

## M.Sc BIOCHEMISTRY

### IV SEMESTER

#### BC 4.1: CLINICAL BIOCHEMISTRY AND ENDOCRINOLOGY

##### Unit 1:

Gastrointestinal hormones - Gastrin, secretin and cholecystokinin. Disorders of gastric function, methods of evaluation. Pancreatic exocrine secretions, pancreatic diseases, steatorrhoea. Malabsorption syndrome - tests for their evaluation and significance.

Plasma proteins - Properties, functions and their variations in diseases, Plasma lipids and lipoproteins, Interrelationship of lipids, lipoproteins and apolipoproteins. Erythropoiesis, abnormalities in blood formation. Anemias. Hemoglobinopathies. Cerebrospinal fluid - composition in health and diseases.

##### Unit 2:

Liver function tests, their significance, Liver diseases - Jaundice, hepatitis, gall stones, cirrhosis and fatty liver. Free radical mechanism and role of reactive oxygen species in diseases. Role of liver in metabolic regulation and drug metabolism. Clinical chemistry of newborn.

Clinical enzymology - Plasma enzymes in diagnosis and prognosis, Isoenzymes in health and diseases (Liver, cardiac and skeletal muscle enzymes)

Kidney - Renal hormones - Renin, erythropoietin and angiotensin. Investigations of renal functions, biochemical investigation of renal disorders. Nephritis, nephrotic syndrome and urolithiasis. Compensatory mechanism for acidosis and alkalosis.

##### Unit 3:

Pancreatic hormones - Biosynthesis of insulin, regulation of secretion of insulin and glucagon, their role in carbohydrate, lipid and protein metabolism. Endocrine disorders of pancreas - Diabetes mellitus, melliturias, hypoglycemia. Glucose tolerance test.

Thyroidal hormones - Chemistry, function and metabolism. Hypo and hyper thyroidism, tests for thyroid function. Parathyroid hormones - Parathormone and calcitonin, their role in calcium and phosphate metabolism, abnormalities of parathyroid functions and methods of evaluation.

Adrenals - Chemistry and biosynthesis of adrenal medullary and adrenal cortical hormones . Disorders of adrenal cortex and adrenal medulla, tests for the evaluation of adrenal functions. Biochemical effects of tumours.

**Unit 4:**

Synthesis, secretion, transport and biological actions of hypothalamic, adenohipophysial and neurohypophysial hormones. Hypothalamic disorders. Pituitary - Clinical syndromes and their evaluation. Penial hormones - Melatonin and serotonin.

Chemistry, biosynthesis and role of androgens , estrogens and progesterone. Hormonal regulation of menstrual cycle, Hormonal contraception. Placental hormones. Biochemistry of reproductive disorders, pregnancy toxemia, pregnancy tests.

## **BC 4.2: GENOMICS, PROTEOMICS AND BIOINFORMATICS**

### **Unit: 1**

Significance of statistical methods in biological investigation, Sampling techniques and evaluation of residues, Probability theory, Binomial distribution, SD & MD, "t" test. Analysis of variance and its significance (ANOVA). Coefficient of correlation (r). Chi - square test and simple regression of equation and regression lines.

Organisation of computers, External and internal storage devices, Basics of operating systems – DOS, Windows, Unix, Linux. WWW, HTML, HTTP, Intra net and Internet concepts.

Origin of Bioinformatics, Branches of bioinformatics, Scope of Bioinformatics

### **Unit: 2**

High throughput DNA sequencing, Whole genome sequencing, shot gun sequencing, sequencing editing, contig assembly

Genome projects: Human genome projects, features of yeast, Arabidopsis genomes.

Introduction to Data Bases, types of Data Bases.

INSD-International Nucleotide Sequence Database, Gen Bank, EMBL, DDBJ, special focus on NCBI, Protein sequence Data base- Swissprot, Tr- EMBL, PIR, Uniprot and Pfam, Structural Data bases-PDB, CATH, SCOP, MMDB

### **Unit: 3**

Structural genomics- Genome annotation, Gene finding. Functional Genomics – Interpro. Comparative genomics - Orthologs, paralogs, and homologs.

Concepts of sequence alignments and its importance. Pairwise and multiple sequence alignment.

Molecular phylogeny concept. Tree types, Tree constructions – UPGMA, Neighbor joining, Maximum parsimony, Minimum evolution, Boot strapping, Blast search tool.

#### **Unit: 4**

Proteomics: Significance and applications of proteomics in Biology.

Introduction to principle and techniques – 2D gel electrophoresis, DIGE electrophoresis, MALDI- TOF/TOF, Q –TOF.

Molecular Modeling – Structure of protein at Primary, secondary, tertiary and quaternary level. Understanding Molegro Molecular viewer for protein 3D visualization – RASMOL. Protein secondary structure prediction – Chou Fasman method.

Homology modeling and docking studies (Using Molegro Virtual Docker)

Molecule Import and preparation from PDB. Docking, Analysis, Constrains, Data analyser, sidechain flexibility and templet docking.

Drug discovery – target identification, target validation, lead identification, lead optimization, Phase I,II and III clinical trials, pharmacodynamics.

### **BC 4.3: APPLIED BIOCHEMISTRY**

#### **Unit: 1**

Methods for measuring nucleic acid and protein interactions – foot printing, CAT assay, gel shift analysis. DNA markers in genetic analysis – RFLP, Minisatellites, Microsatellites, PCR based RAPD markers, Chromosomal Walking, Chromosomal jumping.

DNA fingerprinting, SNPS, Mapping Genes – Somatic cell hybridization mapping, FISH, Transposon tagging. RNA silencing – siRNAs and anti- sense RNAs- their design and applications; shRNA, epigenetic gene silencing.

#### **Unit: 2**

Plant tissue culture: Culture media – Composition and preparation, Totipotency, Organogenesis and plant regeneration, Somatic embryogenesis, Artificial seeds, Micropropagation. Isolation and culture of protoplasts, Somatic hybridization. Plant cell cultures, Plating efficiency, Production of secondary metabolites through in vitro culture.

#### **Unit: 3**

Animal tissue culture: Composition and preparation of culture media, Primary cultures, established/continuous cell lines. Tissue and organ culture.

Stem cells – Sources - embryonic stem cells, adult stem cells, cord blood stem cells. Generation of stem cells by cloning, stem cell differentiation, stem cell plasticity, preservation of stem cells. Organogenesis through stem cells for transplantation. Applications of stem cell therapy- Parkinson's disease and Alzheimer's disease.

#### **Unit: 4**

Vaccines: Principles of vaccination, Design of vaccines. Conventional vaccines – Whole organism, live and attenuated, purified macromolecules. New generation vaccines- Recombinant antigen vaccines, recombinant vector antigens, DNA vaccines, synthetic vaccines, edible vaccines. Vaccine delivery systems – Liposomes, micelles, ISCOMS. Strategies for developing vaccines for malaria, HIV and Salmonellosis.

Gene therapy –Types and use of rDNA constructs for gene therapy. Microarrays and biochips. Principle and applications of Metabolic engineering. Principle and applications of Nanotechnology.

### **PRACTICAL – 1**

#### **BC 4.4 CLINICAL BIOCHEMISTRY AND BIOINFORMATICS**

Analysis of Blood for:

- Hemoglobin and derivatives – Spectroscopy
- Glucose by chemical and enzymatic methods
- Glycosylated hemoglobin

Analysis of serum for:

- Creatine and creatinine
- Uric acid by chemical and enzymatic methods
- Bilirubin
- Chlorides
- Calcium
- HDL Cholesterol and LDL cholesterol
- Total proteins, Albumins and globulins

Thymol turbidity and zinc sulphate turbidity tests

GOT and GPT

LDH, Gamma glutamyl transferase

Acid and Alkaline Phosphatase

Creatine Kinase

Analysis of Plasma for:

Fibrinogen

Analysis of Urine for:

Qualitative tests and microscopic examination

Urea by micro diffusion method

17 Oxo and 17 – Oxogenic steroids

Search of databases:

Using DNA sequence, identifying the protein through database

Using amino acid sequence of a protein, identifying the gene through database

Alignment of DNA and protein sequence using BLAST, FASTA

Multiple sequence alignment (MSA) of proteins and nucleic acids

Phylogenetic tree construction using CLUSTAL tools

Demonstration of 2D electrophoresis