regions of heavy and light chain .Mechanism of antibody diversity, Class switching .
2. Antigen-Antibody infestation and affinity amusement.
3. Monoclonal Antibodies: Principle of hybridoma technology, production characterization and application in diagnosis, therapy and basic research, Fusion methods.
4. Compliment system, components, Activation pathway and regulation of activation pathway, complement deficiency, role of complement system in immune responses opsonization (opsonin)

UNIT IV

1. Cytokines: Suctions and function, cytokine receptors, Signal transduction mediated by cytokine receptors, cytokine regulation of immune response, cytokine related diseases and therapeutic application of cytokine.
2. Cytotoxic T-Cell and their mechanism of action, NK cell and mechanism of target cell destruction, Antibody dependent cell mediated cytotoxicity . techniques of cell mediated immunity.
3. Immunoregulation by antigens, Antibodies, immune complexes, MHC and cytokines.

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4. Hypersensitivity : Definition, I_gE mediated Hypersensitivity, mechanism of mart cell degranulation, mediators of type I reactions and consequences type II reaction, immune complex mediated Hypersensitivity and delayed type Hypersensitivity.

UNIT V

1. Autoimmunity: Organ specific and systemic diseases, mechanism of autoimmunity.
2. Immune response during bacterial (tuberculosis), Parasitic (malaria) and viral (HIV.) infection, congenital and acquired immunodeficiency; diagnosis and therapeutic approaches.
3. Vaccines: Active and passive immunization, whole organism vaccines, macromolecules as vaccines, Recombinant-vector vaccines, DNA vaccines, synthetic peptide vaccines and sub-unit vaccines, Anti-idiotype vaccines.
4. Immunodiagnostics: development of immunodiagnostics kits for infectious and non infectious diseases with example. Precipitation techniques, Agglutination, fluorescence techniques (FACS), ELISA, RIA, western Blotting and immuno-histochemical techniques (Avidin and Biotin system), Antibody engineering.

Practical Exercises

1. Blood Film Preparation and identification of cells.
2. Lymphoid organs and their microscopic organization.
3. Immunization and production of polyclonal antibodies.
4. Double diffusion and Immuno-electrophoresis.
5. Radial immunodiffusion.
6. Purification of IgG from serum.
7. Separation of mononuclear cell by Ficoll-paque.
8. Con-A induced proliferation of thymocytes (by MTT Method).
9. Western blotting.
10. ELISA
11. Preparation o antibody-enzyme conjugates.

Reference Books

1. Immunology, Kubey, R.A. Goldsby, Thomas J.Kindt, Barbara, A. Osbarne (Freeman).
2. Immunology- A short Course, Eli Benamini, Richard Coico, Geoffrey Sunshine.
3. Immunology by Tizzard
4. Fundamentals of Immunology, William Paul.
5. Immunology by Roitt and others.
6. Immunology by Abbas

203. ENZYME TECHNOLOGY

UNIT I

1. Enzyme: Historical aspects, classification and nomenclature, EC number
2. Mechanism of enzyme action and properties of enzymes as catalysts
3. Sub-cellular localization and organization of enzymes
4. Methods of enzyme assay: continuous and sampling techniques, coupled enzyme assays, specific activity, turn over number

UNIT II

1. Enzyme purification: Objectives and strategy, methods of isolation overview of purification techniques and crystallization
2. Criteria of purity and tabulation of purification data, stable storage of enzymes
3. Characterization of purified enzyme.
4. Enzyme engineering: Site directed mutagenesis

UNIT III

1. Enzyme kinetics: Equilibrium and steady state theory, rate equation and determination of Km and V_{max}
2. Factors affecting rate of enzyme reaction: pH, temperature and pressure
3. Enzyme inhibition: reversible and irreversible inhibition, Applications of inhibitors
4. Rapid reaction techniques

UNIT IV

1. Isoenzymes and their physiological significance
2. Allosteric enzymes: co-operativity, MWC and KNF Models
3. Regulation of enzymes
4. Ribozymes and catalytic antibodies

UNIT V

1. Enzyme Immobilization: methods, applications and its effect on kinetic parameters
2. Enzyme Biosensor: Principle, components of biosensor, types
3. Development of enzyme biosensors
4. Applications of biosensor for clinical diagnosis

204. PART A: ENVIORNMENTAL BIOTECHNOLOGY

UNIT I

1. Environment pollution: types, methods for measurement of pollution
2. Solid waste treatment: Composting process, Vermicomposting and its advantages.
3. Biomedical waste and its management
4. Xenobiotics and its degradation

UNIT II

1. Microbial waste treatments: aerobic and anaerobic processes
2. An Integrated pest management- Biopesticides: types and impact on environment.
3. Bioremediation: *In situ* and *Ex situ* techniques advantages and applications of genetically engineered microbes (GEM) in bioremediation.
4. Phytoremediation: Types and its applications, Bioindicators, GMOs and assessment of environmental impact and monitoring.

Practical Exercises

1. Determination of dissolved oxygen concentration of water sample
2. Determination of biological oxygen demand (BOD) of sewage sample
3. Determination of Chemical oxygen demand (COD) of sewage sample
4. Isolation of xenobiot ic degrading bacteria by selective enrichment technique
5. Test for the degradation of aromatic hydrocarbons by bacteria
6. Survey of degradative plasmids in microbes growing in polluted environment
7. Study on biogenic methane production in different habitats

Reference Books

1. Comprehensive Biotechnology. Vol. 4,M. moo- young (Ed-in-chief), Pergmon Press Oxford
2. Environmental chemistry. A.K.De, Wiley Eastern Ltd., New Delhi
3. Introduction to Biodeterioration. D.Allsopp and Seal, ELBS/ Edward Arnold
4. Environmental Biotechnologies and Cleaner Bioprocess by Eugenia J Olguuin et al
5. Environmental Science: Physical Principles and applications by Egbert Boeker et al

204: Part B ANIMAL BIOTECHNOLOGY

UNIT III

1. Animal cell culture: Organization of animal cell and tissue culture laboratory
2. Culture Medium: types, functions of different constituents of media, role of Co_2
3. Primary and established cell line cultures
4. Measurement of parameters of growth

UNIT IV

1. Scaling up of animal cell culture, Cell synchronization
2. Cell cloning and micromanipulation
3. Measurement of cell viability, methods of separation of cell types
4. Stem cell cultures, embryonic stem cells and their applications

UNIT V

1. Commercial applications of cell culture: cytotoxicity and diagnostic tests
2. Cell culture based vaccines
3. 3-D animal cell culture
4. Transgenic animals

Practical Exercises: Part B

1. Preparation of tissue culture medium and membrane filtration
2. Preparation of single cell suspension from spleen and thymus
3. Cell counting and viability
4. Macrophage monolayer from PEC and measurement of phagocytic activity
5. Cell fusion with PEG

Reference Books

1. Culture of Animal Cells by RI Freshney
2. Animal Cell Culture: Practical Approach John R W Masters
3. Animal Cell Culture Techniques by Ed. Martin Clynes
4. Methods in Cell Biology Vol. 57, Animal cell culture methods