



# UNIVERSITY OF CALCUTTA

**GURUPADA SAREN**

**SECRETARY**

COUNCILS FOR UNDERGRADUATE STUDIES,  
UNIVERSITY OF CALCUTTA.

Ref.No : CUS/ 58 /18  
Dated the 01<sup>st</sup> February, 2018

**SENATE HOUSE**

Kolkata – 700 073.

Phone : 2241-0071-74,  
2241-0077-78,2241-4989-90,  
2241-2850-51,2241-2859

Fax : 91-033-2241-3222

E-mail : u.g.councilsc.u@gmail.com

Website :www.caluniv.ac.in

To  
The Principals/T.I.C.  
of all the Undergraduate Colleges  
offering B.Sc. (General) in Molecular Biology  
affiliated to the University of Calcutta

Sir/Madam,

The undersigned is to inform you that the proposed **revised semesterised draft Syllabus for Molecular Biology (General) Courses of Studies under CBCS has been uploaded in the Calcutta University website (www.caluniv.ac.in).**

The said syllabus has been prepared by the **U.G. Board of Studies in Molecular Biology, C.U.**, suppose to be implemented from the academic session 2018-2019

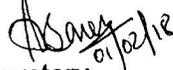
You are requested kindly to go through it and send your feedback within 15<sup>th</sup> February, 2018.

In this regard you may send your observation/ suggestion to the **Department of U.G. Councils, C.U.** or through email (u.g.councilsc.u@gmail.com), and you also may contact **Prof. Ansuman Lahiri**, Department of Molecular Biology, C.U. through e-mail (lahiri.ansuman@gmail.com ).

Your cooperation in this regard will be highly appreciated. Kindly treat the matter as urgent.

Thanking you,

Yours faithfully,

  
Secretary



**University of Calcutta**  
**Syllabus for three-year B.Sc. in Molecular Biology**  
**(General)**  
*under*  
**CBCS System**  
**2018**

## DRAFT SYLLABUS FOR MLBG

Semester	Discipline specific Core courses (4x3=12) (6 credits each)	Ability enhancement compulsory course (AECC) (2) (2credits each)	Skill Enhancement Course (SEC) (2) (2credits each)	Discipline Specific Elective (DSE (2x3=6) (6credits each)
I	DSC-MLBG IA Molecular aspects of living cell	English/Hindi /Mil communication/ Environmental Sc.		
II	DSC-MLBG 1 B Molecular Basis of life	English/Hindi /Mil communication/ Environmental Sc.		
III	DSC-MLBG 1 C Conceptual Molecular Biology		SEC -1 ECA/General Interest/Hobby/Sports/ NCC/NSS/related courses on its own.	
IV	DSC-MLBG 1 D Biophysical techniques, Biostatistics etc.		SEC - 2 ECA/General Interest/Hobby/Sports/ NCC/NSS/related courses on its own.	
V			SEC - 3 ECA/General Interest/Hobby/Sports/ NCC/NSS/related courses on its own.	DSE MLBG 1 A - RDT & Biomechanics DSE MLBG 2 A <b>Microbiology (Syllabus not assigned yet)</b> DSE MLBG 3 A Clinical Biochemistry
VI			SEC - 4 ECA/General Interest/Hobby/Sports/ NCC/NSS/related courses on its own.	DSE MLBG 1 B - Sensory Processes in Biophysics DSE MLBG 2 B- Molecular basis of human diseases & Drug Metabolism DSE MLBG 3 B Biomedical Instrumentation <b>(Syllabus not assigned yet)</b>

## **DSC- MLBG 1A: Molecular aspects of living cell (4+2 credits)**

**TOTAL HOURS- 60; CREDITS- 4**

### **Unit 1 Basic Mathematics( 7 hours)**

Simple algebra: Progressions( A.P. G.P. H.P.) Surds and Indices, Logarithm, Binomial Theorem, Exponential Series. algebraic and differential equations.

Simple trigonometric functions

Simple Calculus: Differentiation and Integration, Differential Equations.

### **UNIT 2 Basic physics(18 hours)**

Units and Dimensions, Scalars and Vectors, Laws of motion, Conservation of Energy

Fluid motion, Particle and wave character of light, Bohr postulates and Basic quantum theory.

Basic principles of electromagnetic radiation: Absorption and emission spectra. Beer-Lambert law, Principles and applications of u.v. and visible spectrophotometry -.

Natural radioactivity: Types of radioactive emissions and their interaction with matter ( alpha, beta, gamma rays), derivation of radioactive decay equation( with simple problems), difference between physical and biological half lives. Average life.

Radiation units : measurement units and dose units of radioactivity.

### **UNIT 3 Basic aspects in chemical reactions(5 hours)**

Importance of Carbon molecule, structure of water, concept of pH/pKa , Buffer, Forces in biological systems : Concept of intra- and intermolecular interactions ( covalent bond, coordinate covalent bond, ionic bond, hydrogen bond, hydrophobic interaction).

### **Unit 4: An Overview of Cells (15 hrs lectures)**

Structure and function of Prokaryotic(bacteria)and Eukaryotic (plant and animal) Cells with nucleus and other organelles. Evolution of the cell: From molecules to the first cell, from prokaryotes to eukaryotes, from single cell to multicellular organisms.

### **Unit 5: Detection of cell(15 hrs lecture)**

Basic working principle of Different microscopes (simple and compound light microscope, Phase contrast, confocal, TEM) with applications.

Preparation of biological samples, sectioning and spreading, shadow casting and staining

Cell sorting (FACS)

## **Practical for DSC 1A:**

- i) Determination of refractive index of a given biological sample by travelling microscope.
- ii) To plot the absorption spectrum of a given biological sample by colorimeter.
- iii) Preparation of phosphate buffer and measurement of pH.
- iv) Chemical tests for amino acids and proteins; estimation of amino acid by formol titration

## **DSC- MLBG 1B: Molecular Basis of life (4 credits)**

### **UNIT I: Basic Biomolecules(35hrs lecture Periods)**

**Carbohydrate:** Structure, Function and properties of Monosaccharides (Hexoses and pentoses), Disaccharides (sucrose, lactose, maltose), storage & structural polysaccharide (glycogen, starch and cellulose).

**Lipids:** Role of lipids in cellular architecture, Definition and classification of lipids, Structure and function of fatty acid, triacylglycerol, phospholipid and sterol.

**Proteins:** Structure and properties of Amino acids, essential and non-essential amino acids, Classification of proteins on the basis of composition, conformation and function, Forces stabilizing protein structure and shape. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins.

**Enzymes:** Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, activation energy and transition state, enzyme activity, specific activity, concept of active sites, Kinetics of enzyme catalysed reactions – Michaelis-Menten equation, Determination of  $K_m$  and  $V_{max}$ , Significance of  $K_m$  and  $V_{max}$ . Definition of enzyme unit and specific activity. Factors influencing the rate of enzyme catalysed reactions, Enzyme inhibitions : Competitive , non-competitive and un-competitive inhibitions, Preliminary concept on allosteric enzyme.

### **UNIT 2: Metabolism (25 hrs lecture periods)**

Carbohydrates Metabolism: Reactions, energetics and regulation. Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions. Pentose phosphate pathway and its significance, Gluconeogenesis, Glycogenolysis and glycogen synthesis. TCA cycle, Electron Transport Chain, Oxidative phosphorylation.

Lipid Metabolism – Structures and roles of Fatty acids & Glycerols, beta oxidation of saturated fatty acids, energy yield, ketone bodies.

Amino acid Metabolism – Amino acid breakdown (Transamination, deamination) Urea cycle.

**Practical for DSC 2A:**

- i) Identification of carbohydrates, lipids, amino acids and of proteins.
- ii) Detection of reducing sugar, polysaccharides.

**DSC- MLBG 1C: Conceptual Molecular Biology (4+2 credits)**

**TOTAL HOURS: 60 CREDITS: 4**

**Unit I: Nucleic Acid(18 hrs)**

Nucleic acids: Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA, DNA as genetic material (with requisite experiments).

Supercoiling of DNA and its importance, linking number, topoisomerases, inhibitors of topoisomerases and their application in medicine, Definition of a gene, Nucleosome structure and packaging of DNA into higher order structures.

**Unit 2: Replication of DNA (12hrs)**

Features of DNA Replication, Proof of Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, the replication fork, origin of replication, stages of DNA replication, enzymes and proteins involved in DNA replication, E. coli DNA polymerases, replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes.

**UNIT 3I: Transcription and RNA processing (15 hrs)**

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains, processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing. Transcription in eukaryotes, inhibitors of transcription and applications as antibiotics.

**UNIT 4: Translation (15 hrs)**

Genetic code and its characteristics, wobble hypothesis, Prokaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl-tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides, Inhibitors of translation. Protein-folding and processing, inhibitors of protein synthesis and their application in medicine.

**Practical: not yet assigned.**

## **DSC- MLBG 1D: Biophysical techniques, Biostatistics etc. (4 + 2 credits)**

### **UNIT I: Biophysical techniques (20 hrs)**

Determination of macromolecular weight by different physico-chemical methods e.g. diffusion, osmosis, viscosity, sedimentation velocity, sedimentation equilibrium, density gradient centrifugation). Purification and isolation by Chromatography (paper, TLC, Gel filtration, Ion exchange, Affinity, High performance liquid) and Electrophoresis techniques.

### **Unit II: Biostatistics (10 hrs)**

Measures of central tendency , variance, deviation, x-squared test

### **UNIT III: Immunology(20hrs)**

Immune Response - An overview, components of mammalian immune system, molecular

structure of Immuno-globulins or Antibodies, Humoral& Cellular immune responses, T-lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells

Basic concept in Autoimmune diseases, Immunodeficiency-AIDS and vaccination. Introduction to immunodiagnostics – RIA, ELISA.

Practical: Haemocytometer, Squamous Cell, Viscosity, Separation by Chromatographic technique, Detection of antigen- antibody reaction by interfacial (ring) precipitin test, Blood group determination.

### **UNIT IV: DNA damage, repair and mutation(5hrs Periods)**

Causes and types of DNA damage, mechanism of DNA repair: Direct repair, base excision repair, nucleotide excision repair, mismatch repair, recombination repair. Molecular basis of mutation, types of mutation important diseases (sickle-cell anaemia, down syndrome, haemophilia, klinefelter syndrome, autism)

### **Unit V: Regulation of gene expression (5hrs)**

Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains.Regulation of gene expression in bacteria, lac operon and trp operon.

#### **Practical:**

- i)** To plot Poisson's distribution by hemocytometer.
- ii)** Measurement of viscosity/fluidity of a solution by Ostwald viscometer.
- iii)** Operation of a compound microscope and identification of its parts.
- iv)** Growth curve of bacteria

## **DSE- MLBG- 1A Recombinant DNA Technology & BIOMECHANICS**

**TOTAL HOURS: 60 CREDITS: 4**

### **UNIT I: Recombinant DNA Technology (35 hrs)**

i) (5 hrs)

Fundamental Techniques of gene manipulation- Gel electrophoresis, Southern blotting, Northern blotting, Western blotting, Transformation, Electroporation, PCR, RT-PCR, cutting and joining DNA molecules.

ii) (5 hrs)

Basic concept of plasmid and phage vectors, cosmids, phagemids and other advanced vectors (expression vectors, vectors that promote solubilisation of expressed proteins, BAC, YACetc).

iii)(5 hrs)

iv) (5 hrs)

Gene Cloning Strategies- Genomic Library, cDNA library, PCR alternative to genomic DNA cloning and cDNA cloning, Different strategies for screening of clone and Library.

v) . (5 hrs)

Gene transfer to Plants- Plant Tissue culture, strategies for gene transfer to plant cells, gene targeting in plants.

vi) (5 hrs)

Mapping and sequencing genomes- Sequencing genes and short stretches of DNA (Sanger sequencing, Automated DNA sequencing), DNA sequencing by microarray, RFLP, SNP, AFLP, in situ hybridization. Applications of Gene manipulation and genomics- understanding the basis of polygenic disorder, Investigatinggenetic disorder of humans, understanding responses to drugs

vii). (5 hrs)

Application of RDT- Production of useful molecules, Improving agronomic traits by genetic modification, using genetic modification to study, prevent and cure diseases

### **UNIT II: BIOMECHANICS (25 hrs)**

#### **Unit 1**

Equilibrium of forces and torques ,Ballistic motion ,Physics of muscles,Muscle power

Normal Locomotion: Walkin ,Jumping ,Propelling, Locomotion in air, Motion of birds

Locomotion in water, Swimming, Role of gravity in human locomotion.

**Practical:**

- i) Plasmid DNA Isolation.
- ii) Restriction digestion, Transformation, Detection of clone.

**DSE-MLBG 2A: Microbiology (Syllabus not assigned yet)****DSE- MLBG 3A: Clinical Biochemistry:****TOTAL HOURS: (30) 2 Credits****UNIT I: Brief idea about Bacteriology & Virology (8 hrs)**

Morphology of bacteria, Bacterial cell- cell membrane, cell wall, mesosome, glycocalyx, slime layer, capsule, flagella, cilia, pili, protoplast, spheroplast, endospore, gram staining, acid fast staining; Basic concept of virus- general characteristics, morphology and structure, classification; Bacteriophages, viruses of animals and plants .

**UNIT II: Clinically important Enzymes(5 hrs)**

Clinically important enzymes (lactate dehydrogenase, Creatine Kinase, Alanine transaminase, Aspartate transaminase, Alkaline phosphatase, Acid phosphatase), Inborn error of metabolism (Phenylketonuria, Alkaptonuria, etc).

**UNIT III: Infectious diseases (9 hrs)**

Bacterial diseases of human (dysentery, cholera, Anthrasis, whooping cough, diphtheria, pneumonia, conjunctivitis, tuberculosis, leprosy, gonorrhoea, typhoid, syphilis ); Viral diseases (influenza, poliomyelitis, viral encephalitis, viral fever, hydrophobia, Small pox, AIDS) and sexually transmitted diseases.

## **UNIT IV: Antibiotics and other chemotherapeutic agents (8 hrs)**

**Control of microorganism by physical & chemical agents, chemotherapeutic agents, Antibiotics- definition, characteristics, classification. Brief dea about Penicillin, Cephalosporin, Polymixin, gramicidin, streptomycin, tetracyclin, chloramphenicol, erythromycin, Nalidixic acid, ciprofloxacin, novobiocin, sulphonamides. Antibiotic resistance, multiple drug resistance.**

## **DSE- MLBG 1B: SENSORY PROCESSES IN BIOPHYSICS**

**TOTAL HOURS: 60 CREDITS: 4**

### **UNIT I: MEMBRANE TRANSPORT OF SMALL MOLECULES AND IONIC BASIS OF MEMBRANE EXCITABILITY (20 hrs)**

Principle of membrane transport- Passive transport, active transport, Ionophore. Carrier protein and Active membrane transport- Uniport, symport, antiport, Na-K pump ATPase. Ion channels and electrical properties of membrane, donnan equilibrium, membrane potential and K-leak channel, Basic structure of nerve cells, action potential propagation in nerve cells, Nernst potential.

### **UNIT II: CELL SIGNALING (10 hrs)**

General principle of cell signalling, basic concept of signalling via G-protein linked cell-surface receptor and its role in Smell and Vision.

### **Unit III: Physics of vision(10 hours)**

Visual organ of human, Qualitative description of defects of vision, Qualitative description of vision, visual sensitivity.

#### **Unit IV: Physics of hearing (10 hours)**

Anatomy of human ear, Properties of sound waves ,sonic,infrasonic, ultrasonic frequencies. Intensity level, qualitative description of noise and its biological effects, Echolocation of bats.Mechanism of human hearing,Place theory,

#### **UnitV: Hemodynamics, Circulation of blood (10 hours)**

Systole and diastole, Electrical measurement of human organs,ECG, EEG,ERG  
EMG

#### **Practical:**

- i) To study the ECG of a human being and determination of the heart beat.
- ii) To study the Ishihara Chart for determination of colour blindness.
- iii) To study the Landolt C Chart for determination of myopia.
- iv) , Measurement of blood pressure

**DSE-- MLBG 2B** Molecular basis of human diseases & Drug Metabolism

(Syllabus not assigned yet)

**DSE MLBG 3 B** Biomedical Instrumentation

(Syllabus not assigned yet)