

## Syllabus for CIS courses

### SB102 Foundation Biology (for Math students) (3credits): 1<sup>st</sup> Sem

#### Introduction

Introduction to what is life, how biology is studied and importance of studying biology (2 hr).  
Chemistry of life: importance of water, brief mention of macromolecules that make life forms (4 hr).  
Nucleic acids and origin of life (4 hr)

**Brief introduction to microscopy:** taking examples of a couple of structures as visualized by light microscopy to fluorescence to confocal to electron microscopy (2 hr)

**Cells as units of life:** Features of fundamental units of life, prokaryotic and eukaryotic cell, organization of prokaryotic cell, organelles in eukaryotes (nucleus, cytoplasm, mitochondria, lysosome, peroxisomes, endomembrane system, cytoskeleton, chloroplast, cell wall, extracellular matrix) (6 hr)

**Cell membranes:** basic structures, specialization of membranes: adherence, selective permeability, active process of transport and communication between organelles, communication between cells and between cells and environment. Other specialized functions of membranes (8 hr)

**Cell communication and multicellularity:** signals, signal receptors, response to signals (10 hr)

Total hours: 36hr

### SB151 Introductory Biology (3 Credits): 2<sup>nd</sup> Sem

**Energy, enzymes and metabolism:** Start with Thermodynamics and move to ATP in biochemical energetics; Enzymes and how they work, introduction to respiration and photosynthesis (8 hrs)

Cell cycle (basic regulation and introduction to apoptosis and cancer) (2 hrs);

**Inheritance biology:** mitosis and meiosis (1hr); Mendelian genetics (2 hrs)

Plant responses to environmental challenges (4 hrs)

Animal physiology, homeostasis and temperature regulation; endocrine system and defense systems (6 hrs)

**Amino acids:** chemical structures and classification, peptide bond, uncommon amino acids and their roles, titration curves of amino acids, isoelectric point, oligo peptides

**Carbohydrates:** monosaccharides, disaccharides, aldoses and ketoses, chiral properties and structural representations, reducing sugars, glycosidic bonds, phosphodiester bonds (7 hrs)

**Nucleotides:** purines and pyrimidines, nucleosides and nucleotides chemical and physical properties, chargaff rules (4 hrs)

**Lipids:** storage lipids, triacyl glycerols, fatty acids and their properties and nomenclature (3 hrs)

Total hours: 36

- a) Life: The Science of Biology by Sadava et al
- b) Biology by Raven and Johnson
- c) Campbells Introduction to biology

### **Structure and Function of Macromolecules (3 credits) : 3<sup>rd</sup> Sem**

**Macromolecules in Biology:** Carbohydrates, Lipid, protein and Nucleic acid  
**Carbohydrates:** Building block, structure, glycosidic bond, different forms of carbohydrates based on structure and function; (8 hrs)

**Proteins:** building block (amino acids), peptide bond, polypeptide, secondary structure, tertiary structure and quaternary structure. Forces that stabilize protein structure, Ramachandran plot, Structural classification of protein- fold/motif, class, family and superfamily,

**Commented [1]:** Moved to Introductory Biology Course

Structure function correlation, functional conformation of protein, protein folding and denaturation, molecular chaperones assist protein folding, regulatory protein- transcription factor structure and function, structure of antibody, motor proteins (myocin, actin), structure and function of myoglobin and hemoglobin, proteins involve in signal transduction and structural change in receptor proteins. (10 hrs)

**Nucleic acids:** Different forms of DNA, interaction of DNA with proteins, drugs, dyes and carcinogens, hydrogen bonding interactions, structure of RNA, basic differences between DNA and RNA structures, structure of yeast phenylalanine tRNA. Different forms of RNA, ribozyme and Riboswitch: structure and function, ribosome: subunits and structure; (5 hrs)

**Structure and function of higher order chromatin:** Packaging of DNA into chromosomes, Superhelicity, Linking Number, Topoisomerases, Histones and their modifications, Euchromatin, Hetrochromatin, Centromere and Telomere Structures, Regulation of different types of chromatin. (5 hrs)

**Lipids:** Classification of lipids, Chemical structure and structural components of membrane; Transport across the membranes, Lipid vitamins, Cholesterol and its derivatives, Eicosanoids, Different types of Lipoproteins and their role in health and disease, Purification and analysis of lipids (8 hrs)

**Commented [2]:** New addition to this course

Total hours: 36 hrs

**Recommended books:** Biochemistry, Lehninger A.H., Proteins: Structure, function and evolution. Dickerson & Geis, 2nd Edn, Protein: Structure and molecular properties: Thomas E. Creighton.

**Lab Courses:**

**Semester 2: Biology Laboratory: Introductory Biology:**

- 1) Parts of flowers: show several types from the University/local neighbourhood etc
- 2) Peel of Onion
- 3) Cheek cells
- 4) Stomata opening and closing
- 5) Culture of Paramecia: Feeding, behavior, chemotaxis, conjugation (Can use any model system or combination of model systems)
- 6) Respiration in animals
- 7) Permanent slide: mitosis, meiosis, Blood cells (diff types of cells from various animals) etc.
- 8) Observation of colour: scales vs insects

**III Semester**

**SB202 Biology Laboratory II:**

- Experiment – 1:** Introduction to Techniques: Use of Pipetmen  
**Experiment – 2:** Preparation of Buffers  
**Experiment – 3:** Qualitative test for lipids  
**Experiment – 4:** Analysis of DNA, RNA by UV-spectrophotometer  
**Experiment – 5:** Estimation of Protein by UV-spectrophotometer  
Ninhydrin test for amino acid determination  
**Experiment – 6:** Estimation of Protein by Lowry method  
**Experiment – 7:** Determination of T<sub>m</sub> of a DNA sample  
**Experiment – 8:** Separation of chlorophyll pigments by paper chromatography  
**Experiment – 9:** Building biomolecules using Molecular Model kit  
**Experiment-10:** Benedict's Test for Reducing Sugars

**IV Semester**

**Biology Lab SB252: Structure and Function of Macromolecules Lab**

- 1) Estimation of Protein by Bradford. Compare sensitivity
- 2) DNA quantification by diphenylamine colorimetric method
- 3) RNA quantification by orcinol method.

- 4) Estimation of Phosphate by Fiske and Sabbarow method
- 5) Growth curve for bacteria and estimation of doubling time (learn to make media, streak colonies, inoculate etc)
- 6) Isolation of plasmid DNA.
- 7) Separation on plasmid on agarose gel
- 8) Separation of proteins by SDS-PAGE