Academic Council Meeting No. and Date: 8 / September 04, 2023

Agenda Number: 2 Resolution Number: 34, 35 / 2.7, 2.28

Vidya Prasarak Mandal's
B. N. Bandodkar College of
Science (Autonomous), Thane

Syllabus for

# Programme Code: BUBC

# Programme: Bachelor of Science

# Specific Programme: Biochemistry

## [F. Y. B. Sc. (Biochemistry)]

**Level 4.5**

**Choice Based Grading System**

## Revised under NEP

From academic year 2023-2024

# Preamble

Biochemistry is a perfect amalgamation of chemical sciences and biological sciences. A biochemist has a knowledge of reactions that drive the core of life processes. As a first step towards the journey of becoming a renowned biochemist, students enrolling for this course will be thrilled by the wonders of chemical reactions that various biomolecules carry out. With a little brush-up to the knowledge obtained in earlier levels of education, the student enrolling in this program would find himself learning exciting concepts of cell biology in first semester and Physiology in second semester.

Under the New Education Policy 2020, the syllabus has been modified to include deeper concepts of topics already present in the syllabus. The learner would follow a student-centric 'Credit System', which will allow continuous assessment and holistic evaluation of the candidate through internal and external modes. With this thoughtfully designed syllabus, it is expected that the learner would have a very strong conceptual base to be used for upcoming years of graduation and would develop a habit of asking questions encouraging his or her curiosity.

Learners will also be required to gain a knowledge of fundamental chemistry as a part of the minor subject. Theoretical microbiology will be dealt with by the students under the Generic elective while the hands-on techniques will be covered under the Vocational education. Students should also be able to speak fluently in the language known as 'window to the world'. Thus, English communication will be covered stressing more on oral and written English in the first semester and scientific writing in second.

With a view of providing holistic education, learners will also be taught Yog, Ayurved, Meditation, Traditional Indian Diet and Stress management as a part of the Indian Knowledge System.

BOS Chairman: Ms. Sayali Daptardar

## PROGRAMME OUTCOMES (POs) OF BACHELOR OF SCIENCE (B. Sc.)

The Undergraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

**PO1 - Disciplinary Knowledge**

Lay a strong foundation of conceptual learning in science. Instil ability to apply science in professional, social and personal life.

**PO2 - Inculcation of Research Aptitude**

Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learners to grasp concepts related to research methodology and execute budding research ideas.

**PO3 - Digital Literacy**

Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning processes.

**PO4 - Sensitization towards Environment**

Build a cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

**PO5 - Individuality and Teamwork**

Encourage learners to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

**PO6 - Social and Ethical Awareness**

Foster ethical principles which will help in developing rational thinking and becoming socially aware citizens. Build an attitude of unbiased, truthful actions and avoid unethical behaviour in all aspects of life.

**Eligibility:** Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board
**Degree Program:** B.Sc.
**Duration:** 1 Year (includes SEM I and SEM II)
**Mode of Conduct:** Offline Laboratory Practicals / Offline lectures / Online lectures
**Total Credits for the Program:** 132
**Specific Programme:** F. Y. B. Sc. Biochemistry (Major)
**Credits:** 06

**Discipline/Subject:** Biochemistry

## Program Specific Outcomes

By the end of the program, the students will be able to:

| | | |
|---|---|---|
| PSO1 | Explain the structure, properties, and functions of biomolecules and describe fundamental biochemical pathways and their regulation. | L1 |
| PSO2 | Relate biochemical concepts to allied fields such as molecular biology, biotechnology, microbiology, and clinical biochemistry, and apply knowledge to real-world applications such as diagnostics, industry, and environmental science. | L2 |
| PSO3 | Analyse biochemical data, interpret experimental results, troubleshoot laboratory problems, and apply biochemical principles to describe metabolic disorders or physiological processes. | L3 |
| PSO4 | Demonstrate competence in standard biochemical laboratory techniques, including preparation of buffers, quantification of biomolecules, enzyme assays, chromatography, and spectrophotometric analyses. | L4 |
| PSO5 | Demonstrate effective scientific communication skills, work collaboratively in laboratory and project settings, and exhibit professional ethics, safety awareness, and responsibility. | L5 |
| PSO6 | Design basic experiments, follow ethical research practices, maintain accurate laboratory records, and prepare scientific reports or presentations based on literature and experimental findings. | L6 |

Pedagogy: Constructivism, Flipped Classroom, Collaborative Learning, Integrative approach, Enquiry based learning

**Assessment: Weightage for assessments (in percentage) For Major and Minor**

| Type of Course | Formative Assessment / IA | Summative Assessment |
|---|---|---|
| **Theory** | **40 %** | **60 %** |

# VPM's B. N. Bandodkar College of Science (Autonomous), Thane
# F. Y. B. Sc. (Biochemistry)
# Structure of Programme

| Course Code | Course Title | No. of lectures | Credits |
|---|---|---|---|
| **Semester I** | | | |
| **Major** | | | |
| 23BUBC1T01 | Biomolecules – I | 30 | 2 |
| 23BUBC1T02 | Cell Biology | 30 | 2 |
| 23BUBC1P01 | Practicals based on 23BUBC1T01 and 23BUBC1T02 | 60 | 2 |
| | **Total** | **120** | **6** |
| **Vocational Skill Enhancement Course (VSC)** | | | |
| 23BU1VSC03 | Laboratory Skills in Microbial Biochemistry | 45 | 2 |
| | **Total** | **45** | **2** |
| **Semester II** | | | |
| **Major** | | | |
| 23BUBC2T01 | Biomolecules – II | 30 | 2 |
| 23BUBC2T02 | Biochemistry & Physiology | 30 | 2 |
| 23BUBC2P01 | Practicals based on 23BUBC2T01 and 23BUBC2T02 | 60 | 2 |
| | **Total** | **120** | **6** |

# Semester I

| Course Code 23BUBC1T01 | Course Title Biomolecules – I | Credits 2 | No. of lectures |
|---|---|---|---|

| | | |
|---|---|---|
| CO1 | Explain the structure, bonding, and physicochemical properties of water and their role in biomolecular interactions. | L2 |
| CO2 | Analyze solute behavior, weak interactions, and concentration units in aqueous biochemical systems. | L4 |
| CO3 | Compare the different types of carbohydrates studying their structures. | L3 |
| CO4 | Analyze the types of lipids based on their structure and functions. | L4 |

**Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **3** | **2** | **1** | **0** | **0** | **0** |
| **CO2** | **2** | **2** | **1** | **1** | **0** | **1** |
| **CO3** | **3** | **2** | **1** | **0** | **0** | **0** |
| **CO4** | **3** | **2** | **1** | **0** | **0** | **0** |

| | | |
|---|---|---|
| **Unit I Water** | 1.1 Biochemistry of Water: Structure and hydrogen bonding, Its effect on Biomolecules<br>1.2 Hydrophobic & hydrophilic substances, Amphipathic compounds with examples<br>1.3 Properties (surface tension, latent heat, specific heat, viscosity, dielectric constant, Colligative properties) of water and their biological significance<br>1.4 Water as a universal solvent, Entropy and dissolution of solute<br>1.5 Effect of non-polar compounds on the structure of water, Weak interactions of biomolecules in aqueous solutions<br>1.6 Concentration units: Avogadro's number, mole, mole fraction, molarity, equivalent weight, normality, molality, percentage (Problems to be worked out) | **15** |
| **Unit II Carbohydrates & Lipids** | 2.1 Carbohydrates: Definition, detailed Classification of carbohydrates (mono, di, oligo, polysaccharides) Occurrence, structures and significance of each<br>2.2 Physical Properties: Isomerism D & L, optical; epimers, anomers<br>2.3 Lipids: Definition and functions<br>2.4 Classification of Lipids (Bloor's): | **15** |

| | | |
|---|---|---|
| | a. Simple (Fats, Oils, Waxes), Derived (Steroids, Sterols, Carotenoids)<br>b. Compound Lipids: Functions of glycerophospholipids Phosphosphingolipids, Glycolipids (Any 3 Examples, structure and significance of each)<br>c. Saturated fatty acids: classification of C2 to C20: even carbon: Common and IUPAC names.<br>d. Unsaturated fatty acids: MUFA, PUFA (Types), Omega-fatty acids.<br>e. Triacyl glycerol - simple and mixed - names and structure | |

# References


| Sr. No. | Title & Author | Edition | Published in |
|---|---|---|---|
| 1 | Lehninger's Principles of Biochemistry - Nelson & Cox | 6th | 2012 |
| 2 | Essentials of Biochemistry - Pankaja Naik | 2nd | 2017 |
| 3 | Fundamentals of Biochemistry - Voet & Voet | 4th | 2010 |
| 4 | Biochemistry - U. Satyanarayana & U. Chakrapani | 4th | 2013 |
| 5 | Zubay's Principles of Biochemistry- Rastogi & Aneja | 5th | 2017 |

| **Course Code 23BUBC1T02** | **Course Title Cell Biology** | **Credits 2** | **No. of lectures** |
|---|---|---|---|

| | | |
|---|---|---|
| CO1 | Compare prokaryotic and eukaryotic cell analysing cell wall, plasma membrane of different types of cells. | L3 |
| CO2 | Explain cell organelles along with their functions. | L2 |
| CO3 | Summarize the different components of cytoskeleton and extracellular matrix giving their significance. | L2 |
| CO4 | Elaborate on cell junctions,movement of fluid through cells, cell division and its checkpoints and differentiate between apoptosis and necrosis. | L2 |

**Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
|---|---|---|---|---|---|---|
| **CO1** | **3** | **2** | **1** | **1** | **0** | **0** |
| **CO2** | **3** | **1** | **1** | **0** | **0** | **0** |
| **CO3** | **3** | **1** | **1** | **0** | **0** | **0** |
| **CO4** | **3** | **1** | **1** | **0** | **0** | **0** |

| | | |
|---|---|---|
| **Unit I Cell & Cell Organelles** | 1.1 Overview of Cell Theories<br>1.2 Comparison between Prokaryotic & Eukaryotic cells<br>1.3 Cell wall of Plant, Algae, Fungi, Bacteria<br>1.4 Plasma membrane<br>1.5 Organelles of Cell<br>a. Nucleus & nucleolus: Structure & functions<br>b. Mitochondria: Organization & functions<br>c. Plastids: Types & functions<br>d. Ribosomes: Structure & functions<br>e. Golgi Apparatus: Structure & functions<br>f. Functions of Lysosomes, Peroxisomes, Mesosomes, Magnetosomes, Glyoxysomes, Proteosomes | **15** |
| **Unit II Cytoskeleton** | 2.1 Cytoskeleton: Comparative analysis of<br>a. Microtubules (Occurrence, Structure, Chemical Composition, MAPs, MTOCs, Function)<br>b. Microfilaments (Distribution, Chemical composition & Function) | **15** |

| | | |
|---|---|---|
| | c. Intermediate filaments (Introduction in brief, Assembly, Types & Function)<br>2.2 Centrioles, Basal bodies, Cilia and Flagella<br>2.3 Extracellular Matrix (proteins, polysaccharides and adhesion proteins)<br>2.4 Cell Junctions (Anchoring, tight, Gap, Occluding, Desmosomes, Plasmodesmata)<br>2.5 Concept of Apoplastic & Symplastic movement<br>2.6 Cell Division: Cell Cycle & Check Points<br>2.7 Concept of Necrosis & Apoptosis | |

# References


| Sr. No. | Title & Author | Edition | Published in |
|---|---|---|---|
| 1 | Lehninger's Principles of Biochemistry - Nelson & Cox | 6th | 2012 |
| 2 | Essentials of Biochemistry - Pankaja Naik | 2nd | 2017 |
| 3 | Fundamentals of Biochemistry - Voet & Voet | 4th | 2010 |
| 4 | Biochemistry - U. Satyanarayana & U. Chakrapani | 4th | 2013 |
| 5 | Zubay's Principles of Biochemistry- Rastogi & Aneja | 5th | 2017 |
| 6 | Cell Biology, Genetics, Molecular Biology, Evolution and Ecology - Verma & Agarwal | 1st | 2005 |
| 7 | Prescott's Microbiology- Willey, Sherwood, Woolverton | 10th | 2016 |
| 8 | Microbiology - Pelczar Michael J.; Chan Jr., E.C.S. , Krieg ,Noel R. | 5th | 2002 |
| 9 | Cell Biology - Gerard Karp | 7th | 2014 |

| **Course Code 23BUBC1P01** | **Course Title Practicals based on 23BUBC1T01 and 23BUBC1T02** | **Credits 2** | **No. of lectures** |
|---|---|---|---|

| | | |
|---|---|---|
| CO1 | Demonstrate the use of basic equipments used in biochemistry laboratory. | L3 |
| CO2 | Apply the basics of volume and concentrations to prepare and standardize chemical reagents, & determine acid value & SAP value of unknown lipid samples. | L4 |
| CO3 | Identify and estimate the presence of carbohydrates and lipids in unknown samples qualitatively. | L5 |
| CO4 | Observe and study cell organelles and cell cycle phases under microscope | L2 |

**Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
|---|---|---|---|---|---|---|
| **CO1** | **2** | **2** | **1** | **0** | **3** | **0** |
| **CO2** | **2** | **2** | **1** | **0** | **3** | **1** |
| **CO3** | **2** | **3** | **1** | **0** | **3** | **0** |
| **CO4** | **2** | **2** | **0** | **0** | **3** | **0** |

| | | |
|---|---|---|
| 1 | Working in Laboratory and Safety Measures | **60 Hours** |
| 2 | Basic instruments: Microscope, Centrifuge, Analytical balance, pH meter | |
| 3 | Calibration of volumetric glassware (Burette, pipette and measuring cylinder) | |
| 4 | Preparation of laboratory reagents & solutions - Concept of Molar, Normal and Percent | |
| 5 | Standardization of Laboratory Reagents | |
| 6 | Qualitative tests for Carbohydrates – Monosaccharides, Disaccharides Polysaccharides | |
| 7 | Detection of Unknown Carbohydrate | |
| 8 | Determination of Acid value of give oil sample | |
| 9 | Determination of SAP value of given oil sample | |
| 10 | Qualitative tests for lipids | |
| 11 | Effect of isotonic, hypertonic and hypotonic solutions on cells – onion peel | |

| | | |
|---|---|---|
| 12 | Preparation of temporary mount of onion peel to observe and study epidermal cells | |
| 13 | Preparation of microscope slide for Monocot & Dicot leaf section | |
| 14 | Observation of stomata & guard cells in leaf under microscope | |
| 15 | Isolation of chloroplast from Spinach | |
| 16 | Detection of mitochondrial activity | |
| 17 | Study of stages of mitosis using onion root tips | |
| 18 | Observing stages of mitosis and meiosis using permanent slides | |
| 19 | Study the motility in bacteria by flagella using hanging drop method | |
| 20 | Observation of movement of paramecium using cilia | |

| Course Code 23BU1VSC03 | Course Title Laboratory Skills in Microbial Biochemistry | Credits 1 | No. of lectures |
|---|---|---|---|

| | | |
|---|---|---|
| CO1 | Elaborate on various microbial cells, bacterial growth and explain the use of dyes and stains for observing organelles in bacterial cells. | L3 |
| CO2 | Analyse nutritional types of microbes, use of different media for their growth and study various methods of their preservation | L2 |
| CO3 | Perform staining and isolation techniques to observe organisms and their colony characteristics | L5 |
| CO4 | Choose correct media and incubation conditions for microbial cultivation | L4 |

**Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **3** | **1** | **0** | **1** | **0** | **1** |
| **CO2** | **3** | **1** | **0** | **1** | **0** | **1** |
| **CO3** | **2** | **3** | **0** | **2** | **3** | **1** |
| **CO4** | **2** | **3** | **0** | **2** | **3** | **1** |

| | | |
|---|---|---|
| **Unit I Basic Techniques in Microbiology** | 1.1 Microbial Diversity: Bacteria, Archaea, Fungi, Algae, Protozoa, Viruses) General features<br>1.2 Observing Bacteria: Dyes and stains: Types, Physicochemical basis Fixatives, Mordants, Decolorizers, Simple and differential staining, Special Staining (Capsule, Cell wall)<br>1.3 Microbial Growth: Growth curve, optimum conditions, Nutritional requirements: Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors, Nutritional types of microorganisms<br>1.4 Types of Culture media, Isolation of microorganisms and pure culture techniques<br>1.5 Preservation of microorganisms | **15** |

| | Course Title Laboratory techniques in Microbial Biochemistry | Credits 1 | No. of lectures |
|---|---|---|---|
| 1 | Microbiology Lab: Introduction to Autoclave, Hot air oven, Glassware, Nichrome loop, Methods of preparation of glassware for Sterilization | | |
| 2 | Observing variety of microorganisms (Diatoms, protozoa) in a drop of lake water under microscope | | |

| | | |
|---|---|---|
| 3 | Wet mount for observing fungi | **30 Hours** |
| 4 | Monochrome Staining, Negative staining | |
| 5 | Differential Staining: Gram Staining | |
| 6 | Special Staining: Capsule staining | |
| 7 | Isolation & Study of colony Characteristics | |
| 8 | Use of Differential & Selective Media: (MacConkey & SMA) | |
| 9 | Inoculation techniques (Spreading, Streaking, Swabbing, Stabbing) | |
| 10 | Study of Growth under different conditions of pH & Temperature | |

# References


| Sr. No. | Title & Author | Edition | Published in |
|---|---|---|---|
| 1 | Prescott's Microbiology- Willey, Sherwood, Woolverton | 10th | 2016 |
| 2 | Microbiology - Pelczar Michael J.; Chan Jr., E.C.S. , Krieg ,Noel R. | 5th | 2002 |
| 3 | Foundations in Microbiology - Talaro & chess | 8th | 2001 |
| 4 | Fundamental Principles of Bacteriology | 2nd | 1973 |

# Semester II

| Course Code 23BUBC2T01 | Course Title Biomolecules – II | Credits 2 | No. of lectures |
|---|---|---|---|

| | | |
|---|---|---|
| CO1 | Describe and compare the structure and components of DNA with evidence to support its helical nature. | L2 |
| CO2 | Analyze the physicochemical properties of DNA and differentiate between nuclease activities and RNA categories, including uncommon RNAs. | L3 |
| CO3 | Explain the structure, classification, stereochemistry, physical and chemical properties of standard and non-standard amino acids, along with their biological functions. | L2 |
| CO4 | Analyze peptide and protein structural organization—primary to quaternary levels, properties, factors influencing protein stability, classification based on molecular shape and their biological importance | L3 |

**Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **3** | **1** | **1** | **0** | **0** | **0** |
| **CO2** | **3** | **1** | **1** | **0** | **0** | **0** |
| **CO3** | **3** | **1** | **1** | **0** | **0** | **0** |
| **CO4** | **3** | **2** | **1** | **0** | **0** | **0** |

| | | |
|---|---|---|
| **Unit I Nucleic Acids** | 1.1 Nucleic Acids: Structure - Purine & Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP), phosphodiester linkage, Formation of polynucleotide strand with its shorthand Representation<br>1.2 DNA: Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA & its features, Properties of nucleotides - Effect of heat on physical properties of DNA: Viscosity, buoyant density, UV absorption, Hypochromism, hyperchromism, Denaturation and Renaturation of DNA, Types: A, B & Z<br>1.3 RNA: various types in prokaryotes and eukaryotes- mRNA & rRNA - general account, tRNA - clover leaf model,<br>1.4 Uncommon RNAs: snRNA, siRNA, miRNAs, snoRNAs, lncRNA, piRNAs, Ribozymes<br>1.5 Nucleases (Endo & Exo) | **15** |

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|---|---|---|
| **Unit II Proteins & Amino Acids** | 2.1 Amino acids: Amino acid structure - D & L forms of all 20 amino acids, Detailed classification based on polarity, nutritional (essential and non-essential amino acid), Chemical structure and chemical nature, reactions with reagents<br>2.2 Physical properties: Zwitter ions, pI of amino acids as ampholytes, melting point, optical rotation, UV absorption<br>2.3 Non-Standard amino acids, Functions of amino acids<br>2.4 Peptides and Proteins: ASBC - APS classification on the basis of molecular shape, composition and function<br>2.5 Primary structure - Formation and characterization of the peptide bond, Secondary structure - Alpha helix and beta sheet, Tertiary(myoglobin) and Quaternary (hemoglobin) structures<br>2.6 Properties of proteins<br>2.7 Protein denaturation (Concept, Conditions, denaturing agents, Enzymes, their mode of action)<br>2.8 Biological importance of Peptides | **15** |

# References


| Sr. No. | Title & Author | Edition | Published in |
|---|---|---|---|
| 1 | Essentials of Biochemistry - Pankaja Naik | 2nd | 2017 |
| 2 | Biochemistry - U. Satyanarayana & U. Chakrapani | 4th | 2013 |
| 3 | Fundamentals of Biochemistry - Jain & Jain | 7th | 2016 |
| 4 | iGenetics: A molecular approach - Peter J. Russell | 3rd | 2016 |
| 5 | Lehninger's Principles of Biochemistry - Nelson & Cox | 6th | 2012 |
| 6 | Textbook of Biochemistry for Medical Students- Vasudevan | 9th | 2019 |

| Course Code<br>23BUBC2T02 | Course Title<br>Biochemistry & Physiology | Credits<br>2 | No. of lectures |
|---|---|---|---|

| | | |
|---|---|---|
| CO1 | Explain fundamental acid–base concepts including pH, pK, pKw, isoelectric pH, buffer and buffering capacity, derive key equations such as ionic product of water and Henderson–Hasselbalch equation and relate pI to pKa values for neutral, acidic and basic amino acids. | L2 |
| CO2 | Interpret ionization and titration curves of glycine, lysine and aspartic acid explaining the action of major physiological buffers and solve numerical problems related to pH, pK, pI and buffer systems. | L5 |
| CO3 | Describe body fluids, blood composition, haematopoiesis and plasma protein functions and interpret mechanisms of gas transport with hemoglobin involvement such as $O_2$ dissociation curves, bohr effect and chloride shift. | L3 |
| CO4 | Summarize the composition, characteristics and functions of major body fluids including bile, lymph, urine, interstitial fluid, cerebrospinal fluid, synovial fluid, seminal fluid, tears, sweat and faeces and interpret their formation processes and diagnostic significance. | L2 |

**Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 |
|---|---|---|---|---|---|---|
| **CO1** | **3** | **1** | **1** | **0** | **0** | **0** |
| **CO2** | **3** | **2** | **1** | **0** | **0** | **0** |
| **CO3** | **3** | **2** | **1** | **0** | **1** | **0** |
| **CO4** | **3** | **2** | **1** | **0** | **2** | **0** |

| | | |
|---|---|---|
| **Unit I<br>pH<br>&<br>Buffers** | 1.1 Definition – pH, pK, pKw, isoelectric pH, buffer, buffering capacity, Electrolytic Dissociation & Electrolytes<br>1.2 Derivations: Ionic product of water, Hendersen– Hasselbalch equation<br>1.3 Relation between pI, pKa1 and pKa2 for a neutral, acidic and basic amino acid<br>1.4 Ionization and titration curves of glycine, lysine and aspartic acid; pKa and pI values of these amino acids<br>1.5 Buffers - Definition, action, Physiological buffers: Hb - HHb, carbonate bicarbonate, phosphate and protein<br>1.6 Numerical on above concepts | **15** |

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|---|---|---|
| **Unit II Blood & Body Fluids** | 2.1 Fluid compartments of the body–ICF and ECF<br>2.2 Haematopoesis Blood: Composition, characteristics and function<br>2.3 Role of plasma proteins, Starling hypothesis<br>2.4 Transport in Blood: Transport of gases $CO_2$ and $O_2$, Role of hemoglobin, $O_2$ dissociation curves<br>2.5 Bohr effect, Chloride shift<br>2.6 Bile: Composition, characteristics and function; storage, Importance of testing Bile<br>2.7 Lymph: Composition, Formation and Circulation<br>2.8 Urine: Composition–normal and abnormal constituents; formation of urine, Importance of testing urine<br>2.9 Function, Characteristics and Composition of interstitial fluid, cerebrospinal fluid, synovial fluid, seminal fluid, tears, sweat and faeces | **15** |

## References


| Sr. No. | Title & Author | Edition | Published in |
|---|---|---|---|
| 1 | Textbook of Medical Physiology - Guyten & Hall | 11th | 2017 |
| 2 | Principles of Anatomy and Physiology - Tortora | 12th | 2008 |
| 3 | Fundamentals of Biochemistry - Jain & Jain | 7th | 2016 |
| 4 | Textbook of Medical Biochemistry - M N Chatterjea | 8th | 2012 |
| 5 | Textbook of Biochemistry for Medical Students- Vasudevan | 9th | 2019 |
| 6 | Lehninger's Principles of Biochemistry - Nelson & Cox | 6th | 2012 |
| 7 | Biophysical Chemistry - Upadhyay , Upadhyay and Nath | 1st | 2009 |

| **Course Code 23BUBC2P01** | **Course Title Practicals based on 23BUBC2T01 and 23BUBC2T02** | **Credits 2** | **No. of lectures** |
|---|---|---|---|

| | | |
|---|---|---|
| CO1 | Perform genomic DNA isolation from plant tissues and execute qualitative tests to detect nucleic acids, amino acids and proteins, including identification of an unknown protein sample. | L5 |
| CO2 | Execute protein purification steps including ammonium sulfate precipitation and dialysis, formulate buffers for experimental use and conduct acid–base titration of a polyprotic acid while evaluating the achromic point of salivary amylase. | L5 |
| CO3 | Extract citric acid from food and Assess pH of different food samples, perform density-gradient centrifugation of blood to separate its components, Measure RBC and WBC counts and detect bilirubin using standard biochemical tests. | L5 |
| CO4 | Detect presence of bile salts, analyze normal and abnormal constituents, titratable acidity of urine and determine hemoglobin content of blood. | L5 |

**Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping**

| | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** |
|---|---|---|---|---|---|---|
| **CO1** | **2** | **3** | **1** | **1** | **3** | **1** |
| **CO2** | **2** | **3** | **1** | **0** | **3** | **1** |
| **CO3** | **2** | **3** | **1** | **0** | **3** | **1** |
| **CO4** | **2** | **3** | **1** | **0** | **3** | **1** |

| | | |
|---|---|---|
| 1 | Isolation of genomic DNA from onion / Banana / Strawberry cells | **60 Hours** |
| 2 | Qualitative tests for Nucleic Acids | |
| 3 | Qualitative tests for Amino Acids | |
| 4 | Qualitative analysis for Protein | |
| 5 | Qualitative test to detect unknown protein. | |
| 6 | Ammonium sulphate precipitation of Proteins. | |
| 7 | Concept of Dialysis in Protein purification | |
| 8 | Preparation of buffers for experimental purpose | |
| 9 | Acid –Base titration of a Polyprotic acid | |

| | | |
|---|---|---|
| 10 | Determination of the Achromic point of Salivary Amylase | |
| 11 | Extraction of citric acid from lemon juice | |
| 12 | Checking pH of various food samples/fruit juices | |
| 13 | Density gradient centrifugation of Blood using Ficoll-Hypaque | |
| 14 | Determination of RBC & WBC count | |
| 15 | Detection of Bilirubin (Iodine test/Gmelin's Nitric acid test/Fouchet's test) | |
| 16 | Detection of Bile salt (Pettenkofer's test, Hays sulphur test) | |
| 17 | Urine analysis- Normal and Abnormal constituents | |
| 18 | Urine Analysis by Dip Stick Method | |
| 19 | Estimation of titratable acidity of Urine | |
| 20 | Determination of Hemoglobin content by the Sahli's hemoglobinometer | |

## Curriculum mapping for the Undergraduate Degree Programme

## F.Y.B.Sc Biochemistry

| | **SEMESTER – I** | **Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)** | | | **Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)** | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Major Course Title** | **EM** | **EN** | **SD** | **PE** | **GE** | **HV** | **ES** |
| **23BUBC1T01** | Biomolecules – I | -- | -- | -- | -- | -- | -- | -- |
| **23BUBC1T02** | Cell Biology | -- | -- | √ | -- | -- | -- | -- |
| **23BUBC1P01** | Practicals based on 23BUBC1T01 and 23BUBC1T02 | -- | -- | √ | -- | -- | -- | -- |
| **23BU1VSC03** | Laboratory Skills in Microbial Biochemistry | √ | √ | √ | -- | -- | -- | -- |
| | ***Total*** | **01** | **01** | **03** | **00** | **00** | **00** | **00** |

| | **SEMESTER – II** | **Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)** | | | **Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)** | | | |
|---|---|---|---|---|---|---|---|---|
| **Course Code** | **Major Course Title** | **EM** | **EN** | **SD** | **PE** | **GE** | **HV** | **ES** |
| **23BUBC2T01** | Biomolecules – II | -- | -- | -- | -- | -- | -- | √ |
| **23BUBC2T02** | Biochemistry & Physiology | -- | -- | -- | -- | -- | -- | -- |
| **23BUBC2P01** | Practicals based on 23BUBC2T01 and 23BUBC2T02 | -- | -- | √ | -- | -- | -- | -- |
| | ***Total*** | **00** | **00** | **01** | **00** | **00** | **00** | **01** |