



KUVEMPU UNIVERSITY

Jnanasahyadri, Shankaraghatta - 577 451

Scheme and Syllabus for

B.Sc. Degree with Biochemistry
as one of the Two Major Subjects (Double Major
Model) (NEP-2020, Model Curriculum of KSHEC,
Bengaluru)



for

V and VI Semesters
(With effect from 2023-24)

Department of Studies in Biochemistry
Kuvempu University, Jnanasahyadri, Shankaraghatta – 577 451

OCTOBER, 2023

Approved by
UG Board of Studies in Biochemistry
Kuvempu University

**LISTING OF COURSES V and VI SEMESTER FOR THE FOUR
YEAR UNDER-GRATUE PROGRAMME IN BIOCHEMISTRY**

Sem. No.	Course Category	Course Code	Course Title	Credits Assigned	Instructional hours per week		Duration of Exam (Hrs.)	Marks		
					T	P		IA	Exam	Total
V	DSC	BIO C9-T	BIOCHEMISTRY OF MACROMOLECULES AND NUTRITION	4	4		2	40	60	100
		BIO C10-P	QUALITATIVE ANALYSIS OF MACROMOLECULES AND NUTRITION	2		4	3	25	25	50
		BIO C11-T	HUMAN PHYSIOLOGY AND ENZYMOLOGY	4	4		2	40	60	100
		BIO C12-P	HUMAN PHYSIOLOGY AND ENZYMOLOGY	2		4	3	25	25	50
VI	DSC	BIO C13-T	METABOLISM WITH CLINICAL CORRELATION	4	4		2	40	60	100
		BIO C14-P	METABOLISM WITH CLINICAL CORRELATION	2		4	3	25	25	50
		BIO C15-T	MOLECULAR BIOLOGY, IMMUNOLOGY AND GENETIC ENGINEERING	4	4		2	40	60	100
		BIO C16-P	MOLECULAR BIOLOGY, IMMUNOLOGY AND GENETIC ENGINEERING	2		4	3	25	25	50

SEMESTER V
DSC – BIO C9

COURSE TITLE	BIOCHEMISTRY OF MACROMOLECULES AND NUTRITION
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course Outcome:

The course provides fundamental insights on the types of macromolecules; and unique structural features, chemical properties and biological importance of each and basics of nutrition.

Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude	x	x	x	x								
Critical thinking		x								x		x
Subject clarity	x	x					x					x
Analytical Skill	x				x	x				x		

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, formation of glycosides, acylation, methylation, condensation – phenyl hydrazine, addition – HCN. Stereochemistry of monosaccharides, (+) and (-), D and L, epimers, anomers, and diastereoisomers. Elucidation of open chain structure and ring 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: Establishment of structures of Sucrose and Lactose, Biological Importance and structure of Isomaltose, Trehalose and Maltose.

Polysaccharides: Partial structure, occurrence and importance of Starch, Glycogen, Inulin, Cellulose, Chitin, and Pectin.

Glycosaminoglycans: Structure of amino sugars, neuraminic and muramic acid. Occurrence, importance of heparin, hyaluronic acid, teichoic acid and chondroitin sulphate. Bacterial cell wall polysaccharide, peptidoglycans.

Nutrition of carbohydrates: Dietary sources, dietary fibers and protein sparing action.

UNIT II: Amino acids and Proteins

15 hours

Amino acids: Structure and classification of amino acids (Based on polarity). Essential and Non-essential amino acids. Reactions of the amino groups with HNO_2 , LiAlH_4 . Ninhydrin, Phenyl isothiocyanate, DANSYL Chloride, Fluorodinitro 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 structure, 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.

Nutrition of proteins- Dietary sources, nutritional classification, Nutritional value of proteins –PER, NPU and Biological value of proteins (BV). Nitrogen balance, mutual supplementation of proteins.

UNIT III: Lipids and Nucleic acids

15 hours

Classification and biological role, fatty acids – Nomenclature of saturated and unsaturated fatty acids with an example for each, Dietary sources, Essential and Non essential fatty acids, Invisible fat.

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

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

Sphingolipids: Structure and importance of sphingomyelin.

Glycerosphingolipids: Structure and importance of gangliosides and cerebroside.

Prostaglandins: Structure and biological importance of PGE₂ and PGI₂. Biological roles of Leukotrienes and Thromboxanes.

Plasma lipoproteins: Types and functions.

Nucleic acids: Composition of DNA and RNA. Nucleosides and Nucleotides. Chargaff's rule. Watson and Crick model of DNA. UV absorption, Effect of alkali and acid on Nucleic acids, Chemical reactions of RNA and DNA. Melting of DNA (T_m). Types of RNA (mRNA, tRNA and rRNA), Secondary structures of tRNA – clover leaf model.

Unit IV: Nutrition

15 hours

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, Riboflavin, Niacin, Pantothenic acid, Pyridoxine, Biotin, Folic acid, Vit-B₁₂ and Vit - C. Fat soluble vitamins- A, D, E and K.

Mineral Metabolism: Physiological functions and deficiency disorders of Ca, P, Na, K, Cl, Mg, 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

8. Swaminathan, M (2009). Text book of food and nutrition. Bappco publishers.
9. Sri Lakshmi, B. (2015). Nutrition Science. New Age International (P) Ltd. New Delhi

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	20
SEMINARS/CLASS WORK	10
ASSIGNMENT/ OPEN DISCUSSION	10
TOTAL	40

SEMESTER V
DSC BIO - C 10 PRACTICAL

COURSE TITLE	QUALITATIVE ANALYSIS OF MACROMOLECULES AND NUTRITION
COURSE CREDITS	02
CONTACT HOURS	4 HOURS/WEEK
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	25
SUMMATIVE ASSESSMENT MARKS	25

Course Outcome:

The practical course will enable the students to learn the principles of reactions pertaining to different macromolecules. They will be able to qualitatively identify the presence of specific macromolecules or amino acids when provided with solution of a mixture of biomolecules.

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, DPA Test, Tollen's Test, Fehling's Test, Picric Acid Test, Osazone Test.
2. **Proteins:** Biuret Test, Ninhydrin Test, colour reactions of proteins (casein 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, Pauly's Diazo Test.
3. **Lipids:** solubility, acrolein test, Salkowski test, Lieberman-Burchard test. Determination of saponification value, iodine number.
4. **Nutrition:** Detection of adulterants in food stuffs, Vit-C from lemon/chillies/gooseberries, Estimation of total sugars in food samples,

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

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
RECORD / VIVA VOCE	10
CONTINUOUS EVALUATION AND CLASS TEST	15
TOTAL	25

SEMESTER V
DSC BIO C11

COURSE TITLE	HUMAN PHYSIOLOGY AND ENZYMOLOGY
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course Outcome:

- Students will be able to describe cell structure and functions, how cells form and divide, and how they differentiate and specialize. the cyclical events of cell division and types of cell divisions. Student's knowledge with regard to the process of cell death and cell aging will enhance to its core.
- Physiology involves the study of how living systems function, from the molecular and cellular level to the system level, and emphasizes an integrative approach to studying the biological functions of the human body.
- Enzymology topics will enable students to describe structure, functions and the mechanism of action of enzymes. Learning kinetics of enzyme catalyzed reactions and enzyme inhibitions and regulatory process, Enzyme activity, Enzyme Units, Specific activity.

Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude	x	x	x									
Critical thinking		x										
Subject clarity	x	x									x	
Analytical Skill	x				x	x						

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:** structure and 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.

- **Cardio-vascular system:** Structure and functions of heart. Blood vessels – types, Overview & functions: Cardiac cycle, cardiac output, regulation of CVS, 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. Ultrastructure of skeletal 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:** Anatomy of GIT and accessory organs, 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- Monomeric enzymes, multifunctional enzymes, oligomeric enzymes and multi- enzyme complexes, isoenzymes- lactate dehydrogenase.

Features of enzyme catalysis:

Catalysis, 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. Lineweaver- Burk plot. Determination of V_{max} & K_m from L-B plot and their significance, K_{cat} and turnover number.

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

REFERENCES:

1. Chatterjee C C, Human physiology, Medical allied Agency. New Delhi 2020
2. Gerard J Tortora, Bryan H Derrickson. Principles of anatomy and physiology, 13th edition, John Wiley & Sons 2000
3. Gyton and Hall, Textbook of medical physiology, 10th edition, Elsevier Health Sciences 2015
4. Sembulingam K & Prema Sembulingam, Essentials of medical physiology, 3rd edition, Jaypee Brothers, 2019
5. Thomas D. Pollard, William C. Earnshaw, Jennifer Lippincott-Schwartz and Graham T. Johnson, Cell Biology, 3rd edition, Elsevier 2017

6. Lodish, Berk, Kaiser, Krieger et al, Molecular Cell Biology, 6th edition, 2010
7. Bruce Alberts, Hopkin, Johnson Morgan, Raff, Roberts, and Walter, Essential Cell Biology, 5th edition, W.W. Norton & Company, 2019
8. Cox, Michael M. Lehninger principles of biochemistry. Freeman, 2013.
9. Lubert Stryer. Biochemistry, 5th edition , 2006
10. Palmer, Understanding enzymes, 4th edition, Prentice Hall/Ellis Horward, Landon 2000
11. Price, Nicholas C., and Lewis Stevens. Fundamentals of Enzymology. Oxford Science Publications. Second edition. New York, 2010
12. Buchholz, Klaus, Volker Kasche, and Uwe Theo Bornscheuer. Biocatalysts and enzyme technology. John Wiley & Sons, 2012.
13. Voet, Donald, Judith G. Voet, and Charlotte W. Pratt. "Fundamentals of Biochemistry." New York: John Wiley& Sons 2008.
14. Devlin, Thomas M. Textbook of biochemistry: with clinical correlations. John Wiley & Sons, 2011.

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	20
SEMINARS/CLASS WORK	10
ASSIGNMENT/ OPEN DISCUSSION	10
TOTAL	40

SEMESTER V
DSC BIO C 12: PRACTICAL

COURSE TITLE	HUMAN PHYSIOLOGY AND ENZYMOLOGY
COURSE CREDITS	02
CONTACT HOURS	4 HOURS/WEEK
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	25
SUMMATIVE ASSESSMENT MARKS	25

Course Outcome:

At completion of this course, it is expected that the students will be able to: Determining the blood grouping and other physiological parameters, Identify of microscopical features of various types of cells and tissues: Understand the anatomy & Physiology of various systems and Learn the various cells and Demonstrate the principle and working of instruments used in cell biology.

EXPERIMENTS :

PART A: HUMAN PHYSIOLOGY

1. Enumeration of RBC and WBC count using Haemocytometer
2. Separation of Serum and Plasma from Blood
3. Estimation of haemoglobin content in blood
4. Understanding principle, working and handling of simple microscope.
5. Examination of prokaryotic and eukaryotic cells.
6. Study of different stages of mitosis and meiosis in onion root tip –squash preparation method.
7. Demonstration of biosafety and sterilization techniques.
8. Determination of blood pressure

PART B: ENZYMOLOGY

1. Isolation of Urease 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 K_m and V_{max} of amylase.
- e) Determination of initial velocity [time kinetics] of amylase.
- f) Determination of optimum temperature of amylase.

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.

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
RECORD / VIVA VOCE	10
CONTINUOUS EVALUATION AND CLASS TEST	15
TOTAL	25

SEMESTER VI
DSC BIO - C13

COURSE TITLE	METABOLISM WITH CLINICAL CORRELATION
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course Outcome:

At the end of the course the students will be able to:

- Understand the concepts of metabolism, characteristics of metabolic pathways and strategies used to study these pathways.
- Gain a detailed knowledge of various catabolic and anabolic pathways and its regulation
- Systematically learn the breakdown and synthesis of amino acids and nucleotides in humans and recognize its relevance with respect to nutrition and human diseases
- Acknowledge the role of inhibitors of nucleotide metabolism which are potentially being used as chemotherapeutic drugs
- Comprehend how the amino acid and nucleotide metabolism are integrated with carbohydrate and lipid metabolism.
- It trains the students to gain concepts of assessing the human physiology using biological fluid.
- It illustrates the mechanism of metabolic disorders at molecular level.
- It facilitates in employability in diagnostic and research institutes.

Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude		x		x				x				
Critical thinking		x		x		x				x		
Subject clarity	x	x				x	x					x
Analytical Skill	x				x	x				x		

UNIT I:

15 hours

Bioenergetics: Laws of Thermodynamics - first and second law. Concept of enthalpy, entropy and free energy. Standard free energy. Endergonic and exergonic reactions. Coupled reactions. High energy compounds and its importance. Electron transport chain. Electron transport complexes: Complex I, II, III and IV. Uncouplers and inhibitors of respiration (Rotenone, Antimycin, Cyanide and 2,4 DNP). Oxidative phosphorylation,

P/O ratio. Formation of ATP - Outline of Mitchell's hypothesis. Substrate level phosphorylation with examples.

Unit II:

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. Pentose phosphate pathway and its significance. Glycogen metabolism – glycogenolysis, glycogen synthesis

UNIT III:

15hours

Metabolism of Lipids, Amino acids and Nucleic acids: Carnitine cycle, β - oxidation and energetics of C16 saturated fatty acid, Biosynthesis of saturated FA. Fatty Acid Synthase complex, Cholesterol Biosynthesis.

General mechanism of amino acid metabolism: Deamination- oxidative and non – oxidative deamination, transamination, decarboxylation (biologically important amines). glycolytic and ketogenic amino acids. Urea cycle and its significance.

Degradation of nucleic acids, action of nucleases - DNase I and II, RNase and phosphodiesterases. Catabolism of purines and pyrimidines.

PART B: CLINICAL BIOCHEMISTRY

UNIT IV:

15 hours

Normal composition of urine – Volume, pH, colour and specific gravity. Chemical analysis and normal values of the constituents-urea, uric acid, creatinine, pigment and their clinical significance.

Abnormal constituents of urine- glucose, albumin, ketone bodies and bile pigments and their pathological significance.

Blood: Normal constituents of blood and their variation in pathological conditions- urea, uric acid, creatinine, glucose, bilirubin, total protein, albumin/globulin ratio. Lipid profile -cholesterol, Triglycerides, lipoproteins-HDL and LDL.

Clinical enzymology: Alkaline phosphatase, SGOT and SGPT. CPK and LDH.

Liver diseases: Cirrhosis, hepatitis, fatty liver and Jaundice

Inborn errors of Metabolism: Phenyl ketonuria, alkpatonuria, albinism. Lesch-Nyhan syndrome, Neimann -pick disease.

Lifestyle diseases: Causes, prevention and markers of cancer, diabetes mellitus, and Atherosclerosis.

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.

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	20
SEMINARS/CLASS WORK	10
ASSIGNMENT/ OPEN DISCUSSION	10
TOTAL	40

SEMESTER VI
DSC BIO – C 14: PRACTICAL

COURSE TITLE	METABOLISM WITH CLINICAL CORRELATIONS
COURSE CREDITS	02
CONTACT HOURS	4 HOURS/WEEK
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	25
SUMMATIVE ASSESSMENT MARKS	25

Course Outcome:

- The practical course will enable the students to learn the estimation of blood substances which tell how well the organs/kidneys are functioning, and glucose, which indicates whether there is a normal amount of sugar in the blood. Blood urea nitrogen is a measure of how well the kidneys are working.
- Learning the structural levels of Nucleic acids.
- Perform clinical urine tests for diagnostic purposes.
- Identify abnormal constituents of urine.

I : Experiments

A. Clinical Biochemistry -Biochemical analysis of urine sample:

1. Qualitative analysis of urine - detection of urea, uric acid and creatinine.
2. Qualitative analysis of abnormal constituents in urine - glucose, albumin, bile pigments, bile salts and ketone bodies.

B. Metabolism: Colorimetric estimation of uric acid, urea, creatinine, inorganic phosphate, Iron, Cholesterol.

II Report:

Visit to scientific/research institute/Clinical Laboratory – Tour report/Project

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

**PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING
/ASSIGNMENT**

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
RECORD / VIVA VOCE	10
CONTINUOUS EVALUATION AND CLASS TEST	15
TOTAL	25

SEMESTER VI

DSC BIO – C15

COURSE TITLE	MOLECULAR BIOLOGY, IMMUNOLOGY AND GENETIC ENGINEERING
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	40
SUMMATIVE ASSESSMENT MARKS	60

Course outcome:

Will be able to explain:

- Concepts of central dogma of molecular biology spanning from DNA Replication till Protein Synthesis and Reverse transcription, mutations, DNA repair mechanism.
- Defines the concept of immunology, concepts of antigen and antibody
- Explain immune system cells, Discuss active immunity and passive immunity
- Explain the cellular immune mechanism
- The students learn about plasmids, vectors and gain knowledge on the construction of cDNA libraries
- Student of this course have knowledge on gene manipulation, gene expression, etc which prepares them for further studies in the area of genetic engineering

Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude		x		x								
Critical thinking		x				x						
Subject clarity	x	x				x	x		x	x	x	x
Analytical Skill	x				x	x				x		

UNIT I: DNA Replication and Mutation

15 hours

History: Identification of DNA as genetic material- Experiments of Griffith, Hershey and Chase: Overview of structure of DNA.

Replication: Types of replication -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 HNO₂ 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: 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.

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.

UNIT III : Immunology

15 hours

Immunity: Cellular and humoral immunity, cellular basis of immunity.

Role of immunologically important organs and cells- bone marrow, thymus, spleen and lymphocytes. Formation, maturation, differentiation and activation of T & B Lymphocytes. 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 (IgG - 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: Immunofluorescence, Immuno diffusion, RIA & ELISA

UNIT IV: GENETIC ENGINEERING

15hours

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.

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.

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	20
SEMINARS/CLASS WORK	10
ASSIGNMENT/ OPEN DISCUSSION	10
TOTAL	40

SEMESTER VI
DSC BIO – C 20: PRACTICAL

COURSE TITLE	MOLECLAR BIOLOGY, GENETIC ENGINEERING AND IMMUNOLOGY
COURSE CREDITS	02
CONTACT HOURS	4 HOURS/WEEK
DURATION OF ESA	03
FORMATIVE ASSESSMENT MARKS	25
SUMMATIVE ASSESSMENT MARKS	25

Course Outcome:

- The practical course will enable the students to learn the principles of reactions pertaining to nucleic acids. They will be able to isolate and quantitate DNA and RNA from different sources and characterization.
- The practical course will enable the students to learn
- Identifying blood groups and types
- Competently perform serological diagnosis
- Analyze components of human sera by performing electrophoresis experiments.

Course Outcomes	1	2	3	4	5	6	7	8	9	10	11	12
Aptitude		x		x								
Critical thinking		x				x						
Subject clarity	x	x				x	x		x	x	x	x
Analytical Skill	x				x	x				x		

EXPERIMENTS: MOLECULAR BIOLOGY AND IMMUNOLOGY

1. Isolation of DNA from banana/endosperm of coconut/ bacteria / any other source
2. Estimation of DNA
3. DNA purity check by UV spectrophotometer.
4. Isolation of RNA from Spinach leaves/any other source.
5. Blood grouping
6. Determination of antigen-antibody reaction by immune diffusion technique
7. Isolation of plasmid from *E. coli*
8. Agarose gel electrophoresis of nucleic acids
9. Restriction digestion
10. WIDAL test
11. ELISA test/Assay
12. Differential Leucocyte count

13. Gramstaining
14. Demonstration of biosafety & sterilization techniques
15. Demonstration of preparation of culture media for bacterial cultivation

REFERENCES :

1. Molecular Biology: A Laboratory Manual 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

PEDAGOGY: MOOC/DESK WORK/BOOK CHAPTER/PROBLEM SOLVING /ASSIGNMENT

Formative Assessment	
ASSESSMENT OCCASION	WEIGHTAGE IN MARKS
RECORD / VIVA VOCE	10
CONTINUOUS EVALUATION AND CLASS TEST	15
TOTAL	25

B.Sc Biochemistry

Internship for graduate Programme – VI Semester

Course title	Internship Discipline specific
No of contact hours	90
No credits	2
Method of evaluation	Presentations/Report submission/Both

Project Assessment			
Formative Assessment		Summative Assessment	Total Marks
Assessment Type	Weightage in Marks	Practical Exams	50
Data maintenance	10	Presentations/Report /Both	
Assessment	10		
Attendance	05		
Total	25	25	

- ❖ Internship shall be Discipline Specific of 90 hours (2 credits) with duration 4-6 weeks.
- ❖ Internship may be full-time/part-time (full-time during semester holidays and part-time in the academic session)
- ❖ Internship mentor/supervisor shall avail work allotment during 6th semester for a maximum of 20 hours.
- ❖ The student should submit the final internship report (90 hours of Internship) to the mentor for completion of the internship.
- ❖ The detailed guidelines and formats shall be formulated by the universities separately as prescribed in accordance to UGC and AICTE guidelines.