DEPARTMENT OF BIOCHEMISTRY AND BIOPHYSICS

SYLLABUS

REVISED IN 2017

TO BE IMPLEMENTED FROM ACADEMIC SESSION 2017-18

SEMESTER – I

Course Name	Subject	Total Class Hours in 16 weeks	Credit	Marks
HCT-1.1	Module – 1 : Molecular Interactions & Physicochemical	32 h direct teaching & 8 h tutorial	2	50
	Module – 2 : Biomolecules	32 h direct teaching & 8 h tutorial	2	50
HCT-1.2	Module – 3 : Molecular Biology	32 h direct teaching & 8 h tutorial	2	50
	Module – 4 : Microbiology and Virology	32 h direct teaching & 8 h tutorial	2	50
HCT-1.3	Module – 5 : Cell Biology (I)	16 h direct teaching & 4 h tutorial	1	25
	Module – 6 : Enzymology	16 h direct teaching & 4 h tutorial	1	25
	Module – 7 : Bioenergetics and Fundamental Metabolism	16 h direct teaching & 4 h tutorial	1	25
	Module – 8 : Statistics	16 h direct teaching & 4 h tutorial	1	25
HCP-1.1	Module – 9 : Physico-chemical Techniques	72 h	1	25
	Module – 10 : Microbiology	72 h	1	25
	Module – 11 : Virology	72 h	1	25
	Module – 12 : Viva covering all modules (1-11)	24 h	1	25

Total Marks : 400 **Total Credits : 16** **HCT : Hard Core Theoretical** **HCP: Hard Core Practical**

HCT-1.1

Module – 1 Molecular Interaction & Physicochemical Techniques Credit-2 Marks – 50

Sl. No.	Courses and Coverage	Class Allotted
1	**Chemical bonds and stabilizing interactions:** Structure of atoms, molecules and chemical bonds. Stablizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction, etc.).	**6**
2	**Water:** Properties, Structure, ionization, pKw	**2**
3	**Acids and Bases:** pH, pKa , pKb , Handerson-Haselbach equation, buffer, measurement of pH.	**4**
4	**Chromatography: Paper, TLC, partition, affinity, ion-exchange, reverse phase, gel filtration, GLC, HPLC**	**5**
5	**Electrophoresis** :Theory, paper electrophoresis, agarose gel electrophoresis, SDS-PAGE, Native PAGE, capillary gel electrophoresis, Disc gel, iso-electric focusing, gradient gel, pulse field gel electrophoresis	**5**
6	**Other Techniques:** Viscosity, Dialysis, Centrifugation, Solvent fractionation, X-ray diffraction.	**5**
7	**Radioisotope techniques:** Radioisotope tracer techniques, measurement of radio activity (Geiger-Muller, scintillation and gamma counters), autoradiography, safety measures.	**5**

Recommended Books:

1. **Biochemistry** **L. Stryer**
2. **Lehninger Principles of Biochemistry** **D. L. Nelson & M.M. Cox**
3. **Biophysical Chemistry** **D. Freifelder**
4. **Physical Biochemistry** **van Holde**
5. **Biochemistry** **D. Das**

Module – 2 Biomolecules Credit-2 Marks – 50

Sl. No.	Courses and Coverage	Class Allotted
1	**Carbohydrate:** Structure and biological function of mono, polysaccharides (glycogen, starch, cellulose, Hetero polysaccharides: chondroitin sulphate, glycosamine, proteoglycan, glycoproteins).	**4**
2	**Lipid:** fatty acids, fats and oils, phospholipids, sphingolipids, glycolipids, cholesterol, gangliosides, lipoproteins, rancidity, acid value, saponification value, Iodine number, acetyl number, R.M. number.	**4**
3	**Proteins:** Amino acids and their physico-chemical properties, Peptide bond, Primary-Secondary-(Ramachandran plot, α-helix, β-strand, β-sheet, turns and loops)-Tertiary (ion-ion, ion-dipole and dipole-dipole, interactions)-Quaternary structures of proteins, domains, motif and folds.	**9**
4	**Nucleic acid:** Nucleotides and their physico-chemical properties, double helical structure of DNA, A-B-Z forms of DNA, Repeat sequences and loops, RNA structure	**9**
	(primary, secondary and tertiary), ribozyme, denaturation and renaturation of DNA, chromosome structure.	
5	**Vitamins (Fat and water soluble):** Structure and Biological functions.	**2**
6	**Micronutrients:** Physiological implications of Ca, Mg, Mn, Fe, Se, Co, Cr, Zn, Cu, Mo, sulfide and sulfate, Metalothionein, ceruloplasmin, ferritin, transferin and their biological functions.	**4**

Recommended Books:

1. **Biochemistry** **L. Stryer**
2. **Lehninger Principles of Biochemistry** **D. L. Nelson & M.M. Cox**
3. **Biochemistry** **Harper**

HCT-1.2

Module – 3 Molecular Biology Credit-2 Marks – 50

Sl. No.	Courses and Coverage	Class Allotted
1	**DNA replication (both prokaryotic and eukaryotic):** Different modes of replication (semi-conservative, Bi-directional, Semi–discontinuous; Initiation (replication origin, associated proteins and enzymes, regulation of initiation); Elongation stage of replication (associated proteins and enzymes); Termination of replication (associated proteins and enzymes).	**7**
2	**Transcription (both prokaryotic and eukaryotic):** Prokaryotic transcription, transcription cycle (initiation, elongation and termination), bacterial promoters, different σ factors, abortive initiation, processivity and editing functions of elongating polymerase, Rho-dependent and Rho-independent terminations. Eukaryotic transcription- RNA polymerases, transcription factors, processing of mRNA in eukaryotes.	**7**
3	**Post-Transcriptional modification:** RNA splicing, Spliceosome machinery, Splicing pathway, Alternative splicing, Exon schuffling, RNA editing, m-RNA transport.	**4**
4	**Translation (both pro- and eukaryotic):** m-RNA, t-RNA, Attachment of amino acids to t-RNA, Ribosome, Initiation, elongation and termination of translation, Post-translational modification.	**7**
5	**Regulation of gene expression:** Principles of transcriptional regulation, different operons and their regulation. Gene regulation at steps after transcription , Regulation of lamda phage. Eukaryotic gene regulation, Control of transcriptional regulator, Gene slicing , RNA in gene regulation , transcriptional control of gene expression, epigenetic regulation.	**7**

Recommended Books:

1. **Molecular Biology of the Gene** **J.D. Watson, Baker, Bell, Gann, Levine & Losick**
2. **Molecular Biology: Genes to proteins** **B. E. Tropp**

3. **Molecular Biology** **R. Weiver**

4. **Gene IX & XI** **L. Benjamin**

Module – 4 Microbiology & Virology Credit-2 Marks – 50

Sl. No.	Courses and Coverage	Class Allotted
1	**Miropganisms:** Microbiology in the 20thCentury, Discovery of microorganisms, Classification of microorganisms, Microbial nutrition, Common nutrient requirements, Requirement for C, H and O, Requirement for n, P and S, Uptake of nutrients (Facilitated diffusion, Active transport) Group translocation, Synthetic or defined media, complex media, Types of media.	**4**
2	**Microbial growth:** Growth curve and equation, cell numbers (colony counts), cell mass., Environmental factors on growth (nutrient concentration, pH, temperature , oxygen concentration , pressure and radiation), Chemostat, Turbidostat.	**3**
3	**Pro- & Eukaryots:** Prokaryotic cell structure (cell wall: Peptidoglycan, Gram positive and Gram negative cell walls), Mechanism of Gram staining, Bacterial surface charge, Capsules, Pili and Fimbriae, Flagella and Motility, Chemotaxis, eukaryotic cell structure (External cell coverings, Cilia and Flagella), Comparision of prokaryotic and eukaryotic cells.	**2**
4	**Microbial spores:** Endospores and exospores, their properties and germination,	**1**
5	**Control of microorganisms**: Physical methods (heat, filtration, radiation), Chemical methods (phenolics, alcohols, halogents , heavy metals, aldehydes and sterilizing gases), Antibiotics (definition and classification, basic mechanism of primary mode of action, Interaction between microbes (symbiosis, antibiosis and commensulism).	**3**
6	**Extreme environment microbes:** Anaerobes, Halophiles, Thermophiles , Acidophiles and Alkyliphiles.	**1**

7	**Biogeochemical roles of microbes:** Carbon, nitrogen and sulfur cycles; Nitrogen fixation and its mechanism.	**2**
8	**Microbiology of water, air, soil and milk.**	**1**
9	**Microbial diseases :** The epidemiology of infectious disease, Human diseases cause by Gram positive and Gram negative Bacteria - Airborne diseases, Direct contact Diseases, Food-borne and water borne diseases with names of infecting microorganisms , Human diseases caused by other bacteria and Human diseases caused by Fungi and Protozoa.	**3**
10	**Bacteriophages:** Discovery, Structures, Plaques, Host specificity, Life cycles of bacteriophages: Virulent phages (T4, T7, ϕX174, RNA phage), Lysogenic phages (λ, P1), Chronic phage (M13).	**6**
11	**Eykaryotic Virus:** Basic structures, Life cycles of RNA viruses (Vesicular Stomatitis Virus, Poliovirus, Reovirus, Retrovirus) and DNA viruses (Simian Virus 40, Adenovirus).	**2**
12	**Viral Diseases:** Human viral pathogens, Factors behind incidence and severity, Acute infection (gastrointestinal, respiratory, liver), Systemic spread, HIV and Aids, Viral oncogenes.	**2**
13	**Diagnosis, Vaccines and Antivirals**	**2**

Recommended Books:

1. **Microbiology** **M.J.Pelczar**
2. **Microbiology** **L.M.Prescott**
3. **Fundamental Principles of Bacteriology** **A.J. Salle**
4. **Molecular Biology: Genes to proteins** **B. E. Tropp**
5. **Molecular Biology** **D. Freifelder**

HCT-1.3

Module – 5 Cell Biol (I) Credit-1 Marks – 25

Sl. No.	Courses and Coverage	Class Allotted
1	**Origin and evolution of Cell:** Prokaryotes, eucaryotes, development of multicellular organisms	**1**
2	**Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.	**4**
3	**Cell membrane:** Membrane lipids & proteins, matrix adhesion proteins, glycoproteins, receptors. Lipid mobility. Phospholipids, glycolipids and spingolipids in membranes. membrane carbohydrate, liposome.	**3**
4	**Transport of small molecules:** Passive-facilitated-carrier mediated diffusion, symport-antiport and co-transport, ion channels, ionophores, , transport processes, P-type, V-type, F type and drug transport ATPases - their mechanism of actions and regulation. Multi drug transport protein, ATP dependent Cl^- channel, cystic fibrosis.	**5**
5	**Cytoskeleton**: Structure and organization of actin filaments, actin, myosin and cell movement, sarcoplasmic reticulum in muscle contraction, intermediate filaments, microtubules, microtubule motor and movement.	**3**

Recommended Books:

1. **Molecular Cell Biology** **H. Lodish & D. Baltimore**
2. **The Cell** **B. Alberts**
3. **Molecular cell Biology** **Karp**
4. **Cell Biology** **Cooper**

5. **Cell Biology** **pollard**

Module – 6 Enzymology Credit-1 Marks – 25

Sl. No.	Courses and Coverage	Class Allotted
1	**Classification-nomenclature-properties-cofactors-units-turnover of enzymes.**	**3**
2	**Catalytic site:** Lock and key or template model, induced fit model, Role of metal ions, metalloenzymes and metal activated enzymes; ternary enzyme-metal substrate complexes, enzyme bridge complexs (M-Enz-S), substrate bridge complexes (Enz-S.M), metal-bridge-complexes (Enz-S.M), role of metal ions in catalysis, Vitamins as coenzymes.	**4**
3	**Catalysis:** Factors affecting catalytic efficiency of enzymes (pH, Temperature etc.), Michaelis-Menten equation, activators, inhibitors, inhibition reactions and their kinetics, allosteric and feedback inhibition, competitive, noncompetitive, uncompetitive and mixed type inhibition, kcat/km – a measure of catalytic efficiency.	**6**
4	Specialized Enzymes : Isoenzymes, regulatory enzymes, regulation of enzyme activity, trypsinogen – chymotrypsinogen – pepsinogen. Carboxyanhydrase.	**3**

Recommended Books:

1. **Biochemistry** **L. Stryer**
2. **Lehninger Principles of Biochemistry** **D. L. Nelson & M.M. Cox**

Module – 7 Bioenergetics and Fundamental Metabolism Credit-1 Marks – 25

Sl. No.	Courses and Coverage	Class Allotted
1	**Bioenergetics :** Organization and function of mitochondria, endosymbioant hypothesis for the biogenesis of mitochondria, electron transport chain, mechanism of oxidative phosphorylation, chemiosmotic hypothesis, respiratory chain inhibitors, coupled reaction, uncouplers, biological energy transducers.	**8**
2	**Fundamental of Metabolisms:** Outlines of Glycolysis, TCA cycles, Metabolism of carbohydrates, lipids, amino acids nucleotides and vitamins.	**8**

Recommended Books:

1. **Biochemistry** **L. Stryer**
2. **Lehninger Principles of Biochemistry** **D. L. Nelson & M.M. Cox**

Module – 8 Statistics Credit-1 Marks – 25

Sl. No.	Courses and Coverage	Class Allotted
1	**General Statistics Methods:** Frequency distribution , Measures of central tendency, measures of dispersion, theoretical distributions (Binomial, Poission and Normal), Sampling variation.	**6**
2	**Statistical evaluation of results:** Estimation of standard error, confidence limits, significance tests.	**4**
3	**Tests:** Simple tests based on normal distribution, normal approximation to binomial and	**6**

	Poission distribution , one and two –tailed tests, use of t-test for small samples, X^2- test of goodness of fit , chi-square test, ANOVA**,** Correlation and linear regression, method of lest squares.	

Recommended Books:

1. **Statistics** **Goon & Goon**
2. **Statistics** **Goon & Das**
3. **Biostatistics** **D. Das**

HCP-1.1

Module – 9 Physico-chemical Techniques Credit-1 Marks – 25

Sl. No.	Courses and Coverage
1	**pH metric titration of Glycine to determine its isoelectric point**
2	**Conductometric titration of KCl with $AgNO_3$ to determine unknown strength of solution**
3	**Verification of Beer's law using crystal violet solution**
4	**Actinometric determination of dose rate of a Ultraviolet light source**
5	**To draw the characteristic curve of a GM counter to determine its plateau characteristics**
6	**To isolate hemoglobin from blood and draw its absorption spectrum**

Module – 10 ***Microbiology Credit-1 Marks – 25***

Sl. No.	*Courses and Coverage*
1	***Microbiological techniques:*** *Sterilization, media preparation, preparation of slants and stabs, pouring of medium into plates, subcultureing.*
2	***Isolation of microorganisms:*** *From soil & water of different places. Serial dilution, plating for counting colonies. Single colony isolation techniques and its preservation.*
3	***Examination of microorganisms:*** *Simple staining, Gram staining, Acid Fast Staining Endospore staining, staining of flagella, staining of capsule, staining of fungi, localization of root nodule bacteria* by staining.
4	***Bacterial growth studies:*** *Bacterial number counting by haemocyto meter and colony counting, bacterial growth curve by spectrophotometry, determination of generation ti me.*
5	***Antibiotic sensitivity tests****: Paper disc / cup method, MIC determination.*

Recommended Books:

Experiments in Molecular Genetics ***J. H. Miller***

Module – 11 Virology Credit-1 Marks – 25

Sl. No.	Courses and Coverage
1	**Preparation of Bacteriophage ØX 174 stock.**
2	**Assay of bacteriophage ØX 174 stock.**
3	**Lytic curve of *E.coli* by ØX 174 .**
4	**UV-inactivation of bacteriophage ØX 174**
5	**Repair of UV-inactivated bacteriophage ØX 174**

Recommended Books:

Experiments in Molecular Genetics **J. H. Miller**