Fergusson College (Autonomous)

Pune

Learning Outcomes -Based Curriculum

for

M. Sc. I - Biochemistry

With effect from June 2019

Programme Structure

Year	Course Code	Course Title	Course	Credits
M.Sc. – I Part I	**Semester I**			
	CHB4101	Biomolecules	Tcore-1	4
	CHB4102	Genetics and Cell Biology	Tcore-2	4
	CHB4103	Biophysical Techniques	Tcore-3	4
	CHB4104	Enzymology and Plant Biochemistry	Tcore-4	4
	CHB4105	Biochemistry Practical – I	Pcore-1	4
	CHB4106	Biochemistry Practical – II	Pcore-2	4
				24
	Semester II			
	CHB4201	Microbiology and Fermentation technology	Tcore-1	4
	CHB4202	Metabolism	Tcore-2	4
	CHB4203	Molecular Biology	Tcore-3	4
	CHB4204	Physiological Biochemistry	Tcore-4	4
	CHB4207	Biochemistry Practical - III	Pcore-1	4
	CHB4208	Biochemistry Practical - IV	Pcore-2	4
				24

Programme Structure

Year	Course Code	Course Title	Course	Credits
M.Sc. – II Part II	**Semester III**			
	CHB5301	Genetic Engineering and Animal cell culture	Tcore-1	4
	CHB5302	Immunology and Toxicology	Tcore-2	4
	CHB5303	Neurochemistry and Endocrinology	Tcore-3	4
	Electives Courses/MOOCS/General Elective (any One)			
	CHB5304	Biostatistics, Bioinformatics and Advance Biophysical techniques	Dcore-1	4
	CHB5305	Nutraceuticals and Pharmaceuticals	Ecore-1/M	4
	CHB5306	Molecular Oncology	Ecore-2/M	4
	CHB5307	Biochemistry Practical - V (Molecular Biology and Immunology)	Pcore-1	4
	CHB5308	Biochemistry Practical - VI (Bioinformatics, Computer Skills and Statistical Analysis)	Pcore-2	4
				24
	Semester IV			
	CHB5407	Biochemistry Practical (Project)	Pcore-1	8
				8

Program Outcomes (POs) for M. Sc. Programme	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the discipline that form a part of an postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	**Social competence:** Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise and help reach conclusion in group settings.
PO4	**Research-related skills and Scientific temper:** Infer scientific literature, build sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	**Trans-disciplinary knowledge**: Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	**Personal and professional competence**: Perform independently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics**: Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability**: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Program Specific Outcomes (PSOs) for M. Sc. Biochemistry	
PSO No.	**Program Specific Outcomes(PSOs)** **Upon completion of this programme the student will be able to**
PSO1	**Academic competence** (i) Articulate fundamental concepts, principles and processes underlying the field of biochemistry and its different branches (ranging from biomolecules, metabolism, nutrition, cell biology, genetics, enzymology, immunology, physiology, endocrinology, plant biochemistry, molecular biology to genetic engineering, neurochemistry) and its linkage with related disciplinary areas/subjects. (ii) Demonstrate an understanding and be able to explain a wide range of biochemical techniques (e.g. basic molecular biology, genetic engineering, microbiology methods, spectrophotometry, enzyme kinetics, chromatography, electrophoresis, immunological assays)
PSO2	**Personal and Professional Competence** (i) Execute critical thinking and be capable in experimental data interpretation and carry out laboratory-orientated numerical calculations. (ii) Identify biochemistry related problems and use appropriate concepts and methods to solve them. (iii) Formulate scientific protocols, write authentic reports and develop effective presentation and conversational competence.
PSO3	**Research Competence** (i) Review scientific literature, develop a hypothesis and formulate scientific protocols and conduct appropriate experiments. (ii) Plan and execute research projects professionally while emphasizing on academic and research ethics, scientific misconduct and creating awareness about intellectual property rights and issues of plagiarism (iii) Integrate informatics and statistical skills to explore and authenticate biological data for experimental and research purpose
PSO4	**Entrepreneurial and Social competence** (i) Develop solutions and apply appropriate techniques towards specific areas related to biochemistry including industrial production, clinical, health, agriculture. (ii) Execute social competence including listening, speaking, observational, effective interactive skills and presenting skills to meet global competencies.

F.Y. M.Sc. Semester I		
Title of the Course and Course Code	**Biomolecules (CHB4101)**	**Number of Credits : 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Recall source, structures and list the significance of biomolecules.	
CO2	Classify biomolecules with suitable examples and differentiate between their features.	
CO3	Apply the knowledge of membrane composition to corelate with its properties and different types of transport mechanisms.	
CO4	Analyze the interrelationship between biomolecules and their derivatives. Identify the sequence of steps required to determine hierarchy in the structural organization of macromolecules.	
CO5	Evaluate in-vitro and in-vivo reactions of biomolecules along with their significance.	
CO6	Assemble and tabulate the coenzymes of vitamins and corelate its significance in biochemical reactions. Plan the use of suitable methodologies for characterization of biomolecules.	

Unit No.	Title of Unit and Contents
1.	**Carbohydrates:** 1.1. Introduction, Biological Significance, Classification with examples. Basic structures of Monosaccharides- Cyclisation of sugars according to Fischer and Haworth formula. Anomers and Epimers. 1.2. Structures of complex carbohydrates- Disaccharides (Homo and Hetero), Oligosaccharides and Polysaccharides (Homo and Hetero). 1.3. Concept of reducing and nonreducing sugars, Mutarotation and inversion. General reactions of sugars with Phenylhydrazine, Acids, Bases, Oxidisng agents and Reducing agents and its significance. 1.4. Derivatives of Sugars- Deoxy sugars, Phosphorylated sugars, Sulfated sugars, Amino sugars, Acetylated sugars, and Sugar acids, Sugar alcohols and its significance.
2.	**Lipids:** 2.1. Introduction, Biological Significance, Classification with examples. Basic structures of major lipid subclasses- Types of fatty acids, Waxes, Glycerophospholipids (Ester linked and Ether linked), Shingophospholipids, Nonphospholipids, Steroids. Essential and non essential fatty acids. 2.2. Blood group substance. Lipoproteins- Chylomicrons, VLDL, LDL and HDL. 2.3. General chemical reactions of lipids- Hydrolysis, Saponification,

	Emulsification, Oxidation. Saponification Number, Acid number, Iodine number, Reichert Meissel number, Polensky number. Hydrolytic and Oxidative rancidity of lipids. 2.4. Amphipathic Lipids-Formation of micelles, monolayers, bilayer, liposomes. 2.5. Membrane structure and composition: Fluid Mosaic model, Significance of biological membranes. Molecular Constituents, percentage composition of plant, animal and microbial membranes, membrane permeability asymmetry and fluidity of membrane, rotation, flip flop movement, lateral diffusion of phospholipids. Protein lipid interaction and factors affecting properties of membranes
3.	**Nucleic Acids:** 3.1. Structure of Nitrogenous bases- Purines and Pyrimidines, Nucleosides, Nucleotides and Polynucleotides. 3.2. The central Dogma, DNA as genetic material 3.3. Structure of DNA. Features of denaturation and renaturation of DNA 3.4. Structure and types of RNA.
4.	**Amino acids:** 4.1. Introduction, Biological Significance, Classification with examples based on R group, Polarity, optical activity. Essential and Non-essential amino acids, Standard and Nonstandard amino acids. 4.2. Z witter ions and Isoelectric pH, Titration curve of amino acids. 4.3. General reactions of Amino acids with Ninhydrin, Sanger's, Dansyl chloride, Dabsyl chloride reagents. Deamination, Transamination and decarboxylation of amino acids. UV spectra of amino acids. 4.4. Peptide bond formation. Solid phase synthesis of peptides.
5.	**Proteins:** 5.1. Classification on the basis of composition, biological role and shape. 5.2. Structural levels of protein: Primary structure – End group analysis of N and C terminus, breaking of polypeptides to small peptides using enzymes and chemical reagents, Amino acid sequencing by Edmann degradation. 5.3. Secondary structure-alpha-helix, beta pleated structure, super secondary structure. 5.4. Tertiary Structure- Forces stabilizing the structure. 5.5. Quaternary structure – Hemoglobin. Denaturation and Renaturation of proteins. 5.6. Ramachandran plot and prediction of protein structure.
6.	**Vitamins and Co-enzymes:** 6.1. Classification- Water-soluble and Fat-soluble vitamins. 6.2. Structure, Coenzyme forms of B- complex vitamins, Source, dietary requirements. 6.3. Biochemical functions, deficiency conditions.

7.	**Transport of Biomolecules across membranes:** 7.1. AT Pases and its types (Sodium- Potassium pump, ABC, P type, V type AT Pases). Sodium, proton Potassium and chloride dependent processes. 7.3. Ion transport: Types, proteins involved in ion transport, ionophores (antibiotics: Gramicidin and Valinomycin) 7.4. Drug transport: Role of liposome in drug transport, cellular permeability, some examples of drugs, role in cell signaling

References:

1. Principles of Biochemistry, Lehninger CRS publication
2. Biochemistry, L. Stryer
3. Biochemistry Voet&Voet
4. Problem Approaches in Biochemistry. Wood and Hood
5. Physiological chemistry- Hawk

Title of the Course and Course Code	Genetics and Cell Biology (CHB4102)	Number of Credits : 04
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Recall the basic concepts and theories related to genetics and cell biology. Describe mendelian principles and its extensions.	
CO2	Articulate the types of mutations, causes and classify them. Interpret the reasons behind sex determination and discuss types of inheritance. Explain genetic complementation test and its uses	
CO3	Apply the principles of genetics to solve the problems. Illustrate different methods of horizontal gene transfer in bacteria.	
CO4	Compare prokaryotic and eukaryotic cells and explain about subcellular organelles and their functions.	
CO5	Review the process of gametogenesis, fertilization, organogenesis and importance of stem cells and types. Compare different types of transport mechanisms across cell membrane.	
CO6	Rearrange the processes and cyclic events of cell division and describe cellular aging and cell death. Integrate the subject knowledge to write and present the scientific topics and research articles.	

Unit No.	Title of Unit and Contents
	Genetics
1.	**Concept of gene:** 1.1. Evolution of gene: Beadle and Tatum's one gene one enzyme concept, one gene one polypeptide concept, 1.2. Allele, multiple alleles, pseudoalleles, multiple gene, 1.3. Fine structure of gene: Cistron, Recon and Muton, Eg. rII locus in T4 phage, 1.4. Complementation test.
2.	**Mendelian genetics:** 2.1. Mendel's History, Genetic terminology, Genotype, Phenotypes 2.2. Mendel's Laws–Dominance, Segregation and Independent assortment with examples
3.	**Extension of Mendelian principles:** 3.1. Co-dominance, incomplete dominance 3.2. Gene interactions : epitasis, pleiotropy, penetrance and expressivity
4.	4.1. Chromosomal Sex determination, 4.2. Sex limited and sex influenced characters

5.	**Extra chromosomal inheritance:** 5.1. Inheritance of mitochondrial and chloroplast genes with examples 5.2. Maternal inheritance, nucleocytoplasmic inheritance
6	**Molecules of Heredity:** 6.1. DNA as genetic material, The central Dogma. Semi conservative mechanism of DNA replication. 6.2. Features of denaturation and renaturation of DNA, cot curve analysis,
7	**Mutation:** 7.1. Types of mutations, causes and detection, 7.2. Germinal vs. somatic mutation, chromosomal and genetic mutations 7.3. Human teratogenesis
8	**Mutant types:** 8.1. Auxotrophs, prototrophs, lethal, conditional mutants 8.2. Mutant isolation and selection method
9	**Microbial genetics:** 9.3. Types of plasmids, Fertility factor, Hfr 9.4. Methods of genetic transfers –transformation, and conjugation in bacteria. Life cycle of bacteriophages, lytic and lysogeny, transduction types: specialized, generalized. 9.5. Mapping genes by interrupted mating technique 9.6. Tetrad analysis.
10.	Genetic Code: Biochemical and genetic analysis of the genetic code.
	Cell Biology
11.	**Brief Introduction about cell:** 11.1 Cell theory, Cell classification, cell variability, size, shape and complexity, function
12	**Animal cell and Plant cell:** 12.1. Animal cell: Morphology and functions of sub cellular components: Nucleus, chromatin and chromosomes, plasma membrane, ribosomes, endoplasmic reticulum, lysosomes, peroxisomes, Golgi apparatus, mitochondria, cytoskeleton 12.2. Plant cell: cell wall, chloroplast, glyoxysomes, dictyosomes, vacuoles xylem, phloem and plant cell epidermis 12.3. Sub-cellular fractionation: Differential and density gradient centrifugation, marker enzymes.
13.	**Cell division and cell cycle:** 13.1. Mitosis: events of different phases and its significance 13.2. Meiosis -Types, process and its significance, comparison of

	mitosis and meiosis, cell cycle check points.
14.	**Cell junction and mechanism of transport across cell:** 14.1. Anchoring junctions, communicating junctions, tight junctions, gap junctions. 14.4. Extracellular matrix and role of collagen, elastin and fibronectin. Plasmodesmata. 14.5. Principles and mechanism of osmo-regulation, diffusion, passive, active and facilitated transport, features of uniport, symport and antiport transport systems, role of proteins in the process like exocytosis, endocytosis-phagocytosis and pinocytosis, receptor mediated endocytosis (cholesterol transport), and ATP, ADP-exchanger.
15.	**Germ cells and Stem cells:** 15.1. Gametogenesis, fertilization and organogenesis: zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals. 15.2. Stem cells: Types

References:

1. Genetics by Monoroe W. Strickberger,1990 (3rd Ed.) Macmillan Pub
2. iGenetics: A Molecular Approach by peter J.Russell
3. Biochemistry, L Stryer, 3rd/4th/5th ed, 1989, Freeman and Co. NY
4. Principles of Biochemistry –Lehninger
5. Molecular Biology of the Gene- Watson Benjamin / Cummings Publ. Company (1987).
6. Introduction to Genetics: A Molecular Approach; T A Brown, Garland Science (2011).
7. Human Molecular Genetics; Peter Sudbery, (2002) Printice Hall
8. Molecular Biology of the Cell, fifth addition– Bruce Alberts, Garland Science
9. Cell and Molecular Biology – DeRobertis and Saunders (1980).
10. The Cell- A molecular approach by Geoffrey M. Cooper
11. Cell Biology – C.J. Avers, Addision Wesley Co. (1986).
12. Molecular biology by Lodish and Baltimore

Title of the Course and Course Code	Biophysical Techniques (CHB4103)	Number of Credits : 04
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Recall basic concepts of separation and purification techniques along with their applications.	
CO2	Articulate concepts, parameters, mechanism and applications of different types of chromatography.	
CO3	Illustrate the types of electrophoresis, applications and principles underlying the techniques. Apply the knowledge for biomolecules separation.	
CO4	Identify sedimentation techniques, applications and the factors affecting sedimentation velocity and coefficient.	
CO5	Review concepts of radioactivity, tracer techniques and radioactive detecting/measuring instruments. Evaluate the separation techniques for biomolecules.	
CO6	Specify the working mechanisms and applications of basic spectroscopic techniques. Compile methods to separate biomolecules and present the subject relevant topics/ research articles.	

Unit No.	Title of Unit and Contents
1.	**Membrane filtration and dialysis:** 1.1 Nitrocellulose, fibre glass, Polycarbonate filters 1.2 Dialysis, reverse dialysis, glass fibre dialysis. 1.3 Freeze drying and lyophilization
2.	**Chromatography theory and practice:** 2.1 Introduction, Partition and Adsorption principle 2.2 Brief introduction of Paper chromatography and Thin layer chromatography 2.3 Column chromatography-parameters employed in column chromatography, retention, resolution, physical basis of peak broadening plate height equation, capacity factors, peak symmetry, standard systems of chromatography and its components, stationary phase, elution. 2.4 Ion exchange chromatography-principle, method, major matrices, examples of cation and anion exchangers, applications. 2.5 Gel chromatography- principle, method, matrix and fractionation range, application. 2.6 Affinity chromatography-principle, method, affinity ligands,immobilization of ligands, activation of matrices, coupling affinity igands, metal affinity chromatography, hydroxyl apatite chromatography, covalent chromatography, hydrophobic interaction chromatography.

	2.7 HPLC -Instrumentation, method, Separate modes: normal and reverse, detectors. Introduction: Fast protein liquid chromatography (FPLC), 2.8 GC –instrumentation, principle, procedure, applications.
3.	**Electrophoretic techniques:** 3.1. general principles, Su7pport media – agarose, paper, cellulse-acetate electrophoresis, polyacrylamide gels. 3.2. Electrophoresis of proteins – SDS-PAGE, native PAGE, disc PAGE, gradient PAGE, Capillary electrophoresis, 3.3. Isoelectric focussing, 2-D gel electrophoresis, Western blotting 3.4. Staining techniques – Coomassie and Silver staining, 3.5. Nucleic acids- Agarose gel electrophoresis, DNA sequencing gels
4.	**Spectroscopy:** 4.1 UV and visible spectrophotometry- Principle, instrumentation and applications 4.2 Atomic Absorption Spectroscopy (AAS), Inductively coupled Plasma Atomic Emission Spectrometry (ICP-AES or IES)
5	**Sedimentation:** 5.1. Theory, Preparatory and analytical ultracentrifuges, Density gradient centrifugation. 5.2. Factors affecting sedimentation velocity, sedimentation coefficient, measurement of S, Zonal centrifugation, DNA analysis 5.3. Determination of molecular weight by sedimentation, diffusion and sedimentation equilibrium methods. 5.4. Applications of sedimentation techniques with examples
6	**Viscosity:** 6.1 Theory, effect of macromolecules on the viscosity of solutions 6.2 Flow time measurement, relative viscosity
7	**Isotope Tracer Techniques:** 7.1 Types of radiations, types of decay, rate of radioactive decay, half-life, units of radioactivity 7.2 Detection and measurement of radioactivity, GM counter –design and application, Scintillation counters, types, advantages and limitations, background noise quenching, Radiation dosimetry, Cerenkov counting
8	Autoradiography: Principle, method and applications
9	X-Ray Diffraction: Principle and applications

References:

1. Physical biochemistry by D. Freifelder II edition.
2. Biochemical techniques by Wilson and Walker.
3. Biophysical techniques by Upadhyay, Upadhyay and Nath.

4. Biochemical calculation by I.H. Segal IInd Edition

Title of the Course and Course Code	Enzymology and Plant Biochemistry (CHB4104)	Number of Credits : 04
Course Outcome (COs) On completion of the course, the students will be able to:		
CO1	Describe basic concepts of biocatalyst (Enzyme) and plant biochemistry. Recall general characteristics of enzymes and outline plant processes	
CO2	Discuss the molecular arrangements of enzymes, interaction behaviour and mechanism of action. Explain enzyme kinetics and processes of plant biochemistry	
CO3	Demonstrate characteristics and potential of enzymes. Generalize the methods of isolation and purification of plant molecules and enzymes.	
CO4	Compare the processes, applications of enzymes and plants molecules. Organize information about enzymes and attribute the role towards specific functions.	
CO5	Evaluate the outcomes of the enzymatic reactions and plant biochemical studies.	
CO6	Specify the role, function and metabolism of different components and processes in plants. Design a method to study enzymes and plant molecules.	

Unit No.	Title of Unit and Contents
	Enzymology
I	**Classification and features of enzymes** 1.1. History, Nomenclature and classification, 1.2. Remarkable properties- High catalytic power, features of active site, enzyme substrate complex formation: lock and key hypothesis, induced fit and substrate strain theory, enzyme specificity, regulation. 1.3. Concept of Isoenzymes, conjugated enzymes- holoenzyme, apoenzyme, prosthetic groups: Cofactors coenzymes, multi-enzymes.
II	**Mechanism of enzymes action** 2.1 Theoretical background of enzymatic reactions 2.2 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, site directed mutagenesis.
III	**Isolation and Purification of Enzymes** 3.1 Industrially useful enzymes (Amylase, Invertase, pepsin) their isolation and purification techniques, 3.2 Immobilization of enzymes and its applications

IV	**Experimental approach to Enzyme mechanics** 4.1 Kinetics studies 4.2 Detection of intermediates 4.3 X-ray crystallographic studies 4.4 Chemical modification of amino acid side chain and Affinity labelling, 4.5 Examples of enzymes chymotrypsin, Pyruvate dehydrogenase complex, ATP synthase, Ribonuclease.
V	**Enzymes kinetics** 5.1 Factors affecting enzyme activity- 5.1.1 pH 5.1.2 Temperature 5.1.3 Substrate, product and enzyme concentrations 5.1.4 Activators and enzyme inhibition –reversible and irreversible 5.2 One-substrate reactions, two substrate reactions, 5.3 pre-steady state kinetics-MM equation, LB equation, significance of Km stopped flow technique, relaxation methods.
VI	**Regulation of Enzyme activity and Enzyme turnover** 6.1 Allosteric regulation, Zymogen activation, phosphorylation and dephosphorylation of enzymes involved in biochemical pathways. 6.2 Ligand binding and induced changes, theoretical models, MWC – KNF models and their usefulness. 6.3 Control of activities of single enzyme: Inhibitor molecules, substrate availability or cofactor and changes in covalent structure of enzyme, 6.4 Mechanism of enzyme degradation: lysozomal degradation, ubiquitation and other cellular processes of enzyme degradation. 6.5 Enyme turnover, Ks and Kd, correlation between the rates of enzyme turnover and structure and function of enzymes, significance of enzyme turnover.
VII	**Applications** 7.1 Clinical aspects and applications of enzymes, Enzymes in food analysis and processing
	Plant Biochemistry
VIII	**Seed germination:** 8.1 Biochemistry and physiology of seed germination and dormancy. 8.2 Energy production in plant cells and its control. Metabolism of sucrose and starch.
IX	**Mineral nutrition:** 9.1 Micro and macro elements, requirement, role, excess and deficiency disorders
X	**Photosynthesis:** 10.1 Chloroplasts, photosystem, mechanism CO2 fixation, C3 and C4 pathways, CAM

XI	**Nitrogen metabolism:**

	11.1 Nitrogen cycle, nitrogen fixation, assimilation of nitrate and ammonium ions, nitrogen transformation during development
XII	**Plant hormones:** 12.1 Types and role in plant growth and development. Auxins, gibberellins, cytokinins, ethylenes, abscisic acid, hormones in senescence and abscission.
XIII	**Secondary metabolites:** 13.1 Active principles in medicinal plants, Definition types, phenolics, flavanoids, lignins, terpenoids alkaloids, Gum, Pectins, 13.2 Pathways: shikkimic acid, mavelonate. Phytochemistry of the medicinally importance plants.
XIV	**Stress physiology:** 14.1 Response of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.
XV	**Introduction to Plant diseases:** 15.1 Pest types, symptoms, treatment, pesticides.
XVI	**PCC Techniques:** 16.1 Callus and cell suspension culture, Micropropogation, Conditioning of tissue culture. 16.2 Somatic cell hybridization, Haploid (anther) culture, Embryo culture, Protoplast fusion, Somatic embryogenesis, Somaclonal variations, Cybrids and Allopheny.

References:

1. Fundamentals of Enzymology by Price and Stevens
2. Enzymology by Dixon and Webb
3. Enzymes by Palmer
4. Enzymes and food processing- GG Birch, N Blackbrough (1981)
5. Introduction to food sciences and technology –GF Stewart and MA Amerine (1973) Academic Press
6. The Cell; Geoffery Cooper and Robert E; 5 Ed (HausmanSinauer Associates 2009)
7. Plant physiology, Salisbury and Ross (2007) CBS publishers and distributors.
8. Plant Physiology- Devlin
9. Plant Biochemistry- Dey
10. Introduction to Plant Biochemistry- T.W. Goodwin and E.L. Mercer

Title of the Course and Course Code	Biochemistry practical I (Analytical Biochemistry) (CHB4105)	Number of Credits : 04
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Recall and tabulate the reactions of biomolecules.	
CO2	Infer color tests and give examples of compounds and differentiate with their properties.	
CO3	Apply the knowledge to identify and estimate concentration of unknown compounds. Demonstrate methods to study and compare different techniques for qualitative and quantitative analysis.	
CO4	Organize, tabulate and represent information and studies with proper understanding.	
CO5	Select the exact techniques for estimation of unknown compounds. Judge the outcomes of color tests and readings.	
CO6	Design a method to study a particular biomolecule and develop a protocol to isolate and purify it.	

(Any Twelve Experiments) Credits: 4

Exp. No.	Experiment Title
1.	Isolation of Starch and characterization
2.	Isolation of milk casein by Isoelectric pH precipitation
3.	Isolation of Egg albumin and globulin
4.	Isolation of Cholesterol and lecithin from egg
5.	Identification of carbohydrate mixture with suitable tests
6.	Specific reactions for Carbohydrate
7.	Detection of amino acids from mixture (qualitatively and quantatively)
8.	Estimation of vitamin C
9.	Estimation of protein by Biuret method
10.	Estimation of protein by Lowry method
11.	Estimation of DNA/RNA by DPA method
12.	Estimation of protein by Bradford method
13.	Estimation of sugar by PSA method
14.	Estimation of sugar by DNSA method
15.	Extraction of fatty acid and Fat acid number, saponification and Iodine value
16.	Estimation of chlorophylls from leaf
17.	Estimation of any of the B vitamin
18.	Detection of phytochemicals from plants
19.	Estimation of amino acid by ninhydrine method
20.	Determination on alpha amino nitrogen of amino acid.
21.	Estimation of inorganic phosphorus by Fiske-Subbarow method

Title of the Course and Course Code	Practical Course II (Enzymology and Biophysical Techniques) (CHB4106)	Number of Credits : 04
Course Outcome (COs) On completion of the course, the students will be able to:		
CO1	Describe the principle, mechanism and role of reagents used in enzymology and biophysical techniques experiments.	
CO2	Estimate enzyme activity and predict the effect of various factors, activators and inhibitor on it. Articulate chemistry and state of amino acids.	
CO3	Carry out isolation, purification and detection of enzymes from different sources. Calculate the concentration of solutions.	
CO4	Demonstrate basic techniques like electrophoresis, chromatography, dialysis for identification and separation of biomolecules. Analyse the properties of amino acids and proteins.	
CO5	Decide the absorption maxima and measure the absorbance of the reactions using UV spectrophotometers.	
CO6	Plan an experiment, interpret and conclude its results. Prepare solutions of a given pH and concentration.	

Exp. No.	Experiment Title
	Enzymology
1.	Extraction, Isolation and detection of common enzyme (invertase/amylase/peroxidase/catalase)
2.	Assay of Enzyme activity and Specific activity
3.	To asses effect of substrate concentration (Vmax and Km) on enzyme activity.
4.	Effect of different parameters (temperature, pH, enzyme concentration) on enzyme activity
5.	To asses effect of activator and inhibitor on enzyme activity
6.	Effect of enzyme immobilization on its activity
7.	Enzyme isolation and purification (Any natural source).
	Biophysical Techniques
1.	Introduction to techniques: Use of pipettes (standardization), Concept of pH, preparation of buffer of desired pH and molarity and measurement of pH.
2.	pH metry: Acid base titration curves. Measurement of pKa of amino acids.
3.	Ion exchange chromatography/ Gel filtration chromatography
4.	Paper Chromatography/Thin layer chromatography
5.	Electrophoresis: Agarose/ 1D- PAGE
6.	UV and Visible Spectrophotometry: Absorption spectra, Verification of Lamberts-Beer's Law, absorption spectrum of proteins /amino acids/molecules
7.	Dialysis, reverse dialysis and membrane filtration

8.	Density gradient Centrifugation
9.	Estimation of micronutrients from food by Flame photometer (any two elements from Ca,K, Na etc)
10.	Demonstration of sophisticated analytical instrument working (GC/ GCMS/ LCMS/XRD / SEM)

F.Y. M.Sc. Semester II		
Title of the Course and Course Code	**Microbiology and Fermentation technology (CHB4201)**	**Number of Credits : 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Describe different types of microscopes, characteristics of different microorganisms, their structures and different sterilization techniques.	
CO2	Explain the effects of different physical and chemical agents on growth of microorganism.	
CO3	Predict and compare the types of plant and animal viruses along with their characteristics. Relate the role of microorganism in nitrogen metabolism.	
CO4	Examine different types of fermentation process and its application in strain improvement and isolation of industrial important microorganisms. Explain the cultivation of microorganism and their pathogenicity.	
CO5	Appraise the knowledge about production of enzymes, primary metabolites, antibiotics, pigments, sweeteners and beverages.	
CO6	Specify the composition of different media and optimum conditions for their growth and applications of fermentation techniques.	

Unit No.	**Title of Unit and Contents**
	Microbiology
I	**Microscopy:** 1.1 Introduction: Visualization of cells and sub cellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells 1.2 Phase contrast microscopy: principle, working and applications 1.3 Fluorescence microscopy: principle, working and applications 1.4 Techniques: specimen preparation Freeze Itching, Freeze fracture, pinch-off.
II	2.1 Classification of microorganisms: system of classification, identifying characters for classification, classification based on different requirements (eg. Nutrition, temperature, oxygen etc.)

	2.2 Characterization methods 2.3 Cell structure and components,
III	**Cultivation of bacteria:** 3.1 Types of growth media (natural, synthetic, complex, enriched, selective- definition with example) 3.2 Ppure culture methods (streak plate, spread plate, pour plate, stab culture, slant culture)**,** pure culture characteristics 3.3 Nutrition, physiology and growth of microbial cells, reproduction and growth, synchronous growth, continuous culture of microorganisms
IV	**Agents for growth control** 4.1 Control of growth by physicals and chemicals agents 4.2 Mutations by growth control agents and mutant characterization
V	**Host microbe interactions** 5.1 Terminology, events of infection, effect of enzyme and other factors 5.2 Endotoxins, exotoxins, capsular material. 5.3 Tissue affinity, resistance and immunity.
VI	**Microbial membrane transport:** 6.1 Phosphotransferase system, Group translocation 6.2 Specialized mechanism for transport of macromolecules (Virus membrane assembly and ribosome).
VII	**Viruses:** 7.1 Viruses of bacteria, plant and animal cells: Structure, classification and life cycle 7.2 Mycoplasma and viriods, diseases

VIII	**Role of Microbes** 8.1 Food spoilage and microbial food toxin
IX	**Nitrogen fixation:** 9.1 Nitrogen cycle in nature, symbiotic and non-symbiotic nitrogen fixation 9.2 Nitrogenase system, nitrate reductase
	Fermentation Technology
X	**Introduction to fermentation**: 10.1 Sterilization and its importance, maintenance of aseptic conditions 10.2 Design of fermenters, fermentation types, aeration and agitation
XI	**Fermentation types:** 11.1 Methods and parameters of cultivation of microorganisms, media for industrial fermentation
XII	**Characteristics and Techniques**: 12.1 Characterization of industrial microorganisms, strain improvement, use of auxotrophic mutants
XIII	**Product purification and treatment:** 13.1 Downstream processing, recovery and purification of fermentation products, effluent treatment
XIV	**Applications:**

	14.1 Fuels from microbes, microbial polymers and microbial steroid bio transformations
XV	**Products from microorganisms**: 15.1 Enzymes (Amylases, Proteases, Pectinases), Primary metabolites (Glu, vit B12), Antibiotics (Penicillin), Pigments (Carotenoids), Sweeteners, Beverages (wine, Beer)

References:

1. Microbiology, M.S. Pelczar, R.D. Reid, E.C.S. Chan, McGraw Hill, NewYork (1986).
2. General Microbiology (Vth Edition), R.Y. Stanier, Prentice Hall (1986)
3. Biology of Microorganisms by Brocks
4. Introductory Microbiology, F.C. Ross, Charles Merril Publication (1983).
5. Principles of Fermentation technology, PF Stanbury, A Whitaker, SJ Hall (2008)
6. Molecular biology and biotechnology- edited by JM Walker and FB Gingold, Royal society of chemistry (1988)
7. Industrial Microbiology – Casida
8. General Microbiology Stainer R.Y. et al (1987) 5th Ed., Macmillan Press Ltd. London
9. Biotechnology by B.D. Singh

Title of the Course and Course Code	**Metabolism (CHB4202)**	**Number of Credits : 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Recall the structure of metabolic intermediates and names of enzymes.	
CO2	Explain and illustrate the steps in biochemical pathways along with their regulations.	
CO3	Apply knowledge of genetics and enzymology to understand the formation of specific intermediates in biochemical pathways and inborn errors of metabolism.	
CO4	Classify the types of metabolic reactions and outline the concepts of bioenergetics.	
CO5	Justify varied conditions required for the occurrence of desired metabolic reactions.	
CO6	Rearrange and write the correct sequence of fates of metabolic products based on the specified physiological conditions.	

Unit No.	**Title of Unit and Contents**
I	**Introduction of Metabolism and Bioenergetics:** 1.1 Anabolism, catabolism, precursors of metabolism and its significance. 1.2 Basic laws of thermodynamics, standard free energy, enthalpy,

	entropy 1.3 High energy compounds, structure and significance of ATP
II	**Carbohydrate metabolism:** 2.1 Carbohydrate Catabolism: Glycolysis, Gluconeogenesis, Pentose Phosphate Pathway, feeder pathways of glycolysis, fates of pyruvate under aerobic and anaerobic conditions. TCA/Kreb's cycle, Glyoxylate cycle, Uronic acid pathway, Cori's cycle. Pasture effect. 2.2 Carbohydrate biosynthesis: Biosynthesis of starch, sucrose, cellulose, Glycogen. Reaction intermediates, enzymes, energetics & regulation of all the pathways. 2.3 Inborn errors of carbohydrate metabolism.
III	**Lipid Metabolism:** 3.1 Fatty acid catabolism: Beta oxidation of saturated and unsaturated fatty acids, odd and even number fatty acids. Reaction intermediates, enzymes, energetic & regulation of all the pathways. 3.2. Lipid biosynthesis: Biosynthesis of fatty acids, fatty acid synthase complex, Triacylglycerol, Phospholipids, Ketogenesis, cholesterol biosynthesis. Reaction intermediates, enzymes, energetic & regulation of all the pathways. 3.3. Inborn errors of lipid metabolism
IV	**Biological oxidation:** 4.1. Structure of mitochondria, features of electron carriers, Electron transport chain in mitochondria and oxidative phosphorylation-chemiosmosis hypothesis. 4.2 ATP synthase complex and its mechanism. 4.3. Inhibitors and uncouples of ETC and OP
V	**Amino acid Metabolism:** 5.1. Amino acid degradation: Amino acid oxidation and production of Urea. Reaction intermediates, enzymes & regulation of all the pathways. Significance of Transamination, oxidative deamination, Decarboxylation reactions of amino acids. 5.2 Degradation of amino acids leading to formation of Pyruvate, Acetyl CoA, α Keto glutarate, Succinyl CoA, Oxalo acetate. Reaction intermediates, enzymes & regulation of all the pathways. 5.3 Amino acid biosynthesis: Synthesis of Glutamate, Glutamine, Proline, Arginine, from α ketoglutarate. Reaction intermediates, enzymes & regulation of all the pathways. 5.4. Synthesis of Serine, Glycine, Cystine, from 3 Phosphoglurate 5.5. Synthesis of amino acid using oxaloacetate and pyruvate as precursor 5.6. Synthesis of Aromatic Amino acids. 5.7. Inborn errors of amino acid metabolism.
VI	**Specialized Molecule derived from Amino acids:**

	6.1 Creatine, Glutathione, Porphyrins, Biological Amines, Nitric oxide. 6.2 Gamma glutamyl cycle.
VII	**Nucleotide metabolism:** 7.1 Degradation of Purines and Pyrimidines. Reaction intermediates, enzymes & regulation of pathway 7.2 Denovo and salvage pathways of Purine and Pyrimidine biosynthesis. 7.3 Reaction intermediates, enzymes & regulation of pathway 7.4 Inborn errors of Nucleotide metabolism

References

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

Title of the Course and Course Code	**Molecular Biology (CHB4203)**	**Number of Credits : 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Describe the general properties of viral, prokaryotic and eukaryotic genomes, structural organization of chromosomes and recall basic concepts related to molecular biology.	
CO2	Explain the molecular mechanism of replication, DNA repair, transcription, translation and related molecular processes in prokaryotes and eukaryotes.	
CO3	Apply fundamental understanding of molecular biology to predict the role of different inhibitors, proteins, enzymes involved in processes. Outline the molecular biology concepts and illustrate the processes.	
CO4	Analyse molecular events in prokaryotic and eukaryotic organisms and compare them. Identify events involved in RNA processing and regulation of gene expressions in prokaryotes and eukaryotes.	
CO5	Justify and review the molecular processes in prokaryotes and eukaryotes. Summarize post-translational modification events and protein targeting mechanisms.	
CO6	Compile the molecular processes in prokaryotes and eukaryotes and specify gene regulation mechanism. Review and prepare a summary of scientific topics/papers related to subject and professionally present literature articles.	

Unit No.	Title of Unit and Contents
I.	**Molecular structure of Genes and Chromosomes:** 1.1. Definition and organization of viral, prokaryotic and eukaryotic genomes, Structural organization of Eukaryotic chromosomes 1.2. Structure of chromatin, nucleosome, Histones, chromatin organization, higher order organization.
II.	**DNA Replication:** 2.1. Chemistry of DNA synthesis, Enzymes involved in DNA synthesis e.g. topoisomerase, helicase, Ligase, DNA polymerase – types, subunits 2.2. Mechanism of Replication in Prokaryotes and Eukaryotes. Okazaki fragments, Origin of replication Replication fork. 2.3. Inhibitors of DNA synthesis.
III.	**DNA Repair:** 3.1. Repair of DNA damage – Direct reversal of DNA damage 3.2. Replication errors and their repair – Mismatch Repair, Base Excision mechanism, Nucleotide Excision mechanism, 3.3. Translesion DNA synthesis, SOS response 3.4. Defective repair system and diseases, Ames test
IV.	**Homologous Genetic Recombination:** 4.1. Recombination pathways, Holliday model, DSB repair model 4.2 Homologous recombination protein machines: RecBCD, Rec A, Ruv AB, RuvC. 4.3 Mobile genetic elements.
V.	**Transcription:** 5.1. Mechanism in prokaryotes: RNA polymerases - subunits, promoters, initiation, elongation and termination of Transcription-Rho dependent and independent. 5.2. Mechanism in Eukaryotes: RNA pol I, II, III, subunits, promoters for RNAP I, II, III, Transcription factors, Transcription process 5.3. Inhibitors of transcription.
VI.	**Post-transcriptional modification of RNA:** 6.1. Types of RNA processing, 5' capping and 3' poly A tailing: mechanism and functions 6.2. Chemistry of RNA splicing: Type of Introns, Types of Splicing pathways: The Spliceosome machinery, Self-splicing, Alternative splicing 6.3. RNA editing
VII.	**Translation:** 7.1. Features of Translation components: mRNAs – structure, ORF; tRNAs – structure, adaptor hypothesis; Aminocyl tRNAsynthetase – attachment of amino acids; Riobosome, Genetic code 7.2. Mechanism in Prokaryotes and Eukaryotes: Intiation, Elongation, Termination

	7.3 Post translational modifications, Inhibitors of protein synthesis.
VIII.	**Protein Targeting and Degradation:** 8.1. Signal hypothesis, signal sequences, glycosylation 8.2. Targeting of protein to ER, mitochondria, chloroplast, lysosomes, Peroxisomes 8.3. Protein degradation.
IX.	**Regulation of Gene Expression:** 9.1. Principles of Gene regulation: regulation of gene expression in Bacteria, phage lambda, DNA binding motifs, 9.2. Gene regulation in Eukaryotes: chromatin remodeling: process, enzymes 9.3. Introduction to epigenetic regulation.

References:

1. Biochemistry (III/IV/V/VI edition, 2008) L. Stryer, WH Freeman and Co.
2. Molecular biology of the gene (V edition, 2004) J D Watson, Person education Inc.
3. Molecular Cell Biology (7th edition.2013) by Harvey Lodish et al.
4. Molecular biology of the cell (2008) B. Alberts, Garland Pub. In., NY
5. Genes X (2010), B. Lewin, John Wiley and sons, NY.

Title of the Course and Course Code	**Physiological Biochemistry (CHB4204)**	**Number of Credits : 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Recall the terminologies, location, and functions of human body parts. Describe in detail physiology and anatomy with special functions.	
CO2	Discuss the working mechanism, conditions, processes of different organs and regulation with respect to functioning of other organs. Implement clinical data in normal and disease conditions of specific organs.	
CO3	Demonstrate the working and processes in body parts at new or different situations. Apply the knowledge to identify the situation with biochemical parameters and execute methods to study clinical prospective.	
CO4	Identify processes with respect to physiology and anatomy of the organs. Explain the effects and role of molecules in different tissues and cells with respect to specific function.	
CO5	Judge the symptoms, implement exact techniques used in study and diagnosis of diseases and describe the path.	
CO6	Develop the skill to read, understand diagnostic reports and identify the future process.	

Unit No.	Title of Unit and Contents
I.	**Blood components and blood clotting:** 1.1 Blood composition, plasma proteins and their diseases. 1.2 Clotting factors, mechanism of coagulation role of vitamin K in clotting process. Conditions that cause excessive bleeding in humans, 1.3 Haematopoiesis, bone marrow stem cell.
II.	**Respiration** 2.1 Mechanics and regulation of respiration, pulmonary and alveolar ventilation and its control, 2.2 Physical principles of gaseous exchange a transport of respiratory gases, respiratory mechanism of acid-base balance, 2.3 Regulation of acid-base balance: acid-base buffers. Nervous and chemical control of respiration. 2.4 Hypoxia acclimatization, cyanosis, dyspnoea, asphyxia, abnormal respiration. Pulmonary function tests.
III.	**Digestion:** 3.1. Anatomy of digestive system, 3.2. Secretion, regulation of secretion, composition and functions of saliva, gastric, pancreatic and intestinal juices and bile. 3.3. Gastro-intestinal hormones. 3.4. Digestion, absorption and transport of carbohydrates, proteins, lipids, nucleic acids and vitamins. 3.5. Malnutrition and malabsorbtion. Intestinal stem cells
IV.	**Liver:** 4.1. Liver – anatomy, physiological functions. 4.2. Detoxification mechanisms. Liver function tests 4.3. Liver disorders: - hepatitis, cirrhosis, Jaundice: etiology and symptoms. 4.4. Liver stem cells
V.	**Kidney:** 5.1. Anatomy, physiological functions, 5.2. kidney function tests, diseases/disorder,
VI.	**Reproduction:** 6.1. Anatomy of male and female reproductive system. 6.2. Functions of reproductive organs.
VII.	**Muscles (Skeletal muscle, cardiac and smooth muscles):** 7.1 Morphology, ultra-structural organization, protein components of myofibrils- Actin, Myosin, Troponin, Tropomyosin, molecular organization of thick and thin filament Proteins in muscles other than muscle filaments, mechanism of muscle contraction, 7.2 Metabolism of muscles. Contraction and relaxation cycle of muscle and regulation.

VIII.	**Cytoskeleton components, chemotaxis and cell motility:** 8.1 Microfilaments (Actin and Myosin) 8.2 Microtubules (cilia and flagella of eukaryotic Cells) 8.3 Intermediate filaments, (molecular composition of cytoskeleton) 8.4 Chemotaxis in prokaryotes and eukaryotes.
IX.	**Nervous tissue:** 9.1 Structure and various components of neuron, their types and functions 9.2 Creation and propagation of nerve impulse. Generation of action potential 9.3 Types of channels in neurons. cholinergic receptors, electroplaxes as a source of acetyl choline receptor and 9.4 Nerve poisons 9.5 Neuronal stem cells and transcription factor
X.	**Biochemistry of vision:** 10.1 Structure of eye, lens, and retina, photoreceptor cells (rods and cones), 10.2 Perception of light, primary events in visual excitation, cyclic GMP 10.3 Role of various proteins of eye, generation of nerve impulse, color vision. 10.4 Visual stem cells.
XI.	**Biochemistry of sense of taste, smell and hearing:** 11.1 Structure of taste buds and olfactory cells, role of cells in perception of taste (various chemical groups) and smell. Olfactory stem cells. 11.2 Structural components of ear, receptors of sound wave, perception of sound mechanism of body balance
XII.	**Biochemistry of sense of touch:** 12.1 Structural components of skin and touch receptors, types of touch receptors 12.2 Epidermal stem cells

References:

1. Text book of physiology- Guyton
2. Principles of neural science Kandel ER, Schwartz JH, Elsevier, N.Holland, NY
3. Neurobiology, Shepherd GM, Oxford Univ. Press
4. Nerve and muscle excitation Junge D, Sinauerassoc, Sanderland, mass
5. Biochemistry, L Stryer, Freeman and Co, NY
6. Biochemistry, Zubay, Addison Wesley and Co
7. Biochemistry, L Stryer, Freeman and Co, NY
8. Biochemistry, Zubay, Addison Wesley and Co.
9. Textbook of Physiology, Guyton

10. Physiology, Berne and Levy
11. Harper's Biochemistry- 27th edition
12. Text book of Human Biochemistry- Ed. G. P. Talwar

Title of the Course and Course Code	**Practical Course III (Microbiology and Special Experiments) (CHB4207)**	**Number of Credits : 04**
Course Outcome (COs) On completion of the course, the students will be able to:		
CO1	Recall different types of sterilization techniques and its importance for cultivation and preservation of microorganisms.	
CO2	Predict the effect of U.V. radiations on growth of microorganisms and study growth curve. Articulate different techniques for isolation of microorganisms and describe the concept of BOD and COD.	
CO3	Use different techniques to isolate microorganism and demonstrate antibiotic sensitivity assay. Execute methods to study and compare the adulteration and pasteurization in milk samples.	
CO4	Analyse the basic phytochemicals present in plants with their role and identify them by performing qualitative and quantitative tests.	
CO5	Evaluate activities of enzymes from different sources.	
CO6	Perform experiments for isolation and characterization of microorganisms, proteins and other biomolecules from natural sources.	

Exp. No.	**Experiment Title**
	Microbiology
1.	Media preparation, pour plate, spread plate and streak plate techniques and Total viable count determination
2.	Sterilization: Steam, Dry heat and filter and Preservation of bacterial culture
3.	Microscopic examination (motility, monochrome staining and gram staining).
4.	Detection of common enzyme (amylase, caseinase, catalase activity)
5.	Phosphatase test and Methylene blue reduction test (MBRT) for the quality of milk
6.	Growth curve analysis of *E. coli*
7.	Ultraviolet irradiation and survival curve
8.	Antibiotic Sensitivity Test
9.	Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)

	Special Experiments (any 6)
1	Extraction, isolation of sub-cellular organelles with respect to marker enzyme and its activity.
2.	Extraction of phytochemicals, screening (qualitative) and quantitative measurements
3.	Extraction of antioxidant from natural source and its activity.
4.	Identification of functional groups in a compounds using IR (Working and interpretation of IR)
5.	Activity of Acetyl choline esterase
6.	Extraction of protein from natural source and nitrogen estimation by Kjeldahl method
7.	Extraction of lip soluble pigments/ Extraction of protein and molecular weight determination
8.	Essential oil extraction and characterization

Title of the Course and Course Code	**Practical Course IV (Clinical Biochemistry and Basics of Cell Culture) (CHB4208)**	**Number of Credits : 04**
Course Outcome (COs) **On completion of the course, the students will be able to:**		
CO1	Recall the basic aspects of clinical biochemistry and cell culture. Describe physiology and anatomy of organs with their special functions.	
CO2	Discuss different principles behind clinical biochemistry experiments and animal cell culture techniques.	
CO3	Carry out the experiments and interpret the results. Calculate cell count and predict the viability.	
CO4	Analyse the experimental data and relate it with clinical parameters.	
CO5	Compare the experimental values with normal values and justify the deviations. Review basics of cell culture, its importance and perform tasks relevant to cell culture.	
CO6	Plan and perform experiments related to clinical biochemistry and animal cell culture techniques .	

Exp. No.	Experiment Title
	Clinical Biochemistry
I	**Experiment for kidney function test**. A. Urine analysis. B. Serum Creatinine C. Urea estimation D. BUN
II	**Experiment for liver function test.** A. SGOT B. SGPT C. ALP D. Albumin E. Proteins F. Bilirubin G. Cholesterol
III	**Blood sugar estimation**. A. Glucose oxidase and peroxidise method B. Folin-Wu method C. Glucose tolerance test
IV.	**Different enzymes studies** A. LDH and its isozymes B. serum amylase
	Cell culture
V	Basics of cell culture: Acquaintance with cell culture laboratory, Culture place: culture cubical P1 to P4; Laminar flow system. Preparatory techniques: Washing of glassware, dry and steam sterilisation. Maintenance of aseptic conditions, Sterilization techniques, Media preparation: Filter sterilization, and media storage. Serum inactivation.
VI	Culturing and sub-culturing of animal cell lines and its maintenance
VII	Cell counting, viable cell count, trypsinization, cryopreservation and revival.
VIII	Culturing and sub-culturing of callus in different media its characterization
IX.	Chick embryo fibroblast culture