Department of Biosciences

Faculty of Natural Sciences

JAMIA MILLIA ISLAMIA
NEW DELHI-110 025

M.Sc. Biosciences (Previous & Final)

Syllabus (w.e.f. 2002-2003)

DEPARTMENT OF BIOSCIENCES

FACULTY OF NATURAL SCIENCES

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M.Sc. BIOSCIENCES
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INDEX

M.Sc. (Previous)

Subjects		**Max. Marks**		
		Theory	**Internal Assessment**	**Total**
Immunology	(BSM)	75	25	100
Biochemistry	(BSM)	75	25	100
Molecular Genetics	(BSM)	75	25	100
Biophysics & Bioinformatics	(BSM)	75	25	100
Molecular Biology of Cell	(BSM)	75	25	100
Microbiology	(BSM)	75	25	100
Practical				200

M.Sc. (Final)

Plant Physiology	(BSM)	75	25	100
Genome Biology	(BSM)	75	25	100
Physical Chemistry of Proteins and Enzymes	(BSM)	75	25	100
Environmental Biology	(BSM)	75	25	100
Animal Physiology	(BSM)	75	25	100
Practical		--	--	200
Project				150

- Internal / Continuous Assessment as per rules.

Immunology (BSM – w.e.f. 2002-2003)

Unit I

1. Introduction Phylogeny of Immune System ; Innate and Acquired System; Clonal nature of Immune Response.
2. Organisation and structure of lymphoid organs.
3. Cells of the Immune system: Hematopoiesis and differentiation, Lymphocyte traffic, T- lymphocytes and B- lymphocytes, Macrophages, Dendritic cells, Natural killer and Lymphokine activated killer cells , Eosinophils, Neutrophils, Basophils and Mast Cells.
4. B-cells and T-cell receptors, generation of diversity.

Unit II

1. Nature and biology of antigens.
2. Antibody generation, structure and function.
3. Antigen- antibody interactions.
4. Monoclonal antibodies and Hybridoma technology, ELISA and RIA, Flourescence and Spectral methods used in Immunology.
5. Major histocompatibility complex.

Unit III

1. The Complement System.
2. Regulation of Immune Response—Antigen processing and presentation, generation of humoral and cellular immune responses. Activation of B- and T-lymphocytes. Cytokines and their role in immune regulation. T- cell regulation, MHC restriction.
3. Cell-mediated cytotoxicity: Mechanism of T-cell and NK cell mediated cytotoxicity, Macrophage mediated cytotoxicity.

Unit IV

1. Immunological tolerance and immunosuppression.
2. Hypersensitivity.
3. Autoimmunity

Unit V

1. Transplantation
2. Tumor immunology.
3. AIDS and other immunodeficiencies.

Recommended Books

1. R.A.Goldsby, T.J. Kindt and B.A. Osborne, 1994, Kuby Immunology, W.H.Freeman, New York.
2. Paul, 1993, Fundamentals of Immunology, Raven Press.
3. B.Davey, Immunology.
4. Tizard, Immunology, Philadelphia : Daunders College Publishing.
5. Coleman, Immunology, WCB / McGrawHill
6. Weir and Roitt, 2000, Immunology, Mosby.

Biochemistry (BSM – w.e.f. 2002-2003)

Unit I : Vitamins

Vitamins: their coenzyme forms, biochemical function, important sources, recommended dietary allowance and deficiency symptoms.

Unit II : Carbohydrate Metabolism

Principles of bioenergetics, Glycolysis: its stages, enzymatic steps, energetics, balance sheet and regulation. Entry of important monoscaccharides and disaccharides in glycolysis HMP pathway, Glycogenolysis, PDH reaction, Tricarboxylic acid cycle: kreb's discovery, enzymes and their location, reactions, isoltopic tests, amphibolic nature, energetics and regulation, gluconeogenesis from amino acids and TCA cycle intermediates, synthesis of glycogen and important disaccharides, Hormonal regulation of carbohydrate metabolism.

Unit III : Lipid Metabolism

Mobilization of lipids, Oxidation of lipids: beta oxidation. Oxidation of unsaturated and odd chain fatty acids, energetics, Formation and oxidation of ketone bodies. Biosynthesis of saturated fatty acids: carbon sources, acetyl CoA carboylasce and reactions of Fatty acid synthase, synthesis of odd chain and unsaturated fatty acids. Triacyle glycerol and phosphoglycerides. Biosynthesis of cholesterol and its regulation.

Unit IV : Amino acid Metabolism

Amino acid oxidation: flow sheet, deamination and transamination reactions, alpha ketoglutorate, Succinate, fumarate and oxaloacetate pathways of amino acid oxidation. Metabloic fates of amino groups, role of glutamate and glutamine, urea-cycle: reactions and regulation. Biosynthesis of standard essential and non essential amino acids, regulation of amino acid biosynthesis, genetic defects in amino acid metabolism.

Unit V : Nucleotide Metabolism

Degradation of purine & pyrimidine nucleotides and its regulation. Biosynthesis of purine & pyrimidine nucleotides, de-novo pathway, salvage, reaction of ribonucleotide reductase and its regulation, purine nucleotide cycle. Genetic defects in nucleotide metabolism, Enzymes of nucleotide metabolism as sites for chemotherapy.

Recommended Books

1. Voet & Voet, 1999, Biochemistry, John Wiley, New York
2. Zubay, Biochemistry, 1995, Brown Publishers.
3. Lehminger, Biochemistry,1998.
4. Stryer, Biochemistry, 1981, W.H. Freeman.
5. Harper, Biochemistry, 2003, McGrawHill.

Molecular Genetics (BSM – w.e.f. 2002-2003)

Unit I: Structure and Replication of Nucleic Acids

Primary and Secondary structure of Nucleic Acids, Pioneering experiments leading to the development of modern genetics, Structure of DNA and the Gene, Fine structure of the gene. Gene-protein relationship, DNA Replication models of DNA replication, semiconservative replication, organization of the replicating chromosome, mechanism of replication, Enzymes involved in replication.

Unit II: Genome in Flux

Recombination in bacteria and their viruses, Conjugation and transformation, sex factors, high frequency recombination strains, Generalized and Specialized transduction, Gene conversion and Genetic mapping, Plasmids, General homologous recombination. Site specific recombination, Transposable elements, Mechanism of transposition.

Unit III: Mutation and DNA Repair

The molecular basis of gene mutation, Consequences of mutations for protein structure, Induction of mutations in prokaryotes. Chemical mutagenesis in higher organisms, Repair of DNA damage: Photoreactivation, excision, post replication and SOS repair mechanisms, Factors determining sensitivity to DNA –damaging agents, Repair of DNA damages in higher organisms.

Unit IV: Expression of Genetic Information

Transcription of DNA: RNA polymerase, sigma factor, Initiation, chain elongation, termination, posts transcriptional modifications, and mRNA and antibiotics affecting transcription. The Genetic Code: evolution of the code, degenerate triplet code, Protein synthesis: t-RNA as adapter molecule, ribosome structure, ribosomal genes. Initiation, elongation and termination of protein synthesis, Modifications of protein synthesis, Inhibitors of protein synthesis.

Unit V: Regulation of Gene Function

Enzyme induction and repression, The lac operon: negative control, catabolic repression of the lac operon: positive control, Positive control with superimposed negative control, The arabinose operon, Negative control with superimposed attenuation: the tryptophan genes. The lambda phage: a complex of operons. Antisense RNA.

Unit VI: Recombinant DNA Technology

Early discoveries, the beginning of recombinant DNA technology, Restriction endonucleases, Joining DNA molecules, Restriction mapping vectors, cloning, selection of recombinant clones, DNA Sequencing, gene probes, other applications of recombinant DNA technology.

Unit VII: Eukaryotic Genome Organization

Structure of chromatin, packaging of DNA, coding and non coding sequences, satellite DNA Transportation in eukaryotes RNA processing (capping, polyadenylation, introns and exons), Ribonucleoproteins, structure of mRNA translational modification.

UNIT VIII

The law of DNA constancy and C value paradox; Numerical and structural changes in chromosomes; Molecular basis of spontaneous and induced mutations and their role in evolution; Environmental mutagenesis and toxicity testing; Population genitics. Polyploidy : Genetic variability.

Recommended Books:

1. Benjamin Lewin, Genes VII, Oxford University Press.
2. Benjamin Lewin, Gene Expression (Bacterial Genome), Volume – I, A Wiley-Interscience Publication.
3. David Friefelder, 1993, Molecular Biology, Jones and Bartlett Publishers, Bostan, London.
4. Arthur Kornberg, 1991, DNA Replication, W.H. Freeman & Co.
5. Ernst, L. Winnacker, 1987, From Genes to Clones (Introduction to Gene Technology) VCH Verlags Gesellschoft mbh, D-6940, Weinheim, Germany.

Biophysics and Bioinformatics (BSM – w.e.f. 2002-2003)

(Part A)

Biophysics

Unit I: Membrane Biophysics

Membrane structrue, passive ion transport, ion channels, genesis of membrane potential in nerve & membrane, Nerst & Goldman equation, Theory of excitation.
recording instruments used in measuring membrane potential.

Unit II: Thermodynamics & Hydrodynamics

Laws of thermodynamics Entropy, Enthalpy, Living Body as thermodynamics system, Concept of closed system & open system.Thermodynamic equilibrium & physiological steady state Osmosis, Permeability, viscosity, thermoregulation. Principles of hydrodynamics poise eqn.

Unit III: Radiation Biophysics

Ionizing and non-ionizing radiations, Free radicals, Ion pairs, radiation units and dosimetry. Direct and indirect radiation action, radiation on proteins, nucleic acids, carbohydrates, cell and whole organisms, Genetic effect of radiation. Radiation in diagnosis and therapeutics, protection from radiation.

Unit IV: Molecular Biophysics

X-ray diffraction studies and NMR studies on mono and oligo-nucleotides, DNA polymorphism, parameters for a-, B-,C-, D-, and Z-DNA. Definitions of roll, tilt and propeller twist. Interaction of DNA with protein, drugs, dyes and carcinogens.

(Part B)

Bioinformatics

Unit I: Introduction to Bioinformatics and Bioinformatics Basics

What is Bioinformatics, Biosciences, Emerging areas in Bioinformatics, Future prospects of Bioinformatics, Introduction to Genomics, Introduction to Proteomies, Human Genome Project, Public Database, Gene Bank, Using fPublic Database.

Unit II: Computer Basics

Computer and its components, Characteristics of computer, Types of Digital Computer, Main Frame, Workstation, Super computer.
Hardware basics: Processor, motherboard slots/cards, bus parallel and serial ports, various storage devices, Client-Server concepts, Memory.

Software basics: Data vs. information, Software: types of software's,
Firmware, Operating system, Languages, Compilers, Interpreters, Ideas of portability and platform dependence, MS-DOS, Windows, Unix, Linux.

Unit III: Bioinformatics Tools, Techniques and Methods

DNA and Protein sequence analysis DNA and protein sequence anaylysis, tools, BLAST, FASTA, Protein Visualization tools, Ras Mol. VMDL, Chyme, ORF finder, Gene finder, Gene Scan.

Biological databases: Medilin EMBL Genebank, PubMed, PDB, Entry and retrieval of Data from public databases.

Unit IV: Bioinformatics Programming

C/C++, PERL, BIOPERL

C/C++: C/C++ Basics, Control Structure, Loop Array,

Perl: Variable, Loop, Array Harsh Regular Expression

Bio Perl: Basics of Bio Perl.

Unit V: Database and Internet Requirements for Bioinformatics

Database: Database basics, RDBMS, MS Access, My SWL, ER Diagram, Relationship.

Internet: Internet and its application, Web server, LAN WAN, Client Server Principles, websites, Protocols and search tools, web browsers, HTML, CGI, ISDN and Dial up connection, Bioinformatics resources on internet.

Unit VI: Biostatistics

Brief description and tabulation of data and its graphical representation.

Measures of central tendency and dispersion: mean, median, mode, range, standard deviation, variance. Idea of two types of errors and level of significance, tests of significance (F &t test); chi-square tests.

Simple linear regression and correlation.

Computer – Oriented Statistical Techniques.

Frequency table of single discrete variable. Bubble sort, Computation of mean, variance and standard deviation; t-test, correlation coefficient.

Recommended Books

1. David W. Mount, Bioinformatics, Seqence & Genome Analysis, Cold Spring Harbor Lab Press.
2. Yaswant Kanitkar, Programming in C, BPB Publications
3. Raja Raman, Computer Basics, TATA McGraw Hill Publication.
4. Stephen Misener and Stephen A. Krawetz, Bioinformatics Methods and Protocols, Humana Press Totwa, New Jersey.
5. D. Higgins and W. Taylor Bioinformatics: Sequence, Structure and databanks Oxford University Press.

Molecular Biology of Cell (BSM – w.e.f. 2002-2003)

Unit –I. Evolution of Cells
Introduction of Evolution, Prebiotic Synthesis, RNA Catalysis: A basis for a precellular genetic system, A reconstruction analysis of cell lineages, Evolution of gene structure: lessons from present day introns distribution.

Unit-II. Plasma Membrane
Early membrane models, Principles of membrane organisation, Detailed structure of erythrocyte membrane, Transport across membrane- Diffusion of small molecules across phospholipid bilayer, overview of membrane transport proteins, Intracellular Ion environment and membrane electric potentials.GLUT1 transport glucose into mammalian cells, Ca++-ATPase, Na+/K+ ATPase, Na+ linked symporters, Import amino acids and glucose , Na+-linked Antiporter Ca++ from cardiac muscle cells.

Unit –III. Internal membrane
Compartmentalisaton of eukaryotic cells, Structure and functional features of Endoplasmic reticulum, Golgi complex, Lysosome, Mitochondria . Structure of Chloroplast. Ribosomes.

Unit-IV Nucleus and Cell Cycle
Nuclear envelope: morphology, ultrastructure and biochemical role of nuclear envelope in nucleocytoplasmic interacton.

Cell Cycle, Chromosome, morphology, composition, Organization of DNA into chromosome.

Unit-V. Eukaryotes chromosomes and Gene.
Major classes of eukaryotes genes, Duplicated protein coding genes, Tandemly repeated genes encoding r-RNA and Histone, Repetitious DNA function, simple sequence DNA, Intermediate repeat DNA and mobile DNA elements, Functional rearrangement in chromosomal DNA.

Unit -VI. Cancer and Cell Death
Characteristic of tumour cells, Use of cell culture in cancer research, DNA viruses and transforming agents. Human tumour viruses, Chemical carcinogencesis. The role of radiation and DNA repair in carcinogenesis, Oncogenes and their proteins: Classification and characterisation, The role of cellular oncogenes in carcinogenesis, The multistep nature of carcinogenesis, Ageing, Apoptosis.

Unit-VII. Techniques in Cell Biology
Principles and application of scanning and transmission electron microscopy.
Techniques for the preparation of material for electron microscopy.
Separation of cell organelles.

Books Recommended:

1. Albert B, Bray D, Raff M, Roberts K, Watson JD, 1994, Molecular Biology of the Cell, IIIrd ed., Garland Publishing Inc., New York.

2. Lodish H, Berk A, Zipursky Sl, Matsudaira P, Baltimore D, Darnell J, 2000, Molecular Cell Biology, IV ed., W.H.Freeman and company.

Microbiology (BSM – w.e.f. 2002-2003)

Unit I: Concepts and Tools in Microbiology

History and Scope of Microbiology. Microbial Biodiversity: Prokaryotes and Eukaryotes, Bacteria, Rickettsias, Chlamydias, Mycoplasmas, Cyanobacteria, Protozoa, Fungi, Algae and Viruses. Major Characterstics used in classification of Microorganisms.. Classification systems: Numerical Taxonomy, Phylognetic system, Phenetic Systems, Bacterial taxonomy and Bergie's Manual of Bacteriology. Techniques used in observation of microorganisms. Light microscopy: Bright–Field microscope, Dark-Field microscope, Phase-Contrast microscope, Preparation and staining of Specimen. Electron microscopy: Transmission electron microscope, Scanning electron microscope, Specimen Preparation for electron microscopy, Limitations of electron microscopy.

Unit II: Structure, Nutrition, Growth and Physiology

Bacterial size, shapes and pattern of arrangement. Structures external to cell wall: Flagella, Pili, Capsule, Sheath, Prosthecae and Stalk. Structure and chemical composition of cell wall. Structures internal to cell wall: Cytoplasmic membrane, Protoplast, Spheroplast, Cytoplasmic inclusions, Nuclear material, Spores and Cysts. Nutritional types of bacteria. Bacteriological media. Physical conditions influencing growth: Solutes and water activity, pH, temperature, Oxygen concentration, Pressure, Radiation etc. Modes of cell division, Growth curve, Synchronous growth, Batch culture, Continuous culture, Quantitative measurement of growth. Bacterial Metabolism: Breakdown of glucose to pyruvate, TCA cycle, Electron transport and oxidative phosphorylation, Fermentation and anaerobic respiration.

Unit III: Control of Microorganisms

Definitions and fundamentals of control. Conditions influencing antimicrobial action. Physical agent / processes used for control: Heat, Filtration, Radiations. Chemical agents: Phenolics, Alcohols, Halogens, Heavy metals, Quarternany ammonium compounds, Aldehydes, Sterilizing gases. Evaluation of antimicrobial agent effectiveness. Chemotherapeutic agents and antibiotics: History of chemotherapy, General characteristics, sulfonamides, Penicillin, Cephalosporin, Aminoglycosides, Chloramphenicoal and other antibiotics, Antifungal drugs. Drug Resistance: Mechanism of drug resistance, Origin and transmission.

Unit IV: Medical Microbiology

Germ free (Gnotobiotic) animals. Normal microflora of human body: Skin, Eye, Respiratory tract, Intestinal tract, Genitourinary tract. Host parasite interaction. Determinants of infectious diseases: Transmission, Attachment, Colonization, Entry, Growth and multiplication. Toxigenicity. Exotoxin, Endotoxins, Leukocidin, Haemolysins. Nonspecific Defense Mechanisms of Host: General barriers, Physical barriers, Chemical barriers, Biological barriers, Phagocytosis, Inflammation, Fever.

Unit V: Food Microbiology

Microorganisms found in food and their sources. Extrinsic and intrinsic parameters of food affecting microbial growth. Microbial spoilage of Vegetable, Fruit, Dairy products, Beer and wine. Food preservation: Physical removal of microorganisms, Temperature effects, Chemical agents and Radiation. Food borne diseases. Microbiology of fermented food: Dairy products, wine, Beer and other fermented alcoholic beverages. Microorganisms as a source of food.

Unit VI: Virology

History of Virology, Distinctive properties of Viruses, Viroids and Prions. Cultivation of Viruses. Virus Purification and assays. General morphology. Viral nucleic acid and its replication. Capsid and envelope. Bacteriophages. Morphology and structure. Replication: Adsorption, Penetration, Synthesis of nucleic acid and protein, Assembly and release. Temperate phages and Lysogeny. Control of viruses: Interferon, Chemical antimicrobial agents and Antiviral antibiotics.

Recommended Books:

1. Madigam, Martinko & Parker, Brock Biology of Microorganisms, Prentice-Hall
2. Stanier, Ingraham, Wheelis & Painter, The Microbial World, Prentice-Hall
3. Talaro and Talaro, Foundations in Microbiology, (WCB)
4. Pelczer & Krieg, Microbiolgoy, (McGraw Hill)
5. Harley & Klein, Microbiology, Prescot, (WCB)
6. Ronald M. Atlas, Microbiology, Fundamentals and Application, McGraw Hill
7. Davies, Dulbecco Eissen and Ginsberg, Microbiology, (Lippincott)
8. Tortora, Funke & Case, Microbiology, An Introduction, Addison Wesley and Longman Inc.
9. James M. Jay, Modern Food Microbiology, Chapman and Hall
10. Volk, Beniganin, Kodner & Parsons. Essentials of Medical Microbiology.
11. Alcamo, Fudamentals of Microbiology, Addition Wesley Long Inc.
12. Elint, Enquist, Krug, Racaniello & Shalker, Pinciple of Virology, (ASM)
13. R.E.F. Mathews, Plant Virology (Academic Press)
14. Cary, Foster & Taylor, Plant Virology Protocols, (Kluwer)

Plant Physiology (BSM – w.e.f. 2002-2003)

Unit I

Membrane transport and translocation of water and solutes: Plant-water relations, mechanism of water transport through xylem, root-microbe interactions in facilitating nutrient uptake, comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transport proteins. Stomatal physiology; Source & sink relationship.

Unit II

Signal transduction in plants overview, receptors and G-proteins, phospholipid signalling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signalling mechanisms.

Unit III

Photochemistry and photosynthesis: Historical background, photosynthetic pigments and light harvesting complexes, carbon assimilation – the Calvin cycle, photorespiration and its significance, C4 cycle, the CAM pathway, biosynthesis of starch and sucrose. Photosystems I & II, their location, mechanism of quantum capture and energy transfer between photosystems – ferridoxin, plastocyanin, plastoquinone, carotenoids.

Unit IV

Respiration : A overview of plant respiration. Respiratory quotient, factors influencing the rate of respiration (light, temperature, oxygen availability etc.)

Unit V

Nitrogen & Sulphur metabolism: Biological nitrogen fixation and ammonia assimilation. Nitrate and sulphate reduction and their incorporation into amino acids (uptake).

Unit VI

Physiology of seed dormancy and germination. Hormonal regulation of growth and development. Photoregulation: Growth responses, physiology of flowering. Vernalization, Senescence.

Unit VII:

Stress of physiology – Plant responses to biotic and abiotic stress, stress tolerance. Types of stresses (drought, salt, high temperature, chilling and flooding). Effects of stress: stress resistance, avoidance and tolerance (salt excluders and includers), various morphological and physiological adaptations. Accumulation of various solutes (osmoregulants/ osmoprotectants): with special emphasis on role of proline, sugars k+ ions and polyamines, Role of growth regulators in stress.

Unit VIII: Plant Tissue Culture

Brief historical background, general techniques, Tissue culture media, Cellular totipotency, Micropropagation and somaclonal variation, production of pathogen free

plants. Role of tissue culture in Haploid and triploid production. Production of secondary metabolites and production of plants tolerant to different stresses, Other applications of plant tissue culture.

Recommended Books:

1. Devlin & Witham, Plant Physiology, CBS.
2. Salisbury, F.B. & Ross, C.W., 1992, Plant Physiology, 4th Edition, Wadsworth Publishing co. California, USA.
3. Taiz, L & Zeiger, E, 1998, Plant Physiology, 2nd Edition, Sinauer Associates Inc. Publishers, Massachusetts, USA.
4. Hopkins, W.G., 1999, Introduction to Plant Physiology, John Wiley & Sons, Inc. New York, USA
5. Noggle & Fritz, Introduction to Plant Physiology, Printice Hall, India.
6. V.K. Agrawal, A Text Book of Biotechnology, S. Chand.
7. Buchanan, B.B., Gruissem, W. and Jones, R.L., 2000, Biochemistry and Molecular Biology in Plants American Society of Plant Physiologists, Maryland, USA.
8. Nobel, P.S., 1999, Physicochemical and Enviromental Plant Physiology (2nd Edition). Academic Press, Sen Diego, USA.
9. Rienert, J. and Bajaj Y.P.S., 1992, Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture, 3rd Edition, Narosa Publishing House, New Delhi.
10. Bhojwane, S.S. and Razdan, M.K., 1996, Plant Tissue Culture : Theory and Practice, Elsvier, Science Publishers, New York, USA.

Genome Biology (BSM – w.e.f. 2002-2003)

Unit I: Gene Technology

Principle of cell Based Cloning, Restriction endonuclease, Ligases, Transfer of DNA into the host cells; Modes & Methods (Transduction, Conjugation and Transformation), Yeast Artificial Chromosome (YAC), cosmid vectors. Chromosome Walking, jumping genes, Genomic Imprinting, Uniparental disomy.

Unit – II: Transgenic and Animal Cell Technology

Principles methods and types of gene transfer in animal oocytes and embryonic stem cells. Production of transgenic animal (Mice), uses of Transgenics in the field of Fisheries and live stock improvements.

Animal cell technology in assessment of gene functions (Knock out mice). Animal cloning: viability and variability, Ethical implications of the uses of clones in therapeutics.

Unit III: Molecular Pathology

Molecular pathology of single gene multifacterial and sex linked diseases with special reference to Marfars Syndrome, Prades Willi Syndrome, Fragile`X' Syndrome. Alkeptonurea, phenyl ketone urea, sickle cell anemia thallaessemia, DMD, Tay sachs diseas, Cancer and characteristics of cancer cells, Involvements of Tumour suppressor genes and oncogenes in cancer. Immunity to parasitic infections. Host response and evasive startegy by the parasites.

Unit IV : Molecular Diagnostics

Principles and process of PCR Techniques, Design and opimization of PCR, Taq DNA polymerase. Types of PCR : Allele spenfic PCR, Inverse PCR, Asymmetric PCR, RT-PCR Applications of PCR in diagnostics, forensic medicine, gene manipulation expression studies and evolutionary biology, Ligase Chain reaction, Repeatative DNA sequences, Types of reprintline DNA, SNP and the application in molecular diagnostics, DNA Fingerprinting, its applications and prospects. Restriction Fragment Length polymorphism (RFLP) and its uses, FISH and chromosome painting, cytokine implications and assay for diagnostic purposes, Prenatal diagnosis.

Unit V: Molecular Therapeutics

Types and models of gene therapy, Gene delivery system virus in delivery system. Applications of gene therapy in correction of different genetic diseases. Ethics associated with somatic and germ cell gene therapy.Triple helix therapeutics, Antisense and oligonucleotide techology.

Antibody engineering (Hybridoma), Immunotherapy and immunization Mechanism of active immunisations various modes of passive immumeration, Interferons and other cytokines in therapeutics.

Books Recommended

1- Winnacker. Earnst L., 1987, Gene to Clone, VCH Publisher. Germany.
2- Tom Strachan and Read AP., 1996, Human Molecular Genetics, Bios Scientific Publisher.
3- Patricia A. Hoffee, 1998, Medical Molecular Genetics, Fence Creek Publishing, Madison Connecticus, USA.
4- Daniel J. Fairbank and W.R. Andersen, 1999, Genetics The Centinity of life, Brook/ Cole Publishing company International Thomson Publishing Company Inc. USA..
5- E. Berijamini R. Coico, G. Sunshine, Immunology : A short course, John Willey & Sons Inc. Publications, USA.
6- IM Roitt, Essential Immunology, Blackwell Science Publication, England.
7- Bruce Albert, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Molecular Biology of the Cell, Garland Publishing Inc. New York, USA.

Physical Chemistry of Proteins and Enzymes (BSM – w.e.f. 2002-2003)

Unit I: Water and Amino Acids

Physicochemical properties of water: pH scale, Henderson-Hasselbach equation and its applications, preparation of buffers (problems), pH measurements. **Twenty standard amino acids:** Notations, general formula, conformation and configuration and side chain configuration. Rare amino acids and a prosthetic groups: Many proteins contain more than 20 standard amino acids. **Properties of amino acids**: *Acids-Base behaviour* (pka values and its determination (potentiometric), ampholytes, zwitterion, (isoelectric point); *optical properties* (absorption spectra of amino acids, Beer-Lambet law, stereochemistry and optical rotation). **Chemical reactions of amino acids.** Reactions of α-amino group, α-carbosyl group and side chains.

Unit II: Peptides & Protein conformation

Definitions: Peptide bond, N- and C-terminal residues, peptide group. **Peptide units:** Bond lengths and angles, cis- and trans-conformations, reaction of peptide bond, charges on peptides (pH-dependence). **Levels of structure in Proteins:** primary structure, secondary structure, tertiary structure and quaternary structure. **Amino acid composition and sequence determination. Dipeptide conformation:** Ramachandran plot, allowed and prohibited contact distances and allowed conformations. **Secondary structure**: (α and other helices, ß-structures, ß-turns), collagen triple helix and other nonrepetitive structure. Motifs or supersecondary structures and domains.

Unit III: Measurements of Protein Structure

Optical techniques: Basic principles and applications of absorption and fluorescence spectroscopy, optical rotatory dispersion, circular dichroism NMR Spectroscopy and X-ray Diffraction. **Hydodynamic techniques:** Viscosity, sedimentation velocity and sedimentation equilibrium, volumes of proteins in solution.

Unit IV: Protein Structure and Stability

The native state: Definition and types of bonding in native proteins. **The denatured state:** Definition and modes of denaturation. **Protein stability,** Definition and theoretical estimation of stability of the native protein, and experimental determination of protein stability from chemical and thermal denaturation studeis (analysis of denaturation curves). **The protein folding problem. Various models of protein folding. The `molten globule' state. General properties of protein folding transition: Stability of folded state and cooperativity of folding. Kinetic aspect of folding:** Experimental results of folding and refolding, transition states for folding, and modes of folding, *in vivo* protein folding.

Unit V: Enzymes

Definition: Enzymes cofactors, catalytic power, specificity, regulation, ribozymes and abzymes. Effect of pH and temperature on enzyme activity. **Basic Equations of Enzyme Kinetics:** Steady state kinetics of the Michaelis-Menten equation. **Michaelis–Menten mechanism:** interpretation of the kinetic phenomena for single-substracte reactions; extensions and modifications of the Michaelis-Menten mechanism ($K_M > K_S$, $K_M < K_S$, $K_M = K_S$; all three mechanisms occur in practice). **The significance of the Michaelis–Menten parameters:** The meaning of k_{cat}, K_M and k_{cat}/K_M. The graphical representation of kinetic data: The Lineweaver–Burk plot and the Eadie – Hof stea plot. **The enzyme inhibition:** Competitive, noncompetitive, uncompetitive and mixed inhibitions. Commiting substrates for an enzyme. Conformational change and allosteric regulation; positive cooperativity; mechanism of allosteric interactions and cooperativity; Negative cooperativity.

Recommended Books

1. G.E Sehulz,. & R.H. Sehirmer, (1987) Principle of Protein Structures, Springer
2. T.E. Greigton (1994) Proteins : Structure and Molecular properties, 2nd edition, New York, Freeman
3. C. Gheis and J. Yon (1986) Protein Folding, Academic Press, New York.
4. C. Tanford (1961) Physical Chemistry of Macromolecules, Academic Press, New York.
5. C. Tanford (1968) Advances in Protein Chemistry
6. C. Tanford (1970) Advanced in Protein Chemistry
7. S. Lapanje (1978) Pysicochemical Aspects of Protein Denaturation, John Wiley & Sons, New York.
8. P.L. Privalov (1979) Advances in Protein Chemistry 33, 167.
9. Mechanism of Protein Folding, (R.H. Pain, ed.), IRL Press, Oxford University Press, Oxford, 1994.
10. C.R. Canter, & P.R. Schimmel, (1980) Biophysical Chemistry, Vols 1-3, Freeman & Co.
1. A.Fersht (1998) Structure and Mechanism in Protein Science Freeman & Co. New York
12. C. Brandon and J. Tooze (1999). Introduction to Protein Structure, 2nd ed. Garland Publishing, New York.

Environmental Biology (BSM – w.e.f. 2002-2003)

(A-Environmental Biotechnology)
(B-Environmental Pollution & Toxicology)

Part-A

Environmental Biotechnology for Bioremediation of Pollutants and Biomass Utilisation (sewage and industrial waste treatment and recycling of matter):

Unit I
Microbial degradation of xenobiotic compounds. Genetic Engineering of biodegradative Pathways by plasmid transfer and gene alteration.

Unit II
Microbial Insecticides (Biopesticides) with special reference to Bacillus thuringensis. Insecticial toxin-toxin gene isolation, mode of action & genetic engineering. Baculoviruses as biocontrol agents.

Unit III
Development of genetically engineered resistant (insect, virus, herbicide) and stress & senescene tolerant plants.

Unit IV
Bioremediation of pollution from contaminated soil, air and water. Microbiology of waste water treatment.

Unit V
Microbial degradation and utilization of biomass. Utilisation of starch & sugar for commercial production of fructose & alcohol. Utilisation of cellulose and lignocelluose, isolation & manipulation of prokaryotic and eukaryotic cellulase genes. Production of single cell protein.

Part-B

Toxicology

Unit VI
Global Environmental Pollution Problems: Types of pollution (Air, water, heavy metals, pesticides, radiation, oil, thermal), photochemical smog, ozone depletion, UV-B, Green House effect and acid rain and their impact.

Unit VII
Toxicants of public health hazard, factors & dose response relationship. Acute, sub-acute & chronic toxicity. Biological magnification, biotransformation.

Unit VIII
Absorption, translocation & excretion of chemicals (Xenobiotics).

Recommended Books:

1- Bernard R. Glick and Jack J. Pasternak, 1994, Molecular Biotechnology – Principles and applications of recombinant DNA, American Society for Microbilogy Press.

2- A.K. Chatterji, 2002, Introduction to Environemntal Biotechnology, Printice Hall of India, Private Limted, New Delhi,

3- A.N. Galzer and H. Nikaido, 1995, Microbial Biotechnology : Fundamentals of Applied Microbiology, W.H. Freeman & Co. New York.

4- E. Hodgson & E.Levi, 1997, A Text Book of Modern Toxicology Appleton & Lange Stamford, Connecticut.

5- C. Ratledge, 1994, Biochemistry of Microbial Degradation, Kulwer Academic Publisher.

6- Ignacicuthu, S.J. & Alok Sen, 1999, Biopesticide in Insect Pest Management Phoenix Publishing House Pvt. Ltd., New Delhi.

7- Gabriel Bitton, 1999, Waste Water Microbiology, Wiely-Liss.

8- Alexender, M., 1999, Biodegradation and Bioremediation, Academic Press.

9- Nicholas P. Cheremisinof, 2001, Biotechnology for Waste Water Treatment, Printice Hall of India Private Ltd.

10- Rose, J, Gordon and Breach, 1998, Environmental Toxicology Current Developments (ed). Science Publishers..

Animal Physiology (BSM – w.e.f. 2002-2003)

Unit I: Chemical Coordination (Hormones)
An over view of Physiology (general and cellular basis), concept of primary and secondary messenger, Endocrine cells and types of chemical signalling Molecular mechanism of action of different types of hormones: Regulatory role of hormones from hypothalamus, pituitory, thyroid, Adrenal, Pancrease and other endocrine cells. Malfunction and clinical corelates.

Unit II: Neural coordination & Brain
Neurons & supporting cells, ionic basis of resting and action potenial, synaptic transmission, excitatory/inhibitory, pre and post synaptic inhibitions, reflexes and types, Autonomic nervous system, functional differentiation of brain and hierarchy of control, Motor functions of spinal cord, Motor and sunsory pathways, intellectual functions of brain, learning and memory, limbic system, Brain activity-sleep.

Unit III: Sensory & Muscular System
Sensory Receptors, types, transduction mechanism, Neuronal architecture of retina and optic pathway, visual transduction, skeletal cardiac and smooth muscles. Neuro muscular junctions, Mechanism of muscle contraction. (Cross bridge model) Muscle tone regulation.

Unit IV: Exchange and Sensing of gases
Exchange of gases at pulmonary surface, transport of respiratory pigment. Oxygen dissociation curve, Neural and hormonal control of breathing. Oxygen, carbon diosixide and pH sensing mechanism, Respiratory acidosis and alkalosis. Regulation of blood pH.

Unit V: Blood Circulation and Excretion
Initiation, conduction and regulation of hearth beat, cardiac cycle, ECG and cardiac out put, Blood pressure and its regulations. Blood coagulation. Regulation of cardiac functions., Glomeular filtration, reabsorption secretion and its regulation, Rennin / Angiotensin system.

Unit VI: Reproduction and Molecular biology of Development
Basic structure and function of ovary and testies, hormonal regulations, parturition and implantation. Molecular events during fertilization, concept of determination, competence and induction to potency, cell differentiation and differential gene activity, genetic regulation of early embryonic development, Homoetic gene

Unit VII: Animal Biotechnology
Cell culture, methods & requirements, cell lines, primary culture, tissue & organ culture, stem cells transgenic animals, Expressing foreign genes in cell culture.

Recommended Books

1- Guyton, A.C. and Hall, J.E., A Text Book of Medical Physiology, Ixth edition, W.B. Saunders Company.
2- Ganong, H, Review of Medial Physiology.
3- Fleur, Strand, Physiology : A regulatory system approach
4- Kendal, E. – Principles of Neurobiology.
5- Fred Delcomyn, Foundations of Neurobilogy, Freeman & Co.
6- Kufler and Nichols, Neuron to Brain.
7- Butler & Lewis, Human Anatomy & Physiology (WCB)