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UNIVERSITY OF MYSORE



Estd. 1916

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No.AC.2(S)/401/13-14

Dated: 24-05-2014

**NOTIFICATION**

**Sub:** Minor Modifications in the curriculum Structure of M.Sc. Bio Science.

**Ref:** 1. Proceedings of Faculty of Science & Technology Meeting held on 14-02-2014.  
2. Proceedings of the Meeting of Academic Council held on 29-03-2014.

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The Board of Studies in Bioscience (PG) at its meeting held on 09-12-2013 has resolved to make minor Modifications in the syllabus of M.Sc. Bioscience from the academic year 2014-15.

The Faculty of Science and Technology and the Academic Council at their meetings held on 14-02-2014 and 29-03-2014 respectively approved the above proposals and the same is hereby notified.

The copy of the Modified syllabus of M.Sc. Bio Science is annexed herewith.

*Jr S. Sampans*  
REGISTRAR.  
UNIVERSITY OF Mysore 24/5/2014  
MYSORE.

To

1. The Registrar (Evaluation), University of Mysore, Mysore.
2. The Chairperson, BOS/DOS in Bio Science, MGM/ P.G. Centre Hassan.
3. The Dean, Faculty of Science & Technology, DOS in Zoology, MGM.
4. The Director, College Development Council, UOM, Mysore
5. The Deputy/Assistant Registrar (Evaluation), University of Mysore, Mysore.
6. Sri Narasimha Murthy, Statistician, E.B. UOM, Mysore.
7. The Supdt. AC.1 & AC.2, A.B., Academic Section /PMEB, UOM., Mysore.
8. The P.A. to the Vice-Chancellor/Registrar/Registrar( Evaluation), UOM., Mysore.
9. The Case Worker, AC.7, Academic Section, University of Mysore, Mysore.
10. The Section Guard File(Supdt.AC.2), A.B., A.C., UOM.
11. The Schedule File.

**University of Mysore**  
**Dept of Bioscience PG Center, Hemagangothri – 573 220**  
**COURSE CONTENT OF M.Sc. BIOSCIENCE BATCH 2014-15**

Name of Department: BIOSCIENCE

Course: M.Sc.

Paper code	Hard Core	Credits	Paper code	Soft Core	Credits
<b>I SEMESTER</b>					
BS 1.1	Biomolecules	4+0+2	BS 1.4	Biophysics	2+0+1
BS 1.2	Plant Physiology	2+0+2	BS 1.5	Microbiology	2+0+1
BS 1.3	Advanced Cell Biology	3+0+1	BS 1.6	Medicinal Plants	2+0+1
		<b>14</b>			<b>6</b>
<b>II SEMESTER</b>					
BS 2.1	Enzymology and metabolism	4+0+2	BS 2.4	Biochemical techniques	2+0+1
BS 2.2	Biostatistics and Computer application	3+0+0	BS 2.5	Toxicology	2+0+1
BS 2.3	Genetics	3+0+2	BS 2.6	Developmental biology	2+0+1
		<b>14</b>			<b>6</b>
<b>III SEMESTER</b>					
BS 3.1	Molecular biology	3+0+2	BS 3.4	Cell culture & Cancer Biology	2+0+2
BS 3.2	Animal Physiology	2+0+2	BS 3.5	Cell biology Techniques	2+0+2
BS 3.3	Immunobiology	2+0+1	BS 3.6	Genomics	2+0+2
		<b>12</b>			<b>8</b>
<b>IV SEMESTER</b>					
BS 4.1	Behavioral biology and Hormones	2+0+0	BS 4.4	Bioinformatics	2+0+0
BS 4.2	Genetic Engineering and Biotechnology	2+0+0	BS 4.5	Ecology and Evolution	2+0+0
BS 4.3	Project Work	0+0+6			
		<b>10</b>			<b>2</b>

**OPEN ELECTIVE**

<b>I Semester</b>	---	--
<b>II Semester</b>	2.1 Human Body And Health	2+1+1
<b>III Semester</b>	3.1 Human diseases and Hygiene	2+1+1
<b>IV Semester</b>	4.1 You and Your Heredity	2+1+1

**Hard Core (HC) = 14+14+12+10=50**

**Soft Core (SC) = 6+6+8+2=22**

**Open Elective (OE) = 4**

**GRAND TOTAL = 76 Credits**

## COURSE CONTENT OF M.Sc BIOSCIENCE FROM THE YEAR 2014-15 ONWARDS

### Semester I

#### BS 1.1 Biomolecules

56 hrs

#### UNIT-I

**Carbohydrates** - Structure and classification of carbohydrates monosaccharides, disaccharides and polysaccharides. Chemistry of monosaccharides - Pentoses, hexoses, dextrose, sucrose, fructose, galactose, amino sugars, muramic acid, neuraminic acid. Linkage in sucrose, lactose and maltose. Glycosides, Isolation of polysaccharides. Homopolysaccharides and heteropolysaccharides -starch, cellulose, glycogen, hyaluronic acid, chondroitin sulphate, chitin, xylans, bacterial cell wall polysaccharides, blood group polysaccharides-structure elucidation- degradation, periodate oxidation, methylation, GC-MS secondary structure.

#### UNIT-II

**Amino acids:** classification, Structure and Chemical reactions of amino acids, Zwitter ion, peptide bond, solid phase peptide synthesis, amino acid analysis, automatic amino acid analysis. Isoelectric point, unusual amino acids, non protein amino acids

**Proteins:** Classification of proteins, Denaturation Physico-chemical properties of proteins, sequencing of proteins, determination of prosthetic groups like carbohydrates and establishing Disulphide bond positions.

**Glycobiology:** Glycoproteins-N and O-glycosylation, Lectins, Carbohydrates in tissue engineering. Proteoglycans-Agrecan, syndecan, and decorin. Pectin and pectic polysaccharides.

#### UNIT-III

**Lipids:** Classification structure and biological role of phospholipids, Sphingolipids, Glycolipids and Plasmalogens. Structure of cholesterol, Structure and function of essential fatty acids, Eicosanoids, Prostaglandins, Thromboxanes, Leukotrienes and Isoprostanes.

**Nucleic Acids:** Structure of Purines and pyrimidines, nucleotides, reaction of nucleosides. Physicochemical properties of nucleic acids. Melting of DNA,  $T_m$  - factors affecting  $T_m$ , Cot curve, classification of DNA based on cot curve. Chargaff's rule, Chemical reactions of DNA and RNA. Base composition, Sequencing of DNA- Sanger's method, unique sequence, nearest neighbour base frequency analysis, repetitive sequence, and Palindromic sequence.

#### UNIT-IV

**Vitamins:** Structure and Biochemical function of Vitamins, A, D, K, E, and Vitamins B-Complex, C Sources, requirements and deficiencies of vitamins. Hypervitaminosis, vitamin - like compounds

**Heterocyclic compounds:** Structure, Biological occurrence and properties of Furan, Indole, Pyrrole, Quinone, Imidazole, Thiazole, Pterin, Isoalloxazine, Porphyrins.

**Secondary metabolites**—Phytochemicals- terpenes, polyphenols, procyanidins, flavonoids, Xanthones, alkaloids and pigments.

**UNIT-I**

**Photosynthesis and Respiration:** Photosynthetic apparatus, Thylakoid, Q-cycle, Electron transport system, Carbon dioxide fixation in C<sub>3</sub> and C<sub>4</sub> and CAM plants, Factors affecting photosynthesis. O<sub>2</sub> evolution, Energetics, photophosphorylation, photoprotective mechanisms. Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

**UNIT-II**

**Plant hormones and Nitrogen fixation:** Biosynthesis, storage, breakdown and transport; physiological effects mechanisms of action. and commercial importance (Auxines, Gibberlines, Cytokinins, Ethylene, Absciscic acid). Artificial plant hormones. Assay of plant hormones. Formation of root nodules in legumes, Biochemistry of nitrogen fixation, Ammonia assimilating pathways, Effects of environment on nitrogen fixation. Nitrogenous system, non symbiotic nitrogen fixation. Senescence and Abscission.

**UNIT-III**

**Sensory photobiology and seed physiology-** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Perception of stimulus. Juvenility and Vernalisation  
Seed dormancy, Inception of germination, Germination and growth regulators

**UNIT-IV**

**Stress physiology and solute transport in plants-** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

**BS 1.3 Advanced Cell Biology****42hrs****UNIT-I**

**Evolution of the cell:** Chemical evolution, Biological evolution, Evolution of adapter molecule, Procell, micro spheres, Evolution of Prokaryotes and Eukaryotes.

**Molecular architecture of Eukaryotic cells:** Biomembranes - Composition, Ultra structure, Gorter and Grendel, Danelli and Daveson and fluid mosaic model.

**UNIT-II**

**Basic functions:** permeability, osmotic principles, carrier proteins, channel proteins, ionophores, aquaporin, passive transport, active transport, Na<sup>+</sup>/K<sup>+</sup> pump, transport protein, pinocytosis, phagocytosis, receptor mediated endocytosis, transcytosis.

**UNIT-III**

**Ultrastructure of Eukaryotic chromosome:** Nucleosome organization, solenoid, mini band, ultra structure of Lamp brush and polytene chromosomes, Heterochromatin and Euchromatin,  
**Eukaryotic cell cycle and its regulation:** Phases of cell cycle Regulation of cell cycle by cell growth and extra cellular signals, Cell cycle checkpoints-CDK's, Coupling of S dependent kinases, growth factors. Inhibitors of cell cycle progression, MPF and progression to metaphase. Apoptosis and its regulation.

#### UNIT-IV

**Cell-Cell interaction:** Cell adhesion molecules, cellular junctions, extracellular matrix molecules involved in interaction: Integrins and selectins.

**Cytoskeleton:** Nature, intermediate filaments, microtubules, microfilaments, actin filaments

### BS 1.4. Biophysics

28hrs

#### UNIT-I

Basic laws of physics and their relevance to biology, Role of Biophysics in natural science, scope and methods of Biophysics.

**Isomerism:** Stereochemistry of monosaccharide. Anomer, Isomer, Epimer, dextro and Laevo rotation, stereochemistry of Amino acids- D and L, R and S.

#### UNIT-II

**Structure of Macromolecules:** Covalent and non-covalent bonds – Ionic and Hydrogen Bonding, Vander wall's forces. Special properties of water.

**Secondary structure of Proteins:** Alpha helix, beta sheet, beta bend and Motifs, prediction of secondary structure, Ramachandran plot, Folding of Protein: Anfinsen's experiment "Molten Globule" 3D structure of myoglobin, hemoglobin, immunoglobulin and collagen.

#### UNIT-III

**Biophysical Techniques:** principles and applications of colorimeter, Spectrometry: Light, UV, IR, Atomic absorption and MS, Fluorimetry, magnetic resonance – NMR and ESR, and Raman Spectra. Light scattering, polarized light, circular dichroism, basic concepts in X-ray crystallography.

#### UNIT-IV

**Radiation Biophysics:** Radiation Spectrum, Radio Isotopes and Radiations. Nuclear decay, Units of Radiation-Curie, Bequerel, Gyre, RAD, LET. LASER, Measurement of Radiation- GM Counter, Liquid and Solid Scintillation, Interaction of radiation with matter. Synthesis of Isotopically labeled compounds (Glucose, ATP etc.,) Determination of position of labeling. Applications of Radio Isotopes.

### BS 1.5 Microbiology

28hrs

#### UNIT-I

**History of Microbiology and Methods of Study Of Microorganisms** contributions of Leeuwenhoek, Pasteur, Jenner, Koch, Flemming and Prusiner, discovery of virus.

Isolation of pure culture, Maintenance and preservation of pure cultures, quantitative measurement of Bacterial growth.

#### UNIT-II

**Microbial genetics:** structural organization of virus, bacteria, alga, fungi and mycoplasma. Recombination in bacteria-Transformation, Transduction and Conjugation and genetic mapping.

#### UNIT-III

**Symbiosis and Pathogenesis:** Host parasite relationship, Bacterial infection, pathogenic properties of bacteria and fungi, endotoxins and exotoxins.

#### UNIT-IV

**Microbiology of Water, air and dairy products:** Microflora, Source of contamination and Testing (IMVIC of water, microbiology of ground water and aquatic reservoirs. Microflora of air, air borne pathogenic microorganism, including viruses. Fermentation: Solid state and submerged; Food spoilage, food preservation.

#### BS 1.6 Medicinal plants

28hrs

#### UNIT-I

**Conservation of medicinal plants:** Non destructive and sustainable exploitation, Cultivation of medicinal plants, Good agriculture practice for medicinal plant cultivation. Pest and disease management in medicinal plants.

#### UNIT-II

**Biotechnology of medicinal Plants:** Micro propagation of medicinal plants Methods, Development of tissue culture protocol for medicinal plants, Hairy root culture, Callus culture, Bio transformation. Possible methods of improving yield, Selection of strains, Biotechnological methods (GM etc.)

#### UNIT-III

#### **Processing, Collection , Quality Control methods**

Method and time of collection. Processing and value addition methods. Collection of Underground parts : Roots, tubers, Bark, Leaves, Flowers, Seed & Fruits, Exudates & gums, Wood & wood extracts. Drug Adulteration, Quality control.

#### UNIT-IV

#### **Phytochemistry & Pharmacological screening of herbal drugs**

Pharmacological screening of herbal drugs, Need for phyto-pharmacological evaluation, Phytochemical screening, extraction methods, characterization of natural compounds.

Evaluation of anti diabetic agents, Evaluation of anti microbial agents and wound healing, Evaluation of anti diarrheal agents

## II Semester

### BS 2.1 Enzymology and Metabolism

56 hrs

#### UNIT-I

**Enzymes:** Localization, Isolation, Purification, Criteria of purity of enzymes, Nomenclature and IUB classification of enzymes. Assay of enzymes.

**Review of Michaelis:** Menten kinetics, Competitive, Non competitive, uncompetitive inhibition. Cleland notation of bisubstrate reactions. Allosteric enzymes. MWC and KMF models. Aspartyl Transcarbamylase.

#### UNIT-II

**Enzyme catalysis:** Active center, nature of catalysis (Acid-Base and covalent) energetics, Effect of pH and Temperature. Structure and Mechanism of action of Lysozyme, Chymotrypsin, Alcohol dehydrogenase, RNA as enzyme.

**Enzyme variants:** Coenzymes, Isoenzymes, Multienzyme complex, Multifunctional enzymes. Applications of enzymes.

### UNIT-III

**Biosynthetic pathways:** Biosynthetic pathways for glucose, amino acids-amino nitrogen, Fatty acid- chain elongation, desaturation in plants and animals, Nucleoside-Salvage pathway, De-nova pathway. New insights into metabolic pathways (Glucose paradox, Conversion of sugars to fats)

### UNIT-IV

**Bioenergetics:** Electron transport chain and ATPase.

**Pathways of Degradation:** Glucose degradation, Ketogenic and glucogenic amino acids, Urea cycle, Pathways of Degradation of fattyacids, Alpha, beta and gama-oxidation. Pathways of Degradation of purines and Pyrimidines,

## BS 2.2. Biostatistics and Computer Application

42hrs

### UNIT-I

**Mathematical principles and their applications in biology.** Logarithms, natural, Logarithms, Applications in Logarithmic growth, radioactive decay. exponential growth, Non linear relationships

**Statistics:** Population, sample: random sample, size of sample, sampling methods, non random sampling. Representation of statistical data: diagrammatically, graphically

### UNIT-II

**Central tendency:** mean, weighted mean, median, mode, measure of dispersion: variance, standard deviation and standard error. Normal distribution, and binomial distribution.

**Hypothesis testing:** student t test,  $\chi^2$ -test, One-way ANOVA, correlation and linear regression, Non parametric statistics Mann Whitney u test.

### UNIT-III

History and development of computers, mainframe, mini, micro and super computer, Organization of a computer, simple details of some commonly used I/O media. Computer languages: machine, assembly and high level language. Number system.

### UNIT-IV

Introduction to problem solving using computer, special packages as computational tools – spread sheet and applications for statistical calculations. Concept of Programming. Introduction to computer networks and resource sharing, Internet, Information browsing, e-mail.

## BS 2.3 Genetics

42hrs

### UNIT-I

**Basic Mendelian principles of inheritance:** Drosophila as an example, Applications of Mendel's principles- the punnet square method, forked-line method, probability method; Formulating and testing genetic hypothesis-the chi-square-test, linkage and crossing over.

**Extra nuclear inheritance:** Maternal effects (Limnae) Organelle heredity (Mitochondria and Chloroplast) Infection heredity (Kappa in paramecium)

## UNIT-II

**Molecular mechanism of Sex determination and dosage compensation;** Trigger for sex determination, sex determination in mammals, secondary sex determination, sex determination in Drosophila, Dosage compensation in mammals and drosophila.

**Genetic recombination at Molecular level:** Reciprocal recombination, site specific recombination, models of recombination (Holliday model), Role of Rec A in Recombination.

## UNIT-III

**Mutation:** Types of mutations-Deletion, duplication, translocation and inversion ,spontaneous and induced mutations, molecular mechanisms of mutations, detection of mutations- Ames test, tests in drosophila (DLT,CIB,SLRL,SMART,ARLT) and mouse (DLT, MNT, Mitotic and meiotic, specific locus test, HMA) DNA damage and Repair mechanism(Photoreactivation,excision,SOS and adaptive response)

## UNIT-IV

**Transposable genetic elements:** Bacterial transposons, Is elements, Composite transposons, Tn3 elements, Eukaryotic transposons-Ac and Ds elements in maize; P elements and Hybrid dysgenesis, Retrotransposons. Alu sequences.

**Human genetics:** Human chromosomes, Chromosomal abnormalities-Sex chromosomal and autosomal; Genetic diseases, Pedigree analysis and genetic counseling, gene therapy.

## BS 2.4 Biochemical Techniques:

28hrs

### UNIT-I

**Chromatography** Principles of partition chromatography, paper, thin layer, column chromatography, ion exchange and affinity chromatography, gas chromatography, gel permeation chromatography, HPLC and FPLC.

### UNIT-II

**Centrifugation** Principles of centrifugation, Svedberg's constant, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation.

### UNIT-III

**Electrophoretic techniques** Principles of electrophoretic separation. Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, pulse field gel electrophoresis, PAGE, SDS- PAGE and Iso electro focusing.

### UNIT-IV

**Biological Solutions:** preparation of solutions-Normality, molarity and molality: Acids and Bases, Buffers, salting in, salting out, Osmosis, Dialysis, Donnan Membrane Equilibrium, Viscosity of macromolecules, relationship with conformational changes, Density.



**UNIT-I**

**Introduction & Scope of Toxicology :**Origin – Scope –Disciplines of toxicology importance of toxicology, Toxicity – Acute &Chronic, Bioassays - methods in toxicology (LD50,LC50,probit analysis)

**Classification of Toxicants:** Pesticides, Heavy metals, Oil and combustion, Chemicals & Radio active substances.

**UNIT-II**

**Exposure of Toxicants:** Route of exposure - Absorption – Distribution – Excretion

**Mechanisms of action Toxicants:** Mode of action of Xenobiotics, Target site interactions – Factors affecting xenobiotic chemicals.

**UNIT-III**

**Toxicants in the environment:** Bioaccumulation, Bio transformation, & Biodegradation Bioaugmentation, Bioremediations.

**Effect of Xenobiotics:** Physiological and biochemical effects of xenobiotics on flora and fauna, effects of Xenobiotics on chromosomes.

**UNIT-IV**

**Environmental Toxic impact assessment:** Impact assessment, Impact on Air quality, water quality, & solid waste. Environmental planning.

**Safety evaluation of toxicants:** Risk assessments, Safety evaluation programme.

**BS 2.6 Developmental Biology.****28hrs****UNIT-I**

**Introduction:** Concepts of development, Intracellular synthesis and its regulation, cell surface, cell adhesion, Restriction and determination, differentiation during development.

**Early development:** gametogenesis, fertilization, cleavage, blastulation and gastrulation in sea urchins, Amphibians, birds and mammals.

**UNIT-II**

**Embryonic polarization and initiation of body plan:** Comparative study in *Drosophila*, *Xenopus*, *C. elegans*, and mouse.

**Plant development-** overview of plant development, flower and leaf development

**UNIT-III**

**Competence and induction:** Mesodermal, primary, secondary, abnormal inductions; regional specificity totipotency and nuclear transfer experiments, cell differentiation and differential gene activity, genetic mechanism of determination and differentiation, ooplasmic determinants.

**UNIT-IV**

**Amphibian metamorphosis:** Morphological and biochemical changes. Hormonal control of metamorphosis, Regeneration and teratogenesis.

## III Semester

### BS 3.1 Molecular Biology

42hrs

#### UNIT-I

Central dogma of molecular biology and its modification

**DNA Replication:** Semi conservative, replication in E.coli and Eukaryote, control of replication, Replication in phage, plasmid and mitochondria.

**RNA Biosynthesis:** DNA dependent RNA biosynthesis in prokaryotes and eukaryotes. Initiation elongation and termination, RNA polymerase I II and III processing of RNA, RNA editing , RNA stability, RNA transport, Antisense RNA.

#### UNIT-II

**Genetic Code:** Triplet codon, Assignment of codons, degeneracy, variation in codon usage, universality

**Protein Synthesis:** Ribosome structure, Bacterial, Eukaryotic protein synthesis, initiation, elongation and termination.

**Post Translation Modification:** Protein folding, role of chaperons. O and N glycosylation , Fatty acylation , attachment of glycosyl anchor, phosphorylation, other modifications.

#### UNIT-III

**Regulation Of Gene Expression:** fine structure of eukaryotic gene, exons, introns, repetitive DNA, Promoters enhancers, silencers, regulatory sequences, DNA-binding Proteins. Organization of Prokaryotic and eukaryotic genes, gene families, tandemly repeating genes, pseudogenes.

**Operon Model:** Lac operon, catabolite repression. Negative and positive control, Trp operon attenuation, antitermination.

#### UNIT-IV

**Regulation at the level of DNA, RNA and Proteins:** DNA supercoiling, Histones, histone acetylation, Glucocorticoids, Regulation by initiation codons (eg yeast GCN4), Cis and Trans factors (eg Ferretin and Transferrin mRNA by Fe) Translational introns, inteins , Accuracy of Transcription and translation, role of t RNA-amino acyl t RNA synthase, ribosomal optimization of translational accuracy, Secondary genetic code, Role of Transcription factors-NF $\kappa$ B Regulation at the level of post translation modification, degradation of proteins-Ubiquitin system.

### BS 3.2 Animal Physiology

-28 hrs

#### UNIT-I

**Digestion:** Carbohydrates, fats and proteins digestion. Role of gastro intestinal hormones in digestion; Absorption from the gastro intestinal tract. Digestive disorders

**Respiration:** The mechanism of respiration, transport of O<sub>2</sub> and CO<sub>2</sub>, respiratory pigments, respiratory quotient, oxygen toxicity, Acid base balance.

#### UNIT-II

**Circulation:** Types of Circulation, structure of heart, conduction of heart beat, Blood pressure, Factors affecting blood pressure. Components of blood, Mechanism and factors involved in blood clotting. Lymphatic system.

**Excretion:** Forms of excretory products, Functional architecture of Kidney, formation of Urine, Mechanism of urine concentration, Hormonal control of Urine formation and Osmoregulation. Renal disorders

### UNIT-III

**Sensory Physiology:** Structure of neuron, types of nerve cells, Resting and action potential, mechanism of conduction of nerve impulse, synaptic transmission, neurotransmitters, Reflex action and reflex arc, Neuromuscular transmission, Autonomic nervous system-distribution and functions, physiology of vision, color vision, Auditory, olfactory and taste signals.

### UNIT-IV

**Muscle Contraction:** Types of muscle-striated, non-striated and cardiac, Structure of skeletal muscle; Muscle contraction-biochemical events, sliding filament theory, Muscle fatigue.  
**Thermoregulation:** Physiological effect of Heat and cold. Temperature regulation in Poikilotherms and homeotherms, acclimation and acclimatization to cold and heat, thermo tolerance and heat shock proteins.

## BS 3.3 Immunobiology

28hrs

### UNIT-I

**Antigens:** Antigenicity and immunogenicity, haptens, determinants, epitopes, protein, antigens, carbohydrates antigens.

**Antibodies:** Classes and subclasses of immunoglobulins, structure of immunoglobulins, hyper variable region, Isotypic, allotypic and idiotypic variations.

### UNIT-II

**Cellular Basis of Immunity:** Types of immunity –active, passive and acquired. Primary and secondary response, Reticular-endothelial system. T, B and accessory cells. Subsets of T and B cells, Antigen processing and presentation. T-B co-operation. Soluble factors lymphokines-structure and functions.

### UNIT-III

**Molecular Biology Of Immunoglobulins:** Immunoglobulin genes, mechanisms of diversity. Theories of antibody formation-Burnet's clonal selection theory. Gene expression in T and B maturation, Molecular mechanism in T-B accessory cell interactions.

**Histocompatibility complex in man:** MHC, HLA polymorphism Tissue haplotypes and disorders, Tissue and organ grafting, graft rejection, Immune suppression

### UNIT-IV

**Non specific defences** – Skin, mucous membrane, secretory Immunoglobulins, complement, Hypersensitivity-types Vaccines and their preparation, Adjuvants.

**Disorder of The Immune System:** Autoimmune disorders, AIDS

## BS 3.4 Cell Culture and Cancer biology

- 28 hrs

### UNIT-I

**Laboratory design & Equipments for cell culture**

Sterile handling area, Laminar flow; Sterilizer, CO<sub>2</sub> incubator, Refrigerators and freezers, Centrifuge, Inverted stage microscope, Shakers; Water bath, Autoclaves and hot air oven Washing, packing and sterilization of different materials used in animal cell culture; Cell culture vessels.

**Media and reagents:**Types of cell culture media; Ingredients of media; CO<sub>2</sub> and bicarbonates; Buffering; Balance salt solutions; serum and serum free media; Trypsin solution; Selection of medium and serum; Other cell culture reagents; Preparation and sterilization of cell culture media.

#### UNIT-II

**Different types of cell cultures:**History of animal cell culture; Different tissue culture techniques; Types of primary culture; Chicken embryo fibroblast culture; Development of cell lines; Characterization and maintenance of cell lines, stem cells; Cryopreservation; Common cell culture contaminants and Secondary culture

**Micropropagation:** History, aseptic manipulation, cell culture, somatic embryogenesis, cellular totipotency, haploid production, zygote embryogenesis, invitro pollination, somatic hybridization and cybridisation, artificial seeds, somaclonal variation

**Applications of cell culture:** Commercial scale production of animal cells, stem cells and their application: application of animal cell culture for invitro testing of drugs, testing of toxicity of environmental pollutants in cell culture; application of cell culture technology in production of human and animal viral vaccines and pharmaceutical proteins.

#### UNIT-III

**Introduction:** Neoplasia, anaplasia, hyperplasia. Benign and malignant cancer

**Characteristics of cancer cells:** Behavioral, biochemical, cytological and genetical

**Incidence and Causes of cancer:** Physical, chemical and living habits

**Carcinogenesis:** chromosomal rearrangements and cancer, cellular proto-oncogens, oncogene activation, growth factors, growth factor receptors and retroviral oncogene

#### UNIT-IV

Free radicals, antioxidants and cancer. Tumor suppressor genes and cancer initiation, promotion, & progression. Strategies of anticancer: Radiotherapy, chemotherapy, immunotherapy and gene therapy

### BS 3.5 Cell Biology Techniques

28hrs

#### UNIT-I

**Techniques:** Cytological and histochemical techniques, Fixation, chemical and physical fixative, cytological and histological staining.

**Microscope:** Light microscopy, Phase contrast, Fluorescence microscopy, Electron microscopy- Scanning and Transmission.

#### UNIT-II

**Sub cellular fractionation:** Methods for cell lysis, differential Centrifugation, Density gradient Analytical Ultra Centrifugation, Flow Cytometry

#### UNIT-III

Mitotic chromosome preparation from plants and animal source ,

Meiotic chromosome preparation from plants and animal source

#### UNIT-IV

Preparation of human chromosomes from the peripheral blood lymphocytes and construction of karyotype and ideogram.

Principle and applications of camera lucida equipment

**UNIT-I**

**Eukaryotic genome;** Genome complexity; Different types of DNA elements in genome of animals and plants; Satellite DNA; LINES; SINES; Trasposable elements; Retroelements and pseudogene.

**UNIT-II**

**Gene Function;** Basic protein synthesis apparatus in eukaryotic cell; Gene expression in eukaryotes and its regulation; Gene promoters and different controlling elements; Global gene expression analysis using RT-PCR, Real Time PCR (Different Chemistries); RNAi approaches; Differential gene expression.

**UNIT-III**

**DNA Microarray:** Printing or oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for Global patterns of gene expression using fluorescent-labelled cDNA or end labelled RNA probes. Analyses of single nucleotide polymorphism using DNA chips.

**UNIT-IV**

**Genetic Markers:** Concepts of allele, gene family, Single locus and multi locus DNA markers; Tools for genome analysis-RFLP, DNA fingerprinting, RAPD, PCR and Automated DNA sequencing; Linkage and pedigree analysis-physical and genetic mapping strategies(chromosome walking, chromosome jumping, exon trapping, in situ hybridization and chromosome painting, microarray technology) and present status of gene map; Genome sequencing projects in human, mouse, drosophila rice and Arabidopsis

**IV Semester****BS4.1 Behavioral Biology and Hormones****28hrs****UNIT-I**

**Introduction:** Classification of behavior types, reflexes and complex behavior, nervous system and behavior; development of Behavior and phylogeny of behavior.

**Genetics and behavior:** Micro evolutionary changes in behavior; Hamilton's rule, inclusive fitness, Kin selection altruism and altruistic behavior.

**UNIT-II**

**Learning and Memory:** Theories of Learning-Cognitive and SR theory of Learning-associative and non-associative types; reasoning and intelligence, learning abilities in animal groups. Imprinting work of Tinbergen and Lorenz.

**Social behavior:** Pheromones and insect behavior. Distance and direction, Communication in Honey bees, chemical communication in ants. Thwarting and conflict behavior, pure attack and escape, threat displays, social signals, appeasement displays, displacement activities, territorial and courtship conflicts.

**UNIT-III**

**Endocrine organs in man:** Hormones of pituitary, Hypothalamus, Thyroid, Parathyroid, Adrenals, Pancreas, Testis, Ovary and Placenta. Chemistry and function. Hierarchy, Interplay and dynamic balance among hormones. Endocrine disorders in man, acromegaly, Goiter, Dwarfism, Diabetes.

#### UNIT-IV

**Mechanism of hormone action:** general mechanism of action- receptor, signal transduction, G-proteins, Heterotrimeric G-protein coupled receptors, receptor tyrosine kinase, eicosanoid receptors.

**Second messengers-** types of second messengers chemistry and function (Ip3, DNA, Ceramide, PA, LPA). Protein kinases AC and G, protein phosphatases, protein motifs in signal transduction, SH2, SH3, PH and others. Pathways of signal transduction, general pathway, growth hormones pathway, stress pathway, MAP kinase pathway, other kinases, signaling in bacteria and plants.

### **BS 4.2 Genetic Engineering and Biotechnology**

**28hrs**

#### UNIT-I

**Enzymes in genetic engineering :** enzymes in genetic engineering, restriction endonucleases; type I, II, III, recognition sequences, properties, nomenclature, classification of type II endonucleases and their activity. DNA ligase: Properties and specificity, S1 nuclease, BAL 31 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase and mode of action. Chemical synthesis of DNA.

#### UNIT-II

**Plasmids:** Properties, incompatibility, isolation and purification techniques, plasmid vectors and their properties, pBR 322 – its construction and derivatives, single stranded plasmids, promoter probe vectors, runaway plasmid vectors. Bacteriophage lambda as a vector:

**Organization of genome:** general structure, rationale for vector construction, improved vectors, invitro packaging, cosmids, phasmids, phagemids vectors of yeast, BAC and plants..

#### UNIT-III

**Construction of gene libraries and cloning:** construction of genomic and cDNA libraries, selection and screening of cloning recombinants: genetic selection, use of chromogenic substrates, insertional activation. Analysis of cloned genes; characterisation of clones, restriction mapping, gene identification, nucleic acid hybridization, southern hybridization, PCR and DNA sequencing. Chromosome walking and jumping, Recombinant DNA technology with reference to cloning and production of interferon and insulin. Cloning of sheep (Dolly).

#### UNIT-IV

**Application of genetic engineering:** Transgenic plants and animals. Bt-cotton, terminator gene, hybridoma. Biopesticides, Biofertilizers, Gene therapy

### **BS 4.3 Project work**

**84hrs**

### **BS 4.4 Bioinformatics**

**28hrs**

#### UNIT-I

Introduction, History, Internet and Bioinformatics, Knowledge Discovery & Data mining, Problems faced in Bioinformatics area, Opportunities in Bioinformatics, Human Genome Project.

#### UNIT-II

**Biological Databases & their Management:** Database Concepts, Introduction, History of Databases, Database Management System, Types of Databases, Codd Rules, Data Normalization. Biological Database and its Importance, Biological Database and their

Functioning, Types of Biological Database, Microbiological Databases, Primary Sequence Databases, Carbohydrate Databases, RNA Databases, Genome Databases, Organism Databases, Biodiversity

### **UNIT-III**

**Sequence Database:** Introduction, Nucleotide Sequence Database, Protein Sequence Databases, The EMBL Nucleotide Sequence Databases, Structure Databases

**Bioinformatics Softwares:** ClustalV Multiple Sequence Alignments, ClustalW Version 1.7, RasMol, Oligo, MolScript, TREEVIEW, ALSCRIPT, Genetic Analysis Software, Phylip.

### **UNIT-IV**

**Biocomputing:** Introduction, Datamining and Sequence Analysis, Database Similarities Searches, Practical aspects of Multiple Sequence Alignment, Phylogenetic Analysis, Predictive methods using Nucleic acid and Protein Sequences, Submitting DNA Sequences to the Databases.

## **BS 4.5 Ecology and Evolution**

**- 28Hrs**

### **UNIT-I**

**Introduction to Ecology;** biotic and abiotic factors, Concept of habitat and niche pond as an ecosystem, interspecific interaction in the ecosystem, food chain and food web, ecological pyramids.

**Bio-geo-chemical cycles,** Carbon cycle, nitrogen cycle, sulphur cycle

### **UNIT-II**

**Pollution:** Air, water and soil pollutants, effects & their abatement. Greenhouse effect, acid rain. Eutrophication

**Conservation Biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Elephant, crocodile, Biosphere reserves).

### **UNIT-III**

**Introduction to evolution:** Big bang theory, Age of stars, confounding data from the Hubbel space telescope, expanding universe, geological time scale

**Theories of evolution:** Lamarckism, Darwinism, Darwin's theory, observations from embryology, comparative anatomy and Biochemistry. Neo Darwinism and neo lamarkism

### **UNIT-IV**

**Molecular phylogeny**– history, terms, definition and limitations, construction of phylogenetic trees using molecular data, construction of phylogenetic trees.

**Mode of speciation-** speciation and factors responsible for speciation; pre and post zygotic speciation.

**Paleontology-** Palaeobotany and zoology, Dating of fossils, different methods, Evolution of man

## OPEN ELECTIVE

### 2.1 Human Body and Health

- 28 Hrs

**Unit-1:** Introduction- external and internal features of human body

**Unit-2:** Digestive system – parts of digestion, Ingestion, Role of different parts of digestive system, Digestion of Carbohydrate, Protein and Lipids. Liver as an organ, absorption, gastrointestinal disorders.

**Unit-3:** Reproductive system – sex organs of male and female, Menstrual cycle, copulation and fertilization, pregnancy, parturition, birth control.

**Unit-4:** Man and pollution – water, air, noise and soil pollution and their effects on health, sewage water – source, biological effects and treatment.

### 3.1 Human diseases and Hygiene

- 28 Hrs

**Unit-1:** Diseases of man – Communicable diseases: cholera, typhoid, shigellosis, gastroenteritis, hepatitis A and B and polio; arthropod borne disease: plague; direct contact diseases: anthrax, gas gangrene; air borne disease: diphtheria, tuberculosis; food borne diseases: botulism, salmonellas, campylobacter jejune, gastroenteritis and protozoan diseases: malaria and amoebiasis

**Unit-2:** Sexually transmitted Diseases and AIDS

**Unit-3:** Syndromes – Down's, Turner and Klinefelter. Genetic diseases- Autosomal, dominant, Autosomal recessive and Sex linked recessive.

**Unit-4:** Human welfare – food, yoga and meditation

### 4.1 You and Your Heredity

-28hrs

**Unit-1:** Introduction, Variations in natural populations: Human races and their distribution.

**Unit-2:** Evolution of Man Human Population analysis, Galton experiments.

**Unit-3:** Mendelian principles in Human population Pedigree analysis and genetic counseling.

**Unit-4:** Cloning and transgenic animal, human chromosomes and amniocentesis.