Title of the Course: M.Sc. Biochemistry

Structure of the course

Basic structure/pattern (Framework) of the proposed postgraduate syllabus for the two year integrated course leading to M.Sc. (Biochemistry) in the colleges affiliated to Savitribai Phule Pune University, Pune.

Semester- I			
S. N.	**Paper No**	**Subject**	**Credits**
1	CCTP-1 BCH-111	Biomolecules (Organic Chemistry of Living Beings)	4 credit (48 L + 12T)
2	CCTP-2 BCH-112	Physical Biochemistry	4 credit (48 L + 12T)
3	CCTP-3 BCH-113	Cell biology and Membrane Biochemistry	4 credit (48 L + 12T)
4	CBOP-1 BCH-114	Section-I: Theory Course (Any one) Elective Option-A: Enzymology Elective Option-B: Bioinformatics	2 credit (24 L + 6T)
		Section-II: Practical Course (Any one) Elective Option-A : Enzymology Elective Option-B : Bioinformatics	2 credit (48 L + 12T)
5	CCPP-1 BCH-115	Biochemistry Practical –I Section I- Analytical Biochemistry Section II- Physical Biochemistry	4 credit (96 L + 24T)
Semester- II			
6	CCTP-4 BCH-211	Metabolism (Reactions of Biomolecules)	4 credit (48 L + 12T)
7	CCTP-5 BCH-212	Genetics (Chemistry of Nucleic Acids)	4 credit (48 L + 12T)
8	CCTP-6 BCH-213	Plant Biochemistry	4 credit (48 L + 12T)
9	CBOP-2 BCH-214	Section-I: Theory Course (Any one) Elective Option-A : Microbiology Elective Option-B : Advanced techniques in Biochemistry	2 credit (24 L + 6T)
		Section-II: Practical Course (Any one) Elective Option-A : Microbiology Elective Option-B : Advanced techniques in Biochemistry	2 credit (48 L + 12T)
10	CCPP-2 BCH-215	Biochemistry Practical –I Section I- Analytical Biochemistry Section II- Physical Biochemistry	4 credit (96 L + 24T)
Total Credits for First Year			**40**

CCTP- Core Compulsory Theory Paper; **CBOP**-Choice Based Optional Paper; **CCPP**- Core Compulsory Practical Paper

SEMESTER – I

CCTP 1
BCH-111: Biomolecules (Organic Chemistry of Living Beings) (4 credit)

Section I: Carbohydrates and Lipids

1. The molecular logic of life : (2 L)
The chemical unity of diverse living organisms, composition of living matter. Macromolecules and their monomeric subunits.

2. Properties of water : (2 L)
With interactions in aqueous systems. Ionization of water, weak acid weak bases.

3. Carbohydrates : (8 L)
Classification, basic chemical structure, general reactions and properties, biological significance, Sugar derivatives, deoxy sugars, amino sugars, and sugar acids.

4. Lipids : (8 L)
Classification, structure and function of major lipid subclasses-acylglycerols, Lipoproteins, chylomicrons, LDL, HDL and VLDL, rancidity. Formation of micelles, monolayers, bilayer, liposomes.

5. Vitamins and Co-enzymes: (4 L)
Classification, water soluble and fat soluble vitamins. Structure, dietary requirements, deficiency conditions

Section II: Proteins

1. Amino acids: (4 L)
Classification, Properties, reactions, rare amino acids.

2. Protein: (4 L)
Classification, Reactions, functions, properties and Solid phase synthesis,

3. Structural levels of protein: (10 L)
   a. Primary Structure: Peptide bond, importance of primary structure.
   b. Secondary structure: alpha-helix, β - structure, β-helix, super secondary structure.
   c. Tertiary Structure: Forces stabilizing, unfolding/ refolding expt. Prediction of tertiary Structure
   d. Quaternary structure – hemoglobin.

4. End group analysis, sequencing and peptide synthesis (4 L)

5. Ramachandran plot. (2 L)

Reference Books:

1. Principles of Biochemistry, Lehninger C Rs. Publ. 7th edition (2017).
2. Biochemistry, L. Stryer, W.H. Freeman, San Francisco (2008).
3. Schaum's Outline Series of Theory and Problems of Biochemistry
4. Problem Approaches in Biochemistry. Wood and Hood.
5. Biochemistry by Voet and Voet, 4th edition (2010

CCTP-2
BCH-112 Physical Biochemistry (4 credit)

Section I- Biophysical Techniques

1. Sedimentation : (4 L)
Theory, Preparatory and Analytical ultracentrifuges, factors affecting sedimentation velocity, measurement of Sedimentation Coefficient, Zonal centrifugation, Specific example of application

2. Molecular separation techniques : (2 L)
Membrane filtration-Nitrocellulose, Fibre glass, Polycarbonate filters, Dialysis and Reverse dialysis

3. Chromatography Techniques : (6 L)
Partition and Adsorption Chromatography- paper, TLC,GLC,GSC, gel filtration, ion exchange chromatography, affinity chromatography, hydrophobic interaction chromatography, metal chelate chromatography, covalent chromatography.DNA cellulose chromatography, MAK hydroxyl-apatite chromatography

4. Electrophoretic Techniques : (4 L)
Types of electrophoresis: moving boundary electrophoresis and zone electrophoresis. Paper Electrophoresis, Cellulose-acetate electrophoresis, Gel Electrophoresis,2D gel electrophoresis, Isoelectric focusing

5. Viscosity : (4 L)
Theory, effect of macromolecules on the viscosity of a solution, Measurement of viscosity , molecular weight determination.

6. Biosensors : (4 L)
Principle, Types, Working, Applications

Section II- Techniques for Characterization of Biomolecules

1. Spectroscopic methods : (16 L)
Principle, instrumentation, methodology and biological applications of Atomic Absorption Spectroscopy (AAS), UV-Visible spectroscopy, Infra red (IR) spectroscopy, Nuclear Magnetic Resonance (NMR) spectroscopy, Optical Rotatory Dispersion (ORD) & Circular Dichroism (CD), Spectrofluoremetry

2. Mass Spectrometry : (8 L)
Principle, component's, working and applications of mass spectrometer, different types of ionization methods used in mass spectrometer (CI,EI,ESI),different types of mass analysers used in mass spectrometer (magnetic sector, quadrapole), MALDI-MS, MALDI-TOF-MS

Reference Books:
1. Physical Biochemistry by D. Freifelder IInd Edition
2. Biochemical techniques by Wilson and Walker,
3. Biophysical techniques by Upadhye and Upadhye,
4. Molecular cell biology 4th ed. Lodish B. Ball, 4th edition

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CCTP-3
BCH-113- Cell Biology and Membrane Biochemistry (4 credit)

Section I- Cell Biology

1. Cell Classification: (2 L)
Cell variability, size, shape and complexity, function

2. Animal Cell : (6 L)
Structure, sub cellular components: Nucleus, chromosomes, plasma membrane, endoplasmic reticulum, lysosomes, peroxisomes, Golgi apparatus, mitochondria, cytoskeleton, sub-cellular fractionation: Differential and density gradient centrifugation, specific staining of organelles and marker enzymes.

3. Cell Division : (4 L)
Cell cycle , mitosis, meiosis

4. Plant Cells : (4 L)
Cell wall and its function, chloroplast, xylem, phloem and epidermal cells. The interaction and communication between the cells, cell-cell reorganization in plants.

5. Fungi : (2 L)
Cell structure, classification and biological importance.

6. Cell Communication : (4 L)
Cell-cell adhesion and the extracellular matrix, intercellular recognization, cell junctions, extracellular matrix and role of collagen, elastin and fibronectin.

7. Germ Cells and Fertilization: (2 L)
Stem cells, cell differentiation, organogenesis, functional and biochemical maturation of tissues

Section II- Membrane Biochemistry

1. Biological membrane, structure, and assembly : (6 L)
Constituents, asymmetry, flip flop, protein lipid interaction, factors affecting physical properties of membranes. membrane associated diseases

2. Membrane transport : (8 L)
Diffusion, passive, active and facilitated, transport role of proteins in the process, receptor mediated endocytosis, osmoregulation and ATP-ADP exchanger. Na, H dependent processes and phosphotransferase synthesis,

3. Specialized transport mechanism : (6 L)
Transport of macromolecules , toxins, control of transport processes and binding proteins.

4. Molecular mechanisms : (4 L)
Ionophores, ion translocating antibiotics, valinomycin, gramicidin, group translocation.

Reference Books :

1. Molecular Biology of the cell– Bruce Alberts – J.D. Watson et al 4th edition (2002)
2. Cell and Molecular Biology – DeRobertis and Saunders, 8th edition (2017).
3. The cell – C.P. Swanson, Prentice Hall (1989)
4. Cell Biology – C.J. Avers, Addision Wesley Co. (1986).
5. Molecular biology by Lodish and Baltimore, 4th edition (2000).
6. Microbiology, M.S. Pelczar, R.D. Reid, E.C.S. Chan,5th edition (2001).
7. General Microbiology (Vth Edition), R.Y. Stanier, Prentice Hall (1986)
8. Biology of Microorganisms by Brocks, 12th edition (2009)
9. Introductory Microbiology, F.C. Ross, Charles Merril Publication (1983).

COBP-1
BCH-114 Section-I : Theory Course (Any one option) (2 credit)

Elective Option-A: Enzymology

1. Basic aspects : (2 L)
Remarkable properties of enzymes, cofactors, nomenclature, classification, isoenzymes and multienzymes.

2. Enzymes kinetics : (6 L)
One-substrate reactions, effect of pH, temperature, inhibitions, two substrate reactions: theory, order analysis, pre-steady state kinetics, stopped flow technique, relaxation methods.

3. Mechanism of enzymes action : (6 L)
Theoretical background, factors leading to rate enhancement of enzyme catalyzed reactions, acid-base catalysis, proximity and orientation effects, covalent catalysis, strain or distortion and

change in environment. Experimental approaches of determination of enzymes mechanism: Kinetics studies, detection of intermediates, chemical modification of amino acid side chain and affinity labeling. Examples of Chymotrypsin, Lysozymes and Ribonuclease.

4. Regulation of Enzyme activity : (6 L)
Control of activities of single enzyme: Inhibitor molecules, availability of substrate or cofactor and changes in covalent structure of enzymes. Zymogen activation and phosphorylation, dephosphorylation, ligand binding and induced changes, allosteric enzymes, Hill equation, Adair equation, M.W.C. and K.N.F. Models, usefulness of the models. Significance of allosteric and cooperative behavior in enzymes.

5. Enzyme turnover: (4 L)
Kinetics of enzyme turnover, measurement of enzyme turnover, Ks and Kd, correlation between the rates of enzyme turnover and structure and function of enzymes, mechanism of enzyme degradation, significance of enzyme turnover

Reference Books:
1. Fundamentals of Enzymology by Price and Stevens, 3rd edition (1999).
2. Enzymology by Dixon and Webb, 2nd edition (1964).
3. Enzymes by Palmer

Elective Option-B: Bioinformatics (Computational Biochemistry)

1. Introduction: (1 L)

2. Scientific literature search: (2 L)
Pubmed, Scopus, google scholar. Measures of scientific impact assessment: impact factor, h-index, i10-index etc.

3. Computational biology resources: (3 L)
EBI, ExPASY, NCBI

4. DNA sequence databases: (5 L)
GenBank, EMBL, DDBJ, dbEST, RefSeq, dbSTS, Probe Database

5. RNA sequence databases: (3 L)
Relevant microRNA, long non-coding RNA, siRNA, tRNA and UTR databases

6. Protein sequence database: (4L)
- GenPept, UniProtKB, UniRef, UniParc, Proteomes, NextProt

7. Sequence alignment: (2 L)
Pair-wise and Multiple Sequence Alignment (MSA) and analysis, Global and Local alignment. Alignment based tools: BLAST, BLAT, CLUSTALW

8. Phylogenetic analysis (2 L)

9. Protein structure database: PDB (1 L)

10. Structure visualization (1 L)

Reference Books:
1. Essential Bioinformatics – **Jin Xiong** Cambridge University Press; 1st edition, Cambridge.
2. A text book of bioinformatics (2008) **Sharma, Munjal and Shankar**. Rastogi Publications, Meerut.
3. Introduction to Bioinformatics (2008) **Arthur M. Lesk** OUP, Oxford

Section-II: Practical Course (Any one option) (2 credit)

Elective Option-A: Enzymology

1. Isolation and detection of enzyme invertase/amylase/peroxidase/catalase.
2. Study of specific activity and progress curve.
3. To Asses effect of substrate conc.(Vmax and Km)on enzyme activity.
4. To Asses effect of pH on enzyme activity.
5. To Asses effect of enzyme conc.
6. To Asses temperature stability of the enzyme.
7. To Asses effect of activator on enzyme activity.
8. To Asses effect of inhibitor on enzyme activity.
9. To Asses the effect of enzyme immobilization on its activity.
10. Statistical analysis of data

Reference Books:
1. Biochemical Techniques Theory and Practice: J.R. Robyt and B.J. White.
2. Practical Biochemistry: Principles and techniques: K. Wilson and J. Walker.
3. Practical Biochemistry by David Plummer
4. Introductory Practical Biochemistry by S.K. Sawhney and R.Singh

Elective Option-B: Bioinformatics (Computational biochemistry)

1. To explore the NCBI resource and to query PUBMED, GenBank, dbEST, RefSeq, dbSTS and Probe databases using the various search strategies. To know and use ENTREZ search engine
2. To explore EMBL-EBI resource and to know various computational tools available at ExPASY
3. To explore and query microRNA, long non-coding RNA, siRNA, tRNA and UTR databases
4. To explore, query PDB and to perform structural visualization
5. To explore UniProtKB protein sequence databases
6. To know sequence file formats
7. To perform pair-wise and multiple sequence alignments. To construct and analyse phylogenetic tree.
8. To perform alignment based searches in various databases

Reference Books:
1. Essential Bioinformatics – **Jin Xiong** Cambridge University Press; 1st edition, Cambridge.
2. A text book of bioinformatics (2008) **Sharma, Munjal and Shankar**. Rastogi Publications, Meerut.
3. Introduction to Bioinformatics (2008) **Arthur M. Lesk** OUP, Oxford.
4. Introduction to Bioinformatics, Teresa Attwood, Parry-Smith David J., Publisher: Pearson Education (Singapore) Pte.Ltd., Latest Edition.
5. Bioinformatics: Sequence and Genome Analysis, Mount David W. Publisher: Cold Spring Harbor Laboratory Press; Latest Edition.
6. Developing Bioinformatics Computer Skills, Gibas Cynthia, Jambeck Per. Publisher: Shroff Publishers and distributors O'Reilly Media, Inc., Latest Edition

Reference Books :
1. Computers and Common Sense- R. Hunt and Shelley, Prentice Hall, New Delhi
2. Computer Programming in FORTRAN-90- V. Rajaraman, Prentice Hall, New Delhi
3. Computing for Biologists- A. Fielding, Addison Wesley Pub.
4. Microcomputers in Biochemical Education- E. J. Wood (Ed), Taylor and Francis Ltd.,

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CCPP-1
BCH-115 Biochemistry Practical –I (semester I) (4 credit)

Section I- Analytical Biochemistry

1. Estimation of amino acid by Ninhydrin method
2. Estimation of protein by Biuret method
3. Estimation of protein by Lowry et.al method.
4. Estimation of protein by Bradford method
5. Estimation of sugar by Folin-wu method
6. Estimation of sugar by Ferricyanide method
7. Estimation of sugar by DNSA method
8. Estimation of DNA by diphenylamine method
9. Estimation of RNA by orcinol method
10. Estimation of Vitamin C from lemon fruits.
11. Estimation of inorganic phosphorus from casein.
12. Estimation on alpha amino nitrogen of amino acid.

Section II- Physical Biochemistry

1. Preparation of buffer of desired pH and molarity
2. Measurement of pH by pH indicators.
3. Determination of dissociation constants from Acid base titration curves .
4. Determination of pI and pKa of amino acids

5. Determination of Nature of ion exchanger,
6. Determination of Capacity of ion exchange column,
7. Determination Viscosity of hydrolyzed, partially hydrolyzed and unhydrolyzed starch.
8. Determination of Relative viscosity of macromolecular solution.
9. Determination of Specific viscosity and intrinsic viscosity.
10.Seperation of Proteins by Polyacrylamide Gel electrophoresis (PAGE).
11.Varification of Lamberts Beer's Law using Colorimeter/Spectrophotometer,
12. Absorption spectrum of proteins and determination of its λmax
13. Separation and detection of amino acids by using Paper chromatography

Reference Books :

1. An introduction to practical Biochemistry – David T. Plummer, Tata Mc Graw Hill Co. Ltd., Bombay. (2015) 3rd Edition
2. Introductory Practical Biochemistry (2001). Ed. S.K. Sawhney and Randhir Singh.
3. Practical Biochemistry by Sadasivam and Manickam.
4. Practical Biochemistry, Principles and Techniques (1995). Ed. Keith Wilson and John Walker. . (2006) 5th Edition
5. Practical Biochemistry by J. Jayaraman
6. Practical Biochemistry by Shinde and Rao

SEMESTER – II

CCTP-4
BCH-211 - Metabolism (Reaction of Biomolecules) (4 credit)

Section –I Carbohydrate and Lipid Metabolism

1. Introduction of metabolism and overview. (2 L)

2. Bioenergetics: (2 L)
Basic low of thermodynamic, internal energy, enthalpy, entropy, concept of free energy, redox potentials, structure and significance of ATP

3. Glycolysis and Gluconeogenesis : (4 L)
Detailed study, energetics, regulation and significance.

4. Citric acid cycle: (2 L)
Detailed study, energetics, regulation and significance.

5. Electron transport and oxidative phosphorylation ,ATP synthase and mechanism (4 L)

6. Alternate pathways of carbohydrate metabolism: (2 L)

Pentose phosphate pathway, glyoxalate cycle, glucuronic acid pathway,

7. Polysaccharide metabolism: (4 L)
Biosynthesis, degradation and regulation of glycogen metabolism starch and cellulose, inborn error of carbohydrate metabolism.

8. Lipid metabolism: (4 L)
Types of fatty acid oxidation, energetics and regulation. Formation of ketone bodies, Biosynthesis of lipid, fatty acid synthase complex, regulation of biosynthesis. Biosynthesis of triglycerides, cholesterol and phospholipids

Section –II Amino acid and Nucleotide metabolism

1. Oxidative degradation of amino acids: (6 L)
Proteolysis, transamination, oxidative deamination, acetyl CoA, alpha ketoglutarate, acetoacetyl CoA, succinate, fumarate and oxaloacetate pathway. Decarboxylation, urea cycle, ammonia excretion.

2. Biosynthesis of amino acids: (10 L)
Amino acid biosynthesis, precursor functions of amino acids, biosynthesis of aromatic amino acids, Histidine, one carbon atom transfer by folic acid (Biosynthesis of glycine, serine, cysteine, methionine, threonine.)

3. Protein Metabolism : (4 L)
Peptides, polyamines, porphyrins, gamma glutamyl cycle, glutathione biosynthesis, nonribosomal protein biosynthesis.

5. Nucleotide metabolism: (4 L)
Biosynthesis , regulation and degradation of purine and pyrimidine nucleotides

Reference Books

1. Biochemistry – Lehninger.
2. Metabolic Pathways - Greenberg.
3. Biochemistry – G. Zubay, Addision Wesley Publ. (1983).
4. Biochemistry – Stryer (1988) 3rd Edition W.H. Freeman and Co.
5. Harper's Biochemistry

CCTP-5
BCH-212- Genetics (Chemistry of Nucleic Acids) (4 credit)

Section I- Principles of Heredity & Variations

1. Molecules of Heredity: (6 L)
Structure of DNA and RNA, DNA as genetic material, denaturation and renaturation of DNA, A, B, and Z forms of DNA.

2. Laws of Heredity: (3 L)
Genotype, Phenotype and Mendelian Laws of inheritance.

3. Classical concept of a gene:Allele, pseudoalleles, multiple alleles (blood groups (2 L)

4. Gene interactions and epistasis and their types. (2 L)

5. Linkage and crossing over: (6 L)
Linkage, linkage groups, types of crossing over, sex linkage, sex limited and sex influenced characters, Recombination,recombination maps in diploids for 2 point and 3 point test cross, (determination of gene order with suitable examples)

6. Sex factors and Plasmids: (5 L)
Fertility factor, Hfr, mapping of E. coli chromosome, Introduction to Operon.

Section II- Population Genetics

1. Mutations : (8 L)
Production of mutants by chemical and physical agents and their characterizations. Auxotroph, prototroph, conditional mutants, mutant isolation and selection. Transformation, conjugation and transduction.

2. Population genetics and genetics of evolution : (8 L)
a. Introduction to the elements of population genetics: genetic variation, genetic drift, neutral evolution; mutation selection, balancing selection, Fishers theorem,
b. Hardy Weinberg equilibrium, factors affecting Hardy Weinberg equilibrium (selection, mutation, migrations and genetic drift)
c. In-breeding depression & mating systems; population bottlenecks, Bayesian statistics; adaptive landscape, spatial variation & genetic fitness

3. Human genetics : (8 L)
Genetic disorders: Chromosomal origin, gene origin –mutation, human teratogenesis. Clinical genetics, pedigree analysis ,diagnostic tools and techniques for human genetic disorder Genetic approaches to complex genetic diseases- hypertension, diabetes and Alzheimer'

Reference Books:

1. Genetics: Principles and Analysis. Sudbury, Hartl, D. L., & Jones, E. W. (1998).
2. Genetics: a Conceptual Approach. Pierce, B. A. (2005).
3. Principles of Genetics. Tamarin, R. H., & Leavitt, R. W. (1991). .
4. Evolutionary Genetics. Smith, J. M. (1998). Oxford: Oxford University Press
5. Genetics Author B. D. Singh Edition 2, reprint Publisher Kalyani Publishers
6. Genetic Mapping and DNA Sequencing edited by Terry Speed, Michael Waterman
7. Biochemistry of antimicrobial action- 4th edition, Chapman and Hall , TJ Franklin

CCTP-6
BCH-213 Plant Biochemistry (4 Credit)

Section I- Physiology and Biochemistry of Plant

1. Physiology and Biochemistry of plant cell and organelles (2 L)

2. Photosynthetic systems in plants (2 L)

3. Molecular biology of source sink relationship in plants (2 L)

4. Plant signaling and behavior: (4 L)
   Plant-plant, plant-insect, plant-pathogen, plant-environmental Factors

5 . Stress Physiology : (4 L)
   Physiology and biochemistry of abiotic (Drought, Salinity, Metal) and biotic (bacteria, fungi,viruses) stresses in plants

6. Physiology and biochemistry of seed germination, dormancy, fruit development and ripening (4 L)

8. Plant diseases: Pest types, symptoms, treatment, pesticides. (4 L)

9. Pharmaceutical and neutraceutical values of plants (2 L)

Section II- Nutrition and Metabolism of Plant

1. Plant nutrition: (2 L)
   Micro and macro elements, requirement, role, excess and deficiency disorders.

2. Photosynthesis: (4 L)
   Mechanism CO2 fixation, C3 and C4 pathways, CAM pathway

3. Nitrogen and Sulfur metabolism: (4 L)
   Nitrogen cycle, nitrogen fixation, assimilation of nitrate and ammonium ions, nitrogen transformation during development, assimilation of sulfate.

4. Plant hormones: (6 L)
   Types and role in plant growth and development, Auxins gibberellins, cytokinins, ethylenes, abscisic acid, hormones in senescence and abscission.

5. Secondary metabolites: (6 L)
   Definition, Types, & chemistry of phenolics, flavanoids, lignins, terpenoids, alkaloids. Chemistry examples and applications of Gum, Pectins, Rubber

6. Seed storage proteins. (2 L)

Reference Books:

1. Biochemistry and Physiology of Plant Hormones, Thomas Moore
2. Plant Biochemistry- Hans Walter Heldt
3. Introduction to Plant Biochemistry- T.W. Goodwin and E.L. Mercer
4. Plant Physiology- Devlin
5. Plant Biochemistry- Dey
6. Plant physiology , Salisbury and Ross (2007) CBS publishers and distributors

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CBOP-2
BCH-214- Section I- Theory course (any one) (4 credit)

Elective Option-A : Microbiology

1. Introduction : (2 L)
   Cell structure and components, characterization and classification of microorganisms.

2. Microscopy: (4 L)
   Theory, phase contrast microscopy, fluorescence microscopy and electron microscopy: Theory, specimen preparation, freeze etching, freeze fracture, shadow casting, electron microscopy of nucleic acids

3. Cultivation of Bacteria : (4 L)
   Nutrition, physiology and growth of microbial cells, reproduction and growth, synchronous growth, continuous culture of microorganisms. Pure cultures and their characteristics.

4. Fundamentals of control of microbial growth : (4 L)
   Control by physical agents, chemical agents and biochemical agents.

5. Host microbe interactions : (4 L)
   Endotoxins, exotoxins, capsular material. Enzymatic and other factors, tissue affinity, resistance and immunity.

6. Viruses: (4 L)
   Viruses of bacteria, plant and animal cells, (Structure, classification and life cycle), mycoplasma and viriods, diseases.

7. Nitrogen fixation: (2 L)
   Historical background, nitrogen cycle in nature, symbiotic nitrogenfixation, nitrogenase system, nitrate reductase.

Reference Books :

1. Microbiology, M.S. Pelczar, R.D. Reid, E.C.S. Chan, Mc Graw Hill, New York, 5th

edition (2001).
2. General Microbiology (Vth Edition), R.Y. Stanier, Prentice Hall (1986)
3. Biology of Microorganisms by Brocks, 12th edition (2009)
4. Introductory Microbiology, F.C. Ross, Charles Merril Publication (1983).

Elective Option-B : Advances techniques in biochemistry:

1. Introduction to nanobiotechnology: Concept, Tools, Methods, Applications. (4 L)
2. Microscopic techniques- SEM, TEM, AFM (4 L)
3. Autoradiography (2 L)
4. HPLC, HPTLC, LCMS, GCMS, (4 L)
5. X ray diffraction studies (2 L)
6. Isotop Tracer Technique (2 L)
7. Lyophilization (2 L)
8. Radioactivity : (4 L)

Properties of radioisotopes, commonly used isotopes, Types of radiations, measurement scintillation and gamma counters. Background noise quenching, radiation hazards Interaction of radiation with matter, passage of neutrons through, matter, interaction of gamma rays with matter

Reference Books:

1. Biochemistry, L Stryer , J.M.Berg, J.L Tymoczko, W.H.Freeman 7th ed.
2. Molecular biology and biotechnology, J.D.Walker, Rapley, 5th edn, 2009.
3. Principles and Techniques of biochemistry and molecular biology, K Wilson and J Walker, 7th edn
4. Physical Biochemistry by D. Freifelder IInd Edition
5. Biochemical techniques by Wilson and Walker,
6. Biophysical techniques by Upadhye and Upadhye,
7. Molecular cell biology 4th ed. Lodish B. Ball, 4th edition

Section-II: Practical Course (Any one option) (2 credit)

Elective Option-A : Microbiology

Microbial Techniques

1. Media preparation, pour plate and streak plate techniques.
2. Microscopic examination (motility, monochrome staining and gram staining).
3. Sterilization: Steam, Dry heat and filter.
4. Preservations of bacterial cultures..
5. Phosphatase test for the quality of milk.
6. Methylene blue reduction test (MBRT) for quality of milk.
7. Growth curve of E. coli.
8. Total viable count determination (pour plate and spread plate).
9. Ultraviolet irradiation and survival curve.
10. Plaque assay for phage.
11. Microbial assay of antibiotic.

Reference Books :

1. Microbial methods – J.Collins and lynes – 8th edition.
2. Medical Microbiology, Vol. II – Cruickschank, 12th edition (1980).

Elective Option-B : Advances Techniques in Biochemistry:

1. Identification of functional groups in a compound using IR spectroscopy.
2. Identification of compound using NMR spectroscopy.
3. Demonstration of sophisticated analytical instrument working (GC/ GCMS/ LCMS)
4. Demonstration and analysis of XRD spectrum.
5. Determination of morphology of molecules using SEM/ TEM data.
6. Determination of E-max of β radiation.
7.Quantitative analysis of elements using AAS.
8. HPLC.
9. Spectrofluoremetry.

Reference Books:

1. Biochemistry, L Stryer , J.M.Berg, J.L Tymoczko, W.H.Freeman 7th ed.
2. Molecular biology and biotechnology, J.D.Walker, Rapley, 5th edn, 2009.
3. Principles and Techniques of biochemistry and molecular biology, K Wilson and J Walker, 7th edn
4. Physical Biochemistry by D. Freifelder IInd Edition
5. Biochemical techniques by Wilson and Walker,
6. Biophysical techniques by Upadhye and Upadhye,
7. Molecular cell biology 4th ed. Lodish B. Ball, 4th edition

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CCPP-2
BCH-215 Biochemistry Practical –I (semester II) (4 credit)

Section I- Analytical Biochemistry

1. Isolation of Albumin and globulin from egg.
2. Isolation of Casein by IpH precipitation from milk.
3. Isolation of Starch and characterization from potato.
4. Isolation of Cholesterol and lecithin from egg.
5. Isolation of Amino acid (cystine) from hair hydrolysate.
6. Isolation of Lipid and estimations.
7. Specific reactions for Carbohydrate.
8. Specific reactions for Amino acids .
9. Determination of Saponification value of fat.
10. Determination of Acid value of fat.
11. Determination of Iodine number of fat.
12. Alpha and Beta amylolysis.

Section II- Physical Biochemistry

1. Determination of void volume of gel filtration chromatography column.
2. Separation of two components in a sample by gel filtration chromatography.
3. Seperation and detection of plant pigments by using TLC.
4. Separation of DNA by paper or agarose gel electrophoresis.
5. Dilution/ separation of given biomolecules by using Dialysis.
6. Concentrate the given biomolecule sample using Reverse dialysis.
7. Separation of amino acids by Ion Exchange chromatography.
8. Absorption spectrum of Nucleic acid and determination of its λ max.
9. Absorption spectra of different hemoglobin derivatives.
10. Quantitative estimation by using Spectrofluorimeter.
11. Measurement of Refractive Index.
12. Sub- Cellular fractionation by sedimentation.
13. RBC membrane fragility.

Reference Books:

1. An introduction to practical Biochemistry – David T. Plummer, Tata Mc Graw Hill Co. Ltd., Bombay. (2015) 3rd Edition
2. Introductory Practical Biochemistry (2001). Ed. S.K. Sawhney and Randhir Singh.
3. Practical Biochemistry by Sadasivam and Manickam.
4. Practical Biochemistry, Principles and Techniques (1995). Ed. Keith Wilson and John Walker. . (2006) 5th Edition
5. Practical Biochemistry by J. Jayaraman
6. Practical Biochemistry by Shinde and Rao