

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTAPUR****Course Structure and Syllabi for Pre Ph.D
BIOTECHNOLOGY (2009-10)****PART - I**Choose any **one** subject of the following

S. NO	PAPER	PAPER CODE
1.	Cell Biology and Biomolecules	09PH23101
2.	General and Industrial Microbiology	09PH23102
3.	Enzymology	09PH23103
4.	Bioprocess Engineering Principles	09PH23104
5.	Biochemical and Biophysical Techniques	09PH23105

PART - IIChoose any **one** subject of the following

S.NO	PAPER	PAPER CODE
1.	Bioinformatics and Computational Molecular Biology	09PH23201
2.	Animal Cell Technology	09PH23202
3.	Genetic Engineering	09PH23203
4.	Immunology	09PH23204
5.	Enzyme Engineering	09PH23205
6.	Plant Biotechnology	09PH23206
7.	Pharmaceutical Biotechnology	09PH23207
8.	Downstream Processing	09PH23208
9.	Nanobiotechnology	09PH23209
10.	Microbial Biotechnology	09PH23210
11.	Environmental Biotechnology	09PH23211
12.	Molecular Virology	09PH23212

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Pre-Ph.D Biotechnology

(09PH23101) CELL BIOLOGY AND BIOMOLECULES

1. Evaluation of Cell:

First cell in the world – cell theory – diversity of cell size & shape – macro & micro compounds in cell – basic properties of cell - Chromosomes – genes – enzymes – identification of DNA as genetic material – structure of DNA

2. Organization of Cellular Genome:

Introns – exons – gene families – pseudogenes – repetitive DNA sequences – number of genes in eukaryotic cells – chromatin – centromeres – telomeres – prokaryotic genes – sequence of yeast genome – genomes of *C. elegans*, *D. melanogaster* & *A. thaliana* – human gene mapping – physical mapping of human genome.

3. Cell Cycle:

Phases of cell cycle – mitosis – meiosis – regulation of cell cycle – cell cycle check points – coupling of S phase to M phase – regulators of cell cycle progression – inhibitors of cell cycle progression – proliferation of differentiated cells – stem cells

4. Cell Structure & Organelles functions:

Structure & functions of nuclear envelope – nuclear pore complex – nucleolus – nucleus during mitosis – Endoplasmic reticulum – golgi apparatus – mechanism of vesicular transport – lysosomes – mitochondrial structure & mechanism of oxidative phosphorylation – structure & functions of chloroplast - electron flow through photosystem I & II – cyclic electron flow – ATP synthesis – peroxisomes.

5. Cytoskeleton Cell Movement:

Microtubules – microtubule motors & movements – cilia – flagella – micro filaments - structure of plasma membrane – membrane proteins – glycocalyx – passive diffusion – facilitated diffusion – carrier proteins – ion channels – active transport driven by ATP hydrolysis – active transport driven by ion gradients – phagocytosis – receptor mediated endocytosis – protein trafficking endocytosis – bacterial cell walls – plant cell wall – extra cellular matrix – cell adhesion proteins – tight junction – gap junction – plant cell adhesion & plasma desmata.

6. Amino acids and Proteins:

Structure & functions of amino acids – classification of amino acids – amino acid derivatives - stereochemistry of amino acids. **Proteins:** Classification & biological functions of proteins - physico-chemical properties of proteins – primary, secondary, tertiary and quaternary structures of proteins.

7. Carbohydrates:

Classification of carbohydrates – configuration & conformations of carbohydrates – structural and biological functions of mono, di, oligo & polysaccharides (homo & hetero) – sugar derivatives – glycol conjugates – proteoglycans – glycoproteins & glycolipids – lectins. **Lipids:** Classification of lipids – structural & biological functions of lipids.

8. Nucleic acids:

Classification & functions of nucleic acids – Watson & Crick proposed DNA – different forms of DNA – organization of DNA – different types of RNA – structural elucidation & biological functions of different RNA molecules.

References:

1. *The world of Cell* by Wayne M. Becker, Lewis J. Kleinsmith and Jeff Hardin., 4th edition, Benjamin/Cummings publishing company.
2. *The Cell* by Geoffrey M. Cooper., 2nd edition, ASM press, Washington.
3. *Cell and Molecular Biology* by Gerald Karp., 5th edition, John Wiley & Sons Inc.
4. *Biochemistry* by U. Satyanarayana and U. Chakrapani., 3rd edition., Books and Allied (P) Ltd, Kolkata.
5. *Biochemical Calculations* by Irwin H. Segel, John Wiley and Sons Inc.
6. *Principles of Biochemistry* by David L. Nelson and Michael M. Cox., 4th edition, W.H. Freeman & Company, New York.
7. *Fundamentals of Biochemistry* by Donald Voet., Judith G. Voet and Charlotte W. Pratt., 2nd edition, John Wiley and Sons (Asia) pvt Ltd.
8. *Biochemistry* by Jeremy M. Berg, John L. Tymoczko and Lubert Stryer., 5th edition, W.H.Freeman & Company, New York.

(09PH23102) GENERAL AND INDUSTRIAL MICROBIOLOGY**1. Beginning of Microbiology:**

History & scope of microbiology – Controversy over spontaneous generation - developments of microbiology in the twentieth century - role of micro organisms in transformation of organic matter & in the causation of diseases – classification & characterization of micro organisms.

2. Microbial Cultivation and Maintenance:

Nutritional types of microorganisms – growth factors – preparation of different culture medias – sterilization techniques- significance of agar in media – isolation of pure culture – maintenance of pure cultures — microbial growth curve.

3. Diversity of microorganisms:

Microbial taxonomy & phylogeny – archea – bacteria – fungi - algae – protozoa – general characteristics of viruses – bacteriophages.

4. Microbial diseases:

Water-borne diseases – air-borne diseases – food-borne diseases.

5. Fermentation Technology:

Classification of fermentation – large scale of fermentation – types of reactors – instruments of fermentation – fermentation reactions – fermentation process – commercialized fermentation.

6. Production of Antibiotics:

Biological productions of penicillin, streptomycin, tetracyclin and other antibiotics – industrial production of enzymes – production of vitamins B, C and A.

7. Production of organic acids:

Lactic acid, citric acid, acetic acid, gluconic acid, fumaric acid etc – large scale production of single cell protein & their importance – production of biofuels.

8. Food Industry:

Bakers yeast & bread making – rennet and other proteolytic enzymes in cheese making – production of different cheeses – other products from diary industry – sweeteners – production of ethanol, beer, wine, related beverages.

References:

1. *Microbiology* by Jacquelyn G. Black.
2. *Microbiology* by Prescott, 7th Ed. McGraw Hill.
3. *Microbial Biotechnology* by Dr. C.D. Swarna latha
4. *Fundamentals of Microbiology* by Jeffrey C. Pommerville.

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(09PH23103) ENZYMOLOGY

1. Introduction to Enzymes:

Nomenclature & classification of enzymes – enzyme properties – co-factors – remarkable properties of enzymes as catalyst – non-protein enzymes.

2. Enzyme Structure:

Determination of molecular mass – determination of amino acid composition – determination of primary, secondary, tertiary and quaternary structures of enzymes – determination of protein structures by X-ray crystallography – multienzymes.

3. Specificity of Enzyme action:

Types of specificity – active site – lock & key hypothesis – induced fit hypothesis – hypothesis involving strain or transition state stabilization – enzyme turn over – monomeric oligomeric enzymes.

4. Enzyme Kinetics:

Energy concept in enzyme catalysed reactions – factors affecting the rate of chemical reactions – kinetics of single-substrate enzyme – catalyzed reactions – kinetics of multi-substrate enzyme catalysed reactions – investigation of active site structure.

5. Inhibition:

Types of inhibition – reversible inhibition – irreversible inhibition – allosteric inhibition – feed back inhibition.

6. Clinical aspects of Enzymology:

Determination of enzyme activities for clinical diagnosis – clinical enzymology for liver diseases, heart diseases, serum in diseases – detection & significance of enzyme deficiencies – use of enzymes to determine the concentrations of metabolites of clinical importance.

7. Regulation of Enzyme activity:

Allosteric regulation – activation enzymes – metabolic pathways – control of enzyme synthesis – isoenzymes.

8. Purification of Enzymes:

Extraction of enzymes - subcellular compartmentation of enzymes – enzyme assays – purification of enzymes by using different techniques – determination of molecular weights.

References:

1. *Enzymes* by Trevor Palmer, 1st edition, East West press pvt Ltd, New Delhi.
2. *Fundamentals of Enzymology* by Nicholas C. Price & Lewis Stevens., 3rd edition, Oxford University press, New York.
3. *Principles of Biochemistry* by Nelson and Cox.
4. *Biochemistry* by Veot and Veot.

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Pre-Ph.D Biotechnology**

(09PH23104) BIOPROCESS ENGINEERING PRINCIPLES

1. Introduction to Process Engineering:

Role of process engineering principles in biotechnological industries - brief overview of fundamentals of chemical engineering - concepts of unit operation & unit processes.

2. Introduction to engineering calculations:

Variables, their dimensions and units - dimensionally homogenous and non-homogenous equations - standard conditions and ideal gases - physical and chemical property data - basics of material and energy balances in a macroscopic view point.

3. Fluid mechanics:

Fluids vs solids - fluid statics and applications including manometer - mass and energy balances in fluid flow - newton's law of viscosity - measurement of viscosity of fermentation broths - flow curves for Non-Newtonian fluids - examples from bioprocess fluids.

4. Friction:

Pressure drop due to skin friction by Rayleigh's method of dimensional analysis - significance of friction factor and Reynold's number - Boundary layer theory and form friction - pressure drop due to form friction.

5. Pumps and beds:

Flow past immersed bodies and drag coefficients - pressure drop in flow through packed beds - fluidization and pressure drop across fluidized beds - flow machinery and control - overview of valves and pumps.

6. Heat transfer:

Models of heat transfer and examples - Fourier's law of heat conduction and analogy with momentum transfer - heat transfer through a cylindrical pipe wall.

7. Heat transfer coefficient:

Convection and concept of heat transfer coefficient - application of dimensional analysis to heat transfer from pipe to a flowing fluid - thermal boundary layer and Prandtl number - overall heat transfer coefficient - correlations for heat transfer coefficients in natural and forced convection - significance of dimensionless numbers - overview of heat exchangers and concept of LMTD.

8. Diffusion and mass transfer:

Fick's law of diffusion - analogy with momentum and energy transport - diffusivities of gases and liquids - fundamentals of mass transfer - theories of mass transfer - concept of mass transfer coefficient - dimensional analysis of some mass transfer operations - dimensionless numbers and significance - correlation for mass transfer coefficients.

References:

1. *Bioprocess Engineering Principles* by Pauline M. Doran, Academic Press
2. *Unit operations of Chemical Engineering 5th ed.* by W L McCabe, J C Smith and P. Harriot Mc Graw-Hill (1993).
3. *Bioprocess Engineering in biotechnology* by Jackson, A.T., Prentice Hall, Engelwood Cliffs.
4. *Principles of Fermentation Technology* by Standury R.F., and Whitaker, A., Pergamon press, Oxford.

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(09PH23105) BIOCHEMICAL AND BIOPHYSICAL TECHNIQUES

1. Basics of Biochemical Techniques:

Acids – bases – pK – pH – buffer solutions – uses of indicators - units of measurements – ion specific electrodes – quantitative biochemical measurements – biosensors.

2. Diffusion and Osmosis:

A molecular kinetic approach to diffusion – methods of determination & significance of diffusion coefficient – diffusion of electrolytes – osmosis – measurement of osmotic pressure – Van't Hoff's laws of osmotic pressure – theories of osmotic pressure & semipermeability – osmotic behavior of cells – molecular weight determination – significance of osmosis in biology.

3. Adsorption & Microscopic Techniques:

Kinds of adsorption interactions – characteristics & molecular orientation of adsorption - adsorption isotherms: quantitative relationships – adsorption from solutions – importance of adsorption phenomenon.

Microscopy: Parts of microscope – different types of microscopes – applications of microscopes in biology.

4. Centrifugation Techniques:

Basic principles of sedimentation – relative centrifugal force – factors affecting sedimentation – different types of centrifuges – their applications – design & care of preparative rotors – separation methods in ultracentrifuges – analysis of subcellular fractionations – determination of molecular weights – ultracentrifugations.

5. Spectrophotometric Techniques:

Laws of adsorption – beer's law – adsorption spectrum specific for a substance – radiant energy sources – wavelength selectors – detection devices – amplification & readout – double beam operations – quantitative analysis of enzymes concentration, molecular weight, cis-trans isomerism & other physico-chemical studies – instrumentation & applications of X-ray, γ -ray, UV, Visible, fluorimetry, turbidometry, nephelometry, IR, Luminometry, flame, atomic absorption, NMR, ESR & mass spectrophotometries.

6. Chromatographic Techniques:

Principle of chromatography – chromatographic performance parameters – studies of plane chromatography, column chromatography, HPLC, GC, hydroapatite chromatography, and DNA cellulose chromatography – an affinity system for fractionating supercoiled & non supercoiled DNA.

7. Electrophoretic Techniques:

Principles of electrophoresis – factors affecting electrophoretic mobility – types of electrophoresis (free electrophoresis, zone electrophoresis, gel electrophoresis, isoelectrofocusing, 2D gel electrophoresis, immuno electrophoresis, pulse field gel electrophoresis, electrophoresis on cellular gel, capillary electrophoresis) – electrophoresis in genetic analysis & proteins.

8. Radio isotope Techniques:

Production of isotopes – radioactive decay – synthesis of labeled compound – measurement of radioactivity (gas ionization, photographic method, excitation) – applications of stable isotopes in biology – safety aspects – dosimetry.

References:

1. *Biophysical chemistry* by Upadhyay, Upadhyay and Nath 4th edition., Himalaya publishing House, Mumbai.
2. *Practical Biochemistry* by Keith Wilson and John Walker., 5th edition., Cambridge University press., U.K.

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(09PH23201) BIOINFORMATICS AND COMPUTATIONAL MOLECULAR BIOLOGY

1. Introduction to Bioinformatics

Scope of Bioinformatics, Introduction to Homology (with special mention to Charles Darwin, Sir Richard Owen, Willie Henning, Alfred Russel Wallace). DNA mapping and sequencing, Map alignment, Large scale sequencing methods Shotgun and Sanger method.

2. Sequencing Alignment and Dynamic Programming

Heuristic Alignment algorithms. Global sequence alignments-Neddleman-Wunsch Algorithm Smith-Waterman Algorithm-Local sequence alignments (Amino acid substitution Matrices (PAM, BLOSUM).

3. Biological Database

Introduction to Biological databases, Organization and management of databases. Searching and retrieval of information from the World Wide Web. Structure databases - PDB (Protein Data Bank), Molecular Modeling Databases (MMDB). Primary Databases NCBL,EMBL, DDBJ. Introduction to Secondary Databases Organization and management of databases Swissprot, PIR,KEGG. Introduction to BioChemical databases-organization and Management of databases. KEGG, EXGESCY, BRENDA, WIT.

4. Evolutionary Trees and Phylogeny

Multiple sequence alignment and phylogenetic analysis.CLUSTAL,W. Basic concepts in systematics, Molecular evolution,Definition and description of Phylogenetic trees and types of trees Dendograms and its interpretation

5. Introduction to Computational Molecular Biology

Introduction to active areas of research in Computational Molecular Biology, Functional Genomics, Comparative Genomics, Dynamic Programming, Graphical representation of biochemical systems, S-systems equations, steady state analysis, Model refinements

6. Genomics

DNA Sequence assembly and gene identification. Homology based gene prediction. SNPs and applications. Methods of studying gene expression, EST approach, Basics of Micro array

7. Proteomics

Introduction to proteins. Protein identification, structure and function determination. Structure comparison methods. Prediction of secondary structure from sequence. Protein homology modeling, Protein threading. Protein ab initio structure prediction. Protein design emphasis on structural Bioinformatics.

8. Drug Design

Drug discovery cycle, Role of Bioinformatics in Drug discovery

References:

1. **Bioinformatics Basics. Applications in Biological Science and Medicine** by Hooman H. Rashidi and Lukas K. Buehler CAC Press 2000.
2. **Algorithms on Strings Trees and Sequences** Dan Gusfield. Cambridge University Press 1997.
3. **Bioinformatics- Sequence and genome analysis.** David W Mount. CSHL Press.
4. **Protein Engineering.** Moody P C E and A J Wilkinson. IRL Press
5. **Creighton T E, Proteins.** Freeman W H. Second edition 1993. Journal Bioinformatics (Oxford University).
6. **Brandon D Tooze – Proteomics**
7. **Bioinformatics: A Machine Learning Approach** P. Baldi. S. Brunak, MIT Press 1988.
8. **Developing Bioinformatics Skills.** Cynthia Gibbs & Per Jambek
9. **Genomics and Proteomics-Functional and Computational aspects.** Springer Publications. Editor-Sandor Suhai.
10. **Bioinformatics- Methods and Protocols-Human Press.** Stephen Misener, Stephen A. Krawetz.
11. **Computational Biochemistry – C. Stan, TSAI WILEY Publications.**
12. **Bioinformatics – A Practical guide to the Analysis of Genes and Proteins – ANDREAS D. BAXEVANIS, B.F. FRANCIS OUELLETTE.**
13. **Bioinformatics – Principles and Applications – Harshawardhan P. Bal TATA MEGRAW HILL.**
14. **Bioinformatics Computer skills** Cynthia Gibbs O'Reille publishers.
15. **Jonathan Pevsner . Bioinformatics and Functional Genomics.** A John Wiley & Sons, Inc., Publication
16. **E.O. Voit Computational Analysis of Biochemical systems,** Cambridge University Press 2000.

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(09PH23202) ANIMAL CELL TECHNOLOGY

1. Biology of Cultured Cells:

Historical background of animal cell culture – advantages of animal tissue culture – types of tissue cultures – cell adhesion – cell proliferation – differentiation – cell signaling – initiation of cell culture – evaluation of cell lines – cell banks.

2. Facilities for Animal Cell Culture:

Equipments – culture vessels – minimal requirements of cell cultures – sterilization techniques – advantages & disadvantages of animal cell culture – biohazards – bioethics – validations.

3. Cultural Media:

Physico-chemical properties of media – balanced salt solution – media constituents – selection of medium & serum – other supplements – serum free media – disadvantages of serum – advantages of serum free media – protein free media.

4. Cultured Cells:

Characterization of cultured cells – measurement of growth parameters of cultured cells – cell synchronization – senescence – apoptosis – types of primary cell culture – isolation of tissue – primary culture – cell lines – subculture – stem cell cultures.

5. Scale-up Cell Culture:

Cell quantification – equipments – types of culture process – scale-up in suspension – scale-up in monolayer – cell growth in scale-up – cell viability – cell cytotoxicity.

6. Cloning & Selection:

Transformation of cells – cell cloning – suspension cloning – isolation of clones.

7. Organ & Histotypic Cultures and Tissue Engineering:

Organ cultures – techniques for organ cultures – histotypic cultures – organotypic cultures – 2-dimensional cultures – tissue engineering – embryogenic stem cell engineering – human embryogenic stem cell.

8. Transgenic Animals:

Transgenic mice and their applications – gene knockout – YAC in transgenesis – transgenesis in large animals – animal bioreactors – Dolly- a transgenic clone.

References:

1. *Culture of Animal Cell* by R. Ian Freshney. 5th Edition., Wiley-Liss.
2. *Biotechnology* by U. Satyanarayana, Books and Allied (P) Ltd, Kolkata.
3. *Animal Cell Culture - Practical Approach*, Ed. John R.W. Masters, Oxford.
4. *Animal Cell Culture Techniques*. Ed. Martin Clynes, Springer.

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(09PH23203) GENETIC ENGINEERING

1. Tools of Genetic Engineering:

Cloning & patenting of life forms – genetic engineering guidelines – DNA cutting & joining – restriction enzymes – classification & nomenclature of restriction enzymes –

DNA ligases – alkaline phosphatase – polynucleotide kinase – terminal transferase – DNA modifying enzymes – prokaryotic host cells – eukaryotic host cells.

2. Cloning Vectors:

Characteristics of a vector – natural plasmids used as vectors – advantages & disadvantages of vectors – plasmids – bacteriophages – cosmids – BAC – YAC – shuttle vector – Ti plasmid – caulimovirus – SV40 – retroviruses – characteristics of expression vector – joining of DNA to vector molecules – linkers – adaptors – connectors – gene libraries.

3. Methods of gene transfer:

Transformation – transduction – conjugation – transposition – cell transformation with plasmids – transfection with phage vectors – recombinant viral techniques – DNA mediated gene transfer methods – somatic cell hybridization – microcell fusion techniques – metaphase chromosome transfer – liposomes – microinjection technique – electroporation.

4. Screening Methods:

Insertional inactivation of marker genes – visual screening methods – plaque phenotype – suppression of a mutation – selection of recombinant deficient phages – Spi phenotype – recombinant efficiency – selection for correct promoter sequence – Alu marker for human genes – immunological techniques – hybrid arrested translation - hybrid selected translation – rescue technique – nucleic acid hybridization – colony hybridization – dot hybridization.

Probes & tests: RNA probes – cDNA probes – DNA probes – nick translated probe – southern blotting – northern blotting – western blotting – precipitin test – immunodiffusion technique – immuno electrophoretic technique – RIA – ELISA – immuno affinity chromatography.

5. Expression of cloned genes:

Maxicell system – minicell system – fused genes – unfused genes – secreted proteins – expression of genes in oocytes of xenopus – expression in transgenic plants & animals.

6. Detection of cloned genes:

Marker rescue technique – transposon tagging – pulse field gel electrophoresis – contour clamped homogeneous electric field electrophoresis – PAGE – other gel electrophoresis – purification of cellular DNA – purification of plasmid DNA – purification of mRNA – restriction mapping – DNA foot printing – chromosome walking and jumping - maxam Gilbert technique – dideoxy nucleotide method – sanger's chain terminator method – automated DNA sequencing – pyro sequencing – DNA chips.

PCR:- Principle of PCR – sources of DNA polymerase – PCR types – applications of PCR.

7. DNA & Protein Engineering:

Oligo nucleotide synthesis – mutagenesis – strategies to improve invitro activities of enzymes – increasing the stability & biological activities of proteins – addition of disulphide bonds – improving kinetic properties of enzymes – human genome project.

8. Applications of Genetic Engineering:

Applications of genetic engineering in plants, animals, biotechnological approaches, biotechnological industries, pharmaceutical, commodity chemicals, protein engineering, designing of enzymes & clinical field – control of environmental pollution – recovery of minerals.

References:

1. *Biotechnology* by U. Satyanarayana., Books and Allied (P) Ltd, Kolkata.
2. *Genetic Engineering* by Sandya Mitra., Macmillan India Ltd.
3. *Molecular Cloning* by J. Sambrook, E.F. Fritsch and T. Maniatis., Cold spring Harbour Laboratory press, New York.
4. *DNA Cloning* by M. Glover & D.D. Hames, IRL press.
5. *Molecular Biotechnology* by S. B. Primrose, 2nd edition., Blackwell Scientific publishers, Oxford.
6. *Genetic Engineering* by S. M. Kingsman and A. J. Kingsman., Blackwell Scientific Publishers, Oxford.

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Pre-Ph.D Biotechnology

(09PH23204) IMMUNOLOGY

1. Introduction:

Origin of immune system – innate immunity – acquired immunity – cells and organs of immune system. Lymphocytes – plasma cells – macrophages – mast cells – T-cells – B-cells – MHC – CD4 – CD8 – CD28 – TNF – receptor family domains – cytokines – chemokines.

2. Immunochemistry:

Types of antigens – properties of antigens – immunogenicity – adjuvant – epitopes – haptens – super antigens. **Antibodies:-** Immunoglobulin structure – Immunoglobulin

functions – antigenic determinants on Immunoglobulin – Immunoglobulin classes – studies on IgG, IgM, IgA, IgE and IgD.

3. Antigen-Antibody interactions:

Types of antigen-antibody interactions – determination of antigen-antibody interactions by various techniques.

4. Hypersensitivity:

Cells & Coomb's classification – types of hypersensitivity – immune deficiencies – primary & secondary deficiencies – T-cell, B-cell & combined immuno deficiencies – complement system deficiencies – AIDS – SCID.

5. Immune response to infectious diseases:

Viral infections – bacterial infections – parasitic diseases – fungal diseases – emerging infectious diseases.

6. Complement system:

Functions of complement – components of complements – complement activation – regulation of complement system – biological consequences of complement activation – complement deficiencies – organization & inheritance of the MHC – MHC molecules & genes – genomic map of MHC genes – cellular expression of MHC molecules – regulation of MHC expression – MHC & disease susceptibility – MHC & immune responsiveness – role of antigen-presenting cells.

7. Immuno Techniques:

Phages display libraries for antibody V-region production – immuno fluorescence microscopy – immuno electron microscopy – immuno histochemistry – immuno precipitin – co-immuno precipitation – immuno blotting – use of antibody in the isolation & identification of genes & their products.

8. Transplantation Immunology:

Types of grafts – immunologic basis of graft rejection – genetics of transplantation antigens – mechanism & types of rejection – clinical manifestation of graft rejection – immuno suppressive therapy – immuno tolerance to allograft – clinical transplantation.

References:

1. *Kuby Immunology* by Thomas J. Kindt, R.A. Goldsby, and Barbara, A.Osbarne, 6th edition., Freeman and company, New York.
2. *Immunology* by David Male, Jonathan Brostoff, David B Roth and Ivan Roitt., 7th edition, Mosby Elsevier.
3. *Immunobiology* by Janeway, Travers, Walport and Shlomchik., 6th edition, Garland Science publishing.

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(09PH23205) ENZYME ENGINEERING

1. Principles of Industrial Enzymes:

Applications of enzymes in industrial, medical, analytical, chemical, pharmaceutical & food sectors – Technology of enzyme production – regulation of microbial enzyme production – genetic engineering for microbial enzyme production.

2. Enzyme Kinetics:

Experimental approaches to the determination of enzyme mechanisms – kinetic data – analysis of kinetic data – pre steady – state kinetics.

3. Energetics:

Objectives & strategy in enzyme purification – methods of homogenization – methods of separation – purify the enzymes by using different techniques.

4. Enzyme Technology:

Use of micro organisms in brewing & cheese making industries – use of micro organisms in the production of organic chemicals – use of isolated enzymes in industrial process.

5. Enzymes in organized systems:

Organized enzyme systems – RNA polymerase from *E. coli* – isolation of multi enzyme proteins – phylogenetic distribution of multi enzyme proteins – PDH complex – glycine decarboxylase multi enzyme complex – tryptophan synthase multi enzyme complex – carbamoyl phosphate synthase & the associated enzymes of the pyrimidine & arginine biosynthetic pathways in *E. coli*, fungi & mammalian cells – fatty acid synthase & arom complex – enzymes involved in DNA synthesis – glycogen particles.

6. Principles of Immobilization of enzymes:

Classification of immobilized enzymes – techniques of enzyme immobilization – immobilized soluble enzymes – choice of immobilization method – properties of immobilized enzymes – enzyme reactors – analytical, therapeutic & industrial applications.

7. Immobilization of enzymes:

Immobilized biocatalysts – a comparison of immobilized enzymes & cells – co-immobilized enzymes – methods of immobilization – effect of immobilization on enzyme properties.

Biosensors:- Types of biosensors – applications of biosensors – therapeutic applications of immobilized enzymes & cells.

8. Large-scale protein purification:

Instruments required for large-scale protein purification – containers – ancillary equipment – vessels – centrifuges – filters – chromatographic techniques.

References:

1. **Biotechnology** by U. Satyanarayana, 1st edition., Books and Allied (P) Ltd, Kolkata.
2. **Enzymes** by Thevor Palmer.,
3. **Enzyme Biotechnology hand book** by NIIR Board of consultants & engineers., Asia pacific business press Inc.
4. **Fundamentals of Enzymology** by Price and Stevens.
5. **Biochemistry** by Veot and Veot.
6. **Enzyme Technology** by Ashok Pandey, Colin Webb, Carlos Ricardo Soccol and Chistian Larroche., Asiatech publishers inc., New delhi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D Biotechnology

(09PH23206) PLANT BIOTECHNOLOGY

1. Conventional Plant Breeding:

Introduction to cell and Tissue Culture - tissue culture as a technique to produce novel plants and hybrids - Tissue culture media (composition and preparation) - Initiation and maintenance of callus and suspension culture - 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.

2. Hybridization:

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 – Cryopreservation - slow growth and DNA banking for germplasm conservation - Basic Techniques in rDNA Technology.

3. Plant Transformation Technology:

Basis of tumor formation - hairy root - features of TI and RI plasmids - mechanisms of DNA transfer - role of virulence genes - use of TI and RI as vectors - binary vectors - use of 35S and other promoters - genetic markers - use of reporter genes - reporter gene with introns - use of scaffold attachment regions - methods of nuclear transformation - viral vectors and their applications - multiple gene transfers - Vectors- less or direct DNA transfer - particle bombardment – electroporation – microinjection - transformation of monocots - Transgene stability and gene silencing.

4. Applications of Plant Transformation for productivity & Performance :

Herbicide resistance – phosphinothricin – glyphosate - sufonyl urea – atrazine - insect resistance - Bt genes - Non-Bt like protease inhibitors - alpha amylase inhibitor - virus resistance - coat protein mediated - nucleocapsid gene - disease resistance – chitinase - 1-3 beta glucanase – RIP - antifungal proteins – thionins - PR proteins - nematode resistance - abiotic stress - post- harvest losses - long shelf life of fruits and flowers - use of ACC synthase - polygalacturanase - ACC oxidase - male sterile lines - bar and barnase systems - carbohydrate composition and storage - ADP glucose pyrophosphatase.

5. Metabolic Engineering & Industrial Products:

Plant secondary metabolites - control mechanisms and manipulation of phenylpropanoid pathway - shikimate pathway – alkaloids - industrial enzymes - biodegradable plastics – polyhydroxybutyrate - therapeutic proteins - lysosomal enzymes – antibodies - edible vaccines - purification strategies - oleosin partitioning technology.

6. Molecular Marker-aided Breeding:

RFLP maps - linkage analysis - RAPD markers – STS – microsatellites - SCAR (sequence characterized amplified regions) - SSCP (single strand conformational polymorphism) – AFLP - QTL - map based cloning - molecular marker assisted selection.

7. Chloroplast Transformation:

Advantages – vectors - success with tobacco and potato - Arid and semi-arid plant biotechnology - Green House and Green-Home technology.

8. Plant Tissue Culture:

Plant cell culture – plant organ culture – regeneration of plants – anther & pollen culture – applications of cell, tissue & organ cultures – large scale plant propagation – plant germplasm bank – in-situ conservation – ex-situ conservation – cryopreservation - techniques of cryopreservation – cold storage – low-pressure & low oxygen storage – applications of germplasm storage – limitations of germplasm storage.

References:

1. *Plant Biotechnology* by J.Hammond, R McGarvey and V. Yusibov (Eds.): Springer Verlag, 2000.
2. *Biotechnology* by U. Satyanarayana., Books & Allied (P) Ltd.
3. *Practical Application of Plant Molecular Biology* by .R.J. Henry: Chapman and Hall. 1997
4. **P.K. Gupta.. Elements of Biotechnology.** Rastogi and Co. Meerut. 1996.

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(09PH23207) PHARMACEUTICAL BIOTECHNOLOGY

1. General:

Introduction and Historical background - Paul Ehrlich's development of arsephenamine and his concept of Chemotherapy - Sulphas as wonder drugs - Importance of heterocyclic chemistry in drug synthesis - Natural Products as Lead molecules - Medicinal Chemistry and drug development.

2. Anti-bacterial Drugs:

Sulphonamides – Sulphamethoxazole-synthesis and mechanism of action, dosage forms - Trimethoprim-synthesis and dosage forms, its mechanism of action - Norfloxacin and Ciprofloxacin-synthesis, dosage forms, structure-activity relationships.

3. Anti-inflammatory Agents – I:

Antipyretics - Analgesics and anti-inflammatory agents - General study - Non-steroidal anti-inflammatory agents: Ibuprofen, structure, synthesis, dosage forms and activity studies.

4. Anti-inflammatory Agents – II:

Indomethacin & Piroxicam – Synthesis, dosage forms & mechanism of action. Steroidal anti-inflammatory agents like betamethasone.

5. Antihistamines and Antifungal agents:

Antihistaminic agents - Diphenhydramine (benadryl)-synthesis, therapeutic use and dosage forms - Cimetidine & Ranitidine-synthesis, dosage forms and applications - Mebendazole & Thiabendazole-synthesis and applications.

6. Antiemetic Agents and Antiamoebic Agents:

Trimethobenzamide – Diphenidol - Metaclopramide-synthesis and therapeutic uses - Metronidazole-synthesis, uses & dosage forms.

7. Sedatives, Hypnotics and Anti-Cancer Agents:

Definition and Classification of Sedative and hypnotic agents - Chlorodiazepoxide, Diazepam, Nitrazepam etc - Chemotherapy of Cancer - Synthesis and uses of Fluorouracil.

8. Pharmaceutical Formulations:

Introduction - Need for the conversion of drugs into medicines - Additives & their role - Route-wise and Form-wise dosage forms - Solid dosage forms - liquid dosage forms & semi-solid dosage forms - Ointments and Creams.

References:

1. *Chemistry of Synthetic Drugs* by N. Evers and D. Caldwell, Ernest Benn Ltd, London.
2. *Berger's Medicinal Chemistry*, Vols. I & II.
3. *Essentials of Medicinal Chemistry*, by A. Kotolkavas and J.H. Burckhalter, Wiley Interscience.
4. *Medicinal Chemistry*, by Ashutosh Kar, New Age International Ltd.
5. *Synthetic Drugs and Polymers* by D. Dasarath, Sri Vani Publishers, Mumbai (2002).

6. *Principles of Organic Medicinal Chemistry* by Rama Rao Nadendla, New Age International (P), Ltd., Publisher, New Delhi, Hyderabad (**2005**).

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D Biotechnology

(09PH23208) DOWNSTREAM PROCESSING

- 1. Introduction:** Basic concepts of bio-separation process, Separation characteristics of proteins and enzymes-size, stability, properties, purification methodologies. Characteristics of bio products, over view of reaction, processes involved in separation, numerical examples illustrating the process.
- 2. Filtration and centrifugation:** Filtration at constant pressure and at constant rate; empirical equations for batch and continuous filtration, centrifugal and cross-flow filtration, Centrifugation: basic principles, design characteristics; ultracentrifuges: principles and applications.
- 3. Techniques Involved in Separation Processes;** Solvent extraction of bio-processes, aqueous two-phase extraction, adsorption-desorption process; Salt precipitation.
- 4. Chromatography:** Chromatographic separation based on size, charge, hydrophobic interactions and metal ion affinity. Affinity chromatography, inhibitors; their preparation and uses, method of linkages.
- 5. Electrophoresis:** SDS-PAGE(Polyacrylamide Gel), horizontal and vertical type, methods, case studies.
- 6. Membrane based separation processes:** Micro-filtration, Reverse osmosis, Ultra filtration and affinity ultra filtration, concentration polarization, rejection, flux expression, Membrane modules, dead-ended and cross-flow mode, material balances and numerical problems, biological applications.
- 7. Products polishing:** Crystallization. Product recovery trains –a few examples.
- 8. New and emerging techniques:** Pervaporation, Super critical extraction, Foam based separation.

References:

- 1. Downstream processing for Biotechnology**, P.A. Belter, E.L. Cussler and Wei-shou Hu, Bioseparations Wiley-Interscience, 1st edition, 1988.
- 2. Biochemical Engineering fundamentals**, 2nd ed. By J E Bailey and D F Ollis, McGraw Hill (1986)
- 3. Principles of fermentation technology**, by P F Stanbury and A Whitaker, Pergamon press(1984)
- 4. Comprehensive Biotechnology**, Vol.2 Ed; M.Moo-young(1985)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D Biotechnology

(09PH23209) NANOBIO TECHNOLOGY

1. Nanomaterials Properties

Nanomaterials: Introduction, Properties of materials & nanomaterials, role of size in nanomaterials. Electronic Properties, Classification of materials: Metal, Semiconductor, Insulator and Band structures, Brillouin zones. Dielectric Properties, Polarization, ferroelectric behaviour. Magnetic Properties, Fundamentals of magnetism, Different kind of magnetism in nature: Dia, Para, Ferro, Antiferro, Ferri, Superpara. Important properties in relation to nanomagnetism. Thermal Properties Concept of phonon, Thermal conductivity, Specific heat, Exothermic & endothermic processes.

2. Nanomaterials Synthesis

Physical Methods- Inert gas condensation, Arc discharge, Plasma arc technique, Ion sputtering, Laser pyrolysis, Chemical vapour deposition method and Electro-deposition. Chemical Methods- Metal nanocrystals by reduction, Photochemical synthesis, Electrochemical synthesis, Liquid-liquid interface, Hybrid methods, Solvated metal atom dispersion, Post-synthetic size-selective processing. Biological Methods of Synthesis- Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Viruses as components for the formation of nano-structured materials.

3. Carbon Nanotube

Preparation of Carbon Nano-Tubes- CVD and other methods of preparation of CNT Properties of Carbon Nanotubes- Electrical, Optical, Mechanical, Vibrational properties etc. Applications of Carbon Nanotubes- Field emission, Fuel Cells, Display devices. Other Important Carbon based materials- Preparation and Characterization Fullerene and other associated carbon clusters/molecules, Graphene-preparation, characterization and properties, DLC and nano-diamonds.

4. Nanosensors

Micro and nano-sensors, Fundamentals of sensors, biosensor, MEMS and NEMS. Sensors for aerospace and defense: Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry, Sensor for bio-medical applications: Cardiology, Neurology and as diagnostic tool, For other civil applications: metrology, bridges etc. Biosensors: Clinical Diagnostics, generation of biosensors, immobilization, characteristics, applications, conducting Polymer based sensor, DNA Biosensors, optical sensors. Biochips.

5. Nanodevices

Metal Insulator Semiconductor devices, molecular electronics, information storage, molecular switching, Schottky devices. Quantum Structures and Devices. Quantum layers, wells, dots and wires, Mesoscopic Devices, Nanoscale Transistors, Single Electron Transistors, MOSFET and NanoFET, Resonant Tunneling Devices, Carbon

Nanotube based logic gates, optical devices. . Connection with quantum dots, quantum wires, and quantum wells.

6. **Nanocomposites**

Metal based nanocomposites- Metal-Oxide or Metal-Ceramic composites, their preparation techniques and their final properties and functionality. Metal-metal nanocomposites, some simple preparation techniques and their new electrical and magnetic properties. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Electrical property of fractal based nanocomposites. Polymer based nanocomposites- Preparation and characterization of diblock Copolymer based nanocomposites; Polymer-carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

7. **Bionanocomposites**

Nanocomposite biomaterials, teeth and bone substitution- Natural nanocomposite systems as spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. DNA as functional template for nanocircuitry; Protein based nanocircuitry; Neurons for network formation. DNA nanostructures for mechanics and computing and DNA based computation; DNA based nanomechanical devices. Nanoparticles for bioanalytical applications- Nanodevices for sensing and therapy. Use of nanoparticles for MRI, X Ray, Ultrasonography, Gamma ray imaging. Nanoparticles as molecular labels; biological labeling using quantum dots as molecular labels; Tissue Engineering.

8. **Optical Properties of Nanomaterials and Plasmonics**

Optical luminescence and fluorescence from direct, bandgap semiconductor nanoparticles, surface-trap passivation in core-shell nanoparticles, carrier injection, polymer-nanoparticle LED's and solar cells, electroluminescence; barriers to nanoparticle lasers; doping nanoparticles, light emission from indirect semiconductors, light emission from Si nanodots.

Elements of Plasmonics- Introduction: Plasmonics, merging photonics and electronics at nanoscale dimensions, single photon transistor using surface plasmon, nanowire surface plasmons-interaction with matter, single emitter as saturable mirror, photon correlation, and integrated systems.

References:

1. **Nanomaterials Handbook**- Yury Gogotsi
2. **Introduction to Nanotechnology** - Charles P. Poole Jr. and Franks. J. Qwens
3. **Nanomaterials Handbook**- Yury Gogotsi
4. **Chemistry of nanomaterials** : Synthesis, properties and applications by CNR Rao et.al.
5. **Properties and Applications**- Carbon Nanotubes Michael J. O'Connell
6. **Nanotubes and Nanowires**- CNR Rao and A Govindaraj RCS Publishing
7. **MEMS & MOEMS Technology and Applications**- P. Rai Choudhury
8. **Nanocomposites Science and Technology** - P. M. Ajayan, L.S. Schadler,
9. **Bionanotechnology: Lessons from Nature** by David S. Goodsell
10. **Springer Handbook of Nanotechnology** by Bharat Bhushan

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D Biotechnology

(09PH23210) MICROBIAL BIOTECHNOLOGY

1. Microbial Growth and Physiology

Ultrastructure of *Archea* (*Methanococcus*) – Eubacteria (*E.coli*) – unicellular eukaryotes (yeast) and viruses (Bacterial, plant, animal and tumour viruses) – Microbial growth: Batch, fed-batch, continuous kinetics, synchronous growth, yield constants, methods of growth estimation, stringent response, death of a bacterial cell.

Microbial Physiology: Physiological adaptation and life style of prokaryotes – unicellular eukaryotes and the extremophiles (with classical example from each group).

2. Microbes of Environment:

Role of microorganisms in natural system and artificial system – influence of microbes on the Earth's environment and inhabitants – 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.

3. Fermentation: Raw materials used as media for industrial fermentations – development of inocula for industrial fermentations – isolation, preservation and strain improvement of industrially important microorganisms.

4. Bioreactors – designing and application of biofermentor – aeration, agitation and sterilization of fermentors – surface, submerged, batch and continuous fermentations – scale-up of fermentations.

5. Bioprocessing – recovery of particulates, product isolation, extraction, precipitation, chromatography, centrifugation, membrane separation, electrophoresis, distillation, super-critical fluid extraction, whole broth processing, integrated product separation and purification.

6. Industrial production - (1)antibiotics – streptomycin, penicillin, cephalosporin and tetracycline, (2) biomass production of *Bacillus megaterium*, *Acinetobacter cerificans*, *Candida utilis* from hydrocarbons, (3) organic acids- citric acid, lactic acid (4) amino acid- L-lysine (5) Enzymes- amylase, protease and lacase, stabilization of enzymes (6) Vaccines- rabies, FMD vaccines, hepatitis B (7) Alcohol- ethanol and butanol. 8. Food- cheese, yogurt and flavoring components

7. **Bio-Leaching-** Microbial leaching – Organisms of leaching, chemistry of microbial leaching, commercial process
8. **Bio-fertilizers and biopesticides:** Biofertilizers – Cultivation, mass production and inoculation of *Rhizobium*, *Azotobacter*, *Azospirillum*, *Azolla* and cyanobacteria, phosphate-solubilizing bacteria. Carrier-based inoculants, methods of application, quality control, agronomic importance. Microbiology and biochemistry of biogas production.
9. Biopesticides- *Bacillus thuringiensis*, microbial control of plant pathogens (baculovirus, bacterial and fungal).

References:

1. **Principles of fermentation technology (2nd edition)** by STANBURY, WHITAKER & HALL.
2. **Biotechnology: A Text Book of Industrial microbiology 2nd edition** by CRUEGER & CRUEGER.
3. **Microbial Technology Vol I** by PEPPLER & PEARLMAN (Editors).
4. **Microbial Technology Vol II** by PEPPLER & PEARLMAN (Editors).
5. **Immobilized cells: Principles and Application** by TAMPION & TAMPION.
6. **Methods in Food and Dairy Microbiology** by DILIELLO.
7. **Industrial Microbiology** by CASIDA.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D Biotechnology

(09PH23211) ENVIRONMENTAL BIOTECHNOLOGY

1. Environmental Pollution:

Atmosphere – hydrosphere – lithosphere – biosphere – source of pollutions – nature of pollutants – pollution monitoring & measurements – ecosystem – global environmental problems.

2. Structural & Functional dynamics of Microbial life:

Microbial diversity – microbial activity & growth – microbial community profiling – molecular basis of microbial community profiling – limitations of genetic fingerprinting techniques – biosensors – bioreporter - microchips – microscopy in environmental applications.

3. Air & Water Pollution:

Indoor air pollution control – out door air pollution control – particulate emission control – control of gaseous emissions – control of pollutants from vehicles – primary water treatment – secondary water treatment – alternative water treatment – management of solid waste – treatment of disposal of non-hazardous solid waste – medical solid waste management – processing & disposal of medical wastes – hazardous waste treatment process – soil pollution – soil erosion – soil conservation – potential emergency control methods.

4. Lignocellulose Degradation:

Micro organisms of lignocellulose degradation – degradation of lignocellulose – modular structure of cellulases & xylanases – directed evaluation of enzyme catalysts – prospects of bioconversions – bioutilisation of effluent – prospects of genetic engineering in bioconversion.

5. Degradation of Xenobiotic Compounds:

Xenobiotic compounds in environment persistent compounds – chemical properties of influencing biodegradability – micro organisms for biodegradation mechanism – genetics & evaluation for biodegradation – characteristics of aerobic micro organisms for degradation of organic pollutants.

6. Bioabsorption of metals & Bioremediation:

Micro organisms & metal absorption – mechanisms of bacterial metal resistance – factors effecting bioabsorption – bioreactors – phytoremediation – mechanisms of bioabsorption & bioaccumulation in specific metals – bioremediation by micro organisms – bioremediation technologies – measuring bioremediation in the field – efficiency of bioremediation.

7. Biofertilizers & Biopesticides:

Types of composting – composting process - physico-chemical characteristics of the environment – methods for composting – vermicomposting – biofertilizers in agroecosystem – biopesticides – advantages of biopesticides – microbial & antimicrobial pesticides – characteristics of pesticides.

8. Applications:

Preparation, properties & applications of biopolymers, bioplastics, bioleaching, biomethanation – advantages of biodiesel – evaluation of the toxicity of biofuel – production of biofuel – pulp and paper industry – tanning industry – distilling industry – dye industry – antibiotic industry – petroleum industry –dairy industry.

References:

1. *Biotechnology* by U. Satyanarayana, Books and Allied (P) Ltd, Kolkata.
2. *Environmental Biotechnology* by Indu Shekhar Thakur., IK International pvt. Ltd.
3. *Environmental Chemistry* by A.K. De, Wiley Eastern Ltd., New Delhi.
4. *Introduction to Biodeterioration* by D. Allsopp and K.J. Seal. ELBS/Edward Arnold.

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
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Pre-Ph.D Biotechnology

(09PH23212) MOLECULAR VIROLOGY

1. Introduction

History and principles of virology, virus taxonomy, introduction to replication strategies. *Infrastructure*: Principles of bio-safety, containment facilities, maintenance and handling of laboratory animals and requirements of virological laboratory

2. Virus structures, animal and plant viruses

Virus structure and morphology, viruses of veterinary importance and plant viruses.

3. Virus Replication

RNA viruses: General strategies, replication of plus stranded RNA virus (polio), negative strand RNA viruses (VSV and influenza). Other RNA viruses Replication of double stranded RNA virus (rota), ambisense RNA (LCM) and retroviruses (HIV and HTLV). DNA viruses , Replication of double stranded DNA viruses (SV40, pox), ssDNA virus (AAV), Prion proteins, replication of plant virus (Poty).

4. Antivirals and Viral Vaccines

Conventional vaccines -killed and attenuated, modern vaccines—recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines), vaccine delivery and adjuvants, large scale manufacturing—QA/QC issues.

Antivirals : Interferons, designing and screening for antivirals, mechanisms of action, antiviral libraries, antiretrovirals—mechanism of action and drug resistance.

Modern approaches of virus control Anti-sense RNA, siRNA, ribozymes, in silico approaches for drug designing.

5. Virological methods

Cultivation and purification of viruses 5 hrs. In vivo, in vitro and in ovo systems for virus growth, estimation of yields, methods for purification of viruses with special emphasis on ultracentrifugation methods.

6. Diagnostic methods

Immuno diagnosis, haemagglutination and haemagglutination-inhibition tests, Complement fixation, neutralization, Western blot, RIPA, flow cytometry and immunohistochemistry. *Nucleic acid based diagnosis* Nucleic acid hybridization, polymerase chain reaction, microarray and nucleotide sequencing.

Microscopic techniques Fluorescence, confocal and electron microscopic techniques -- principles and applications. *Analytical techniques*. Electrophoresis, chromatography, membrane filtration, NMR, X-ray crystallography.

7. Veterinary and Agricultural viruses

Viral diseases of veterinary importance will cover History, Disease burden, Clinical presentation and diagnosis, Epidemiology and risk factors, virus replication strategy, Pathogenesis, zoonotic importance and Prevention and treatment of species of agricultural importance. *Farm animals* Cattle diseases: Foot and Mouth Disease, Bovine Ephemeral fever, Rinderpest, Bovine Spongiform encephalopathy Sheep and goat diseases: Bluetongue, Nairobi sheep disease/ Ganjam, Peste des Pestits ruminants, Rift Valley Fever Pig diseases: Swine influenza, Japanese Encephalitis, Hog cholera/ swine fever Horse diseases: Equine influenza, Equine infectious anemia and equine encephalitis. Dog diseases: Rabies, Infectious canine hepatitis Canine distemper *Poultry and other animals* Poultry diseases: Newcastle disease, Marek's disease, Avian influenza. Viral diseases of laboratory animals. Viral diseases of honeybees, silkworm and fishes.

8. HIV/ AIDS

Natural History of AIDS, Global epidemiology of HIV, epidemiology of HIV in India. Sexually transmitted diseases and their relation with HIV, opportunistic infections in HIV infected individuals. Social and behavioural aspects of prevention and control. Natural history. Biology of HIV and its detection Structure and replication of HIV, immunopathogenesis of infection, laboratory diagnosis of HIV infection. HIV isolation, characterization and viral estimation.. *Preventive and therapeutic approaches* Trials pertaining to prevention and therapy, Antiviral therapy and drug resistance HIV vaccines.

References:

1. **Virology Methods Manual.** Brian W.J. Mahy (Editor), Hillar O. Kangro (Editor). Latest edition / Pub. Date: January 1996. Publisher: Elsevier Science & Technology Books.
2. **Methods and Techniques in Virology.** Pierre Payment, Trudel (Editor). Latest edition / Pub. Date: July 1993. Publisher: Marcel Dekker.
3. **Diagnostic Virology Protocols: Methods in Molecular Medicine.** John R. Stephenson (Editor), Alan Warnes Latest edition / Pub. Date: August 1998. Publisher: Humana Press.
4. **Diagnostic Procedures for Viral, Rickettsial, and Chlamydial Infections.** Edwin H. Lennette (Editor), David A. Lennette, Evelyne T. (Eds.) Lennette, Evelyne T. Lennette (Editor). Latest edition / Pub. Date: January 1995. Publisher: American Public Health Association Publications.
5. **Fields Virology** Vol 1 and 2. B.N. Fields, D.M. Knipe, P.M. Howley, R.M. Chanock, J.L. Melnick, T.P. Monath, B. Roizman, and S.E. Straus, eds.), 3rd Edition. Lippincott-Raven, Philadelphia, PA.
6. **Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses.** S. J. Flint, V. R. Racaniello, L. W. Enquist, V. R. Rancaniello, A. M. Skalka. Latest edition / Pub. Date: December 2003 Publisher: American Society Microbiology--- Chapters 3-13.
7. **Laboratory Animal Medicine: Principles and Procedures.** Margi Sirois. Latest edition / Pub. Date: November 2004. Publisher: Elsevier Health Sciences.
8. **HIV and Aids** by Michael A. Palladino, David Wessner. Latest edition / Pub. Date: March 2005 Publisher: Benjamin Cummings.
9. **HIV Libman, Harvey J.** Makadon. Royal Society of Medicine Press Ltd. 2006.
10. **Veterinary Virology**, II edition, authors: Frank Fenner et al, Academic press, Inc,

California, USA.

11. **Vetrinary Medicine** by Blood and Henderson.