

**SARDAR PATEL UNIVERSITY  
VALLABH VIDYANAGAR**



**Programme: MSC (CBCS)  
Syllabus with effective from: JUNE-2017**

**BIOCHEMISTRY  
Semester II**

**PS02CBIC21: Molecular Biology**

**Unit I: DNA structure**

DNA structure: Chemistry of DNA, DNA structure, Different conformations of DNA (B, A and Z), Denaturation and Renaturation of DNA.

DNA topology: Supercoiling, Biology of Supercoiled DNA, DNA topoisomerases and their mechanism of action.

DNA- protein interactions: General features, Sequence specific DNA binding protein motifs, ss DNA binding proteins.

**Unit II: Organization of genome and its replication**

Organization of DNA into chromosomes: Packaging of DNA and organization of chromosome in bacterial cells; Packaging of DNA in eukaryotic nucleosome and chromatin condensation, assembly of nucleosomes upon replication, chromatin modification.

DNA replication: Mechanism of DNA polymerase catalyzed synthesis of DNA, Types of DNA polymerases in bacteria, Initiation of DNA replication and its regulation in prokaryotes, assembly of replisome and progress of replication fork, termination of replication. DNA replication in eukaryotes and archaea. Inhibitors of DNA replication.

**Unit III: Gene expression in prokaryotes and eukaryotes**

Transcription: RNA polymerases, features of prokaryotic and eukaryotic promoters, assembly of transcription initiation complex in prokaryotes and eukaryotes, and its regulation; synthesis and processing of prokaryotic and eukaryotic transcripts.

Translation: structure and role of t-RNA in protein synthesis, ribosome structure, basic features of genetic code and its deciphering, translation (initiation, elongation and termination in detail in prokaryotes as well as eukaryotes).

**Unit IV: Regulation of gene expression**

Regulation of gene expression in prokaryotes: Operon concept, positive and negative regulation. Examples of lac, ara, and trp operon regulation; global regulatory responses.

Regulation of gene expression in eukaryotes: Transcriptional, translational and processing level control mechanisms.

**References Books:**

Genes X: Lewin

Molecular Biology of the Gene: Watson et al

Molecular Genetic of Bacteria: Snyder and Champness

Molecular Biology, 4<sup>th</sup> Edition: Burton E Tropp

Principles of Genetics: Snustad and Simmons

## PS02CBIC22: Toxicology

### Unit-1

Definition and scope of toxicology: Eco-toxicology and its environmental significance.

Toxic effects : Basic for general classification & nature. Dose-Response relationship: Synergism and Antagonism, Determination of ED50 & LD50. Acute and Chronic exposures. Factors influencing Toxicity. Pharmacodynamics & Chemodynamics, dose conversion between animals and human

Diagnosis of toxic changes in liver and kidneys : Metabolism of drugs: paracetamol and aspirin with their toxic effects on tissues.

### Unit-2

Xenobiotics Metabolism: Absorption & distribution. Phase I reactions. Oxidation, Reduction, Hydrolysis and Hydration. Phase II reaction/Conjugation : Methylation, Glutathione and amino acid conjugation. Detoxification.

Biochemical basis of toxicity : Metabolism of Toxicity : Disturbances of Excitable membrane function. Altered calcium Homeostasis. Covalent binding of cellular macromolecules & Genotoxicity. Tissue specificity of Toxicity.

Toxicity testing : Test protocol, Genetic toxicity testing & Mutagenesis assays : In vitro Test systems – Bacterial Mutation Test, Ames Test, Fluctuation Tests, *In vivo* Mammalian Mutation tests –DNA repair assays, Chromosome damage test, Evaluation of Apoptosis and necrosis

### Unit-3

Pesticide toxicity : Insecticides : Organochlorines, Anti cholinesterases – Organophosphates and Carbamates, Fungicides. Herbicides, Environmental consequences of pesticide toxicity. Biopesticides.

Food Toxicity : Role of diet in cardio-vascular disease and cancer. Toxicology of food additives.

### Unit-4

Metal Toxicity : Toxicology of Arsenic, mercury, lead and cadmium. Environmental factors, affecting metal toxicity effect of light, temperature & pH.

Air pollution : Common air Pollutant & their sources. Air pollution & ozone. Air pollution due to chlorofluorocarbons (CFCS) and asbestos.

### References:

1. Klaassen, C. D (8<sup>th</sup> Eds.). (2013). *Casarett and Doull's toxicology: the basic science of poisons* . New York: McGraw-Hill.
2. John A. Timbrell (4<sup>th</sup> Edn) (2008) Principles of biochemical toxicology. Taylor & Francis Ltd, London,.
3. Smart, R. C., & Hodgson, E. (4<sup>th</sup> Eds.). (2013). Molecular and biochemical toxicology. John Wiley & Sons.
4. Relevant review articles / research papers / handouts of latest development in the subject.

## PS02CBIC23: Fundamentals of Immunology

### Unit I

Introduction to immune system: mechanisms of barrier to entry of microbes / pathogens;  
Cells and organs of the immune system involved in innate and adaptive immunity: cells of the immune system, primary and secondary lymphoid organs, Hematopoiesis and its regulation

Innate immunity: receptors of the innate immunity (TLR and sensing of PAMPs, CLR, RLR and CLR); Inflammatory responses

Antigens: antigenicity, and immunogenicity. B and T cell epitopes

### Unit II

Antibody: Structure of immunoglobulin; classes of immunoglobulins, Signal transduction pathways emanating from the BCR,

The Organization and Expression of Lymphocyte Receptor Genes: Hozumi and Tonegawa's Experiment, Multigene organization of Ig Gene, Mechanism of VDJ recombination, B cell receptor expression, allelic exclusion, B cell isotype switching and somatic hypermutation; expression of membrane bound and soluble immunoglobulin; T cell receptor genes and expression

Complement system: Overview of classical, alternative and lectin complement pathways, functions of complement, regulation of complement, complement deficiencies, microbial complement evasion strategies

### Unit III

The Major Histocompatibility Complex and Antigen Presentation: The structure and function of MHC molecules, general organization and inheritance of MHC, self – MHC restriction, endogenous and exogenous pathway of antigen processing and presentation; cross presentation of exogenous antigen, presentation of non peptide antigens

Cytokines: properties, receptors, associated diseases, therapeutic applications, cytokine signaling pathways: JAK-STAT and FAS-FASL signaling pathways

### Unit IV

Basics of Antigen-antibody interactions: Agglutination, precipitation, RIA and ELISA

Cell and antibody mediated effector response: Antibody mediated effector response (Neutralization, opsonization/ phagocytosis, complement fixation, ADCC); Cell mediated effector response (Generation of effector CTL's, Granzyme and Perforin Mediated Cytolysis, Fas-FasL Mediated Cytolysis, NK cell mediated cytolysis)

Immunity to infection: Immunity to viruses, Immunity to bacteria and fungi, Immunity to parasites (protozoa and worms).

### References

1. Owen, J. A., Punt, J., & Stranford, S. A. (2013). *Kuby immunology* (7<sup>th</sup> Edn). New York: WH Freeman.
2. Murphy, K., & Weaver, C. (2016). *Janeway's immunobiology* (9<sup>th</sup> Edn) Garland Science.
3. Male, D., Brostoff, J., Roth, D., & Roitt, I. (2012). *Immunology* (8<sup>th</sup> Edn) *With STUDENT CONSULT Online Access*. Elsevier Health Sciences.

4. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2014). *Cellular and molecular immunology* (6<sup>th</sup> Edn) Elsevier Health Sciences.
5. Relevant review articles / research papers / handouts of latest development in the subject.

## PS02EBIC21: Biostatistics

### Unit - I

Definition of Biostatistics

Data Collection:

Types of Biological Data:

Qualitative (Categorical ) Data: Nominal and Ordinal Data

Quantitative (Numerical) Data: Discrete and Continuous Data

Methods of Collecting Data:

Survey Method: Concept of a statistical population and sample from a population; Methods of drawing sample from the population, Simple Random Sampling (SRS), Stratified Random Sampling, Cluster Sampling; Experimental Method

Presentation:

Construction of frequency distribution (Simple or Discrete and Grouped): Rules for constructing Grouped frequency distribution

Diagrammatic Presentation: Bar Diagram (Chart), Simple, Sub – divided (Component), Percentage, Multiple, Pie Chart

Graphical Presentation: Line Graph, Histogram (For uniform class width only), Frequency Polygon, Frequency Curve, Ogives or Cumulative Frequency Curves

Descriptive Statistics:

Measures of Central Tendency (Averages): Mean or Arithmetic Mean, Median, Mode, Partition Values (For Raw and Grouped Data), Quartiles, Deciles, Percentile, Partition values using graphs (Ogives).

Measures of Dispersion (Variation): Range, Quartile Deviation (Q.D), Inter Quartile Range (IQR), Standard Deviation (SD) and Variance, Coefficient of Variation (C.V), Box – and – Whisker Plot.

Measures of Skewness and Kurtosis: Karl – Pearson's Coeff. of Skewness, Bowley's Coeff. Of Skewness, Kurtosis (Definition Only).

### Unit - II

Probability and Probability Distributions:

Elements of Probability theory: Concept, Classical definition of Probability, Laws of Probabilities (Statements Only), Conditional Probability, Examples

Probability Distributions: Binomial Distribution. Definition, Conditions for applicability of Binomial Distribution, Examples applicable in the field of Biosciences; **Normal Distribution**, Definition (Normal and Standard Normal Distribution), Properties of Normal Distribution, Examples applicable in the field of Biosciences

### Unit - III

Correlation and Regression Analysis:

Correlation: Meaning, Types of Correlation, Positive, Negative, Non – Sense or Spurious, Methods of studying correlation, Scatter Plot (diagram) method, Karl-Pearson's Correlation Coefficient (Product Moment) Method; Properties of Correlation Coefficient

Coefficient of determination and its meaning: Spearman's Rank Correlation Coefficient; Properties of Rank Correlation Coefficient

Regression: Meaning, Properties of Regression Coefficients, Applications in the field of Biosciences

Testing Of Hypothesis: Contingency tables, Goodness of Fit

**Unit - IV**

Large Sample Test: Z - test for (Single) population proportion; Z - test for difference between two population proportions; Z - test for (Single) population mean; Z - test for difference between two population means

Small Sample Test: t – test for (Single) Population Mean, t – test for difference between two population means (Unpaired t-test), t – test for difference between two population means (Paired t-test)

Analysis Of Variance (ANOVA) : One – Way Classification , Two – Way Classification

**References:**

- Fundamentals of statistics by S.C. Gupta
- Principles of Biostatistics by Marcello Pagano and Kimberlee Gaurea
- Biostatistics : A Foundation For Analysis in the Health Sciences by Daniel, Wayne (Seventh Edition), Wiley India Pub.

## PS02EBIC22 - Medical Biochemistry

### Unit 1

Principles of Diagnostic Enzymology: Serum Enzyme in heart disease, Liver disease, GI tract disease, muscle disease, bone diseases and in Malignancy, clinical importance of Isoenzyme (creatinine kinase and lactate dehydrogenase, Alkaline phosphatase)

Disorders of mineral metabolism: Hypercalcaemia, hypocalcaemia, normocalcaemia, hypophosphataemia and hyperphosphataemia.

Vitamin : Dietary sources, biochemical functions and specific deficiency diseases

### Unit 2

Organ function tests: Liver function tests - Bile pigment metabolism - Jaundice and its type; Blood coagulation disorder- Haemoglobinopathies, sickle cell anaemia.

Functions of Kidney, Urine formation and renal function tests disease of kidney - Renal Calculi, Theory of formation and analysis, chronic renal failure;

Gastric Analysis - Composition of gastric juice, concepts of free and bound acid, Fractional Test Meal;

Pancreatic function tests; Thyroid function tests; Cardiac function test

### Unit 3

Lifestyle Diseases:

Cardiovascular Problems- Systemic Hypertension and Arteriosclerosis, Stroke,

Neurological Disorders - Epilepsy, Sleep Disorders, Alzheimer's Disease, Parkinson Disease, Huntington's disease,

Cancer biology- Mechanism of carcinogenesis, tumor suppressor genes and oncogene, Cancer markers

### Unit 4

Infectious disease:

Relation between normal microbiota and host, opportunistic microorganisms, Spread of infectious diseases, Respiratory tract infection- Tuberculosis; Gastro intestinal tract infection: Food poisoning

Biochemistry of AIDS

### Reference Book

- Textbook of Medical Biochemistry; (Eight Edition), By Dr (Brig) MN Chatterjea, Rana Shinde; JAYPEE BROTHERS MEDICAL PUBLISHERS (P) LTD
- Clinical Biochemistry- Metabolic and Clinical aspects By---William J. Marshall & Stephen K. Angert.
- Biochemistry with clinical correlation--- By Thomas Devli
- Text book of Medical Physiology --- By Guyton.
- Textbook of Biochemistry for Medical Students: D.M. Vasudevan and Sreekumari, S, 6th Edition, 2010, Jaypee Brothers Medical Publishers, New Delhi.
- Tietz Textbook of Clinical Chemistry, Third Edition. Carl A. Burtis and Edward R. Ashwood, eds.
- Harper's Illustrated Biochemistry- R.K.Murray, D.K.Grannes and V.W.Rodwell, McGraw Hill



## **PS02EBIC23: Microtechniques**

### **Unit I**

Light microscopy

Properties of lenses, Optical corrections, Properties and types of objectives, Oculars and Illumination.

Light microscopes: Bright field, dark field, fluorescence, phase contrast, polarizing, differential interference contrast.

Micrometry and photomicrography

### **Unit II**

Basic components of electron microscopes. Thermionic and field emission guns. Types of electron microscopes: TEM, SEM, STEM, ESEM and HVEM

### **Unit III**

Maceration, squash and clearing techniques. Sample preparation for light microscopy. Classification of fixatives, formulas', (Plant and animal samples).

Sample preparation for light microscopy: Fixation, dehydration and infiltration procedures.

Embedding media for light microscopy. Stains and staining procedures- negative and positive staining procedures. Microtomes: Rotary, sliding, cryostat. Histochemical localization of metabolites for light microscopy: Starch, proteins, lipids, total carbohydrates, lignins, polyphenols, nucleic acid, histones, cutin, suberin and waxes. Localization of enzymes: Peroxidase, acid phosphatase and succinic dehydrogenase.

### **Unit IV**

Freeze etching and freeze fracturing.

Sample preparation for Electron microscope: Fixatives, double fixation, dehydration and infiltration procedures, embedding media for electron microscopy. Fixation and embedding of particulate samples like bacteria, virus etc. ultra-microtome and freezing ultramicrotome-semi thin sectioning, ultrathin sectioning, grids, formavar coating, Staining for electron microscopy.

Ultrastructural cytochemistry: Tannin, protein, cell wall polysaccharide, lignin and membrane.

Enzymes: Peroxidase and phosphatase.

Immunocytochemistry.

### **References:**

- Microscopy and Microtechnique: R Marimuthu MJP Publisher, Chennai
- The study of plant structure: Principles and selected methods- T. P. O' Brien and M E McCully.
- Plant Microtechnique- Johansen, DA, McGraw Hill Book Co., New York.
- Botanical Microtechnique and Cytochemistry; Graeme P. Berlyn and Jerome P Micksche.

**PS02CBIC24: Lab I (Practicals based on PS02CBIC21 and PS02CBIC22)**

**PS02CBIC25: Lab II (Practicals based on PS02CBIC23 and PS02EBIC2X)**