

STUDY CENTRE FOR BIOCHEMISTRY
DEPARTMENT OF CHEMISTRY

COURSE STRUCTURE

for

(M.Sc. Biochemistry)
Four Semesters (Two Year)

Programme

Based on

Choice Based Credit System (CBCS)
(As per Ordinance-14)

I & II Semester 2020-21
III & IV Semester 2021-22



AWADHESH PRATAP SINGH UNIVERSITY, REWA (M.P.)

Semester Course of M.Sc. Biochemistry

Programme	: M.Sc. Biochemistry
Programme Code	: 78
Duration	: 4 Semester (Two Year)
Eligibility	: Graduation with Chemistry, Biotechnology, Microbiology and Biochemistry as a subject.
Age Limit	: No age limit
Admission Procedure	: The admission will be done as per merit of qualifying examinations

PROGRAMME OBJECTIVES & STRUCTURE

PO #	PROGRAMME OUTCOME
PO 1	Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, check out the degree to which these assumptions are accurate and valid, and look at our ideas and decisions (intellectual, organizational, and personal) from different Perspectives.
PO 2	Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and Technology.
PO 3	Social Interaction: Elicit views of others, mediated is agreements and help reach conclusions in group settings.
PO 4	Effective Citizenship: Demonstrate empathetic social concern and equity-centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
PO 5	Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
PO 6	Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
PO 7	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.

PROGRAMME SPECIFIC OUTCOME

PSO #	PROGRAMME SPECIFIC OUTCOME
PSO 1	To gain essential knowledge and skills to pursue a career in research, industry and in academic set up.
PSO 2	To integrate and apply the techniques in Analytical biochemistry, Clinical biochemistry, Microbiology, Molecular biology and Bioinformatics.
PSO 3	To understand the depth of scientific knowledge in the broad range of fields including Cell biology, Metabolism, Pharmaceutical Biochemistry, Genetics, Nutritional Biochemistry, Immunology and Enzymology.
PSO 4	Provide the biochemical basis of human diseases, protein structure and conformation, non-invasive diagnostics, biochemical pathway regulation and drug development and synthesize this knowledge and apply the same for multitude of laboratory applications.

Course Outcome (COs)

S.No.	Course Name	Course Code
Semester-I		
101	Bio-organic Chemistry	BCH-101
Course Outcome		
C01	Understand occurrence and classification of carbohydrate	
C02	Understand definition and classification of lipids	
C03	Discuss classification and properties of proteins	
C04	Understand nature of genetic material of nucleic acid	
C05	Explain classification of porphyrins	
102	Cell Biology	BCH-102
Course Outcome		
C01	Understand the structures and purposes of basic components	
C02	Explain molecular organization and biogenesis and function mitochondria	
C03	Discuss Bio-membrane transport	
C04	Understand cell cycle	
C05	Discuss molecular organization and nucleus	
103	Human Physiology and Endocrinology	BCH-103

Course Outcome		
C01	Understand composition of blood and blood coagulation	
C02	Understand digestive system	
C03	Understand excretory system	
C04	Understand structure of skeletal muscles	
C05	Discuss hormonal action in human body	
104	Biophysical Chemistry & Techniques	BCH-104
Course Outcome		
C01	Understand physical properties and structure of water	
C02	Understand basic principle of centrifugation	
C03	Explain thermodynamics	
C04	Understand general principle of chromatography	
C05	Learn basic concepts of spectroscopy	
105	Lab I: Bio-organic Chemistry and Biophysical Chemistry & Techniques	BCH-105
Course Outcome		
C01	Understand qualitative analysis	
C02	Discuss cell fractionation	
C03	Understand colorimetric and spectrophotometric analysis	
C04	Understand chromatography analysis	
C05	Demonstration of electrophoresis	
106	Lab II: Human physiology & Endocrinology and cell biology	BCH-106
Course Outcome		
C01	Determine Hb% in blood samples	
C02	Learn microscopic observations	
C03	Understand blood film preparation and identification of cells	
C04	Explain isolation of cell organelles	
C05	Estimation of proteins from animal cell material	
Semester-II		
201	Enzymology	BCH-201
Course Outcome		
C01	Understand nomenclature and classification of enzymes	
C02	Discuss co-enzyme and cofactors	
C03	Explain multi enzyme and allosteric enzymes	
C04	Understand mechanism of catalysis	
C05	Understand general mechanisms of enzyme regulation	

202	Microbial Biochemistry	BCH-202
	Course Outcome	
C01	Understand classification of microorganisms	
C02	Explain general organization of bacterial cells and bacteriological media	
C03	Explain role of microorganisms in food spoilage	
C04	Understand viruses structure	
C05	Discuss sterilization and disinfection	
203	Biostatistics and Computational Bioinformatics	BCH-203
	Course Outcome	
C01	Explain introduction of Biostatistics	
C02	Understand probability	
C03	Understand correlation and regression analysis	
C04	Discuss computer fundamentals	
C05	Understand internet and its applications	
204	Molecular Biology	BCH-204
	Course Outcome	
C01	Understand chemical nature of genetic materials	
C02	Understand transcription mechanism	
C03	Explain bacterial recombination	
C04	Understand DNA binding properties	
C05	Discuss Mutation types	
205	Lab I: Enzymology and Molecular Biology	BCH-205
	Course Outcome	
C01	Understand Enzyme assay	
C02	Determine specific activity of enzymes	
C03	Estimation of DNA	
C04	Estimation of RNA	
C05	Understand electrophoresis of genomic DNA	
206	Lab II: Microbial Biochemistry and Bioinformatics	BCH-206
	Course Outcome	
C01	Preparation of culture media	
C02	Understand VRDL test	
C03	Explain drug and target databases	
C04	Explain protein structure database	
C05	Understand gram staining	

Semester-III		
301	Metabolism and Plant Biochemistry	BCH-301
	Course Outcome	
C01	Understand bioenergetics and carbohydrate metabolism	
C02	Discuss lipid metabolism	
C03	Explain nucleic acid metabolism	
C04	Discuss protein metabolism	
C05	Understand photosystem	
302	Immunology	BCH-302
	Course Outcome	
C01	Explain introduction of immune system	
C02	Understand effect or mechanism of immunity	
C03	Understand antigen	
C04	Understand transplantation immunology	
C05	Understand immunity to infection and immunological techniques	
303	Clinical Biochemistry	BCH-303
	Course Outcome	
C01	Understand LFT and KFT	
C02	Understand disorders of metabolisms	
C03	Understand Biochemical aspects of Hematology	
C04	Explain mechanism of drug action	
C05	Discuss disorders of erythrocyte metabolism	
304	Genetic Engineering	BCH-304
	Course Outcome	
C0 1	Understand laws of Mendels	
C0 2	Understand Recombinant DNA Technology	
C0 3	Explain Tissue Culture	
C0 4	Discuss population genetics	
C0 5	Understand Gene Techniques	
305	Lab I: Genetic Engineering and	BCH-305
	Course Outcome	
C01	Isolation of genomic DNA	
C02	Understand Western Blotting	
C03	Understand Hematology	

C04	Understand Assay of serum marker enzymes	
C05	Understand Blood and Urine analysis	
306	Lab II: Plant Biochemistry and Immunology	BCH-306
Course Outcome		
C01	Estimation of plant lipids and carbohydrates	
C02	Understand Mitosis	
C03	Understand single immune diffusion	
C04	Understand blood grouping	
C05	Understand Sandwich ELISA	
Semester-IV		
401	Pharmaceutical Biochemistry	BCH-401
Course Outcome		
C01	Discuss Pharmacokinetics	
C02	Understand pharmacodynamics and drug target	
C03	Explain regulatory affairs and pharmacovigilance	
C04	Understand Intellectual property rights	
C05	Understand pharmaceutical associated toxicity	
402	Biochemical Toxicology and Clinical Research	BCH-402
Course Outcome		
C01	Understand nutrition toxicology and immune toxicology	
C02	Explain pre clinical toxicology	
C03	Discuss clinical research	
C04	Discuss biological testing and bioassays during clinical trials	
C05	Understand bioavailability and bioequivalence studies	
403	Food and Nutritional Biochemistry	BCH-403
Course Outcome		
C0 1	Gain detail understanding of Nutraceuticals; use of nutraceuticals in traditional health sciences from intestine in to blood it affect the body	
C0 2	Understanding of factors that affect food digestion and absorption, Bioavailability and Bioequivalence concept	
C0 3	Understanding of importance of food for existence of life	
C0 4	Learn how to processing and loss of nutrients take place during processing and cooking	
C0 5	Recommended dietary allowances for different categories of human	

	beings	
404	Industrial Biochemistry	BCH-404
Course Outcome		
CO 1	Gain detail understanding of Techniques of fermentation systems, Role of Fermentation, Biochemistry of Fermentation for industrial product development	
CO 2	Understanding of commercial enzyme in beverages and their associated biochemical process	
CO 3	Understanding of importance of food, Food additives, artificial food additives and their biochemistry	
CO 4	Learn how to processing are involve in prebiotics and probiotics production in industry	
CO 5	Learning in the development and production of different bioactive product for human welfare	
405	La I: Pharmaceutical Biochemistry and Industrial Biochemistry	BCH-405
Course Outcome		
CO1	Qualitative analysis of lipids	
CO2	Saponification value of fats	
CO3	Drug stability and solubility analysis	
CO4	Quality validation of process	
CO5	Standard operating procedure updating and review	
406	Lab II: Biochemical Toxicology & Clinical Research and Nutrition Biochemistry	BCH-406
Course Outcome		
CO1	Determination of metal content in samples	
CO2	Understand Food processing and fortification test	
CO3	Understand BMR calculation	
CO4	Estimation of Minerals quantitative test	
CO5	Understand Enzymes related toxicity testing	

**M.Sc. BIOCHEMISTRY
(FOUR SEMESTER COURSE)
SCHEME OF EXAMINATION
(CBCS Syllabus)
(Effective from 2020-21)**

Semester-I

Paper	Course	Title of the Paper	Credit	Marks
Paper I	BCH-101	Bio-organic Chemistry	4	100(60+40)
Paper II	BCH-102	Cell Biology	4	100(60+40)
Paper III	BCH-103	Human Physiology and Endocrinology	4	100(60+40)
Paper IV (Generic Elective)	BCH-104	Biophysical Chemistry & Techniques	4	100(60+40)
Practical (Lab I + Lab II)			4	200(100+100)
Comprehensive Viva Voce			4*	100
Total			24	700

*Virtual Credit

Semester-II

Paper	Course Code	Title of the Paper	Credits	Marks
Paper I	BCH-201	Enzymology	4	100(60+40)
Paper II	BCH-202	Microbial Biochemistry	4	100(60+40)
Paper III	BCH-203	Molecular Biology	4	100(60+40)
Paper IV (Generic Elective)	BCH-204	Bio statistics and Computational Bioinformatics	4	100(60+40)
Practical (Lab I + Lab II)			4	200(100+100)
Comprehensive Viva Voce			4*	100
Total			24	700

*Virtual Credit

Semester-III

Paper	Course Code	Title of the Paper	Credits	Marks
Paper I	BCH-301	Metabolism and Plant Biochemistry	4	100(60+40)
Paper II	BCH-302	Immunology	4	100(60+40)
Paper III (Discipline Elective)	BCH-303	Clinical Biochemistry	4	100(60+40)
Paper IV (Generic Elective)	BCH-304	Genetic Engineering	4	100(60+40)
Practical (Lab I + Lab II)			4	200(100+100)
Comprehensive Viva Voce			4 *	100
Total			2 4	700

*Virtual Credit

Semester-IV

Paper	Course Code	Title of the Paper	Credits	Marks
Paper I	BCH-401	Pharmaceutical Biochemistry	4	100(60+40)
Paper II	BCH-402	Biochemical Toxicology and Clinical Research	4	100(60+40)
Paper III (Discipline Elective)	BCH-403	Food and Nutrition Biochemistry	4	100(60+40)
Paper IV (Generic Elective)	BCH-404	Industrial Biochemistry	4	100(60+40)
Practical (Lab I + Lab II)			4	200(100+100)
Comprehensive Viva Voce			4*	
Total			24	700

*Virtual Credit

Grand Total Marks M.Sc. (Ist to IVth Sem) = **2800**

M.Sc. BIOCHEMISTRY
Semester-I
Paper-I
BCH-101: Bio-organic Chemistry

COURSE OBJECTIVES

The objective of this paper is to provide students with a basic understanding of

- The physical and chemical properties of the components of living things.
- The principles of bioenergetics.
- Structural, chemical biology and three-dimensional construction of macromolecules (carbohydrates, proteins, nucleic acids and lipids).
- Functional properties and importance of carbohydrates, proteins, nucleic acids and lipids.

UNIT-I

Carbohydrate- Occurrence, Classification, structures, properties, and biological importance of mono, oligo and polysaccharide, stereo isomerism, optical isomerism and reaction of aldehyde and ketone groups of sugars, mutarotation, ring structure of mono saccharides.

UNIT-II

Lipids- Definition and classification, structure, properties of fatty acids and prostaglandins, classification distribution and biological importance of fats, waxes compound and derived lipids, physical and chemical properties of fats, steroids, cholesterol and bile acids, characterization of fats.

UNIT-III

Proteins- Introduction, classification and properties of amino acids, Biologically active peptides, classification based on solubility, shape composition and function structure and properties of peptide and proteins. Protection and deprotection of N-terminal and C-terminal ends functional groups in the side. Chain denaturation and Renaturation of protein. Determination of amino and sequences of a polypeptide chain.

UNIT-IV

Nucleic acid- Nature of genetic material, evidences that DNA is the genetic material, Structure & constitution of nucleic acids (purines, pyrimidines, nucleoside) features of double helix DNA, structure, types, composition, of RNA & DNA, biological role of DNA & RNA. Nucleoproteins, central dogma of molecular biology.

UNIT-V

Porphyryns- Porphyrins Nucleus and classification of Porphyrins. Important metalloporphyrins. Biosynthesis and degradation of porphyrins. Bile pigments chemical nature and their physiological significance.

Books Suggested

1. Biochemistry by L. Stryer, W.H. Freeman and Co. 5th 2002.
2. Fundamentals of Biochemistry by Voet and Voet, John Wiley and sons NY (2002).
3. Lehninger's Principle of Biochemistry by David L. Nelson and Michael M. Cox. W. H. Freeman; 4th edition (2004).
4. Text Book of Biochemistry with clinical correlation by Thomas .M. Devlin, John Wiley-Liss, Hoboken N. J. publishers (2006).
5. Biochemistry by Zubey, GL WCB Publishers.

COURSE OUTCOMES

- To understand the concepts of preparation of buffers, molarity, normality, ionization, molality.
- The understanding of different types of chemical bonding, molecular machinery of living cells, principles that govern the structures of macromolecules and their participation in living system.
- To identify with the classification and structural properties of carbohydrates, proteins, nucleic acids and lipids, glycoproteins and glycolipids and their significance in biological systems.
- By the end of the course, the students will be able to demonstrate advanced knowledge and understanding of aspects of physical and chemical properties of aqueous solutions, concepts of free energy.

M.Sc. BIOCHEMISTRY

Semester - I

Paper-II

BCH-102: Cell Biology

COURSE OBJECTIVES

- To equip students with a basic knowledge of the structural and functional properties of cells
- To examine properties of differentiated cell systems and tissues.
- Aspect of cell cycle and cell death.
- To introduce the fascinating mechanism of cell signaling along with brief overview on developmental biology.
- To provide thorough knowledge on classical genetics.

UNIT-I

Cell, cell wall and Extracellular Matrix (ECM), composition, cellular dimensions, Evolution, Organisation, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria, cyanobacteria, mycoplasma and prions.

UNIT-II

Molecular organisation and biogenesis and function Mitochondria, endoplasmic reticulum, golgi apparatus, plastids chloroplast, Leucoplast, centrosome, lysosome, ribosome, peroxisome, Nucleus and nucleolus. Endo membrane system, concept of compartmentalization.

UNIT-III

Bio-membrane Transport- Physiochemical properties of cell membranes. Molecular constituents of membranes, asymmetrical organisation of lipids and proteins. Solute transport across membrane - Fick's law, simple diffusion, passive-facilitated Diffusion, active transport- primary and secondary group translocation, transport ATPases, Membrane transport in bacteria and animals Transport mechanism- mobile carriers and pores mechanisms. Transport by vesicle formation, endocytosis, exocytosis, cell respiration.

UNIT-IV

Cell cycle- Cell division by mitosis and meiosis, Comparison of Meiosis and Mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, apoptosis, cell cycle checkpoints.

UNIT - V

Molecular organization and Nucleus, nucleolus, composition, properties, envelope, structure properties, stability, cleavage, functions and types of chromosomes, chromosomal arrangement, Chromosome staining, chromosomal observation aberration, chromatin, structure, heterochromatin, heterochromatin and polychromatin.

Books Suggested

1. Cell Biology Protocols by Harris, R., Graham, J. & Rickwood, D.
2. Color Atlas of Biochemistry by Koolman, J. & Roehm, K. H.
3. Molecular Biology of The Cell - Bruce Alberts.
4. Molecular cell Biology by Harvey Lodish. W. H. Freeman; 6th edition (2007).
5. Cell Biology Protocols by Harris, R., Graham, J. & Rickwood, D.
6. Current Protocols in Protein Science (All Vol) John Wiley & Sons.
7. The World of the cell by Becker, Kleinsmith and Harden Academic Internet Publishers; 5th edition (2006).
8. The Cell: A Molecular Approach, Fourth Edition by Geoffrey M. Cooper and Robert E. Hausman.
9. Cell and Molecular Biology by concepts and experiments by Gerald Karp (2005) John Wiley sons & Inc.

COURSE OUTCOMES

- Students will understand the structures and purposes of basic components of cell, especially membranes and organelles.
- Appreciate the cellular components underlying cell division along with a deep insight to cell division, cell death and uncontrolled cell division.
- Students will learn the basic principles of inheritance and patterns of heredity.
- Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.

M.Sc. BIOCHEMISTRY

Semester-I

Paper-III

BCH-103: Human Physiology and Endocrinology

COURSE OBJECTIVES

- The course is designed to assist the students to learn and understand fundamental concepts and principles of respiratory, renal, digestive, cardiovascular, muscle and neuro physiology.
- To develop a vocabulary of appropriate terminology to effectively communicate information related to anatomy and physiology.
- To study the interrelationships within and between anatomical and physiological systems of the human body.
- To understand the basic mechanisms of homeostasis by integrating the functions of cells, tissues, organs, and organ systems.
- To study the role and mechanism of endocrine system in metabolism, regulation of normal homeostatic condition of body and other physiological functions.

UNIT-I

Blood- Composition of blood, structure & functions of formed elements, plasma and its constituents & function of plasma proteins.

Blood coagulation- Mechanism & regulation, fibrinolysis, role of Hb in oxygen & carbon dioxide transports or 2,3 Dpce, Bohr effect and chloride shift.

UNIT-II

Digestive system- Composition, function & regulation of digestive juices, Digestion, absorption of carbohydrate, proteins and fats of nucleic acids, minerals and vitamins.

UNIT-III

I. Excretory system- Structure of nephron, mechanism of urine formation, clearance values, composition of urine, Homeostasis & acid- base balance & imbalance.

II. Structure of neuron conduction of impulses across the nerve fibre salutary conduction. Synaptic transmission, role of neurotransmitter.

UNIT-IV

Muscles- Structure of skeletal muscles, Bio-chemical characterization of extra cellular matrix, plasma lemma, transverse tubular system, sarcoplasmic reticulum and myofibrils.

Actin, myosin, tropomyosin, troponin, Z-disc and H-line components. The sliding filament mechanisms and other theories metabolic and chemical changes during muscle constriction.

UNIT-V

Hormones- endocrine system, basic knowledge of endocrinology, Classification of endocrine system, structure, function and disorders of pituitary, anterior and posterior pituitary gland, thyroid and parathyroid, adrenal, pancreases and reproductive hormones in case of human and female.

Books Suggested

1. Human Physiology by Devis.
2. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray, Daryl K. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
3. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd.
4. Text book of Biochemistry and Human Biology -Talwar , G.P. and Srivastava. L.M., Printice Hall of india.
5. Human Physiology Chatterjee.C.C, Medical Allied Agency.
6. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers. 1. Principles of Anatomy & Physiology by Tortora, G.J.
7. Textbook of Medical Physiology by Guyton and Hall.
8. Essentials of Medical Physiology by Sembulingam K.
9. Proteins: structure and function by Whitford, D.

COURSE OUTCOMES

- This course will provide a sound basis in human physiology to support in-depth understanding of physiological processes of all body systems in detail and on an appropriate level.
- Students will be able to explain how the activities of organs are integrated for maximum efficiency.
- Students will be prepared to identify how changes in normal physiology lead to disease and it will support further study in health and medical sciences or related fields.

- This paper will also provide understanding of hormonal action in human body to regulate normal physiological activity of different organ system as well as metabolic process.

M.Sc. BIOCHEMISTRY
Semester-I
Generic Elective
Paper-IV
BCH-104: Biophysical Chemistry & Techniques

COURSE OBJECTIVE

- The objectives of this paper is to develop student's knowledge and capabilities in areas of analytical chemistry that are particularly relevant to the analysis of a range of sample types
- To understand the physical principles of a range of quantitative and quantitative analytical techniques.
- To study the range of spectroscopic technique to characterize the biomolecules.
- To understand the governing mechanisms and driving forces of various advanced separation processes.

UNIT-I

Water- Physical properties & Structure of water, hydrogen bonding, ionisation of water. pH scale concept of acids-bases & buffers, buffer ionisation behavior of amino acids and proteins. Henderson-Hasselbalch equation, biological buffering system. Principle of osmosis- Electroendomosis, Donnan-membrane equilibrium & its biological applications.

UNIT-II

Centrifugation- Basic principle of sedimentation, centrifuge and their uses. Preparative & analytical centrifugation and their application in biochemistry. Electrophoresis-General principle, factors affecting electrophoretic mobility, moving boundary & zonal electrophoresis, paper & gel electrophoresis, isoelectric focusing.

UNIT-III

Thermodynamics- Open, closed & isolated system, first & second laws of thermodynamics and their applications in living organisms. Molecular basis of entropy, Helmholtz & Gibbs free energy, equilibrium constant. Chemical potential, Phosphate group transfer potential coupled reactions.

UNIT-IV

Chromatography- General principle of partition, absorption, paper, column, thin layer, ion exchange & gas chromatography (GLC, GSC). Affinity & high performance liquid chromatography (HPLC) & Gel filtration chromatography.

UNIT - V

Spectroscopic techniques- Basic concepts of spectroscopy, General principle of NMR, ESR, UV, IR & Visible spectrophotometers Single beam and Double beam, Nanodrop spectrophotometer and X-ray diffraction technique.

Books Suggested

1. Analytical Biochemistry by Holme, D. J. & Peck, H.
2. Biochemical calculation by Segel.

3. Introduction to Protein Architecture: The structural biology of proteins by Lesk, A. M.
4. Modern Experimental Biochemistry by Boyer, R.
5. Biochemistry by Todd, W. B., Mason, M., Bruggen, R. V. & Macmillan
6. Wilson.K.AndWalker.J.Pub:CambridgePress2.PhysicalBiochemistry-Friefelder,Publisher D.W.H.FreemanPress.
7. Biophysical Chemistry:Principles and Techniques, 2nd edition by A.Upadhyay, K. Upadhyayand N.Nath. Himalaya Publishing House.

COURSE OUTCOMES

- To understand the concepts of preparation of buffers, molarity, normality, ionization, molality.
- The understanding of different types of chemical bonding, molecular machinery of living cells, principles that govern the structures of macromolecules and their participation in living system.

- To identify with the classification and structural properties of carbohydrates, proteins, nucleic acids and lipids, glycoproteins and glycolipids and their significance in biological systems.
- By the end of the course, the students will be able to demonstrate advanced knowledge and understanding of aspects of physical and chemical properties of aqueous solutions, concepts of free energy.

**SEMESTER-I
PRACTICAL
(Duration: 6 hrs.)**

Note- Practical examination of Bio-organic Chemistry/ Cell Biology/ Human Physiology and Endocrinology/ Biophysical Chemistry & Techniques will be conducted at the end of each semester during examination. Students will be given two exercises in the practical examination.

Lab I: Bio-organic Chemistry and Biophysical Chemistry & Techniques

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Bio-organic Chemistry

Qualitative /Qualitative Analysis

1. Monosaccharides, Disaccharides and Polysaccharides.
2. Extraction of Starch from potato.
3. Extraction of Casein from milk.
4. Extraction of Lecithin from egg yolk.
5. Standard curve of maltose.
6. Standard curve of BSA.
7. Preparation of Buffers and determination of pH.
8. Titration of a weak acid.

Biophysical Chemistry & Techniques

Colorimetric and Spectrophotometric analysis:

1. Absorption spectrum determination based on Beer Lambert's Law.
2. Estimation of glucose by O T method.
3. Estimation of fructose by Seliwanoff's method.
4. Estimation of Ribose by Bial's method.
5. Estimation of Protein by Biuret method.
6. Estimation of Cholesterol by Zak's method.
7. Estimation of Phosphorus by Fiske Subbarow method.
8. Estimation of Iron -Wang's method.
9. Estimation of amino acid by Ninhydrin method.

Chromatography Analysis

1. Separation of sugar & amino acid by paper chromatography.
2. Separation of colour substances by paper chromatography.

Spectrophotometric analysis:

- Protein estimation by UV Spectroscopy.
- Cell fractionation (centrifuge).
- Demonstration of Electrophoresis.

Books Suggested

1. Biochemical Methods 1992, by S. Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi.
2. Laboratory Manual in Biochemistry, 1981. J. Jayaraman, New Age International publishers, New Delhi.
3. An introduction to practical biochemistry. By: David T Plummer. Publisher Tata McGraw- Hill.
4. Biochemical Calculations - Segel, I.H. John Wiley & sons.
5. Experimental Biochemistry: A Student companion- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd.
6. Experiments And Techniques In Biochemistry: by Sheel Sharma, Galgotia publications

COURSE OUTCOMES

The students will be able to-

1. Estimate the qualitative and quantitative measurement of bioactive molecule from the different sources.
2. Separate and analyze different biomolecules present in different samples.
3. Student know the knowledge and handling with standard protocols and modern instrumentation.

Lab II: Human Physiology & Endocrinology and Cell Biology

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Human Physiology and Endocrinology

1. To determine Hb% by Sahli's hemometer in blood samples.
2. To determine the hematocrit.
3. To determine the concentration of heparin in blood samples.
4. To determine the PTT in blood samples.
5. To demonstrate the effect of diet and hormones on the glycogen content of rat liver.
6. Microscopic observation of LS and TS of Reproductive organs and tissue.
7. Microscopic observation of LS and TS of Stomach related tissue.
8. Microscopic observation of Skin Muscles.
9. Microscopic observation of heart Muscles.

Cell Biology

1. Blood film preparation and identification of cells.
2. Cell organs fraction analysis by centrifuge.
3. Cell organelles observation under microscopy.
4. Isolation of cell organelles.
5. Cell membrane protein and lipid extraction.
6. Blood Film preparation and identification of cells.
7. Extraction and estimation of proteins from plant cell material.

8. Extraction and estimation of proteins from animal cell material.
9. Microscopic slide based observation of cellular division.
10. Bacterial cell staining and identification and characterization.

Books Suggested

1. Physiology by Guyton and Hall.
2. Medical Physiology by Best and Taylor.
3. Physiology by Garrett.
4. Harper's Reviews of Biochemistry.
5. Experiments and Techniques in Biochemistry: by Sheel Sharma, Galgotia publications.
6. Biochemical Methods 1992, by S.Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi.
7. Laboratory Manual in Biochemistry, 1981. J.Jayaraman, New Age International publishers, New Delhi.
8. Experimental Biochemistry: A Student companion- Sashidhar Rao, B and Deshpande, V. IK International (P) Ltd.
9. Experiments and Techniques In Biochemistry: by Sheel Sharma, Galgotia publications.

COURSE OUTCOMES

The students will be able to

1. Estimate the qualitative physiological functional measurement according to their structure.
2. Separate and isolated by the fraction preparation of cellular components from any cellular /organ based samples.
3. Student know the knowledge and handling with standard protocols and modern instrumentation related to cell and organelles etc.

M.Sc. BIOCHEMISTRY
Semester- II
Paper-I
BCH-201: Enzymology

COURSE OBJECTIVES

- To study classification and basic structural properties of enzyme
- Detailed study on mechanical and kinetics properties of enzyme including various models of kinetics and various types of inhibition
- To acquire a detail knowledge of mechanism of enzyme action, regulation and allostery in enzyme
- To develop an understating on application and technological aspects of commercial valuable enzyme.

UNIT-I

Nomenclature and classification of enzymes, factors affecting the rate of enzyme catalyzed reactions, Michaelis-Menten concept of uni-substrate reaction, Briggs-Haldane relationship, Enzyme turnover and its significance, concept of Bi and multisubstrate reaction with classification and examples, kinetics of multisubstrate reaction, Ping-pong and ordered bi-bi mechanism.

UNIT-II

Co-enzyme and cofactors, metallo enzymes, protein-ligand binding, cooperativity, Hill equation and plot, immobilized enzymes and their industrial applications.

UNIT-III

Multi enzyme and allosteric enzymes; occurrence and properties of multienzyme system, mechanism of action and regulation of pyruvate dehydrogenase and fatty acid synthetase complex, symmetrical and sequential models for action of allosteric enzymes and their significance.

UNIT - IV

Mechanism of catalysis: acid-base catalysis, electrostatic catalysis, covalent catalysis, serine protease ribonuclease, chymotrypsin, lysozyme, triose phosphate isomerase.

UNIT-V

Enzyme regulation general mechanisms of enzyme regulation, feedback inhibition and feed forward stimulation, control of enzyme activity by products and substrate. Enzymes repression, reversible and irreversible inhibition, covalent modification of enzymes.

Books Suggested

1. Enzymes By Palmar.
2. Fundamentals of Enzymology, Price. NC. and Stevens. L., Oxford University Press.
3. Enzymes-Biochemistry, Biotechnology, Clinical chemistry-Palmer, T.
4. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Pub.: W.H Freeman.
5. Enzymes by Dixxon and Webb.
6. Fundamental of Enzymology by Price and Steveas.
7. Enzymes reaction Mechanisms by Walsch.
8. Enzymes structure and Mechanism by Alan Fershit.

COURSE OUTCOMES

- Students will be prepared for theoretically & practically to understand properties of enzyme.
- Enzymes are functional and its role in living system is unique.

- To understand ability to difference between a chemical catalyst and biocatalyst along with concept of enzymes-substrate kinetics and its importance in biological reactions.
- Enzymology paper is core Biochemistry subject, detailed understating of enzymology will help students to prepare their mind for interdisciplinary functional properties of protein.
- This paper gives platform to develop vast range of application of industrially valuable enzymes.

M.Sc. BIOCHEMISTRY
Semester - II
Paper - II
BCH-202: Microbial Biochemistry

COURSE OBJECTIVES

- To enable the student to learn the regulation of genes in bacteria.
- Morphology, classification and types of viruses.
- To introduce to the process of biological nitrogen fixation.
- Detailed information on antibiotics.

UNIT - I

Classification of microorganisms, general characteristics of main groups of microorganism's classification of bacteria, structure, recombination.

UNIT II

General organization of bacterial cells, gram-positive and gram-negative organisms, structure and function of bacteria physiology, membrane transport, locomotion and reproduction of bacteria, aerobic & anaerobic respiration.

Bacteriological media: types, and their use, culture characteristics of bacteria on different media. Cultivation, maintenance and preservation of culture, bacterial growth kinetics, growth curve, batch, continuous and synchronous culture, measurement of growth and factors affecting growth.

UNIT III

Role of microorganisms in food spoilage, food and food additives, food poisoning, food born infections and sewage (domestic and industrial) disposal, microbiology of food and dairy products, Industrial production of ethyl alcohol, lactic acid, ascorbic acid and penicillin, production of vaccine. Microorganism associated disease.

UNIT IV

Viruses structure, isolation, identification, properties and classification, replication of RNA, viruses negative strand (VSV), positive strand (polio), retroviruses, replication of DNA (Adenovirus or SV 40), Plant viruses, Animal virus, Bacteriophages, Viroids, virus and cancer.

UNIT V

Sterilization and disinfection, culture media methods of securing pure culture, fermentation, stock cultures, fermentation media, continuous and multiple fermentation.

Control of microorganisms-Microbial death, concept of bioburden, thermal death and decimal reduction time. Control of microorganism by physical and chemical agent, Antimicrobial agent, antimicrobial sensitivity.

Books Suggested

1. Food microbiology -Adams, M.R. and Moss M.O.
2. Foundations in Microbiology -Kathleen Talaro and Arthur Talaro.
3. Industrial Microbiology -Patel, H.P.
4. Industrial Microbiology -Casida.
5. Industrial Microbiology -Prescott and Dunn.
6. Microbiology Concepts and Applications -Paul A. Ketchum.
7. Microbiology Concepts and Applications -McKane and Kandel.

COURSE OUTCOMES

- Students will be able to appreciate the entire spectrum of microscopic life forms - from relatively simple, small but unique viruses to bacteria.
- Enable the students to understand the fine mechanism of regulation of gene expression.
- Awareness will be created on different types of viruses and diseases caused by them.
- Appreciate the crucial role played by bacteria in nitrogen metabolism. 30
- Students will get deep insight to antimicrobials.

M.Sc. BIOCHEMISTRY

Semester- II

Generic Elective

Paper-I

BCH-203: Bio statistics and Computational Bioinformatics

COURSE OBJECTIVE

- Detailed understanding of genome projects, related disciplines of Bioinformatics use of Databases and Tools in Biological Discovery, Major Bioinformatics Resources.
- To gain detail on biological databases like primary sequence databases, protein three dimensional databases, Protein Structure Mathematical model databases, PCR and quantitative PCR primer databases, Chemical Databases, Drug & Drug Target /Therapeutic Target Databases, Disease databases, Immunological database.
- In depth study of various types of tools including sequence submission tools, Chemical molecule designing software, Protein & Chemical molecule visualization tools, Docking software, Molecular dynamics software; QSAR, ADME Toxicity prediction, Allergen prediction, Venomics & Antivenomics.

UNIT- I

Introduction to Biostatistics, applications, Methods of sampling, tabulation of data, its diagrammatic and graphical representation. Measurement of central tendency – mean, median and average. Measures of dispersion, variance and standard deviation, mean deviation, standard error, Range, Coefficient of variation.

UNIT- II

Probability, frequency distribution, measurement of central value frequency table, cumulative and relative frequency correlation, covariance correlation analysis and coefficient.

UNIT- III

Correlation and Regression, analysis, correlation and regression coefficients, linear regression and regression equation, test and types of significance, t-test, chisquare test and analysis of variance. Design of experiment, randomization, replication, local control, complementary randomized block design. Factor analysis, path analysis.

UNIT IV

introduction to computer fundamentals storage of data, operating system, concept of hardware and software and general operating commands (MS-DOS, MSWORD, Excel, PowerPoint), open office in Linux: Word Processor, spreadsheet Introduction to programming in basic and C.

UNIT-V

Introduction to internet and its application, introduction to bioinformatics: Introduction to MEDLINE on PubMed system for accessing biological information, Entrez, Swissport, PIR, NCBI. Stastical analysis software's, Plant Genome Database, Sequence Database: Content, structure and annotation for Human Genome Database, Multiple sequence allgnment programme- Clustal w, x. File management, file transfer (ftp, Wsftp), email.

Books Suggested

1. Fundamentals of Biostatistics by Bernard Rosner 5th Ed.
2. Bioinformatics Methods and Applications by Rastogi, S.C.
3. Bioinformatics for Dummies by Jean-Michel Claverie.
4. Textbook of bioinformatics by Subramaniam, C.
5. Introductory Biostatistics by Chap T. Le.
6. Fundamentals of Biostatistics by Bernard Rosner.
7. Review & Research papers from Bioinformatics & related Journals.
8. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, 2008.
9. David W. Mount, Bioinformatics- Sequence and Genome analysis, 2004.

COURSE OUTCOMES

- Students will choose appropriate experimental strategy for research in basic and applied biology.
- Explanation and integration of bioinformatics principles and its applications to basic and applied biology.
- Students will gain *in silico* training on data mining, database searching, software application, quantitative analysis and interpretation, molecular modeling, QSAR and various DNA, RNA and Protein analytical tools.
- Moreover, this paper enables students to acquire the knowledge of statistical analysis and its principles.

M.Sc. BIOCHEMISTRY
Semester - II
Paper - IV
BCH-204: Molecular Biology

COURSE OBJECTIVE

- Detailed understanding of prokaryotic and eukaryotic replication, types of DNA polymerases and inhibitors of DNA replication
- To gain detail on prokaryotic and eukaryotic transcription, translation and gene expression regulation
- To develop an understating of advanced technologies like RFLP, Sequencing, SSR, REMAP, SCAR and various types of PCR

UNIT I

Organisation, Identification and chemical nature of genetic materials, Gene concept morphology, chemical structure, concept of codon viral and prokaryotic DNA replication, Enzymology of DNA replication.

UNIT II

Transcription mechanism of both prokaryotes and eukaryotes, transcription factors, Translation, anti-genes RNA, regulation of gene expression in prokaryotes. Post transcription modification in eukaryotes, Post translation modification types and significance, Genetic code: evidence and properties.

UNIT-III

Bacterial recombination, conjugation, transformation,transduction, transposons, transposable element in prokaryotes and eukaryotes, types and significance retrovirus, DNA damage and repair, cot values C value, paradox DNA sequencing technique di-deoxynucleotide, partial rib substitution and gilbert etc PAGE detection and extraction of DNA from gels.

UNIT IV

Satellite DNA, recombination of DNA, DNA binding properties, split genes, Overlapping genes, Pseudogene, Cryptic genes, centromere DNA, Promiscuous DNA. Rearrangement of DNA.

UNIT V

Mutations types, classification and mechanism, mutagens types structures mode of functioning mutagenesis, site directed mutagenesis suppressor mutation, mutations determination, Mutation rate.

Books Suggested

1. Genes VIII, by Benjamin Lewin.
2. Molecular Biology, by Turner et al.
3. Cell and Molecular Biology: Concept and Experiments, by Geraid Karp.
4. An Introduction to grnrtric Analysis by Griffiths et al.
5. The Biochemistry of Cell Signaling, Helmreich JM, Oxford Press.
6. Cell signaling - John T Hancock, Oxford University press.
7. Cell and Molecular biology. Second edition: Edited by C A Smith and E J Wood. Chapman & Hall publication.

COURSE OUTCOMES

- Students will choose appropriate experimental strategy for research in basic and molecular biology.

- To perform laboratory techniques in basic biology, molecular biology, and advanced techniques. Explanation and integration of biological principles, as applied to basic and molecular biology.
- Development of strong diversified background in modern biology, appropriate to the individual student goals. Develop critical-thinking, and problem based learning skills.
- This paper will open an understanding of current trends in molecular and genetic research, and critically appraise published work.

**SEMESTER-II
PRACTICAL
(Duration: 6 hrs.)**

Note-Practical examination of Inorganic Enzymology/ Molecular Biology/ Microbial Biochemistry will be conducted at the end of each semester during examination. Students will be given two exercises in the practical examination.

Lab I: Enzymology and Molecular Biology

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Enzymology

Enzyme assay

1. Determination of specific activity, effect of pH, temperature and substrate concentration of:
 - (a) Salivary Amylase
 - (b) Urease
2. Enzyme curve of amylase
3. Temperature curve of amylase
4. pH curve of amylase
5. Substrate curve
6. Specific activity of amylase
7. Activity staining of amylase
8. Activity of Immobilized Amylase
9. Fractionate BSA by salt precipitation
10. Specificity of enzyme action
11. Time course of enzymatic reaction

Molecular Biology

1. Estimation of DNA by diphenylamine method.
2. Estimation of RNA by Orcinol method.
3. Spectroscopic determination of melting temperature(T_m) of calf thymus DNA.
4. Demonstration of Amplification of desirable gene by Polymerase chain reaction.
5. Isolation, quantification and characterization (Spectrophotometric and agarose gel
6. Electrophoresis of total RNA, mRNA from plant and microbial sources.
7. Isolation, quantification and characterization (Spectrophotometric and agarose gel

8. Electrophoresis of genomic DNA from bacteria (*E. coli*).
9. Isolation, quantification and characterization (Spectrophotometric and agarose gel electrophoresis of genomic DNA from plant.
10. Molecular Profiling of Blood Plasma.
11. Molecular profiling of Animal tissues.

Books Suggested

1. Biochemical Methods 1992, by S.Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi.
2. Laboratory Manual in Biochemistry, 1981. J.Jayaraman, New Age International publishers, New Delhi.
3. Enzyme assays- A Practical Approach, Eienthal, R and Dawson, MJ, IRL press
4. Practical Biochemistry- Rameshwar. A, Kalyani Publisher.
5. Principles of Genetics by Eldon John Gardner, Michael J. Simmons, D. Peter Snustad; John Wiley.
6. Modern Genetic Analysis Anthony JF Griffiths, William M Gelbart, Jeffrey H Miller, and Richard C Lewontin. Pub. W. H. Freeman.
7. Statistics, Basic Concepts and Methodology for the Health Sciences Daniel WW, Pub Wiley India.
8. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W. H. Freeman.

COURSE OUTCOMES

1. Student will learn about the enzymatic reaction and standardization etc.
2. Student will learn about the pH and temperature and associated other factors necessary for the curve development.
3. Determination of specific activity will also acknowledge by the students.
4. Student will learn about the bioactive molecules separation by using the electrical charges.
5. Student will learn about the demonstration of Amplification of desirable gene by Polymerase chain reaction.
6. Isolation, quantification and characterization by using Spectrophotometric technique with involvement of agarose gel electrophoresis of genomic DNA from plant and animal tissue are also understand by the students.

Lab II: Microbial Biochemistry and Bioinformatics

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Microbial Biochemistry

1. Preparation of culture media and sterilization methods.
2. Isolation of pure cultures: Streak plate method and Serial dilution method.
3. Gram Staining.
4. Differential staining: Acid fast staining, Giemsa staining, Leishmann staining.
5. Methods of isolation and identification of gram+ve and gram -ve bacteria.
6. Methods of isolation and identification of Fungi (Soil fungi).
7. Bacterial growth curve.
8. Widal test, VDRL test.

9. Antibiotic sensitivity by Disc diffusion and Broth dilution Methods.
10. Assay of penicillin and streptomycin as secondary metabolites.
11. Biotransformation of Antibiotics and Steroids.
12. Biodegradation of lignocellulosic waste.
13. Biodegradation of phenolic compounds.
14. Biodegradation of hydrocarbons.
15. Dye decolourization by microorganisms.
16. Isolation of bacteriophages from sewage / waste water
17. Reactivation of lysogenic viruses.
18. Plaque assay.
19. One-step growth assay.
20. Plaque reduction neutralization test

Bioinformatics

1. Retrieve Sequence From Nucleotide Databases (Genbank, Ena, Ddbj).
2. Retrieve Sequence From Protein Primary Sequence Database: Unipro.
3. Study of Literature Database-Pubmed.
4. Study of Compound Database-Pubchem.
5. Drug and Target Databases.
6. BLAST Search and Phylogenetic Tree.
7. Download Protein 3D Structure From Pdb.
8. Protein 3D Structure Visualization Tool-Rasmol.
9. Protein Structure database.

Books Suggested

1. Kannan N (1996) Laboratory Manual in General Microbiology. 1st Edition, Palani Paramount Publications, Palani, Tamilnadu.
2. Sundararaj T. Microbiology – Laboratory Manual. Revised and Published by Aswathy Sundararaj, No.5. 1st Cross Street, Thirumalai Nagar, Perungudi, Chennai.
3. Aneja KR (2005). Experiments in Microbiology, Plant pathology and Biotechnology. 4th Edition, New Age International Publishers, Chennai.
4. James G Cappuccino & Natalie Sherman (2008) Microbiology: A Laboratory manual. 8th Edition, Published by Pearson Education.
5. Statistics, Basic Concepts and Methodology for Health Sciences Daniel W, Pub Wiley India
6. Biostatistics Arora & Malhan, Himalaya Publishing House. .

COURSE OUTCOMES

1. Student will learn about genomic database study.
2. Student will learn about the all Study of molecular and Compound Database along with their structures etc.
3. Bioinformatics and statistical tools along with computer application are essential it benefited to student for new drug research and development fields etc.
4. Student will learn about the Microbial handling, isolation, purification and identification etc.
5. Student will learn about the all basic experimental handling concern to microbial testing and disease identification etc.
6. Microbial biochemistry knowledge in student establish microbial biochemical process and their management etc.

M.Sc. BIOCHEMISTRY
Semester-III
Paper-I
BCH-301: Metabolism and Plant Biochemistry

COURSE OBJECTIVES

- An advanced understanding of the core principles and topics of metabolic process and their biochemical reactions.
- To enable students to acquire a specialized knowledge and understanding of how enzymes and metabolites in living system works to produce energy and synthesizing different biomolecules.
- To study biochemical pathways involved in intermediary metabolism.
- To understand the principles and major mechanisms of metabolic control and of molecular signaling by hormones.
- The metabolism of dietary and endogenous carbohydrate, lipid and protein.

UNIT-I

Bioenergetics-Biological oxidations, oxygenases, hydroxylases and dehydrogenases, Gibb's energy, free energy changes, and redox potentials, phosphate potential, electron transport chain, substrate level phosphorylation and oxidative phosphorylation.

Carbohydrate Metabolism-Glycolysis, gluconeogenesis, Krebs' Cycle, hexose monophosphate shunt and glyoxylate pathway.

Glycogenolysis-glycogenesis, synthesis of mucopolysaccharides and bacterial cell wall polysaccharides.

UNIT-II

Lipid metabolism-Fatty acid oxidation-Beta oxidation and ω oxidation. Biosynthesis and degradation of fatty acids triglycerides and phospholipids, cholesterol and bile acids, ketone bodies.

UNIT-III

Nucleic acid Metabolism-Nucleic acid metabolism, degradation of nucleoprotein, Catabolism of purin Pyrimidines, Biosynthesis of Purine, Pyrimidines, nucleolides and its regulation. - Gout and Liesch nyhan Syndrome.

UNIT-IV

Protein Metabolism-Proteolysis, deamination, transamination and decarboxylation reactions, urea cycle, Metabolism of individual amino acids. Plant Hormones-Growth regulating substances and their mode of action, molecular effects of auxin, gibberellic, abscisic acids and cytokinins, gaseous plant hormone.

UNIT-V

Photosystem I & II, their location, Mechanism of quantum capture and energy transfer between photo systems- ferridoxin, plastocyanin, photoquinone, carotenoids The Hill reaction, photophosphorylation and reduction of CO_2 . C3, C4 and CAM metabolism, light and dark reaction and photorespiration.

Books Suggested

1. Biochemistry by Mathews
2. Biochemistry by Satyanarayana, U.
3. Biochemistry: The Chemical Reactions of Living Cells by Metzler, D. E.
4. Lehninger Principles of Biochemistry, David L. Nelson, Michael M. Cox Publisher: W.H. Freeman.

5. Molecular Biology of the Cell, 3rd edition. Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts, and James D Watson. Publisher New York: Garland Science.
6. Biochemistry, 4th Edition-Donald Voet, Judith G.Voet-Publisher John Wiley & Sons.
7. The Cell: A Molecular Approach, by Geoffrey M. Cooper & Robert E. Hausman, Pub.
8. Molecular Cell Biology, Baltimore et. al. (1995) Scientific American Publication.

COURSE OUTCOMES

- Metabolism refers to all biochemical reactions which occur in the living organisms.
- By studying this paper students will be able to differentiate the anabolic and catabolic pathways and their important enzymatic steps, understand how glycolysis produces metabolic energy as well as producing intermediates for further metabolic reactions.
- To acquire knowledge related to the principles and basic mechanisms of metabolic control and how regulation of biochemical pathways leads to normal integrated metabolism, understand the organization of a typical mitochondrion, locating membranes, enzymes, respiratory complexes, the F₀-F₁ complex, important transporter proteins and how it functions to synthesize ATP.
- To understand the importance of Integration of Metabolism, degradation, catabolism, hormonal regulation of metabolism etc will be exposed with the fact that perturbations in the biomolecules lead to various diseases. To open new way into metabolic engineering for the production of useful compounds.

M.Sc. BIOCHEMISTRY
Semester-III
Paper-II
BCH-302: Immunology

COURSE OBJECTIVE

- In-depth knowledge and understanding of major cellular and molecular mechanisms underlying immunological processes in health and diseases
- To acquire a knowledge of immunochemical techniques in qualitative and quantitative analysis of antibodies and antigens.
- An understanding of the factors that determine the effectiveness of immune responses to microorganisms (bacteria, viruses, parasites) and tumours and how protective immunity can be elicited by vaccination.

UNIT-I

Introduction of immune system: Innate and acquired immunity, Active-passive immunity, Structure and functions of lymphoid organs, Cells involved in immune response (development of immune cells), Phagocytic cells & their killing mechanisms.

UNIT-II

effect or mechanism of immunity: Macrophage activation, Cell mediated cytotoxicity, Hypersensitivity and its types, MHC genes organization, types, functions.

UNIT-III

Antigen: Types of antigen, Immunoglobulins- structure, occurrence & functions, Antigen-antibody reaction, Antigen binding sites, Hybridoma technology, Monoclonal antibodies production, principle of selection, characterization, application in diagnosis, therapy and basis research.

Antibody engineering: Chimeric and Humanized monoclonal antibodies, Mice engineered with Human Ig loci, Phase display library for monoclonal antibody.

UNIT-IV

Transplantation immunology: immunologic basis of graft rejection & HLA tissue typing, Transplantation diseases, Complement system – mode of activation, classical - alternative pathways, Biological functions of complement proteins, Cell mediated & humoral immune response. **Cancer immunology:** tumor antigen, immune response to tumor, oncogene and induction, cancer immunotherapy.

UNIT-V

Immunity to infection: Immune tolerance, Immunosuppression, Immunodeficiency disorders, Autoimmunity, Vaccines- Active and Passive immunization whole organism vaccine, purified macromolecule as a vaccine, DNA vaccine, Recombinant vaccine and Subunit vaccine & diseases.

Immunological techniques: Immunoelectrophoresis, Radial & Double immunodiffusion, RIA & ELISA, Western blotting and Immunohistochemical technique.

Books Suggested

1. Kuby Immunology, Thomas J. Kindt, Richard A Goldsby, Publisher WH Freeman & Co.
2. Immunology- Ashort Course.
3. Immunology by Tizzard.
4. Fundamental of Immunology by William Paul.
5. Immunology by Abbas.
6. Roitt's Essential Immunology, Tenth Edition, Ivan Roitt, Peter Delves
7. Veterinary Immunology: Ian R. Tizard, I.R. Thomson press
8. The Immune System. By Peter Parham Publisher Garland publishing
9. Biochemistry - J. David Rawn – Neil Patterson publication, NC.

COURSE OUTCOMES

- To attain a working knowledge of current immunological principles as they relate to the cells and molecules of the immune system.
- Understanding of mechanism of interaction in defending the body against invading microorganisms.
- Students will get knowledge of development and acquisition of ability to recognize antigens and finally how they malfunction in autoimmune diseases.
- Students will extend and solidify their understanding of the presented principles through critical readings from the primary research literature.

M.Sc. BIOCHEMISTRY

Semester-III

Paper-III

BCH-303: Clinical Biochemistry (Discipline Elective)

COURSE OBJECTIVE

- To study the classification and functional properties of blood components.
- To understand the coagulation, anti-coagulation mechanism of blood and its disorders.
- To study the biochemical, clinical, pathological and diagnostic aspects of diseases.

- To study dietary types, requirements, utilization and functions of different class of diet.
- To study the nutrition deficiency disorders and balance diet.

UNIT-I

Fluid & electrolyte balance and imbalance in various diseases.

Liver Function Tests: Van den Bergh test for bilirubin, urine and fecal urobilinogen, Determination of galactose, epinephrine test, Detoxification and excretion tests, Prothrombin Time, Determination of blood ammonia.

Kidney Function Tests: Urea clearance test, Creatinine clearance test, renal plasma flow, Concentration and dilution test, Function tests of pancreases,

UNIT-II

Disorders of Carbohydrates Metabolism: Diabetes mellitus Glycated hemoglobins, Blood sugars hypoglycemias, various types of glucose tolerance tests.

Disorders of Lipids: Hypolipoproteinemia, Hyperlipoproteinemia, Atherosclerosis

Diagnostic tests for apolipoproteins, HDL - cholesterol, LDL - cholesterol and triglycerides. Fatty liver, Fats in diseases, Lipoproteins disorders, Ketone bodies.

Diagnostic Tests for Proteins: Total protein, albumin, globulin and fibrinogen

Disorders of Thyroid: Hyperthyroidism, Hypothyroidism. Thyroid function Tests: T3, T4, TSH, TRH

UNIT-III

Enzymes in different diagnosis of disease & their clinical significance: Serum Aspartate aminotransferase, alanine aminotransferase, creatine kinase, gamma glutamyl transpeptidase, alkaline phosphatase.

Biochemical Aspects of Hematology:

Complete blood count (CBC)- RBC, WBC, platelet counts, Hb, Bleeding time, clotting time

Cerebrospinal fluid (CSF) chemistry and clinical significance.

- Biochemistry of detoxification, Xenobiotic metabolism.
- Metal ion toxicity, chelation therapy, antioxidant therapy.
- Biochemistry of Ageing, Cancer, AIDS, Cholera-Vibriotoxins, pathogenesis. Jaundice, Arthrities, Nutrition and Chronic clinical disease.

UNIT-IV

Mechanism of drug action- Penicillin, Tetracycline, Streptomycin, Chloramphenicol & Sulphonamides.

Apoptosis: Carcinogens, Cancerous growth & Chemotherapy, radioactivity: radioisotopes in medicine.

UNIT-V

Disorders of mineral metabolism and trace elements: Hypo-Hypercalcemia, Hypo-Hyperphosphatemia, Disorders of amino acids, steroids and vitamins.

Disorders of erythrocyte metabolism: hemoglobinopathis, thalassemias & anemia's.

Biochemical Hazards of dangerous environment pollutants.

Books Suggested

1. Text book of Biochemistry and Human Biology -Talwar , G.P. and Srivastava. L.M., Printice Hall of india.
2. Human Physiology - Chatterjee. C.C, Medical Allied Agency.
3. Textbook of Medical Biochemistry By MN Chatterjea and Rana Shinde, Jaypee Brothers.

4. Lehninger Principles of Biochemistry 5th edition By David L. Nelson and Michael M. Cox, WH, Freeman and Company.
5. Clinical Biochemistry: An Illustrated Colour Text (Paperback) 3rd Edn By Allan Gaw, Michael Murphy, Robert Cowan, Denis O'Reilly, Michael Stewart and James, Shepherd. Publisher: Churchill Livingstone.
6. Harper's Biochemistry (Lange Medical Books) (Paperback) By Robert K. Murray.
7. Granner, Peter A. Mayes and Victor W. Rodwell. Publisher: Appelton and Lange.
8. Clinical Biochemistry By Richard Luxton. Scion Publishing Ltd.

COURSE OUTCOMES

- Advanced understanding and knowledge of theoretical and practical aspects of blood biochemistry and its components.
- Connection of blood to entire organ system of body in single circulatory channel and consequences of environmental and genetic factors of blood disorders.
- Rationale and theoretical basis for methods and tools used in the diagnosis of common biochemical disorders.
- Distinguish between fat-soluble vitamins and water-soluble vitamins, biochemical functions and synthesis for these vitamins.

M.Sc. BIOCHEMISTRY
Semester-III
Generic Elective
Paper-IV
BCH-304: Genetic Engineering

COURSE OBJECTIVE

- To equip students with a basic knowledge of the structural and functional properties of cells.
- To examine properties of differentiated cell systems and tissues.
- Aspect of cell cycle and cell death.
- To introduce the fascinating mechanism of cell signaling along with brief overview on developmental biology.
- To provide thorough knowledge on classical genetics.

UNIT-I

Laws of Mendel's Applications and deviations, Monohybrid and dihybrid crosses, Sex determination and Sex linked inheritance, Sex differentiation, Blood group inheritance and determination, Maternal effects and cytoplasmic inheritance, Fine structure of gene.

UNIT-II

Recombinant DNA Technology

Restriction enzymes- nomenclature, classification and mode of action. Cloning vectors- Plasmid, Bacteriophages, cosmid, phagemid and animal virus. Purification of DNA from living cells, Manipulation of purified DNA, Cloning in Pro & eukaryotic cells, DNA hybridization and blotting techniques. cDNA library. DNA probe, Nick translation, Genetic mapping.

UNIT-III

Tissue Culture

Micropropagation, somatic cell culture, Somatic cell hybridization. Protoplast isolation - fusion, Nif gene transfer. Transformation techniques, integration and analysis or conformation of transgene

integration. Transgenic plant and transgenic animals, Application of recombinant DNA technology or Genetics engineering in agriculture, medicine DNA vaccine and molecular diagnostic.

UNIT-IV

Population genetics- Gene pool and gene frequency, models of gene pool structure-Classical hypothesis, Balanced hypothesis, Hardy- Weinberg law and its application in calculating gene frequencies, deviations from Hardy-Weinberg equilibrium.

Genetics involved-Sickle cell anaemia, Thalessemia and Cancer.

UNIT-V

Gene Techniques - DNA finger printing, DNA foot printing, RFLP, RAPDs, Molecular markers, PCR, Immuno-PCR, Antisense RNA technology, Biosensor development and applications, Microarray chips, types and their application, Human Genome project (HGP). Biosafety and ethical consideration for GMOs.

Book Suggested

1. Gene and Genome by Premrose.
2. Genetics by P. K. Gupta.
3. Cell Biology Protocols by Harris, R., Graham, J. & Rickwood, D.
4. Color Atlas of Biochemistry by Koolman, J. & Roehm, K. H.
5. Molecular Biology of The Cell - Bruce Alberts
6. Molecular Cell Biology by Lodish, H.
7. Principles of Genetics by Eldon John Gardner, Michael J. Simmons, D. Peter Snustad; John Wiley 3.
8. Molecular Genetics of the gene by Watson.
9. Genes IX by Lewin, B.
10. Essential Molecular Biology by T. A. Brown
11. Biotechnology by B. D. Singh.
12. Route map in gene technology by Walker and Rapley.

COURSE OUTCOMES

- To provide thorough knowledge on classical and population genetics along with evolutions.
- Understanding of application of recombinant DNA technology or Genetics engineering in agriculture, medicine DNA vaccine and molecular diagnostic.
- Understanding of Biosafety and ethical consideration for genetic modified organism and crops developments.
- Understanding of modern gene techniques, operation and advantages in recovery and hilling of genetics involved disease.
- Understanding of Blood group, sex and other associated genetic inheritance process.

**SEMESTER-III
PRACTICAL
(Duration: 6 hrs.)**

Note- Practical examination of Inorganic Enzymology/ Molecular Biology/ Microbial Biochemistry will be conducted at the end of each semester during examination. Students will be given two exercises in the practical examination.

Lab I: Genetic Engineering and Clinical Biochemistry

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Genetic Engineering

1. Restriction Digestive Enzymes identification.
2. Isolation of Plasmid DNA and Separation in Electrophoresis.
3. Isolation of genomic DNA.
4. Chromosome microscopic observation during the cell division of different phases.
5. Demonstration of Gel Electrophoresis
6. Isolation of DNA from Blood
7. Bacterial Transformation
8. Western Blotting
9. Isolation of Plasmid DNA By Alkaline Lysis Method
10. Bacterial Genomic DNA Isolation
11. DNA Extraction from Plant Tissue (Strawberry)
12. Nucleic Acid Purity Assessment Using A260/A280 Ratio.

Clinical Biochemistry

I. Hematology

1. Estimation of Hemoglobin – colorimetric method
2. Enumeration of RBC & WBC
3. Differential Smear – Blood cells count
4. Bleeding time & Clotting time
5. Identification of blood grouping & typing
6. Evaluate ESR & PCV
7. Ascorbic Acid Estimation
8. Iron Estimation

ii. Assay of serum marker enzymes

1. Determination of activity of SGOT and SGPT
2. Determination of activity Acid Phosphatase and Alkaline Phosphatase.
3. LFT(Liver function Test), KFT (Kidney function test).

iii. Blood analysis

1. Estimation of blood glucose by Asatoor and King method.

2. Estimation of serum creatine and creatinine by - Alkali-Picrate method.
3. Estimation of Determination of Total proteins in whole blood Biuret method.
4. Determination of urea in serum.
5. Estimation of Cholesterol in serum.
6. Estimation of Tryglyceride in serum.
7. Determination of Bilirubin (Conjugated & Unconjugated) in serum.

IV. Urine analysis

1. Estimation of Urea in urine
2. Determination of Creatine and Creatinine in urine-Alkali-Picrate method
3. Estimation of Uric acid
4. Determination Chloride
5. Physical properties of urine: Microscopic and visual observation for normal and abnormal constituents, color, density, crystals and pH etc.

Books Suggested

1. Biochemical Methods (1992), by S. Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi.
2. Introductory practical Biochemistry (2005), by S. K. Sawhney and Radhir singh, Alpha Science International publishers, 2nd Edition.
3. Practical Clinical Biochemistry -Varley, H. CBS Publications
4. Practical Clinical Biochemistry-Methods and Interpretations - Ranjna Chawla- Jaypee
5. Lab Manual in Biochemistry, Immunology and Biotechnology - Arti Nigam and Archana Ayyagari, Tata McGraw-Hill New Delhi.
6. Biochemical Methods (1992), by S. Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi.
7. Introductory practical Biochemistry (2005), by S. K. Sawhney and Radhir singh, Alpha Science International publishers, 2nd Edition.

COURSE OUTCOMES

1. The students will be able to Performed all hematological tests related to human body system.
2. The students will be able to perform functional test of the body like LFT, KFT related to diagnosis purpose.
3. Student understands the process of disease diagnosis, related to other collected body fluids.
4. Students understand the concept of Histopathology, biochemical test, pathological investigation, recovery response etc.
5. The students will be able to isolate the DNA from different resource.
6. The students will be able to perform the Nucleic Acid Purity Assessment Using A260/A280 Ratio.
7. Student understands the process of Restriction Digestion by using the enzymes.
8. Students understand the concept of bacterial transformation, isolation of Plasmid DNA and manipulation etc.

Lab II: Plant Biochemistry and Immunology

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Plant Biochemistry

1. Estimation of plant lipids and carbohydrates
2. Estimation of plant proteins
3. Microscopic observation of plant cell.
4. Isolation of Chlorophyll
5. Mitosis
6. Osmosis in Onion Cells
7. Effect of Temperature on Plant Cell Membrane
8. Isolation of Chloroplast
9. Extraction, separation and determination of absorption spectra of plant pigments.
10. Fractionation of cell organelles from plant tissues.
11. Estimation of nitrogenase.
12. Estimation of nitrate reductase- *in vivo* method.
13. Fruit ripening. Estimation of total phenolic compounds.
14. Estimation of anthocyanin pigments.

Immunology

1. Single (Radial) Immuno diffusion.
2. Double (Ouchterlony) immune diffusion.
3. Immuno electrophoresis.
4. Blood Grouping
5. Widal Test
6. Immuno diagnosis related to Ag-Ab interaction concept.
7. Testing kit related diagnosis based on Ag-Ab reaction etc.
8. Sandwich ELISA
9. Lymphoid organs and their microscopic organization.

Books Suggested

1. Biochemical Methods (1992), by S. Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi.
2. Introductory practical Biochemistry (2005), by S. K. Sawhney and Radhir singh, Alpha Science International publishers, 2nd Edition.
3. Biochemical Methods (1992), by S. Sadasivam and A. Manickam, Second Edition, New Age International Publishers, New Delhi.
4. Introductory practical Biochemistry (2005) by S. K. Sawhney and Radhir singh, Alpha Science International publishers, 2nd Edition.

COURSE OUTCOMES

1. The students will be able to perform, immune diagnosis related to Ag-Ab interaction concept.
2. The students will be able to perform, blood and other fluid related Ag-Ab interaction concept.
3. The students understand the role of immunology in case of various diseases related to allergy, bacteria, virus, AIDS, Arthritis, skin allergens etc.
4. The students will be able to Performed all bioactive molecule and compound separation related to plant cells.
5. The students will be able to perform estimation of essential beneficial pigments.
6. Student understands the process of disease diagnosis related to plants parts and products.
7. Students understand the concept of estimation of plant proteins, Chloroplast etc.

M.Sc. BIOCHEMISTRY
Semester-IV
Paper-I
BCH-401: Pharmaceutical Biochemistry

COURSE OBJECTIVES

- To study the drug development process, absorption and metabolism
- To develop a concept of drug action, receptor interaction, roll of enzyme in stimulation or inhibition of drug activity
- To understand the lethal and effective dose of drug; Mechanism of drug delivery systems.
- To study the different guidelines for manufacturing of drugs.
- In-depth study of intellectual property rights.

UNIT-I

Pharmacokinetics

Source and nature of drugs, classification, nomenclature. principles of drug action, absorption, distribution and elimination of drugs, routes of drug administration. Drug-protein interactions. dose response curve - ED50 and LD50, Origin of drug from plants and animals, Uses of Pharmacokinetics In Drug Development Process, Concept of Prodrug and Soft Drug. Synergism and Antagonism, Acute and chronic exposures, factors influencing toxicity.

UNIT-II

Pharmacodynamics and drug target

Introduction, Concept of Receptor Agonists and Antagonists, Drug Receptors receptors, Enzymes, carrier proteins Interactions, Theories of Drug Activity Relationship, Forces involved in drug - receptor interaction, Receptor theories. Cholinergic and anticholinergic drugs, adrenergic and adrenergic blockers, General anesthetics, Local anesthetics. Adverse reactions to drugs and common drug receptor interactions, Treatment of Diseases by Enzyme Stimulation, Elementary treatment of drug Receptor Interaction, Ld50, Ed50, Mic and Mec, Membrane Active Drugs, Mechanisms of drug effects, Drug delivery Systems, Liposomes.

UNIT-III

Regulatory Affairs and Pharmacovigilance

Pharmaceutical Products-their Manufacturing, Analytical Aspect, Product Registration and their Requirement looking to WHO-GMP, European DMF, US-FDA Regulations, ICH Guidelines, pharmacopael and extra pharmacopael Entry.

Definition and aims of pharmacovigilance, Adverse drug reactions, Classification, mechanism, predisposing factors and causality assessment. Role of clinical pharmacist in reporting, evaluation, monitoring, prevention and management of ADR, drug induced diseases. Pharmaco epidemiology, Epidemiological approach, measurements epidemiology, (rates, ratios, and proportions), measurement of mortality, morbidity. Descriptive, analytical and experimental epidemiology.

UNIT-IV

Intellectual Property Rights

Documentation Required for Filing Patent, Chemical, Physical and Biological (Clinical) Data Documentation, Patent Writing Art and Introduction of Concept of Non-infringing Patent Ability, Looking to GATT-WTO Scenario, Computer Based Data Mining in Drug Research, Pharmaceutical Product Management Aspect.

UNIT-V

Pharmaceutical associated toxicity

Xenobiotics metabolism, Phase-I reactions, Oxidation, reduction, hydrolysis & hydration. Phase-II reactions\conjugation, Methylation, glutathione & amino acid conjunctions, detoxifications. Metabolism of CCl₄ & Paracetamol & their effect in liver & kidney.

Book Suggested

1. Environmental Biology and Toxicology, P. D. Sharma, Rastogi.
2. Textbook of Toxicology, BalramPani, IK.
3. Casarett&Doull's Essentials of Toxicology, Klaassen, MGH.
4. Toxicology: Principles and Applications, Niesink, CRC.
5. Clinical Toxicology, FACMT, Saunders.
6. Environmental Pollution and Toxicology, Johi, APH.

COURSE OUTCOMES

- Gain detail understanding of how drug act inside the body after absorption from intestine in to blood.
- Understanding of factors that affect drug absorption, interaction with target receptors and inhibition of enzymes.
- Understanding of process of product registration and different guidelines which control the manufacturer to follow correct strategy for manufacturing of drug.
- Learn how to write and file the patent; how to document clinical data of the concern drug research.

M.Sc. BIOCHEMISTRY

Semester-IV

Paper-II

BCH-402: Biochemical Toxicology and Clinical Research

COURSE OBJECTIVES

- To study the ICMR and Ethical Guidelines as per standardized toxicological values.
- To understand the in vitro-in vivo performed experimentation.
- To study the Biological testing and bioassays during Clinical trials observation.
- To study about the Single dose and repeat dose toxicity studies.
- To study the Nutrition toxicology and Immunotoxicology.

UNIT-I

Nutrition toxicology and Immunotoxicology: Determination of metal content in samples, Neurotoxicology, Occupational toxicology. toxicology of environmental, Risk assessment and chemical safety evaluation, Legislation and International regulation, Toxic metals in environment, toxicity of Petroleum, Pesticide types and toxicity, Environmental consequences of pesticide toxicity.

Pesticide, ionizing radiations and gaseous pollutants. Toxicokinetics, Biotransformation and degradation of toxicants.

UNIT-II

Pre clinical toxicology: Basic Concepts, toxicants of public health hazards and toxic compounds, Epidemiology and biostatistics in Toxicology, Absorption, translocation and excretion of toxicants. Systemic toxicology (Single dose and repeat dose toxicity studies), Carcinogenicity, Mutagenicity,

Teratogenicity, Reproductive toxicity, Local toxicity, Genotoxicity, animal toxicity requirements. Exposure assessment and analytical methods in toxicology, toxicological pathology.

UNIT-III

Clinical research: Types of clinical trials, single blinding, double blinding, open access, randomized trials and their examples, interventional study, ethics committee and its members, cross over design, Institution Ethics Committee/Independent Ethics Committee. Clinical research data management. Organ, genetic and reproductive toxicology, Toxic genomics.

UNIT-IV

Biological testing and bioassays during Clinical trials: Testing drugs in vitro and in vivo, New drug discovery process- purpose, main steps involve in new drug discovery, timelines in steps, advantage and purposes of steps, clinical research ethics, unethical trials, thalidomide tragedy, Clinical trials phases, Safety monitoring in clinical trials. Regulatory requirements in clinical trials, Schedule Y, ICMR guidelines, documentation in clinical study. Indian GCP guidelines (CDCSO guidelines) ICMR Guidelines, Ethical Guidelines for Biomedical Research on Human Subjects Schedule.

UNIT-V

Bioavailability and Bioequivalence studies: Factors affecting bioavailability, types: absolute v/s relative, single v/s multiple dose studies, healthy volunteers vs patient studies, measurement of bioavailability, drug dissolution rate and Bioavailability, in vitro-in vivo correlation, methods for enhancement of bioavailability. Bases for Determining Bioequivalence, Design and Evaluation of Bioequivalence Studies Analytical Methods, Reference Standard, Extended Release Formulations, Combination Drug Products, Study Designs.

Book Suggested

1. Pharmacology and Pharmacotherapeutics, 23 rd Edition, Popular Prakasham, Bombay.
2. Modern Pharmacology with clinical correlations, 6th Edn., Charles R. Creig, and Robert E. Stitzel, Lippincott Williams & Wilkins.
3. Foye's Principles of Medicinal Chemistry, Williams, D.A. 6th Edn. Lippincott Williams & Wilkins (2008).
4. Fundamentals of Experimental Pharmacology, Ghosh, M.N. 2nd Edn, Scientific Book Agency, Kolkatta (1984).
5. Wilson and Walker's Principles and Techniques in Biochemistry and Molecular biology; 8th Edn., Andreas Hofmann and Samuel Clokie; Eds. Cambridge University Press, New Delhi.
6. Applied Biopharmaceutics and Pharmacokinetics, Shar gel, L. 2012. McGraw- Hill Medical.
7. Text Book of Receptor Pharmacology, Foreman, J.C. & Johansen, T. J. 2nd Edn., CRC Press (1996).
8. Drug discovery and Development 2nd Ed. Reymond G Hill, Humphry P Rang, Churchill Livingsten, Lange (2012).
9. Applied Biopharmaceutics & Pharmacokinetics, 5th Edn. Leon Shargel, Susanna WuPong, Andrew B.C. Yu.
10. Basic and Clinical Pharmacology, Prentice hall, International, Katzung, B.G.
11. Clinical Pharmacology, Scientific book agency, Laurence, DR and Bennet PN.
12. Remington Pharmaceutical Sciences, Lippincott, Williams and Wilkins.
13. Text Book of Therapeutics Drug and Disease Management Hardbound. Richard A Helms.
14. IPR, Biosafety and Bioethics, Deepa Goel and Shomini Pearson (2013).

COURSE OUTCOMES

- Gain detail understanding of how drug and toxicant act inside the body an after absorption from intestine in to blood it affect the body.
- Understanding of factors that affect drug absorption, Bioavailability and Bioequivalence concept.

- Understanding of process of product registration and different guidelines which control the manufacturer to follow correct strategy for manufacturing of drug and Pre clinical toxicology studies.
- Learn how to write and file the patent; how to document clinical data of the concern to clinical research.
- Understanding of process Biological testing and bioassays during Clinical trials of drug and toxicant.

M.Sc. BIOCHEMISTRY
Semester-IV
Discipline Elective
Paper-III
BCH-403: Food and Nutritional Biochemistry

COURSE OBJECTIVES

- To study the classification and functional properties of blood components.
- To understand the coagulation, anti-coagulation mechanism of blood and its disorders.
- To study the biochemical, clinical, pathological and diagnostic aspects of diseases.
- To study dietary types, requirements, utilization and functions of different class of diet.
- To study the nutrition deficiency disorders and balance diet.

UNIT -I

Direct and indirect calorimetry, energy value of the foods, thermal equivalent of oxygen, respiratory quotient, calorific action of the foods, basal metabolic rate- definition and its measurement, factors affecting BMR, energy requirements of the human beings.

UNIT-II

Nutritional aspects of the carbohydrate- Different dietary types, available and unavailable carbohydrates, requirements, utilization and functions. Special role of non-starch polysaccharides.
Nutritional aspects of the lipids- Different dietary types, requirements, utilization and functions. Essential fatty acids.

UNIT-III

Nutritional aspects of the proteins- Quality of proteins, digestibility coefficient, net protein utilization, biological value and amino acid score, protein requirements and functions. Nutritional diet support of infant. Pre-operation and post operational condition. Importance of food for existence of life. Modes of nutrition in life forms Comparable and contrasting features

UNIT -IV

Nutritional aspects of the vitamins and minerals. WHO and ICMR recommendation of Vitamins and Minerals. Disease and Minerals diagnosis.

Human Health and Disease: Nutrition (Health), definition, classification, food and non food sources. Nutraceuticals; use of nutraceuticals in traditional health sciences. Role of omega-3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinolates; organosulphur compounds in health and disease (prevention and control).

UNIT -V

Balanced diet- Recommended dietary allowances for different categories of human beings. Food processing and loss of nutrients during processing and cooking. Naturally occurring anti-nutrients. Disorders related to the nutrition - Protein energy malnutrition, Starvation, Obesity.

Functional foods: Definition, development of functional foods, benefits and sources of functional foods in Indian diet. Effects of processing conditions and storage.

Book Suggested

1. Vitamins, Their Role in the Human Body by Ball.
2. The Vitamins by Gerald F. Combs .
3. Human Nutrition by Geissler Powers.
4. Human Nutrition and Dietetics by Ashok Kumar Sharma.
5. Nutritional Biochemistry by Tom Brody.
6. Human Nutrition and Dietetics by Davidson & Passmore.

COURSE OUTCOMES

- Gain detail understanding of Nutraceuticals; use of nutraceuticals in traditional health sciences from intestine in to blood it affect the body.
- Understanding of factors that affect food digestion and absorption, Bioavailability and Bioequivalence concept.
- Understanding of importance of food for existence of life.
- Learn how to processing and loss of nutrients take place during processing and cooking.
- Recommended dietary allowances for different categories of human beings.

M.Sc. BIOCHEMISTRY
Semester-IV
Generic Elective
Paper-IV
BCH-404: Industrial Biochemistry

COURSE OBJECTIVES

- To study the classification and functional properties of fermentation technique and products.
- To understand the standard process and SOP for industrial setup and product development.
- To study the biochemical aspects of industrial protocols and standardization regarding product development.
- To study dietary types, requirements, utilization of fermented industrial antibiotics etc.
- To study the Commercial enzyme in beverages development and production.

UNIT-I

Techniques of fermentation systems, Role of Fermentation, Biochemistry of Fermentation: Fermentation of Carbohydrates, Protein. Lipid Metabolism, Formation of flavour. Advanced continuous fermentation for anaerobic microorganisms, Fermentation process development of carbohydrate based therapeutics. Commercial production of plant proteins in microorganisms. Benefits of fermented products.

Bioprocess development for detoxification and decolonization, Fermentation process validation. Genetic manipulation of industrially important microorganisms.

UNIT-II

Food processing and fortification: Principles, objectives and rationale, selection and basis of fortificants. Technology of fortifying cereal products. Characteristics of nutrients used in cereal fortification. Fortification methods. Fortification premixes, Design and composition of premixes and quality control. Fortification of bread, pasta, noodles, biscuits, and breakfast cereals.

UNIT-III

Development of nutraceutical and functional foods, Standards for health claims.

Development of Prebiotics and probiotics: Mechanics and usefulness of probiotics and prebiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes, probiotic allergy, Industrial production of Antibiotics: Penicillin, Streptomycin, Tetracyclines Organic acids, Citric acid, Lactic acid, Acetic acid, Enzymes: Amylases, Proteases, lipases Amino acids - Lysine, Glutamic acid.

UNIT-IV

Food additives: Definitions, functions and uses in processed food products. Chemical, technological and toxicological aspects of acid, base buffer systems, salts and chelating/sequestering agents, leavening agents, antioxidants, emulsifying and stabilizing agents, anti-caking agents, thickeners, firming agents, flour bleaching agents and bread improvers.

Sweetening agents: Artificial sweeteners, composition, uses. Natural and synthetic colors, food Flavors, Spices and flavoring constituents, flavors in food industries.

UNIT-V

Beverages Technology: Beverages; importance of beverage fortification, Health benefits of fortification, Selection of nutrients for fortification, Levels to be added, Characteristics of fortificants and method of fortification, Bioavailability, Organic Vs inorganic salts. Health foods; selection of nutrients, Technology of incorporation of fortificants, bioavailability.

Commercial enzyme in beverages: fruit juices, beer, wine, and distilleries; dairy, baking, oils and fats, plantation products, animal products. Malting and germination of grains process, characteristics, nutritional benefits and uses. Domestic use products like detergents. Textiles, Denim processing, Leather industry.

Book Suggested

1. Biochemistry Ed. Donald Voet & Judith G. Voet, John Wiley & Sons, Inc.(2010).
2. Lehninger- Principles of Biochemistry; D.L.Nelson and M.M. Cox, 6th Edn. MacMillan Publications (2012).
3. Nutrition: Science and Applications, 3rd Edn. Lori A. Smolin, Mary B. Grosvenor, Wiley (2013).
4. Introduction to Human Nutrition, 2nd Edn. Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, Hester H. Vorster, Wiley-Blackwell (2009).
5. Nutrition: Everyday Choices, 1st Edition; Mary B. Grosvenor, Lori A. Smolin Wiley (2006).
6. Bioactive Food as Dietary Interventions for Liver and Gastrointestinal Disease; Watson Elsevier (2012).
7. Food, Nutrition and Health. Tapsell L. Oxford University Press (2010).

COURSE OUTCOMES

- Gain detail understanding of Techniques of fermentation systems, Role of Fermentation, Biochemistry of Fermentation for industrial product development.
- Understanding of commercial enzyme in beverages and their associated biochemical process.

- Understanding of importance of food, Food additives, artificial food additives and their biochemistry.
- Learn how to processing are involve in prebiotics and probiotics production in industry.
- Learning in the development and production of different bioactive product for human welfare.

**SEMESTER –IV
PRACTICAL
(Duration: 6hrs.)**

Note- Practical examination of Inorganic Pharmaceutical Biochemistry/Biochemical Toxicology and Clinical Research, Nutrition Biochemistry /Industrial Biochemistry will be conducted at the end of each semester during examination. Students will be given two exercises in the practical examination.

Lab I: Pharmaceutical Biochemistry and Industrial Biochemistry

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Pharmaceutical Biochemistry and Industrial Biochemistry

1. Qualitative analysis of lipids.
2. Pharmacokinetics studies by the linearity estimation.
3. Saponification value of fats.
4. Iodine number of oil.
5. Peroxide value of fats.
6. Artificial sweeteners stability analysis.
7. Drug stability, solubility analysis.
8. Preservative stability analysis.
9. Antibiotics sensitivity test for Amphotericin.
10. Pharmaceutical associated toxicity determination: Xenobiotics.
11. Qualitative and quantitative determination of nutritive value of food ingredients.
12. Qualitative and quantitative determination of plant proteins.
13. Qualitative and quantitative determination of fermented product.
14. Quality validation of process.
15. Neurotoxicology, Occupational toxicology testing.
16. Commercial enzyme estimation concern to beverages industries.
17. Standard Operating Procedure updating and review.

Book Suggested

1. Tietz Text book of Clinical Chemistry.
2. Clinical Chemistry by DF Calbreath.
3. Clinical Biochemistry by Varley.
4. Practical Biochemistry By S. P. Singh.
5. Practical Biochemistry by A.C. Dev.
6. Pharmacology by Rang and Dale.

COURSE OUTCOMES

- Estimate the pharmacokinetics of the pharmaceutical compounds in pure and combined form.
- Estimate and validate the Quality of process and developed product.
- Quality validation process for raw material and product.
- Quality validation for Standard operating procedure (SOPs) use for the product formulation and development.
- Students understanding the process of product registration and different guidelines which control the manufacturer to follow correct strategy for manufacturing of drug.
- Students learn how to write and file the patent; how to document clinical data of the concern drug research.

Lab II: Biochemical Toxicology & Clinical Research and Nutrition Biochemistry

Experiment - 1	30
Experiment -2	30
Viva Voce	20
Record	20
Total	100

Biochemical Toxicology and Clinical Research

1. Determination of LD50 /LC50
2. Determination of metal content in samples
3. Determination of Biological Oxygen Demand
4. Determination of Chemical Oxygen Demand
5. Biomarkers of neurotoxicity of organophosphate compounds.
6. Quality validation of process associated with toxicology.
7. Food processing and fortification test.
8. Enzymes related toxicity testing.
9. Metal toxicity determination in dietary dairy products.
10. Artificial additives based toxicity testing from dietary substance.
11. Microorganism base testing of dietary products.
12. Fungus base testing of dietary products.
13. Secondary metabolites base testing of dietary products.
14. Neurotoxicology, Occupational toxicology.
15. Biomarkers of neurotoxicity of organophosphate compounds.

Nutrition Biochemistry

1. Nutritional value determination for dietary products and substances.
2. Qualitative/ quantitative estimation of carbohydrate, protein, fatty acid and vitamins etc.
3. Identification of Vitamins according to source based identification.
4. Identification of Minerals according to source based identification.
5. Minerals quantitative estimation test.
6. Caloric metric measurement for dietary substances.
7. BMR calculation.

8. Electrolyte measurement.

Books Suggested

1. Tietz Text book of Clinical Chemistry.
2. Clinical Chemistry by DF Calbreath.
3. Clinical Biochemistry by Varley.
4. Practical Biochemistry By S. P. Singh.
5. Practical Biochemistry by A.C. Dev.
6. Pharmacology by Rang and Dale.
7. Biochemistry and Molecular Biology of Antimicrobial Drug Action by Franklin, T. & Snow J. A.
8. Pharmacology by S. D. Seth.
9. Pharmacology by Tara V Shahbhag.
10. Pathology by Edward.
11. Pharmacology by M C Prabhakar.
12. Pharmacology by Arvind Arora.

COURSE OUTCOMES

1. The students will be able to learn about the classification and functional properties of blood components.
2. Students understand the coagulation, anti-coagulation mechanism of blood and its disorders.
3. Students understand the biochemical, clinical, pathological and diagnostic aspects of diseases.
4. Students understand about the dietary types, requirements, utilization and functions of different class of diet.
5. Students getting the knowledge about the nutrition deficiency related disorders and balance diet.