

TUMKUR UNIVERSITY

Undergraduate Biochemistry Syllabus (3 Major system)-2024-2025

B.Sc., Biochemistry Semester-III

Course code: **3BCDSCT-03**

Course Title: **Biomolecules and Analytical Techniques-3 (Theory)**

COURSE TITLE	Biomolecules and Analytical Techniques-3
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

The course provides fundamental insights into the types of macromolecules, highlighting their unique structural features, chemical properties, and biological importance. Students will gain an understanding of biological sample preparation and develop an appreciation for the chemistry and application of various analytical instruments. The curriculum also emphasizes the proper care and maintenance of laboratory equipment and chemicals. Additionally, students will learn about clinically relevant biochemical analyses of various components, including proteins, electrolytes, hormones, and others.

3BCDSCT-03-Biomolecules and Analytical Techniques-3

UNIT I: General introduction to Biomolecules and Carbohydrates

15 hrs

Biomolecules: types, function, diversity and distribution. General introduction of composition of living matter.

Carbohydrates: Classification, Stereoisomerism and optical isomerism of sugars. Ring structure and tautomeric forms, mutarotation. Important derivatives of Monosaccharides, Disaccharides and Trisaccharides (Glucose, fructose, galactose, arabinose, mannose, maltose, lactose, cellobiose, gentiobiose, Melibiose, Turanose, Sucrose, Trehalose, Mannotriose, Rabinose, Rhamnose, Raffinose, Gentionose, Melizitose.). Classification, occurrence and biological importance of polysaccharides e.g. starch, glycogen, cellulose, chitin, agar, algenic acids, pectins, glycosaminoglycans (heparin, hyaluronic acid, and chondroitin sulphate). glycoproteins, proteoglycans (aggrecan, syndecan and decorin), sialic acids, blood group polysaccharides and bacterial cell wall polysaccharides.

UNIT II: Lipids and Nucleic acids

15 hrs

Lipids: Composition of lipids- fatty acids, glycerol. Definition and classification of lipids. Classification of fatty acids and physio-chemical properties of fatty acids (Saponification, iodine number, hydrogenation and acid number). Separation of fatty acids, distribution of fatty acids in nature and characterization of fatty acids. Properties of glycerol. Systematic nomenclature and classes of glycerides, MAG, DAG, TAG. **Phospholipids-** PC, PG, PE, PS, LPC, PI and plasmalogens. Properties and function of phospholipids. Sphingolipids- sphingosine, ceramide, sphingomyelin, glycolipids cerebrosides, gangliosides and sialic acids. Properties and function of Prostaglandins. Isoprenoids- types and structures, structure of sterols, Bile acids, steroid hormones, plant sterol, ergosterol, stigma sterol, cholesterol, glucocorticoid, mineralocorticoids. Lipoproteins- classification, composition and their importance, Role of Lipids in cellular architecture and functions.

Nucleic acids: Importance of nucleic acids in living system, general composition of nucleic acids, the purine and pyrimidine bases, Tautomeric forms of bases. Reactions of purines and pyrimidines, structure of nucleosides and nucleotide, deoxynucleotides, cyclic nucleotides and polynucleotides. Watson and crick model for DNA. Denaturation and renaturation of DNA (T_m curve). Different types of DNA and RNA. Secondary structures of tRNA- clover leaf model.

UNIT III: Biological sample preparation, Centrifugation and Chromatography

15 hrs

Introduction and objectives of sample preparation from tissues and cells. Sample preparation types: living and postmortem. Extraction of macromolecules: liquid-liquid, liquid-solid and precipitation methods. **Centrifugation-** Introduction, principle, sedimentation, sedimentation coefficient, angular velocity, centrifugal field, relative centrifugal field. Types- Preparative, analytical, differential, density gradient and ultra-centrifugation. Basic instrumentation: types of rotors and their design. Laboratory centrifuge: operational instruction and applications. Analytical Centrifuges- application in sub-cellular fractionation.

Chromatography- General principles of chromatography- adsorption and partition. Classification based on - Nature of stationary and mobile phase are brought together- Planar and column chromatography. Based on types of mobile and/or liquid phase, adsorption and partition- Gas chromatography and liquid chromatography. Based on stationary Phase- Thin layer chromatography, Paper chromatography; ascending, descending, circular, 2-D chromatography, R_f values. Principles and applications of ion-exchange, gel-filtration and affinity-chromatography. Advanced chromatography- HPLC and FPLC, UPLC and GLC.

UNIT IV: Electrophoretic, Radioisotopic and Spectroscopic methods

15 hrs

Electrophoresis: General principle, work of Tiselius, Supporting media- paper, agarose, polyacrylamide. Chemistry of polymerization of acrylamide gels, methodology and applications of native PAGE and SDS-PAGE, 2-D electrophoresis. Identification of proteins- dyes and biological activities. Principle and application

of agarose gel and Pulse field electrophoresis, capillary electrophoresis and isoelectric focusing, immune-electrophoresis.

Radio isotopic methods: Radioactivity- Types of radioactive decay, Properties of α , β , γ radiations. Group displacement law, Decay law- decay constant, half-life period and average life of a radioactive element. Detection of radioactivity - GM counter and scintillation counters (only principle and working) Applications of radioisotopes- ^3H , ^{14}C , ^{13}I , ^{60}Co and ^{32}P . Biological effects of radiations. Radiolabeling, safety measures in handling radio isotopes.

Spectroscopic methods: Dual nature of light, electromagnetic spectrum, transition in spectroscopy. Principle, design and application of UV-Vis spectrophotometer. Beer-Lambert law and its limitations, determination of molar absorption coefficient of molecules. Working principle and application of a colorimeter, flame photometer and fluorimeter. Principle and application of IR, and Raman, ESR and NMR spectroscopy.

REFERENCES

1. Principles of Biochemistry (2012) by Voet D, Voet JG and Pratt CW. 4th Edition, John Wiley and Sons Inc, ISBN-10. 9781118092446.
2. Lehninger- Principles of Biochemistry (2013) by Nelson DL and Cox MM. 6th Edition. Macmillan Publications. ISBN-10. 1464109621.
3. Biochemistry-The chemical reactions of living cells (2003) by David E Metzler. 2nd Edition, Elsevier Academic Press. ISBN-978-0124925403.
4. Fundamentals of Biochemistry (2005) by J.L. Jain, 6th Edition, published by S. Chand. ISBN-81-219-2453-7. Biochemistry (2010) by Berg JM, Tymoczko JL and Stryer L, 7th Edition, Freeman and company. ISBN-9781429229364
5. Harper's Illustrated Biochemistry (2018) by Weitz M and Boyle PJ. 31st Edition, McGraw-Hill Education ISBN- 978-1-259-83793-7.
6. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th Edition, Cambridge University Press. ISBN-9781108716987
7. Analytical techniques in Biochemistry and Molecular Biology (2011) by Rajan K. 1st Edition, Springer New York, NY. ISBN- 978-1-4419-9784-5.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Course code: 3BCDSCP-03

Course Title: Biomolecules and Analytical Techniques-3 (Practical)

COURSE TITLE	PRACTICAL COURSE ON Biomolecules and Analytical Techniques-3
COURSE CREDITS	02
CONTACT HOURS	4 Hr/Week
DURATION OF EXAM	03Hrs
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

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 when provided with solution of a mixture of biomolecules. This course aims to provide experimental practice of analytical techniques in Biochemistry. Upon successful completion, students should develop skills in handling instruments and understand its application in research work.

1. Carbohydrates: Qualitative analysis of monosaccharides (glucose, ribose, deoxy ribose, fructose, galactose) disaccharides (lactose, maltose, sucrose) and polysaccharides (starch, glycogen)- 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. Lipids: a. Solubility, acrolein test, Salkowski test, Lieberman-Burchard test. Determination of saponification and iodine value of fat/oil.
3. Estimation of total sugars in food samples.
4. Separation of plasma, serum and erythrocytes using centrifuge.
5. Determination of packed cell volume/ hematocrit.
6. Resolution of basic, acidic and aromatic amino acids by descending and circular paper chromatography.
7. Identification and resolution of pigments by thin layer chromatography.
8. Recording the absorption spectrum of riboflavin, protein, and DNA.
9. Colorimetric estimation of glucose by DNS method.
10. Estimation of DNA by diphenylamine method.
11. Estimation of RNA by orcinol method.
12. Electrophoretic separation of plasma proteins and DNA.

REFERENCES:

1. Practical Biochemistry (2011) by GeethaDamodaran, Jaypee publishers, ISBN- 9789350251416.
2. Biochemical Methods (2007) by Sadasivam S and Manickam A. 3rd Edition, New Age International Pvt Ltd. ISBN-81-224-0976-8.
3. An Introduction to Practical Biochemistry (2017) by David T Plummer. 3rd Edition, McGraw Hill Education, ISBN- 978-0070994874.
4. Analytical techniques in Biochemistry and Molecular Biology (2011) by Rajan K. 1st Edition, Springer New York, NY. ISBN- 978-1-4419-9784-5.
5. Wilson and Walker's Principles and Techniques of Biochemistry and Molecular Biology (2018). 8th Edition, Cambridge University Press. ISBN- 9781108716987.
6. Laboratory Manual in Biochemistry (2011) by Jayaraman J. 1st Edition, John Wiley and Sons Ltd, ISBN- 9780852264287.
7. Biochemistry and Molecular Biology (2014) by Papachristodoulou D, Snape A, Elliott WH and Elliott DC. 5th Edition, Oxford University Press, ISBN- 9780199609499

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
RECORD/ VIVA VOCE	5
CONTINUOUS EVALUATION AND CLASS TEST	5
TOTAL	10

Course code: **3BCOEC-3.1**

Course Title: **Nutritional Biochemistry- 3.1** (Elective)

COURSE TITLE	Nutritional Biochemistry- 3.1
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome

On successful completion of the course, the student will be able to understand the various factors influencing basal metabolism and their physiological functions. The course also enables students to comprehend the nutritional values of essential nutrients such as vitamins, minerals, proteins, carbohydrates, and lipids. Furthermore, students will gain insight into the beneficial effects of food components in the prevention and management of diseases.

3BCOEC-3.1: COURSE TITLE: NUTRITIONAL BIOCHEMISTRY

Unit I:

15hrs

Basic Concepts of Nutrition: Introduction, Basic principles of a balanced diet to provide energy and nutrients. Composition of foods and proximate analysis of foods. Calorific value of foods and Basal metabolism. Basal Metabolic Rate (BMR), Factors affecting BMR, Energy requirements for different physical activities, Specific dynamic action of food, Nutritive value of proteins. Energy requirements and recommended dietary allowance (RDA) for infants, children and pregnant women. Protein calorie malnutrition.

Unit II:

15hrs

Macronutrients and Micronutrients: Carbohydrates-Digestible and non-digestible and Dietary fibers. Essential fatty acids, lipoproteins and cholesterol. Essential amino acids, Fortification of foods, Protein requirement for different categories.

Vitamins-Sources, requirements, functions and deficiency symptoms of Vitamin-C, Thiamine, Riboflavin, Pyridoxine, Folic acid, Vitamin B12. Absorption of fat soluble vitamins- A, D, E and K.

Minerals-Source, Daily requirement, functions and deficiency disease symptoms of Macro-minerals (Ca, P, and Cl) and micro minerals/trace elements (I, Fe, Zn and Se).

Unit III:**15hrs**

Dietetics and Diet Therapy: Introduction. Food pyramid. Diet planning and introduction to diet therapy. Nutritional requirements for different age groups, anemic child, expectant women, and lactating women. Diet planning for prevention and cure of nutritional deficiency disorders.

Diet therapy: Functional foods, Anthropometric measurements, dietary considerations during fever, malaria, and tuberculosis. Prevention and correction of obesity, underweight, and metabolic diseases by diet therapy. Dietary interventions to correct and or manage the gastrointestinal diseases (indigestion, peptic ulcer, constipation, diarrhea, steatorrhea, irritable bowel syndrome).

Functional foods- based diet therapy for diabetes, cardiovascular disease and cancer. Osteoporosis and bone health. Wellness diets, fitness diets, obesity and weight management and BMI, Mediterranean diet, nutrients as antioxidants, diet and cancer, food preservatives, food adulterants.

REFERENCES

- Clinical Dietetics and Nutrition, 2002, Antia FP and Abraham P. Oxford University Press; 4th Edition. ISBN-10: 9780195664157.
- Oxford Handbook of Nutrition and Dietetics, 2011, Webster-Gandy J, Madden A and Holds worth M. Oxford University Press, Print ISBN-13: 9780199585823.
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- Human Nutrition and Dietetics. 1986, Passmore R. and Davidson S. Churchill Livingstone Publications, ISBN-10: 0443024863.
- Rosemary Stanton's Complete Book of Food & Nutrition, 2007, Simon & Schuster Publishers, Australia, ISBN 10: 0731812999
- Food Science and Nutrition, 2018, Roday S. Oxford University Press Publishers, ISBN: 9780199489084/0199489084.
- Food Science, 2007, Srilakshmi S. New Age International (P) Limited Publishers, ISBN: 9788122420227/8122420222.
- Human Nutrition and Dietetics. J.S. Garrow, W. Philip T. James, Alan Ralph. Churchill Livingstone Publisher.
- Modern Nutrition in Health and Disease. Michael G. Wohl, Robert S. Good hart, Maurice E. Shils. Lea &Febiger Publisher, U.S.A.
- Mechanism and Theory in Food Chemistry. DWS Wong. Springer Cham Publishers.
- Advanced Text Book on Food and Nutrition, Vol. I & II. Swaminathan M. The Bangalore Press.
- Food, Nutrition and Health. Tapsell L. Oxford University Press (2010).
- Modern Nutrition in Health and Disease. Maurice E. Shils, Moshe Shike. Lippincott Williams & Wilkins, Philadelphia.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Course code: **3BCOEC-3.2**

Course Title: **Plant Biochemistry- 3.2 (Elective)**

COURSE TITLE	Plant Biochemistry- 3.2
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course outcome

On successful completion of the course, the student will be able to understand the structural organization and functional components of plant cells, including membranes, cytoskeleton, and transport systems, as well as the mechanisms of energy production and photosynthesis. The course also enables students to comprehend the roles of primary metabolites, plant growth regulators, and photoreceptors in plant growth and development. Furthermore, students will gain insight into plant responses to biotic and abiotic stresses, the classification and functions of secondary metabolites, and their significance in ecological adaptation and therapeutic applications.

3BCOEC-3.2: Course Title: Plant Biochemistry

Unit-I Plant Cell – Structure and Molecular Components

15hrs

Cytoskeleton-an overview. Plant cell division and the cell cycle. Outline of energy production in plant cells. An Overview of Photosynthesis: C₃, C₄ plants and Crassulacean Acid Metabolism (CAM); photorespiration; phytochromes and phototropins. Plant Cell Membranes and Membrane Transport: Introduction to plant cell membranes and membrane constituents. Organization of transport systems across plant membranes. Different types of pumps operating at plant cell and organelle membranes; importance of H⁺-ATPases. Ion channels – properties and significance; aquaporins and water transport. Important Primary Metabolites of Plants: Cellulose, starch, sucrose, oligosaccharides, fructans, gums, mucilages, polyunsaturated fatty acids, lignin, surface waxes, sulfides, and sweet proteins.

Unit-II Plant Growth and Stress Responses

15hrs

Plant Growth Regulators: Auxins, cytokinins, gibberellins, abscisic acid, ethylene, brassinosteroids, salicylic acid. Plant Responses to Biotic and Abiotic Stresses: Introduction; plant pathogens and diseases; plant defense systems – hypersensitive response, systemic acquired resistance, and induced systemic resistance. Plant biotic stress responses to pathogens and insects. Plant Abiotic Stress Responses: Salt stress, drought, and heavy metal

stress responses; osmotic adjustment and the significance of osmotic agents such as proline, sugar alcohols, and quaternary ammonium compounds. An overview of oxidative stress and oxidative damage. Antioxidant enzymes and stress tolerance.

Unit-III Plant Secondary Metabolites (Natural Products)

15hrs

Introduction; secondary metabolites (natural products) – definition and significance; classification of plant secondary metabolites (natural products). Phenolics: Classification of phenolic compounds; classification of flavonoids; classification of anthocyanins. Isolation, purification, and characterization of phenolics.

Terpenoids: Volatile compounds; plant growth regulator terpenoids – gibberellins, abscisic acid, brassinosteroids, and saponins. Isolation, purification, and characterization of terpenoids.

Biological Properties of Secondary Metabolites Role of secondary metabolites in plants; physiologically active secondary metabolites in modern medicine; therapeutic compounds for human ailments.

REFERENCES:

- Lehninger’s Principles of Biochemistry – Nelson & Cox. CBS Publishers & Distributors, 2013
- Principles of Biochemistry-Moran, Horton, Scrimgeour, Perry. Pearson, 5thEdition, 2011
- Plant Biochemistry- P.M. Dey& J.B. Harborne. Hart Court Asia Pvt Ltd. 1997
- Plant Biochemistry and Molecular Biology- P. Lea & Richard C Leegood., John Wiley & Sons.1999
- Introduction to Plant Biochemistry - Goodwin and Mercer. CBS Publisher and Distributors. 2005
- Biochemistry and Molecular Biology of Plants - Buchanan, Greussem and Jones. American Society of Plant Physiologists.2000
- Natural Products from plants. Peter B. Kaufman, Lel and J. Cseke, Sara Warber, James A. Duke, Harry L. Brielmann, CRC Press, Boca Raton 1999.
- Natural Products Targeting Clinically Relevant Enzymes. Paula B. Andrade, Patricia Valentao David M. Pereira. Wiley-VCH Verlag GmbH & Co 2017
- Plant Cell Tissue and Organ Culture: Fundamental Methods - O.L. Gamborg& G.C. Phillips Narosa Publishers, New Delhi, 1995.
- KantR. Sweet proteins–Potential replacement for artificial calorie sweeteners. Nutrition J. 2005; 4:5 doi:10.1186/1475-2891-4-5.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Syllabus of Theory and Practical B.Sc., Biochemistry Semester-IV

Course code: 4BCDSCT-04

Course Title: Proteins and Enzymology-4 (Theory)

COURSE TITLE	Proteins and Enzymology-4
COURSE CREDITS	04
TOTAL CONTACT HOURS	60
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

The course provides a bird's-eye view of the structure and properties of proteins and enzymes. It is designed to offer a fundamental understanding of amino acids, proteins, enzymes, and their biochemical importance. This foundation will help students think critically about the versatility and diverse structures and functions of proteins and enzymes, as well as their metabolic and clinical significance.

4BCDSCT-04: Proteins and Enzymology

UNIT I: AMINO ACIDS AND PEPTIDES

15 hrs

Amino acids- Definition, classification and structures based on polarity and nutritive value. Physico-chemical properties of amino acids -amphoteric molecules, ionization, zwitterions, pK values, isoelectric point, titration of amino acids (glycine, glutamic acid, lysine, histidine-only nature of graph), Formal titration of glycine (reaction and principle). **Reaction of amino acids:** reaction due to amino groups (reaction with mineral acids, alkyl halides, acetyl chloride, nitrous acid, ninhydrin and fluorescein), reaction due to carboxylic acid group (reaction with base, alcohol, $LiAlH_4$, metal oxide). **Peptide bond:** Definition, structure and geometry of peptide bond, bond lengths and configuration. **Biologically important peptides-** Peptide hormones, antibiotics and growth factors and their functions in brief (glutathione, vancomycin, oxytocin, insulin and endorphin). Merrifield solid-phase peptide synthesis using protection/deprotection protocol (brief outline). N-terminal amino acid determination (Edman degradation, dansyl chloride reagent, Sanger's reagent) and C-terminal amino acid determination (carboxypeptidase and using hydrazine).

UNIT II: PROTEINS

15 hrs

Proteins: Classification and occurrence of proteins based on composition, shape, function and structure with examples. **Structural organization and biological importance of Proteins**-Primary(insulin), secondary (α helix, β pleated sheet, β -bends and triple helix), tertiary and quaternary structure with suitable examples. Forces that stabilize three dimensional structure of proteins- covalent and non-covalent bonds. **Protein folding**-Importance of primary structure in folding, assisted folding by molecular chaperones and PDI and conformational disease (Defects in protein folding, Example-Alzheimer's and Prion based). **Denaturation and renaturation of protein** (eg-Ribonuclease A), Anfinsen's experiment.

UNIT III: ENZYMES

15 hrs

Introduction to enzymes: Nature of enzymes- protein and non-protein (ribozyme), cofactors, prosthetic group, apoenzyme and holoenzyme. IUBMB classification of enzymes with examples. International units of enzyme activity, specific activity and ketal. Zymogen, monomeric and oligomeric enzymes- monomeric enzyme, multifunctional enzymes, oligomeric enzymes and multi-enzyme complexes. Isozymes-lactate dehydrogenase and creatine kinase. Involvement of coenzymes in enzyme catalysed reactions.

Features of enzyme catalysis- catalysis, enzyme as a catalyst (general characteristics of enzymes), energy of activation, concept of collision theory and transition state theory. Active site-catalytic power and specificity of enzymes. **Theory of enzyme catalysis**- Fischer's lock and key hypothesis and Koshland induced fit hypothesis.

UNIT IV: ENZYMES KINETICS

15 hrs

Enzyme kinetics of single substrate reactions- review of law of mass action, equilibrium constant, mono-substrate reactions, relationship between initial velocity and substrate concentration. Michaelis-Menten equation (derivation not required), determination and significance of V_{max} and K_m . Factors affecting the rate of reactions-enzyme concentration, substrate concentration, pH, temperature and activators including metal ions. Line weaver burk plot, K_{cat} and turnover number.

Reversible inhibition- Competitive, non-competitive (allosteric inhibition), uncompetitive inhibition with graphical representations using LB plot and with examples. **Irreversible inhibition**-suicide inhibition, antibiotics as inhibitors- penicillin, Drug action- receptor theory, structure-activity relationships of drug molecules with enzyme with suitable example, applications of enzymes.

REFERENCES

1. Lehninger: Principles of Biochemistry (2013) 6th Ed., Nelson DL and Cox MM. W.H. Freeman and Company (New York), ISBN: 13: 978-1-4641-0962-1 / ISBN: 10:1-4292- 3414-8.
2. Textbook of Biochemistry with Clinical Correlations (2011) 7th Ed., Devlin TM. John Wiley & Sons, Inc. (New York), ISBN: 978-0-470-28173-4.
3. Biochemistry (2012) 7th Ed., Berg JM, Tymoczko JL and Stryer L. W.H. Freeman and Company (Newyork), ISBN:10:1-4292-2936-5, ISBN:13:978-14292-2936-4
4. Fundamental of Biochemistry-Life at the Molecular Level (2016), 5th Ed by Voet D,Voet JG, and Pratt CW.John Wiley & Sons, ISBN-978-1118-918432.
5. Biochemistry (2011) 4th Ed., VoetD and Voet JG.John Wiley & Sons Asia Pvt.Ltd. (New Jersey), ISBN: 978-1180-25024.
6. Fundamentals of Enzymology (1999) 3rd Ed., Nicholas CP and Lewis S. Oxford University Press Inc. (Newyork), ISBN:0 19 850229 X.
7. Enzyme Kinetics: Principles and Methods byBisswanger H (2017) Published by Wiley-VCH Verlag GmbH & Co. KGaA. ISBN:9783527342518.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Course code: 4BCDSCP-04

Course Title: Proteins and Enzymology-4 (Practical)

COURSE TITLE	PRACTICAL COURSE ON Proteins and Enzymology-04
COURSE CREDITS	02
CONTACT HOURS	4 Hrs/Week
DURATION OF EXAM	03 Hr
FORMATIVE ASSESSMENT MARKS	10
SUMMATIVE ASSESSMENT MARKS	40

Course Outcome:

The practical course will enable the students to learn the qualitative and quantitative analysis of amino acid and proteins. The students also learn the collection, separation and identification of proteins/enzymes. They also learn enzyme.

4BCDSCP-04: PROTEINS AND ENZYMOLOGY [PRACTICAL]

1. Separation of amino acids by paper chromatography.
2. Qualitative test for amino acids.
3. Determination the concentration of glycine solution by formylation method (Formal titration).
4. Qualitative test for proteins.
5. Estimation of protein using Biuret method.
6. Estimation of protein using Lowry method.
7. Assay of salivary α amylase/ β -amylase and construction of maltose/glucose calibration graph by DNS method.
8. Effect of temperature on amylase activity and determination of optimum temperature.
9. Effect of p^H on amylase activity and determination of optimum pH.
10. Determination of effect of sodium chloride on amylase activity.
11. Determination of K_m and V_{max} of salivary amylase.
12. Isolation of Urease and determination of its activity.
13. Separation and identification of proteins by SDS-PAGE.

REFERENCES:

1. Practical Biochemistry (2011) by Geetha Damodaran, Jaypee publishers, ISBN- 9789350251416.
2. Biochemical Methods (2007) by Sadasivam S and Manickam A. 3rdEdition, New Age International Pvt Ltd. ISBN-81-224-0976-8.
3. An Introduction to Practical Biochemistry (2017) by David T Plummer. 3rdEdition, McGraw Hill Education, ISBN- 978-0070994874.
4. Laboratory Manual in Biochemistry (2011) by Jayaraman J. 1stEdition, John Wiley and Sons Ltd, ISBN- 9780852264287.
5. Biochemistry and Molecular Biology (2014) by Papachristodoulou D, Snape A, Elliott WH and Elliott DC. 5thEdition, Oxford University Press, ISBN- 9780199609499.
6. Vogel's Qualitative Inorganic Analysis (2012) by G. Svehla. 7th Edition, published by Pearson Education, ISBN-9788131773710.
7. Advanced Experimental Chemistry (1989) by Gurtu JN, Kapoor R and Chand S. 4th Edition, S. Chand & Company Ltd.

FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
RECORD/ VIVA VOCE	5
CONTINUOUS EVALUATION AND CLASS TEST	5
TOTAL	10

Course code: **4BCOEC-4.1**

Course Title: **Human Physiology- 4.1** (Elective)

COURSE TITLE	Human Physiology-4.1
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

The course provides students with a foundational understanding of the structure and function of the human body, from the cellular level to organ systems. Key learning outcomes include the ability to describe basic anatomical terms, explain homeostatic mechanisms, and identify the structure and function of cells, tissues, and organ systems. Students will also be able to relate anatomical knowledge to physiological processes and understand how these systems interact to maintain overall health.

4BCOEC-4.1: HUMAN PHYSIOLOGY

UNIT I

15 hours

Respiratory System: Structure and functions of lungs. Mechanism of respiration (pulmonary ventilation), gas exchange mechanism. Biochemical events in the transport of gases and factors affecting them. Role of lungs in acid-base balance, acidosis, and alkalosis. Bohr effect, hypoxia, and emphysema.

Cardiovascular System: Structure and functions of the heart. Types, overview, and functions of blood vessels. Cardiac cycle, cardiac output, regulation of the cardiovascular system, blood pressure, heart rate, and ECG. Origin and conduction of heartbeat; measurement of arterial blood pressure.

Blood: Hematopoiesis, composition and functions of blood. Blood cells – types and functions; red blood cells and white blood cells – structure and functions; platelets – structure and functions. Blood coagulation, blood groups – ABO, Rh, and other rare blood groups.

UNIT II

15 hours

Nervous System: Brief outline of the nervous system. Neurons – types and structure of multipolar neurons, mechanism of nerve impulse transmission along long axons and across synapses. Resting membrane potential and action potential. Neurotransmitters – excitatory and inhibitory, with examples.

Muscular System: Types of muscles and their structures, ultrastructure of skeletal muscle. Contractile and regulatory proteins of muscle, sliding filament model of skeletal muscle contraction.

Connective Tissues: Types and functions of connective tissue, structure and types of bone and cartilage. Long bone – composition, structure, growth, remodeling, and factors affecting growth.

UNIT III

15 hours

Digestive System and GIT: Anatomy of the gastrointestinal tract (GIT), digestion, absorption, and transportation of carbohydrates, proteins, and lipids. Role of various enzymes involved in the digestive process. Microbiota of the GIT and its significance, intestinal putrefaction, and fermentation.

Hepatic System: Structure of liver lobule, role of liver in metabolism, storage, and detoxification. Liver function tests.

Excretory System: Brief outline of the excretory system, formation of urine – glomerular filtration, tubular reabsorption, and secretion. Active and passive transport of sugars, amino acids, urea, and creatinine. Role of kidney in acid-base balance. Role of aldosterone and ADH. Kidney function tests.

References

- Guyton, A. C., & Hall, J. E. (2020). Textbook of medical physiology (14th ed.). Elsevier.
- Sherwood, L. (2015). Human physiology: From cells to systems (9th ed.). Cengage Learning.
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FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Course code: **4BCOEC-4.2**

Course Title: **Food and Water Quality Analysis- 4.2** (Elective)

COURSE TITLE	Food and water quality analysis -4.2
COURSE CREDITS	03
TOTAL CONTACT HOURS	45
DURATION OF EXAM	3 Hrs
FORMATIVE ASSESSMENT MARKS	20
SUMMATIVE ASSESSMENT MARKS	80

Course Outcome:

The course provides foundational knowledge and analytical skills related to water sampling, and the analysis of water and food. It covers food analysis, food intoxication, and food borne infections. The course also includes various types of contamination and their detection in water and food. Additionally, it addresses different types of food additives, preservation methods, and relevant food regulations.

4BCOEC-4.2: FOOD AND WATER QUALITY ANALYSIS

UNIT I

15hrs

Microbiological quality of water: Methods of water sampling and isolation of microorganisms from water sample. Medium: Growth medium, differential medium and specific medium. Treatment and safety of drinking (potable) water. Methods to detect portability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for fecal coli forms (b) Membrane filter technique and (c) Presence/absence tests. Toxic chemicals analysis in water: Analysis of pesticides, dioxanes, hydrocarbons, disinfectants, antibiotics, surfactants and heavy metals. Mineral estimation in water.

UNIT II

15hrs

Microbial food contamination and control: Factors affecting growth and survival of microbes in foods, natural flora and source of contamination of foods. Spoilage of vegetables, fruits, meat, eggs, milk, butter, bread and canned Foods.

Methods of detection of food borne pathogens: Biochemical and rapid detection methods of food borne pathogens in dairy products, stored foods, instant food mix and packed foods. Food borne diseases: Food intoxication, food infection, shigellosis.

Methods of detection of toxic chemicals in foods: Rapid testing methods. Analysis of heavy metals, pesticides, fungicides, antibiotics, toxins, dioxanes in foods, fruits and vegetables. Food sanitation and control: HACCP, Indices of food sanitary quality and sanitizers.

Unit III

15hrs

Food additives, adulterants and contaminants: Definition, objectives and principles of food additives, adulterants and contaminants. Different types of food additives (benzoates, propionates, sorbates, disulphites), artificial sweeteners (aspartame, saccharin, dulcin, sucralose, and sodium cyclamate), flavors [vanillin, alkyl esters (fruit flavors) and monosodium glutamate]. Artificial food colorants Coal tar dyes and non-permitted colors and metallic salts.

Food preservation: Definition, objectives and principles of food preservation. Different methods of food preservation. Preserved products: jam, jelly, sauces, pickles, Squashes, syrups types, composition and manufacture, selection, cost, storage, uses and nutritional aspects, Food Standards: ISI, Agmark, FPO, MPO, PFA, FSSAI. Food sanitation and control: HACCP, Indices of food sanitary quality and sanitizers.

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.FORMATIVE ASSESSMENT	
ASSESSMENT	WEIGHTAGE IN MARKS
CLASS TEST (2 CLASS TEST)	15
ASSIGNMENT/ OPEN DISCUSSION	5
TOTAL	20

Scheme of B.Sc Biochemistry Theory Question Paper (Core and Elective)

B.Sc Degree Examinations (Revised NEP-SEP) Biochemistry 2024-25

Duration: 3 Hours	The question paper shall consist of two parts: Part A, Part B and Part C	Max. Mark 80
PART-A	Answer any 10 out of 12 questions [Q 1 to Q 12] (three questions from each unit)	10×2=20
PART-B	Answer any 6 out of 8 questions [Q 13 to Q 20] (two questions from each unit)	6X5= 30
PART-C	Answer any 3 out of 5 questions [Q 21 to Q 25] (1 and half questions from each unit)	3X10= 30

- i) Equal weightage of marks shall be given to all the units in Part A, Part B and Part C.
- ii) In part C, each main question shall have only three sub-divisions (a), (b) and (c) with (4+4+2), (5+3+2) or (4+3+3) marks respectively.

PRACTICAL

DURATION ;3 hours	Max. Marks; 40
Performance	30 marks Two experiments; one major and one minor
Viva-voce	5 marks
Record	5marks (minimum 8 experiment should be recorded)