ST. PHILOMENA'S COLLEGE (AUTONOMOUS)

Affiliated to University of Mysore
Accredited by NAAC with 'B^{++}' Grade
Bannimantap, Mysore, Karnataka,
India-570015

DEPARTMENT OF BIOCHEMISTRY

The Board of Studies in Biochemistry which met on 16/10/2024 has approved the syllabus and pattern of examination for NEP Semester V &VI for the Academic Year 2024-25

BOS COMMITTEE MEMBERS

Sl. No.	Name	Designation
1	Ms. Blessy George	Chairman
2	Dr. K. Kemparaju	University Nominee
3	Dr. Naveen S	External Member
4	Dr. Raghu Ram Achar	External Member
5	Dr. Shobha N	External Member
6	Ms. Samyukta	Internal Member
7.	Ms. Shruthi G	Internal Member

Semester V
BSc Biochemistry
Core Course Content

Course Title: **BIOCHEMISTRY OF BIOMOLECULES AND NUTRITION (Theory)**	Course Credits: **4**
Course Code: DSC-5T: **BIO C9-T**	T per week: 4
Total Contact Hours**: 60**	
Formative Assessment Marks:40	Summative Assessment Marks:60

Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies

Formative Assessment		
Assessment Occasion	**Assessment type**	**Weightage in Marks**
C1 First component	Test-40 marks test for 90 minutes	10
C1 Second Component	Assignment	10
C2 First component		10
C2 Second Component		10
Total		**40**

Course Objectives:

1. To understand the structure, classification, and biological roles of carbohydrates, including their nutritional importance and chemical properties.

2. To explore the structure, function, and nutritional significance of lipids and nucleic acids, focusing on their roles in metabolism and health.
3. To study the structure, classification, and functions of amino acids and proteins, emphasizing their nutritional value and role in metabolism.
4. To learn the basics of nutrition, the functions of vitamins and minerals, and the impact of antinutritional factors and food adulterants.

Course Learning Outcomes:

CLO	After the completion of this course, the student will be able to	Cognitive level
CLO-01	Demonstrate a comprehensive understanding of carbohydrate chemistry, including structure, properties, and biological functions, enabling them to analyze complex carbohydrate structures and their roles in biological systems.	Understand and Apply
CLO-02	Analyze the structure and function of lipids and nucleic acids, applying their knowledge to explain biochemical processes and their physiological significance.	Analyze
CLO-03	Apply their knowledge of amino acid structure and protein chemistry to analyze protein function, structure-function relationships, and the impact of protein modifications on biological processes.	Apply
CLO-04	Demonstrate a comprehensive understanding of the principles of human nutrition, including energy metabolism, macronutrients, micronutrients, and the impact of dietary factors on health and disease.	Understand & Apply

COURSE CONTENT:

UNIT I: Carbohydrates **15 hours**

Definition, empirical formulae, classification, biological importance. **Monosaccharides**: Configuration relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses: Oxidation, reduction, reducing property, condensation – phenyl hydrazine. Interconversion of aldoses and ketoses by chemical method. Stereochemistry of monosaccharides, (+) and (-), D and L, epimers, anomers, and diastreoisomers. Elucidation of open chain structure of glucose. Conformation of glucose (only structures), mutarotation. Structure of galactose, mannose, ribose and fructose. Structure and biological importance of deoxy sugars and sugar acids.

Disaccharides: Structures of Sucrose and Lactose, Biological Importance and structure of Isomaltose and Maltose.

Polysaccharides: Partial structure, occurrence and importance of Starch, Glycogen,

Cellulose and Pectin.

Glycosaminoglycans: Structure of amino sugars, neuraminic and muramic acid. Occurrence, importance and the structure of the repeating units of heparin, hyaluronic acid . Bacterial cell wall polysaccharide, peptidoglycans.

Nutritional aspects of Carbohydrates:

Dietary sources of carbohydrates, dietary fibres (types, beneficial & adverse effects), protein sparing action, Glycaemic index, lactose intolerance

UNIT II: Lipids and Nucleic acids **15 hours**

Classification and biological role, fatty acids – nomenclature of saturated and unsaturated fatty acids.

Acylglycerols: Mono, di and triacylglycerols. Saponification, saponification value, iodine value, acid value and significance. Rancidity, hydrolysis.

Phosphoglycerides: Structure of lecithin (phosphatidylcholine), cephalins, phosphatidyl inositol, plasmalogens, and cardiolipin. Biological role of phosphoglycerides.

Sphingolipids: Structure and importance of sphingomyelin.

Glycerosphingolipids: Composition and importance of gangliosides and cerebrosides. Prostaglandins: Types, structure of PGE_2, PGD_2 and PGF_2 Alpha. Biological roles of thromboxanes, leukotrienes, and prostaglandins.

Plasma lipoproteins: Types and functions.

Nutritional aspects of Fats:

Dietary sources of fats, visible and invisible fat, trans fats, essential and omega fattyacids and their biological importance, role of DHA and EPA.

Nucleic acids: Composition of DNA and RNA. Nucleosides and Nucleotides. Other functions of nucleotides – source of energy, component of coenzyme and second messengers. Chargaff's rule. Watson and Crick model of DNA. Effect of alkali and acid on DNA, effect of alkali on RNA and exposure of UV radiation on DNA. Chemical reactions of RNA and DNA. Melting of DNA (Tm). Types of RNA (mRNA, tRNA and rRNA), Secondary structures of tRNA – clover leaf model.

UNIT III: Amino acids and Proteins **15 hours**

Amino acids: Structure and classification of amino acids based on polarity. Reactions of the amino groups with Ninhydrin, Phenyl isothiocyanate, Fluro dinitro benzene. Reaction of carboxyl group – Hydrazine. Zwitterionic properties. pKa values, D & L notation
Peptides: Peptide bond, structure and biological importance of glutathione.

Proteins: Classification of proteins based on solubility, structure and functions with examples. Forces that stabilize the structure of proteins, Primary structure of proteins, methods of determining N- and C- terminal amino acids, amino acid composition, sequencing by Edman's degradation method. Secondary Structure – α helix. β-sheet, β-bend. Tertiary and quaternary structures- hemoglobin, denaturation and renaturation of proteins. Anfinsen's experiment.

Nutritional aspects of Proteins:
Dietary sources of proteins, Essential amino acids, nutritional classification, nutritive value of proteins- Protein Efficiency Ratio (PER) and biological value (BV). Nitrogen balance, mutual Supplementation of proteins. Malnutrition - Kwashiorkar and Marasmus

Unit IV: Nutritional Biochemistry 15hours

Introduction: Concept of Nutrition, calorific value of foods and its determination (Bomb calorimeter). Respiratory quotient, Basal Metabolic Rate, factors affecting BMR. Specific dynamic action (SDA) of foods.

Vitamins: Biochemical functions and deficiency symptoms of Thiamine, Folic acid, Vit-B_{12} and Vit - C. Fat soluble vitamins- A, D, E and K.

Mineral Metabolism: Physiological functions and deficiency disorders of Ca, Na, Fe, I

Antinutritional factors: Sources and harmful effects of anti-vitamins (Eg. Avidin, Dicoumarol), Natural toxicants (Eg. Lathyrus sativa) and adulterants (Eg. butter yellow, lead chromate).

REFERENCES:

1. Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W. Pratt, 4th Edition, John Wiley and Sons Inc, 2012
2. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications 2012
3. Biochemistry- the chemical reactions of living cells, David E Metzler, 2nd Edition, Elsevier Academic Press,
4. Fundamentals of Biochemistry, Jain, J.L, S.Chand publication 6th Edition, 2005.

5. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Freeman and company, 7th Edition, 2010.
6. Harper's Illustrated Biochemistry, Victor W Rodwell, et.al,31st edition, McGraw Hill Education Lange ® 2018.
7. Biochemistry, Lubert Stryer 5th edition 2015

V Semester

BSc (Biochemistry Practical)

Core Course Content

Course Title: **QUALITATIVE ANALYSIS OF BIOMOLECULES AND THEIR NUTRITIONAL ASPECTS (Practical)**	Course Credits: 2
Course Code: DSC-5P: **BIOC10-P**	P per week: 4
Total Contact Hours**:** 56	
Formative Assessment Marks:25	Summative Assessment Marks:25

Formative Assessment	
Assessment occasion	Weightage in marks
Class test (One class test) + Viva/ Continuous evaluation	20
Practical record	05
Total	25

Course objectives:

1. Identify and differentiate between mono saccharides (glucose, fructose, galactose), disaccharides (lactose, maltose, sucrose), and polysaccharides (starch, glycogen).
2. precipitation reactions of proteins, including those induced by salts, organic solvents, acidic reagents, heavy metal ions, and heat.
3. Acquire skills in the extraction and detection of starch and vitamins from natural sources.
4. Identify and analyze common food adulterants through relevant experiments.

Course Learning Outcomes:

CLO	After the completion of this course, the student will be able to	Cognitive level
CLO-01	Demonstrate proficiency in performing a variety of biochemical tests to identify and characterize carbohydrates, proteins, lipids, nucleic acids, and food components.	Apply & Analyze
CLO-02	Effectively analyze qualitative data from biochemical tests to identify unknown substances, determine the presence of specific functional groups, and assess the purity of samples.	Apply & Analyze
CLO-03	Develop the ability to design and conduct simple biochemical experiments, troubleshoot experimental challenges, and optimize experimental conditions for accurate and reliable results.	Create

Course content:

EXPERIMENTS:

1. **Carbohydrates:** mono saccharides (glucose, fructose, galactose) disaccharides (lactose, maltose, sucrose) and polysaccharides (starch, glycogen), ribose, deoxy ribose- Molisch Test, Iodine Test, Benedict's Test, Barfoed's Test, Seliwanoff's test, Bial's test, Tollen's Test, Fehling's Test, Picric Acid Test, Osazone Test.
2. **Proteins:** Biuret Test, Ninhydrin Test, Precipitation reactions of proteins- Precipitation by salts (half-saturation test), precipitation by organic solvents, precipitation by acidic reagents, precipitation by heavy metal ion, precipitation by heat; colour reactions of proteins (gelatin and albumin) and any five amino acids (tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine)- Xanthoproteic test, Millon's Test, Sakaguchi Test, Hopkins- Cole Test, Lead acetate test,
3. **Lipids:** solubility, acrolein test, Salkowski test, Lieberman-Burchard test.
4. **Nucleic acids:** diphenylamine test, orcinol test
5. **Nutrition experiments**

A. Extractions and detection of iron from drumstick leaves, vitamin c from natural sources,

B. Detection of food adulterants.

REFERENCES :

1. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
2. Biochemical methods, S. Sadasivam , A. Manickam, 3rd Edition, New Age International Pvt Ltd, 2007
3. An Introduction to Practical Biochemistry, David Plummer , 3rd edition 2017
4. Laboratory manual in Biochemistry , J. Jayaraman 2011

Semester V
BSc Biochemistry
Core Course Content

Course Title: **HUMAN PHYSIOLOGY AND ENZYMOLOGY (Theory)**	Course Credits: **4**
Course Code: DSC-6T: **BIO C11**	T per week: 4
Total Contact Hours**: 60**	
Formative Assessment Marks:40	Summative Assessment Marks:60

Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies

Formative Assessment		
Assessment Occasion	**Assessment type**	**Weightage in Marks**
C1 First component	Test-40 marks test for 90 minutes	10
C1 Second Component	Assignment	10

C2 First component		10
C2 Second Component		10
Total		**40**

Course Objectives:

1. To understand the basic body plan, nervous, respiratory, cardiovascular, and muscular systems in humans, with a focus on structure, function, and physiological mechanisms.
2. To explore the structure and function of bones, digestive, hepatic, excretory, and endocrine systems, including the regulation of hormones and metabolism.
3. To study the nature, classification, and catalytic properties of enzymes, including enzyme-substrate interactions and the role of cofactors and isoenzymes.
4. To understand enzyme kinetics, the Michaelis-Menten equation, factors affecting enzyme activity, and mechanisms of enzyme inhibition.

Course Learning Outcomes:

CLO	After the completion of this course, the student will be able to	Cognitive level
CLO-01	Apply their knowledge of human anatomy and physiology to analyze the structure and function of the nervous, respiratory, cardiovascular, and muscular systems, and explain their interrelationships in maintaining homeostasis.	Apply
CLO-02	Analyze the structure and function of the skeletal, digestive, hepatic, excretory, and endocrine systems, and explain how these systems interact to maintain homeostasis.	Apply & Analyze
CLO-03	Apply their understanding of enzyme kinetics and mechanisms to analyze the catalytic properties of enzymes, predict the effects of inhibitors and activators, and interpret experimental data to elucidate enzyme function.	Apply & Analyze
CLO-04	Design and conduct experiments to investigate enzyme kinetics, inhibition, and regulation, interpreting data to elucidate enzyme mechanisms and their physiological significance.	Create

Course content:

Part-A: HUMAN PHYSIOLOGY

UNIT I: **15 hours**

Basic body plan in humans & Location of organs.

Nervous System: Brief outline of nervous system, Neurons – types, structure of multipolar neuron, mechanism of nerve impulse transmission- along axon, across synapse. Action potential & resting potential. Neurotransmitters – Excitatory & Inhibitory with examples.

Respiratory system: functions of lungs, mechanism of respiration (pulmonary ventilation), gas exchange mechanism, biochemical events in the transport of gases & factors affecting, role of lungs in acid-base balance.Hypoxia, emphysema.

Cardio-vascular system: functions of heart. Blood vessels – types, Overview & functions: blood pressure, heart rate, ECG. Body fluids – blood (composition, structure & functions of blood cells), blood clotting mechanism, Lymph and CSF.

Muscular System: Types of muscles and their structure. Ultra structure of skeletal muscle. Contractile & regulatory proteins of muscle. Sliding filament model of skeletal muscle contraction.

UNIT II: **15 hours**

Bone and Cartilage: Structure and types of bone and cartilage. Long bone – Composition, structure, growth & remodeling, factors affecting.

Digestive System and GIT: Digestion, absorption & transport of carbohydrates, lipids and proteins. Role of various enzymes involved in digestive process.

Hepatic System: Structure of a liver lobule. Role of liver in metabolic, storage and detoxification.

Excretory System: Brief outline of excretory system, formation of urine – Glomerular filtration, tubular reabsorption & secretions. Role of kidney in acid-base balance. Regulation of kidney function.

Endocrine System: Brief outline of various endocrine glands and their secretions. Dynamic balance and regulation of hormonal secretions. Classification of hormones based

on structure and site of production. Physiological role of hormones of hypothalamus, pituitary, adrenal, thyroid, pancreas and gonads. Regulation of their secretion.

Part-B: ENZYMOLOGY

UNIT III: 15 hours

Introduction to enzymes:

Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme, IUBMB classification of enzymes with examples. International Units of enzyme activity, specific activity.

Monomeric and oligomeric enzymes- multifunctional enzymes and multi- enzyme complexes, isoenzymes- lactate dehydrogenase.

Features of enzyme catalysis:

Catalysis, reaction rates and thermodynamics of reaction. Activation energy and transition state theory, catalytic power and specificity of enzymes (concept of active site), Theories of enzyme catalysis- Fischer's lock and key hypothesis, Koshland's induced fit hypothesis.

UNIT IV: 15 hours

Enzyme kinetics of single substrate reactions:

Michaelis-Menten equation, equilibrium constant – mono substrate reactions, relationship between initial velocity and substrate concentration, Factors affecting the rate of chemical reactions - enzyme concentration, substrate concentration- pH, temperature and metal ions. Line weaver- Burk plot. Determination of Vmax & Km from L-B plot and their significance, K_{cat} and turnover number.

Enzyme inhibition:

Reversible inhibition- competitive, uncompetitive, non-competitive with graphical representations using L-B plots, Evaluation of Km and Vmax in presence of inhibitor mixed and substrate. Irreversible inhibition- Suicide inhibition - antibiotics as inhibitors- penicillin.

V Semester

BSc (Biochemistry Practical)

Course Title: **HUMAN PHYSIOLOGY AND ENZYMOLOGY (Practical)**	Course Credits: 2
Course Code: DSC-6P: **BIOC12-P**	P per week: 4
Total Contact Hours**: 56**	
Formative Assessment Marks:25	Summative Assessment Marks:25

Formative Assessment	
Assessment occasion	Weightage in marks
Class test (One class test) + Viva/ Continuous evaluation	20
Practical record	05
Total	25

Course objectives:

1. Perform blood typing experiments and interpret the results.
2. Gain proficiency in using a Haemocytometer for the enumeration of red and white blood cells.
3. Perform experiments to estimate the hemoglobin content in blood.
4. Develop practical skills in isolating and studying enzymes.
5. Investigate the influence of pH, temperature, and substrate concentration on enzyme activity.

Course learning outcomes:

CLO	**After the completion of this course, the student will be able to**	**Cognitive level**
CLO-01	Demonstrate proficiency in performing a variety of biochemical techniques, including hematological assays, microscopy, and enzyme activity measurements.	Apply & Analyze
CLO-02	Effectively analyze experimental data to calculate relevant parameters, interpret results, and draw conclusions about physiological and biochemical processes.	Apply & Analyze
CLO-03	Develop the ability to design and conduct simple biochemical experiments, troubleshoot experimental challenges, and optimize experimental conditions to achieve reliable and accurate results.	Create

Course content:

EXPERIMENTS: HUMAN PHYSIOLOGY

1. Determination of ABO bloodgrouping
2. Enumeration of RBC and WBC count using Haemocytometer
3. Separation of Serum and Plasma from Blood
4. Estimation of hemoglobin content in blood
5. Determination of blood pressure
6. Understanding principle, working & handling of simple microscope
7. Demonstration of biosafety & sterilization techniques

EXPERIMENTS: ENZYMOLOGY

1. Isolation of Acid phosphatase and demonstration of its activity.
2. Salivary amylase/β-amylase

a. Construction of Maltose/glucose calibration curve by DNS method and determination of activity of amylase

b. Determination of specific activity of amylase

c. Determination of pH optimum of amylase.

d. Determination of Km and Vmax of amylase.

e. Determination of initial velocity [time kinetics] ofamylase.

f. Determination of optimum temperature of amylase.

g. Effect of sodium chloride on amylase.

3. Determination of activity of yeast invertase.

REFERENCES:-

1. Essentials of Medical Physiology, K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi., 2019
2. Text book of Medical Physiology- C,Guyton and John.E. Hall. Miamisburg, OH, U.S.A, 12th edition 2011
3. Textbook of Practical Physiology , C.L. Ghai, Jaypee

brother's medical publishers, New Delhi, 10th edition 2022
4. A Hand book of practical Microbiology, R. Saravanan , D. Dhachinamoorthi ,CH. MM. Prasada Rao , 2019
5. Essentials of Medical Physiology , K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi., 2019
6. Text book of Medical Physiology- C,Guyton and John.E. Hall. Miamisburg, OH, U.S.A, 12th edition 2011
7. Textbook of Practical Physiology, C.L. Ghai, Jaypee brother's medical publishers, New Delhi, 10th edition 2022
8. A Hand book of practical Microbiology, R. Saravanan, D. Dhachinamoorthi , CH. MM. Prasada Rao , 2019
9. An introduction to Practical Biochemistry, David Plummer, 3r edition 2017
10. Laboratory manual in Biochemistry, Jayaraman J,New Age International publications, 2011
11. Practical Manual of Biochemistry, Sattanathan G., Swaminathan P. and Balasubramanian B. Sky fox press, 2020
12. Practical manual of Biochemistry, S.P Singh, 7th edition, CBS publications, 2013.
13. Sawhney, S. K., and Randhir Singh. Introductory practical biochemistry. Alpha Science Int'l Ltd., 2000.

Semester VI
BSc Biochemistry
Core Course Content

Course Title: **METABOLISM WITH CLINICAL CORRELATIONS (Theory)**	Course Credits: **4**
Course Code: DSC-7T: **BIO C13**	T per week: 4
Total Contact Hours**: 60**	
Formative Assessment Marks:40	Summative Assessment Marks:60

Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies

Formative Assessment		
Assessment Occasion	**Assessment type**	**Weightage in Marks**

C1 First component	Test-40 marks test for 90 minutes	10
C1 Second Component	Assignment	10
C2 First component		10
C2 Second Component		10
Total		**40**

Course Objectives:

1. To understand the principles of bioenergetics, including thermodynamics, ATP synthesis, oxidative phosphorylation, and the chemiosmotic hypothesis of energy production.
2. To explore the metabolic pathways of carbohydrates, including glycolysis, the TCA cycle, gluconeogenesis, and the pentose phosphate pathway, and their regulatory mechanisms.
3. To study the metabolism of lipids, including fatty acid oxidation, synthesis, and cholesterol metabolism, with emphasis on energy production and regulation.
4. To examine the metabolism of amino acids and nucleic acids, including their catabolism, biosynthesis, and significance in nitrogen balance and nucleotide formation.

Course learning outcomes:

CLO	After the completion of this course, the student will be able to	Cognitive level
CLO-01	Apply thermodynamic principles to understand energy transfer and utilization in biological systems, focusing on the role of ATP in cellular metabolism and the mechanisms of oxidative phosphorylation.	Apply
CLO-02	Analyze the key pathways of carbohydrate metabolism, including glycolysis, gluconeogenesis, glycogenolysis, the TCA cycle, and the pentose phosphate pathway, to understand energy production and utilization in the cell.	Apply & Analyze
CLO-03	Apply their knowledge of lipid and nucleic acid metabolism to analyze metabolic pathways, predict the effects of metabolic disorders, and evaluate therapeutic interventions targeting these pathways.	Apply & Analyze
CLO-04	Analyze the metabolic pathways of amino acid catabolism and biosynthesis, correlating these processes with nitrogen balance, energy production,	Analyze

	and the synthesis of other biomolecules.	

Course content:

UNIT I: **15 hours**

Bioenergetics: Laws of thermodynamics, free energy change, equilibrium constant, ATP cycle, phosphorylation potential, and phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, Oxidative phosphorylation: Proton gradient generation, redox loop, Q cycle, Proton pumping. The electron transport chain - Peter Mitchell's Chemiosmotic hypothesis and Proton motive force. Fo-F1 ATP synthase, structure and mechanism of ATP synthesis.

UNIT II: **15 hours**

Metabolism: Anabolism and catabolism, compartmentalization of metabolic pathways.

Metabolism of Carbohydrates: Reactions and energetics of glycolysis, entry of fructose, galactose, mannose and lactose into glycolytic pathway. Fates of pyruvate - conversion of pyruvate to lactate, alcohol and acetyl CoA. Cori's cycle.

Reactions and energetics of TCA cycle, amphibolic and integrating roles of TCA cycle. Anaplerotic reactions. Regulatory steps of glycolysis and TCA cycle, Gluconeogenesis and glycogenolysis. Pentose phosphate pathway and its significance.

UNIT III: **15 hours**

Metabolism of Lipids:

Introduction, hydrolysis of triacylglycerols, transport of fatty acids into mitochondria, β-oxidation of saturated and unsaturated fatty acids, ATP yield from fatty acid oxidation. Biosynthesis of saturated and unsaturated fatty acids. Fatty Acid Synthase complex. Elongation of Fatty acid (Mitochondrial elongation). Cholesterol metabolism: synthesis, degradation

UNIT IV: **15 hours**

Metabolism of Amino acids and Nucleic Acid: General mechanism of amino acid metabolism: Deamination- oxidative and non – oxidative deamination, transamination, decarboxylation (biologically important amines) and desulphuration. Catabolism of carbon skeleton of amino acids, glycogenic and ketogenic amino acids. Urea cycle and its significance.

Degradation of nucleic acids, action of nucleases-DNase I and II, RNase and phosphodiesterase's. Catabolism of purines and pyrimidines. Salvage pathways. De novo biosynthetic pathways of purine and pyrimidine nucleotides. Conversion of ribonucleotides to deoxy ribonucleotides.

REFERENCES

1. Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W. Pratt, 4th Edition, John Wiley and Sons Inc, 2012
2. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications 2012
3. Biochemistry- the chemical reactions of living cells, David E Metzler, 2nd Edition, Elsevier Academic Press,
4. Fundamentals of Biochemistry, Jain, J.L, S.Chand publication 6th Edition, 2005.
5. Biochemistry, Jeremy M. Berg, John L. Tymoczko, Lubert Stryer, Freeman and company, 7th Edition, 2010.
6. Harper's Illustrated Biochemistry, Victor W Rodwell, et.al,31st edition, McGraw Hill Education Lange ® 2018.

VI Semester

BSc (Biochemistry Practical)

Core Course Content

Course Title: **METABOLISM WITH CLINICAL CORRELATIONS (Practical)**	Course Credits: 2
Course Code: DSC-7P: **BIOC14-P**	P per week: 4

Total Contact Hours: 56	
Formative Assessment Marks:25	Summative Assessment Marks:25

1.

Formative Assessment	
Assessment occasion	Weightage in marks
Class test (One class test) + Viva/ Continuous evaluation	20
Practical record	05
Total	25

Course objective:

1. Gain practical skills in performing accurate blood glucose measurements
2. Correlate enzyme activity with physiological conditions and potential clinical implications
3. Develop practical skills in handling samples, chemical reactions, and spectrophotometric measurements
4. Gain hands-on experience in sample extraction, purification, and quantification techniques.

Course learning outcomes:

CLO	**After the completion of this course, the student will be able to**	**Cognitive level**
CLO-01	Demonstrate proficiency in performing a variety of clinical laboratory techniques for the analysis of biological fluids, including blood and urine.	Analyize
CLO-02	Effectively analyze laboratory data to assess patient health status, diagnose diseases, and monitor treatment efficacy.	Apply & Analyze
CLO-03	Adhere to quality control measures and safety protocols in the clinical laboratory setting.	Apply

Course content:

I : Experiments

1. Estimation of Blood glucose
2. Estimation of Urea
3. Estimation of creatinine

4. Estimation of cholesterol
5. Qualitative analysis of urine for
   - urea, uric acid, creatinine and amino acids
   - Chlorides, sulphates, phosphates and ammonia.
   - Abnormal constituents such as glucose, albumin, bile pigments, bile salts and ketone bodies.
6. Liver function test- Assay of SGOT, SGPT

II: Report:

Visit to scientific/research institute/Clinical laboratory- Tour report.

OR

Submission of assignment on recent trends in biochemistry

REFERENCES:

1. Practical Biochemistry, Geetha Damodaran, Jaypee, 2011
2. Biochemical methods, S. Sadasivam , A. Manickam,

   3rd Edition, New Age International Pvt Ltd, 2007
3. An Introduction to Practical Biochemistry, David Plummer , 3rd edition 2017
4. Laboratory manual in Biochemistry , J. Jayaraman 2011

Semester VI
BSc Biochemistry
Core Course Content

Course Title: **MOLECULAR BIOLOGY AND IMMUNOLOGY (Theory)**	Course Credits: **4**
Course Code: DSC-8T: **BIO C15**	T per week: 4
Total Contact Hours**: 60**	
Formative Assessment Marks:40	Summative Assessment Marks:60

Pedagogy: Written Assignment/Presentation/Project / Term Papers/Seminar/Field studies

Formative Assessment		
Assessment Occasion	**Assessment type**	**Weightage in Marks**
C1 First component	Test-40 marks test for 90 minutes	10
C1 Second Component	Assignment	10
C2 First component		10
C2 Second Component		10
Total		**40**

Course Objectives:

1. To explore the mechanisms of DNA replication, the role of mutations, and the experiments leading to the identification of DNA as genetic material.

2. To understand transcription, the genetic code, translation mechanisms, and the regulation of gene expression in both prokaryotes and eukaryotes.

3. To introduce the principles and techniques of genetic engineering, including DNA manipulation, PCR, and blotting techniques, and explore applications like transgenic organisms and gene therapy.

4. To study the types of immunity, the role of immune cells and organs, antibody structure, immunological disorders, and common immunological techniques.

Course learning outcomes:

CLO	After the completion of this course, the student will be able to	Cognitive level
CLO-01	Analyze the molecular mechanisms underlying DNA replication, mutation, and repair, and apply this knowledge to understand genetic variation and its impact on cellular processes.	Apply & Analyze
CLO-02	Apply their understanding of gene expression to analyze the regulation of gene expression in prokaryotes and eukaryotes, and predict the consequences of genetic alterations on cellular processes.	Apply & Analyze
CLO-03	Apply their knowledge of molecular biology techniques to understand the principles of genetic engineering, including gene cloning, recombinant DNA technology, and its applications in biotechnology.	Apply & Analyze
CLO-04	Analyze the structure and function of the immune system, including the components involved in innate and adaptive immunity, and the mechanisms underlying immune responses to pathogens and foreign substances.	Apply & Analyze

Course content:

UNIT I: DNA Replication and Mutation 15 hours

History: Identification of DNA as genetic material- Experiments of Griffith, Hershey and Chase: Watson and Crick model of DNA. Central dogma of molecular biology and its modification

Replication: Types of replications -Conservative, semi conservative and dispersive: Evidence for semi conservative replication- Messelson and Stahl experiment: Mechanism of semi conservative replication- Steps involved in replication, Enzymes and proteins involved in replication

Mutation: Concept of mutation, Mutagens – chemical and physical, Molecular basis of mutation: spontaneous and induced mutations, effect of HNO_2, alkylating agents, intercalating agents and UV-radiation. Point mutations: Concept of missense, nonsense and frame shift mutations.

UNIT II: Transcription, Genetic code, Translation and Regulation of gene expression 15 hours

Transcription: Types of RNA, RNA polymerases, promoters, enhancers, silencers, role of sigma factor, Structure of mRNA in prokaryotes, Mechanism- initiation, elongation and termination (Rho- dependent and independent), post transcriptional processing: capping, splicing and poly adenylation.

Genetic code: characteristics of genetic code, wobble hypothesis.

Translation: Mechanism of translation - amino acid activation, charging of tRNA, initiation, elongation, and termination; post-translational modification; Inhibition of protein synthesis by antibiotics.

Regulation of Gene expression:

General aspects of regulation, transcriptional regulation - inducible and repressible system, Operon concepts - lactose, tryptophan operons, Regulation of translation. Brief account of Eukaryotic gene expression.

Unit III : Genetic Engineering **15 hour**

Historical development, Aim and scope of genetic engineering.

Isolation of DNA, Cutting of DNA by restriction endonucleases – staggered cut and blunt end.

Outline of techniques of genetic engineering: Cutting genomic DNA, Separation of fragments by agarose gel electrophoresis. Vectors, plasmids-PBR 322, insertion of foreign DNA into Vectors. Transfections of vectors into host cells. cDNA (brief discussion), principles of polymerase chain reaction (PCR) and applications.
Blotting techniques: Principle of Southern, Northern blotting and Western blotting.
Applications of Genetic engineering.

1) Transgenic plants, transgenic animals and gene therapy.
2) Human genome project.

Unit : IV Immunology **15 hours**

Immunity: Types of immunity, Cellular and humoral immunity, cellular basis of immunity. Role of immunologically important organs and cells- bone marrow, thymus, spleen and lymphocytes. Formation and functions of T & B Lymphocytes and macrophages. Helper T-cells and killer T-cells.

Antigens: Definition, Haptens, Epitopes, antigens and antigenicity.

Antibodies: Definition, types and their functions. Structure of a typical Immunoglobulin (lgG - Light chain, heavy chain, hyper- variable region, constant domains, Fab and Fc regions).

Immunization : Vaccination -Vaccines and their preparations, primary and secondary response.

Immunological disorders: Allergy (hyper sensitivity reactions), AIDS.

Immunological techniques: Precipitation reaction, Immuno diffusion, RIA ELISA

REFERENCES:

1. Cox, Michael M. Lehninger principles of biochemistry. Freeman, 2013.
2. Lubert Stryer. Biochemistry, 5th edition , 2006
3. Owen, Judith A., Jenni Punt, and Sharon A. Stranford. Kuby immunology. New York: WH Freeman, 2013.
4. Delves, Peter J., Seamus J. Martin, Dennis R. Burton, and Ivan M. Roitt. & Roitt's essential immunology. Vol. 20. John Wiley & Sons, 2011.
5. Molecular Biology - David Friefelder, Narosa Publication- house Pvt. Ltd. New Delhi,2020
6. A Textbook of Biochemistry: Molecular and Clinical Aspects S. Nagini. 2nd edition . Sci Tech Publ., Chennai, 2007
7. Principles of Biochemistry, Donald Voet, Judith G Voet, Charlotte W. Pratt, 4th Edition, John Wiley and Sons Inc, 2012
8. Lehninger- Principles of Biochemistry; DL Nelson and MM Cox [Eds), 6th Edn. Macmillan Publications 2012
9. Biochemistry, Lubert Stryer , W.H Freeman and Company Limited
10. T.A. Brown, Gene cloning: An introduction, Chapman and Hall, 1995.

VI Semester

BSc (Biochemistry Practical)

Core Course Content

Course Title: **MOLECLAR BIOLOGY AND IMMUNOLOGY (Practical)**	Course Credits: 2

Course Code: DSC-8P: **BIOC16-P**	P per week: 4
Total Contact Hours**:** 56	
Formative Assessment Marks:25	Summative Assessment Marks:25

2.

Formative Assessment	
Assessment occasion	Weightage in marks
Class test (One class test) + Viva/ Continuous evaluation	20
Practical record	05
Total	25

Course objective:

1. To demonstrate proficiency in isolating DNA and RNA from various sources
2. To accurately determine the concentration of isolated DNA and RNA through spectrophotometric analysis
3. To demonstrate competence in separating and visualizing nucleic acids through agarose gel electrophoresis
4. To master the techniques of blood grouping and pregnancy testing, showcasing skills in immunodiagnostic assays.
5. To master the enzyme-linked immunosorbent assay (ELISA) technique, showcasing proficiency in quantitative immunodetection.
6. To demonstrate proficiency in performing and interpreting agglutination reactions, showcasing skills in immunological testing.

Course learning outcomes:

CLO	**After the completion of this course, the student will be able to**	**Cognitive level**
CLO-01	Demonstrate proficiency in performing a variety of biochemical techniques, including nucleic acid isolation, protein analysis, immunological assays, and hematological analyses.	Apply
CLO-02	Effectively analyze experimental data to quantify biomolecules, interpret results, and draw conclusions about biological processes and human health.	Apply & Analyze
CLO-03	Develop the ability to design and conduct biochemical experiments, troubleshoot experimental challenges, and	Create

	optimize experimental conditions to achieve reliable and accurate results.	

Course content:

EXPERIMENTS: MOLECULAR BIOLOGY

1. Isolation of DNA from banana/endosperm of coconut/ bacteria / any other source
2. Isolation of RNA from spinach leaves/any other source
3. Determination of DNA
4. Determination of RNA
5. Purity check by UV spectrophotometer (DNA and RNA ratio)
6. Agarose gel electrophoresis of nucleic acids

I. EXPERIMENTS: IMMUNOLOGY

1. Blood grouping and pregnancy test
2. ELISA test/assay
3. Total leukocyte count
4. Differential leukocyte count
5. Radial immune diffusion test
6. Agglutination reactions
7. Serum electrophoresis

REFERENCES :

1. Molecular Biology: A Laboratory Manual by by Ashwani Kumar S.K. Gakhar, Monika Miglani, 2019
2. Wilson And Walkers Principles And Techniques of Biochemistry And Molecular Biology 8th ed (Sae) by Hofmann, 1983
3. Laboratory Manual of Microbiology, Biochemistry and Molecular Biology by J. Saxena, M. Baunthiyal, I. Ravi , 2015

4. Biochemical methods, S. Sadasivam , A. Manickam, 3rd Edition, New Age International Pvt Ltd, 2007

5. An Introduction to Practical Biochemistry, David Plummer , 3rd edition 2017

6. Laboratory manual in Biochemistry , J. Jayaraman 2011

7. A handbook of practical and clinical immunology , 2017 G.P Talwar and S.K Gupta

8. Practical Immunology ,2000, Frank C Hey, Publisher: John Wiley and Sons Ltd

9. An Introduction to Practical Biochemistry, David Plummer , 3rd edition 2017

10. Laboratory manual in Biochemistry , J. Jayaraman 2011.

Blueprint of End semester examination

B.Sc. Semester V/VI Examination
Model question paper, (Theory)
Biochemistry

Time: 2 ½h Max. Marks: 60

NOTE: All sections are compulsory

PART – A

1. Answer any ***five*** of the following 5 x 2 = 10

a)
b)
c)
d)
e)
f)
g)

PART – B

Answer any ***four*** of the following 4 x 5 = 20

2.
3.
4.
5.
6.
7.

PART – C

Answer any ***three*** of the following 3 x 10 = 30

8.

9.

10.

11.

12.

Note: PART C may include sub questions a, b