UNIVERSITY OF CALCUTTA

Notification No. CSR/ 12 /18

It is notified for information of all concerned that the Syndicate in its meeting held on 28.05.2018 (vide Item No.14) approved the Syllabi of different subjects in Undergraduate Honours / General / Major courses of studies (CBCS) under this University, as laid down in the accompanying pamphlet:

List of the subjects

Sl. No.	Subject	Sl. No.	Subject
1	Anthropology (Honours / General)	29	Mathematics (Honours / General)
2	Arabic (Honours / General)	30	Microbiology (Honours / General)
3	Persian (Honours / General)	31	Mol. Biology (General)
4	Bengali (Honours / General /LCC2 /AECC1)	32	Philosophy (Honours / General)
5	Bio-Chemistry (Honours / General)	33	Physical Education (General)
6	Botany (Honours / General)	34	Physics (Honours / General)
7	Chemistry (Honours / General)	35	Physiology (Honours / General)
8	Computer Science (Honours / General)	36	Political Science (Honours / General)
9	Defence Studies (General)	37	Psychology (Honours / General)
10	Economics (Honours / General)	38	Sanskrit (Honours / General)
11	Education (Honours / General)	39	Social Science (General)
12	Electronics (Honours / General)	40	Sociology (Honours / General)
13	English ((Honours / General/ LCC1/ LCC2/AECC1)	41	Statistics (Honours / General)
14	Environmental Science (Honours / General)	42	Urdu (Honours / General /LCC2 /AECC1)
15	Environmental Studies (AECC2)	43	Women Studies (General)
16	Film Studies (General)	44	Zoology (Honours / General)
17	Food Nutrition (Honours / General)	45	Industrial Fish and Fisheries – IFFV (Major)
18	French (General)	46	Sericulture – SRTV (Major)
19	Geography (Honours / General)	47	Computer Applications – CMAV (Major)
20	Geology (Honours / General)	48	Tourism and Travel Management – TTMV (Major)
21	Hindi (Honours / General /LCC2 /AECC1)	49	Advertising Sales Promotion and Sales Management –ASPV (Major)
22	History (Honours / General)	50	Communicative English –CMEV (Major)
23	Islamic History Culture (Honours / General)	51	Clinical Nutrition and Dietetics CNDV (Major)
24	Home Science Extension Education (General)	52	Bachelor of Business Administration (BBA) (Honours)
25	House Hold Art (General)	53	Bachelor of Fashion and Apparel Design – (B.F.A.D.) (Honours)
26	Human Development (Honours / General)	54	Bachelor of Fine Art (B.F.A.) (Honours)
27	Human Rights (General)	55	B. Music (Honours / General) and Music (General)
28	Journalism and Mass Communication (Honours / General)		

The above shall be effective from the academic session 2018-2019.

SENATE HOUSE
KOLKATA-700073
The 4th June, 2018

Paul 4/6/18
(Dr. Santanu Paul)
Deputy Registrar

University of Calcutta

Syllabus for three-year B.Sc. in Molecular Biology (General)

under CBCS

2018

SCHEME AND SYLLABUS FOR CHOICE BASED CREDIT SYSTEM IN B.Sc. (GENERAL) MOLECULAR BIOLOGY

Semester (20 credits each)	**Discipline Specific Core Course (DSC) (6 credits each)**	**Ability Enhancement Compulsory Course (AECC) (2 credits each)**	**Skill Enhancement Course (SEC) (2 credits each)**	**Discipline Specific Elective Course (DSE) (6 credits each)**
I	**MLB-G-CC-1-1** Cell Biology - Principles and Techniques	**MLB-G-AECC-1** English/ Hindi/Mil communication/ Environment Sc.		
II	**MLB-G-CC-2-1** Basics of biomolecules	**MLB-G-AECC-2** English/ Hindi/Mil communication/ Environment Sc.		
III	**MLB-G-CC-3-1** Concepts of Molecular Biology		**MLB-G-SEC-A** 1.Radiation Biology 2. Biostatistics	
IV	**MLB-G-CC-4-1** Biophysical Techniques		**MLB-G-SEC-B** 1.Biomedical Instrumentation 2. Bioinformatics	
V			**MLB-G-SEC-A** 1. Radiation biology 2. Biostatistics	**MLB-G-DSE-A-5-1** Recombinant DNA Technology **MLB-G-DSE-A-5-2** Genomics
VI			**MLB-G-SEC-B** 1. Biomedical instrumentation 2. Bioinformatics	**MLB-G-DSE-B-6-1** Sensory Processes in Biophysics **MLB-G-DSE-B-6-2** Clinical Biochemistry

Course Details

MLB-G-CC-1-1

Cell Biology - Principles and Techniques (4 + 2 = 6 credits)

MLB-G-CC-1-1-TH (4 credits/50 marks)

Unit 1: Cell Biology (12 hours)

Cells as basic functional unit of living body, cellular classification (3 domains, i.e. eubacteria, archaebacteria, eukaryotes), (2 hrs)

Prokaryotic cell organization (Prokaryotic cell structure, Bacterial cell walls), (2 hrs)

Eukaryotic cell organization (Brief idea of structure and function of --- Plasma membrane, Nucleus, Endoplasmic reticulum, Golgi apparatus, Mitochondria, Chloroplast, Lysosome, Peroxisome, cytosol, Plant cell wall, Plant cell vacuole,) (6 hrs)

Brief idea of cell cycle (recapitulation of mitosis and meiosis) (2 hrs)

Unit 2. Molecules of Life 1 (28 hours)

Importance of carbon molecule (valency, chiral carbon, types of isomer) (2hrs)

Concept of intra- and intermolecular interaction (covalent bond, ionic bond, hydrogen bond, hydrophobic interaction, van der Waals interaction), (3 hrs)

Structure and Water, Henderson-Hasselbalch equation & its significance, Concept of pH / pKa, isoelectric pH (pI) and Buffer. (5hrs)

Carbohydrate: Structure, Function and properties of Monosaccharides (Hexoses and pentoses), Disaccharides (sucrose, lactose, maltose), storage & structural polysaccharide (glycogen, starch and cellulose).(8hrs)

Lipids : Definition and classification of lipids, Structure and function of fatty acid, storage lipids, structural lipids . (4 hrs)

Roles of lipid in Membrane structure, fluid Mosaic model of membrane structure, Transport of small molecules (Passive and active transport), Transport of macromolecules (exocytosis, endocytosis, phagocytosis, pinocytosis). (6hrs)

Unit 3: Microscopy Techniques (20 hours)

Optical microscopy, the nature of light—its particle and wave character. Ray diagrams and image formation.(4 hours)

Simple and compound microscopes, Applications of optical microscopes, Numerical Aperture (NA) Resolution, Contrast, depth of field and depth of focus, Angular magnification, Spherical aberration, Chromatic aberration of optical system (definitions

only). Mathematical expression for limit of resolution in terms of Rayleigh criteria. Empty magnification.(6 hours)

Basic principles of oil immersion microscope. Limitations of optical microscopes.(2 hours)

Electron microscopy---basic working principle, advantages of electron microscope over optical microscope, Optical Microscopy vs. TEM, Electrostatics and magnetostatics electron microscopes, Relation between the applied voltage and wavelength of electrons.(8 hours)

MLB-G-CC-1-1-P (2 credits/25 marks)

1. Determination of refractive index of a given biological sample by travelling microscope
2. Determination of relative sizes of nucleus and cytoplasm of squamous cells
3. Preparation of phosphate buffer and measurement of pH
4. Qualitative tests for reducing sugar, non-reducing sugar, polysaccharide, lipid
5. Quantitative estimation of glucose.

Suggested Reading

1. De Robertis, EDP and De Robertis EMF. (2006) Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.
2. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
4. Nelson D. L. and Cox M.M. (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company
5. Voet, D. and Voet J.G. (2004) Biochemistry 3rd edition, John Wiley and Son
6. Sharma, V. K. (1991) Techniques in microscopy and cell biology. Tata McGraw Hill
7. Reimer, L. and Kohl, H. (2008) Transmission electron microscopy. Springer.

MLB-G-CC-2-1

Basics of biomolecules (4 + 2 = 6 credits)

MLB-G-CC-2-1-TH (4 credits/50 marks)

Molecules of life (30 hours)

Amino acids: structure of twenty amino acids,classification, titration curve of amino acids, concept of zwitterionic structure, physical and chemical properties. (8 hours)

Proteins: classification of proteins on the basis of composition, conformation and function, different level of structural organization of proteins(primary, secondary, tertiary & quaternary), forces stabilizing protein structure and shape, physical and chemical properties. Domains and Motifs, Role of weak forces in biology (10 hours)

Enzymes: classification and nomenclature, Holoenzyme, apoenzyme, cofactors, coenzyme, prosthetic groups, activation energy, and transition state, enzyme, activity, enzyme units (International Unit and SI unit), specific activity, turnover number, concept of active sites, Kinetics of enzyme catalysed reactions - Michaelis-Menten Equation, Lineweaver Burk Plot, Determination of K_m and V_{max}, Significance of K_m and V_{max}, Factors influencing the enzyme reaction, and Enzyme inhibition (competitive, noncompetitive and uncompetitive inhibitions, Preliminary concept of allosteric enzyme. (12 hours)

Bioenergetics and metabolism of biomolecules (30 hours)

Glycolysis (4 hours)

Fate of pyruvate under aerobic and anaerobic condition, TCA cycle, electron transport chain, oxidative phosphorylation, role of inhibitors and uncouplers. (8 hours)

Glycogenesis, Glycogenolysis, Gluconeogenesis, Pentose phosphate pathway (8 hours)

β-oxidation of saturated fatty acid (4 hours)

Transamination, oxidative deamination, and urea cycle. (6 hours)

MLB-G-CC-2-1-P (2 credits/25 marks)

1. Qualitative tests for amino acid, protein.
2. Identification of unknown compounds (from sugars, polysaccharide,lipid,amino acid and protein)
3. Estimation of protein by Lowry method using UV-Visible spectrophotometer or colorimeter.
4. Calculation of R_f value and separation of unknown amino acid by TLC or paper chromatography.
5. Estimation of amino acid by formol titration.

Suggested Reading

1. Sharma, D.K. (2013) Biochemistry. Narosa Publishing House
2. Nelson D. L. and Cox M.M. (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company
3. Voet, D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons.
4. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W. H. Freeman

MLB-G-CC-3-1

Concepts of Molecular Biology (4+2 credits)

MLB-G-CC-3-1-TH (4 credits/50 marks)

Basic Concepts of genome and its organisation (20 hrs)

Nucleic acid as the genetic material (Griffith's experiment, Avery, MacLeod and McCarty's experiment, Hershey-Chase experiment), Importance of Molecular Biology, Central Dogma of Molecular Biology, Model organisms for studying Molecular Biology. (5 hrs)

Structure and functions of Nucleic acids: Nucleosides & Nucleotides, purines and pyrimidines. Biologically important nucleotides, (5 hrs)

Watson and Crick model of DNA structure, A, B & Z forms of DNA, Supercoiled and relaxed DNA, denaturation and renaturation of DNA, melting temperature (Tm), hyperchromic effect.(5 hrs)

Genome and its organisation : (idea about gene, coding sequence, regulatory sequence, intron, exon, Nucleosome structure and packaging of DNA into higher order structures, brief idea of chloroplast DNA and Mitochondrial DNA).(5 hrs)

Replication of DNA in prokaryotes (10 hrs)

Features of DNA Replication, Proof of semiconservative nature of DNA replication, Features of bidirectional DNA replication. (5 hrs)

Mechanism of bidirectional DNA replication (5 hrs)

Gene expression (20 hrs)

RNA structure and types of RNA, Transcription in prokaryotes with E. Coli as model system: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains, (5 hrs)

Genetic code, properties of genetic code, Wobble hypothesis (3 hrs)

Components of Protein synthesis machinery : Messenger RNA, tRNA structure and function, Charging of tRNA, aminoacyl tRNA synthetases, ribosome structure and assembly , Mechanism of protein synthesis in prokaryotes : initiation, elongation and termination. (7 hrs)

Principles of gene regulation, negative and positive regulation, concept of operons, Regulation of gene expression in bacteria : lac operon concept. (5 hrs)

Damage, Repair and Mutation (10 hrs)

Causes (spontaneous, chemical agent, radiation) and types of DNA damage (2 hr)

Mechanism of DNA repair: Direct repair, base excision repair, nucleotide excision repair, mismatch repair, recombination repair. (3 hrs)

Molecular basis of mutation, types of mutation (missense mutation, nonsense mutation, silent mutation, point mutation, frameshift mutation). (5 hrs)

MLB-G-CC-3-1-P (2 credits/25 marks)

1. Determination of absorption spectra of DNA and protein using UV-Visible spectrophotometer.
2. Estimation of DNA by diphenylamine reaction.
3. Estimation of RNA by orcinol method
4. Using turbidometry (light scattering) to estimate microbial growth.
5. Measure the OD ratio at 260 and 280 nm for supplied DNA and protein samples.
6. Estimate purity of DNA sample.
7. Observation of bacterial morphology by negative stain method (nigrosin) using light microscope.

Suggested Reading

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Laboratory Press, Pearson Publication.

MLB-G-CC-4-1

Biophysical techniques (4 + 2 = 6 credits)

MLB-G-CC-4-1-TH (4 credits/50 marks)

Diffusion (6 hours)

Boyle's law, Charles' law, Gas laws (Ideal gas and real gas equation), Dalton's law of partial pressure. Diffusion in fluids,Fick's laws(Statement and explanation), Facilitated diffusion e.g. gas exchanges in lungs.

Osmosis (4 hours)

Definition,contrast with diffusion,Tonicity and isotonic solutions.Effect of tonicity on R.B.C. Cell nutrition.

Viscosity (10 hours)

Definition, Laminar and turbulent flow, Concept of Reynolds number,
Newton's law of viscosity,Newtonian and non- Newtonian fluids, Coefficient of viscosity, Relative viscosity and fluidity. Measurement by Ostwald's viscometer. Dependence of viscosity on temperature and other factors e.g. size and shape of solutes (general idea)Viscosity of human blood (general idea).

Centrifugation (8 hours)

Theory of ultracentrifugation, Relative centrifugal force (RCF),Sedimentation rate sedimentation coefficient, Isopycnic (equilibrium) sedimentation, (discussion with example e.g. Meselson and Stahl Experiment)

Spectrophotometry and other methods (12 hours)

Absorption of light, Transmittance, Absorbance(Optical density), Lambert-beer law, Method of determining Absorption spectrum of chlorophyll by spectrophotometer. A brief idea on Dialysis,Chromatography(Gel filtration,Ion exchange), Electrophoresis.

Immunology (20 hours)

Immune Response - An overview, Primary and secondary immune response, components of mammalian immune system.

Basic concept on Molecular structure of Immunoglobulin 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.

MLB-G-CC-4-1-P (2 credits/25 marks)

1. Human blood group determination.
2. Measurement of relative viscosity/fluidity of DNA by Ostwald viscometer.
3. Light microscope observation of relative distribution of WBC in a fresh blood smear.
4. Gram staining of bacteria.

Suggested Reading

1. Hallet FR, Speight PA and Stinson RH (1978) Introductory Biophysics. Chapman and Hall Ltd.
2. Hallet FR, Stinson RH and Speight PA (1982) Physics for the biological sciences. Methuen.
3. Srivastava, PK (2011) Elementary Biophysics. Narosa Publishing House
4. van Holde KE, Johnson WC and Ho PS (2005) Principles of Physical Biochemistry. Pearson Education India

MLB-G-DSE-A-5-1

Recombinant DNA Technology (4+2 = 6 credits)

MLB-G-DSE-A-5-1-TH (4 credits/50 marks)

Cloning: Cloning vectors (pBR322, pUC18/19, YACs), Bacteriophage lambda and M13 based vectors. Cosmids, Ti plasmid as transformation vector. Use of linkers and adaptors, Homopolymeric tailing, c-DNA synthesis and cloning. Genomic DNA and c-DNA libraries. (20 hours)

Restriction and Modification systems in bacteria: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering, Restriction Mapping, Restriction Fragment Length Polymorphism (RFLP). (10 hrs)

Enzymes used in Recombinant DNA techniques: DNA ligase, Polynucleotide Kinase, DNA Polymerase, Reverse Transcriptase, Terminal deoxynucleotidyl transferase, Phosphatases. (10 hours)

Polymerase Chain Reaction & qPCR, Electrophoresis & Blotting Techniques, Site- Directed Mutagenesis, DNA Sequencing, Reporter Gene Assays, DNA-Protein Interaction Assays, Protein-Protein Interaction Assays, DNA Fingerprinting. (20 hours)

MLB-G-DSE-A-5-1-P (2 credits/25 marks)

1. Isolation of plasmid DNA.
2. Restriction enzyme digestion of plasmid DNA.
3. Preparation of competent cells by calcium chloride method and transformation of *E. coli* with plasmid DNA.
4. Primer design for PCR.

Suggested Reading

1. Chaudhuri, K. (2012) Recombinant DNA Technology. TERI Press.

MLB-G-DSE-A-5-2

Genomics ((4 + 2 = 6 credits)

MLB-G-DSE-A-5-2-TH (4 credits/50 marks)

Genomes and Gene Structure: Gene families, Functional domains; Transcriptomics; Proteomics; Biological databases. (10 hours)

Genome sequencing techniques and applications: Sequencing strategies and the shotgun method; Massively parallel sequencing and its applications; Next-Generation sequencers. (20 hours)

Genome assembly and annotation: Gene finding; Promoter identification; Transcription factor binding site analysis. (10 hours)

Comparative genomics: Comparative and evolutionary genomics; Gene duplication; Genome duplication; Paralogous and orthologous genes; Neofunctionalization. (10 hours)

Ecological genomics: Ecology; Phenotypic plasticity; Molecular Markers, Model Organisms. (10 hours)

MLB-G-DSE-A-5-2-P (2 credits/25 marks)

1. Comparison of two large DNA sequences using dot plot servers such as YASS or PipMaker
2. Detection of internal repeats in a genome using genomic dot plots
3. Prediction of the locations and exon-intron structures of genes in genomic sequences from a variety of organisms using web servers such as GENSCAN
4. Complete elucidation of the location, structure, transcripts of a given number of human genes using the Ensembl genome browser.

Suggested Reading

1. Campbell AM and Laurie JH (2007) Discovering Genomics, Proteomics and Bioinformatics. Pearson.

MLB-G-DSE-B-6-1

Biophysics of Sensory Processes (4+2 - 6 credits)

MLB-G-DSE-B-6-1-TH (4 credits/50 marks)

Neurobiophysics

Description and function of neurons. Origin of membrane potential (Gibbs-Donnan effect; Membrane transport—relevant points; Nernst potential). Voltage clamp method (brief idea). Threshold potential. Action potential and its characteristics. Axonal conduction and speed of propagation. Synaptic transmission (chemical**). (15 hours)**

Electrical signals from the heart – Electrocardiogram (ECG)
Physical basis of electrocardiography. Recording of ECG. Mention of heart problems that can be detected. (**5 hours)**

Physics of vision
Nature of light. Eye lens and refraction. Accommodation of the eye. Errors of refraction (myopia, hyperopia, astigmatism) and their correction (qualitative). Optical elements of the human eye. Binocular vision.Visual acuity and its testing. Retina and photoreceptors. Photoreceptors and fibre optics (salient points). Mechanism of rod vision (brief discussion). Colour vision. Colour blindness (salient points). (**20 hours)**

Physics of audition
Nature of sound. Values of sound velocity in air, water, iron, human body. Energy, power and intensity of sound wave (definitions only). Sound impedance (qualitative idea). Loudness, pitch and quality of sound (definitions).

Intensity level. Values of intensity level of some standard sounds. Noise pollution – main causes and important effects on humans.

Human ear and the process of hearing. Doppler effect (basic idea) and its important applications in the medical field. Echolocation by bats (qualitative discussion). **15 hours**

Physics of cardiovascular system
Action of the heart as a double pump. Blood pressure – systolic and diastolic. Measurement of blood pressure. **5 hours**

MLB-G-DSE-B-6-1-P (2 credits/25 marks)

1. Determination of blood pressure with the help of mercury or aneroid sphygmomanometer.

2. Determination of heart rate of a human being from the ECG records.

3. Interpretation of ECG.

4. Detection of colour blindness with the help of Ishihara chart.

5. Interpretation of visual acuity by Snellen's chart.

Suggested Reading

1. Agarwal SK (2006) Advanced Biophysics. APH Publishing.

MLB-G-DSE-B-6-2

Clinical Biochemistry (4 + 2 = 6 credits)

MLB-G-DSE-B-6-2-TH (4 credits/50 marks)

Unit 1 (20 hours)

Idea about the features of pathogenic and non-pathogenic microorganisms. General properties of synthetic and naturally occurring antimicrobial drugs: selective toxicity, and modes of action, of Penicillin, Chloramphenicol and Streptomycin. Antibiotic resistance.: mechanism of drug resistance, origin & transmission of drug resistance in microbes.

Unit 2 (20 hours)

Mechanism of Bacterial Pathogenicity: entry, colonization, pathogenicity, course of infectious disease, duration of symptoms

Mechanism of damage of host cell Exo-and endotoxins - definition and general properties.

General properties and importance of clinically important enzymes like SGOT, SGPT, Alkaline phosphatase and Creatine kinase, lactate dehydrogenase

Unit 3 (20 hours)

Disorders of thyroid, pituitary, adrenal, hypothalamic, ovarian, testicular and renal hormones;

Use of tumour markers in oncology

Iron status, protein abnormalities, therapeutic drug monitoring and drugs of abuse testing and the genetic basis of disease.

MLB-G-DSE-B-6-2-P (2 credits/25 marks)

1. Isolation of pure culture by streak plate technique.
2. Antibiotic sensitivity assay by paper disc method
3. Staining of *Aspergillus niger* by lactophenol cotton blue. [*A. niger* from rotten citrus fruit]

Suggested Reading

1. Crook, M.A. (2012) Clinical Biochemistry and Metabolic Medicine. Hodder Arnold.

MLB-G-SEC-A

1. Radiation Biology (2 credits/25 marks)

Radiation quantities: Exposure; absorbed dose; equivalent dose; effective dose; activity; linear energy transfer. (10 hours)

Cellular response to radiation: Radiolysis of water and radical formation; indirect and direct action; time scale of radiation effects; cell kinetics, mitotic death and apoptosis; DNA damage and chromosomal aberrations; radiation sensitivity; sublethal damage and cell survival curves; dose-rate effect; oxygen effect; relative biological effectiveness; radioprotectors and radiosensitizers. (10 hours)

Sources of radiation to the human populations; radiation carcinogenesis; whole-body radiation effects; doses and risks associated with medical radiology; radiation protection. (10 hours)

Suggested Reading

1. Saha G.B. (2006) Physics and Radiobiology of Nuclear Medicine. Springer-Verlag.

2. Biomedical Instrumentation (2 credits/25 marks)

Measurement of blood pressure, Cardiac output , Heart rate, Heart sound , Pulmonary function measurements, spirometer, Blood Gas analysers, pH of blood – measurement of blood pCO2, pO2, finger-tip oxymeter, ESR, GSR measurements. (8 hours)

Electrodes, Limb electrodes, floating electrodes, pregelled disposable electrodes, Micro, needle and surface electrodes, Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier, ECG, EEG, EMG, ERG, Lead systems and recording methods, Typical waveforms, Electrical safety in medical environment, shock hazards, leakage current-Instruments for checking safety parameters of biomedical equipments. (8 hours)

Radiographic and fluoroscopic techniques, Computer tomography, MRI, Ultrasonography, Endoscopy, Thermography, Different types of biotelemetry systems, Retinal Imaging, Imaging application in Biometric systems, Analysis of digital images. (8 hours)

Pacemakers, Defibrillators, Ventilators, Nerve and muscle stimulators, Diathermy, Heart – Lung machine, Audio meters, Dialysers, Lithotripsy. (6 hours)

Suggested Reading

1. Singh, M. (2010) Introduction to Biomedical Instrumentation. Prentice Hall India.

MLB-G-SEC-B

1. Biostatistics (2 credits/25 marks)

Keywords and terms used in biostatistics. Concept of frequency distribution (frequency distribution table, simple and group frequency distribution, data presentation), mean, median, mode, standard deviation; Simple problems on mean, median, mode and standard deviation. (12 hours)

Correlation and Regression analysis: Relation between two variables, scatter diagram, definition of correlations, curve fitting, principles of least squares, Two regression lines, Pearson's coefficient of correlation, Rank correlation, Tied ranks. (5 hours)

Probability theory: Random variable (discrete and continuous), Probability density function (discrete and continuous), Distribution function for discrete random variable. Distribution function for continuous random variable, Joint probability distribution, Conditional and marginal distribution. The expected value of a random variable. (8 hours)

Standard distributions: Uniform distribution. Binomial distribution, Poisson distribution, Normal and standard normal distributions. (5 hours)

Suggested Reading

1. Banerjee PK (2006) Introduction to Bio-Statistics. S. Chand & Co.

2. Bioinformatics (2 credits/25 marks)

Nucleic acid and protein sequences; sequence databases and information retrieval; pairwise sequence comparisons; PAM and BLOSUM scoring matrices; global and local alignment algorithms; statistical significance of pairwise alignments; BLAST and FASTA. (7 hours)

Multiple sequence alignments (MSA) - hierarchical and non-hierarchical methods; tools for MSA. (3 hours)

Molecular phylogenetic analysis: Introduction to molecular evolution, the molecular clock hypothesis and neutral evolution; tree nomenclature and structure; tree-building methods - neighbour joining (NJ), maximum parsimony (MP), maximum likelihood (ML) methods; tree-evaluation methods; bootstrapping. (12 hours)

Protein and nucleic acid structure databases; The Protein Data Bank (PDB); structure comparison; SCOP and CATH. (8 hours)

Suggested Reading

1. Lesk, AM (2004) Introduction to Bioinformatics. Oxford University Press

Semester-wise Molecular Biology (General) Courses

	Sem-1	Sem-2	Sem-3	Sem-4	Sem-5	Sem-6
Core Courses (CC/GE)	3Th+3P (3X4+3X2=18 Credits) **CC1:** Cell Biology - Principles and Techniques	3Th+3P (3X4+3X2=18 Credits) **CC2:** Basics of biomolecules	3Th+3P (3X4+3X2=18 Credits) **CC3:** Concepts of Molecular Biology	3Th+3P (3X4+3X2=18 Credits) **CC4:** Biophysical Techniques		
Discipline Specific Elective Courses (DSE)					3Th+3P (3X4+3X2=18 Credits) **DSE-A** Any **one** from 1. Recombinant DNA Technology 2. Genomics	3T+3P (3X4+3X2=18 Credits) **DSE-B** Any **one** from 1. Sensory Processes in Biophysics 2. Clinical Biochemistry
Ability Enhancement Compulsory Course (AECC)	1 Th + 0 P (1X2=2 Credits) **AECC-1 Communicative English**	1 Th + 0 P (1X2=2 Credits) **AECC-2 Environmental Studies**				
Skill Enhancement Course (SEC)			1Th+0P (1X2=2 Credits) **SEC-A** Radiation biology/Biostatistics	1T+0P (1X2=2Credits) **SEC-B** Biomedical Instrumentation/ Bioinformatics	1T+0P (1X2=2 Credits) **SEC-A** Radiation biology/Biostatistics	1T+0P (1X2=2 Credits) **SEC-B** Biomedical Instrumentation/Bioinformatics

Total No. of Courses and Marks	**4 X 100 =400**	**4 X 100 = 400**	**4 X 100 = 400**	**4 X 100 = 400**	**4 X 100 = 400**	**4 X 100 = 400**
Total Credit 120	**20 Credits**	**20 Credits**	**20 Credits**	**20 Credits**	**20 Credits**	**20 Credits**