

# SAURASHTRA UNIVERSITY



**COURSE STRUCTURE  
&  
SYLLABUS  
FOR  
UNDERGRADUATE PROGRAMME  
IN  
BIOCHEMISTRY 1<sup>st</sup> and 2<sup>nd</sup> Semester  
CORE COURSES  
UNDER  
CHOICE BASED CREDIT SEMESTER SYSTEM  
w.e.f June, 2016.**

## PREFACE

Science is pivotal to the development of any modern society. However, the creation of a scientific temper in society necessitates proper education and guidance. An effective science education can be imparted at the undergraduate level only by revamping the present curriculum. To achieve this goal, the curriculum should be restructured, giving emphasis to various aspects such as the creativity of students, knowledge of current developments in the discipline, awareness of environment impacts due to the development of science and technology, and the skills essential for handling equipment and instruments in laboratories and industries.

The Higher Education Council has taken the initiative to reformulate the undergraduate syllabi by introducing choice based credit and semester system. This is to cope with the internationally followed curricula and mode of evaluation. This approach has necessitated the revision of the present curriculum.

This curriculum is prepared to give sound knowledge and understanding of Biochemistry to undergraduate students. The goal of the syllabus is to make the study of Biochemistry stimulating, relevant and interesting. The syllabus is prepared with a view to equipping the students with the potential to contribute to academic and industrial environments. This curriculum will expose students to various fields in Biochemistry and develop interest in related disciplines. Biochemistry, being a border science to biology, chemistry, physics and engineering, has a key role to play in learning these disciplines.

The new and updated syllabus is based on an interdisciplinary approach with vigor and depth. Care has been given to ensure that the syllabus is not very heavy while remaining compatible to the syllabi of other universities at the same level. Biochemistry being an experimental science, sufficient emphasis is given in the syllabus for training in laboratory skills and instrumentation.

The syllabus has been prepared in a participatory manner, after discussions with a number of faculty members in the subject and also after evaluating the existing syllabi of B.Sc Part-III, the new syllabi of XI<sup>th</sup> & XII<sup>th</sup> standards and U.G.C. model curriculum and the syllabi of other Universities.

The units of the syllabus are well defined and the scope of each is given in detail. The number of contact hours required for each unit is also given. A list of reference books is provided at the end of each course.

## Broad objectives

To enable the students

- To understand basic facts and concepts in Biochemistry while retaining the exciting aspects of Biochemistry so as to develop interest in the study of Biochemistry as a discipline.
- To acquire the knowledge of terms, facts, concepts, processes techniques and principles of the subject.
- To develop the ability to apply the principles of Biochemistry.
- To be inquisitive towards advanced Biochemistry and developments therein.
- To appreciate the achievements in Biochemistry and to know the role of Biochemistry in nature and in society.
- To develop problem solving skills.
- To be familiarised with the emerging areas of Biochemistry and their applications in various spheres of Life sciences and to apprise the students of its relevance in future studies.
- To develop skills in the proper handling of apparatus and chemicals.
- To be exposed to the different processes used in industries and their applications.

## COURSE STRUCTURE FOR UG PROGRAMME BIOCHEMISTRY- 101 SEMESTER 1

Semester	Course	Title	Hours/week	Credit	Exam hours	Internal marks	External Marks	Total Marks
1st	101	Physical and Chemical aspects of Biochemistry	6	4	3	25	75	100
1 <sup>st</sup>	101	Practicals	6	3			25	25

Saurashtra University  
Semester 1<sup>st</sup> Syllabus of Biochemistry(CBCS)  
**New Proposed Syllabus- June 2016**  
Biochemistry – 101  
**Physical and Chemical Aspects of Biochemistry**  
**Paper Code - 16031200010101**

Credit : 4

Theory : 6 lectures/week

Total Lectures: 60

**UNIT.1 Chemical Bond and Water**

[12 hours]

Concepts of Atoms and Molecules,

Chemical Bonds and their importance in structure of biomolecules: Ionic Bonds ,Covalent bond.

Dipole moment and molecular structure. Weak chemical forces-hydrogen bond, inter and intramolecular hydrogen bonds, effects of hydrogen bonding, Van der Waals forces.

Electrophiles and Nucleophiles.

Water as a biological solvent, physical and chemical properties of water, importance of water for living organisms.

**UNIT. 2 Introduction to Thermodynamics and Biochemical reaction** [12 hours]

Introduction to thermodynamic system, first and second law of thermodynamics, concept of free energy, standard free energy, High-energy compounds and their applications in biochemistry.

Biochemical reactions: Biochemical equation-oxidation reduction reaction-redox potential and its role in biological reaction

**UNIT. 3 pH, Buffer and Physiological Buffers.**

[12 hours]

Properties of Acid and Base. Shapes of titration curves of strong and weak acids and bases. Meaning of  $k_a$  and  $pK_a$  values.

Concept of pH and pOH, numerical problems of pH , methods to determine pH, pH meters- types of electrodes , principle and working of pH meter.

Buffers, buffer capacity and factors affecting buffering capacity,Henderson – Hesselbalch equation, simple numerical problems involving application of this equation.

Physiological Buffers: Types and importance.

**UNIT 4. Osmosis, Viscosity, Diffusion and Adsorption:**

[12 hours]

Basic principles, factors affecting, biological importance and applications of Osmosis, Viscosity , Diffusion and Adsorption in life sciences.

## **UNIT 5. Solutions:**

[12 hours]

Mole concept , Normal , Molar , Molal and Percent Solutions. Numerical problems. Stock, Working solutions . preparation of w/v, v/v and dilute solutions. Concepts of Density and specific gravity

## **Biochemistry Practicals:101**

Credit: 3

6 Hours / Week

1. Introduction to Basic Instruments used in Biochemistry laboratory- Microscope, Balance, Vortex mixer, Magnetic stirrer, Refrigerator, Water Distillation system, Water bath , Incubator , Hot air Oven.
2. Use, importance and cleaning of different types of glassware and auto pipettes and their calibration.
3. Principle and Use of pH meter.
4. Measuring and adjusting pH of given sample.
5. Preparation of different types of buffer solutions.
6. Preparation and Numerical problems on Normal Solutions.
7. Preparation and Numerical problems on Molar Solutions.
8. Preparation and Numerical problems on percent solutions and dilutions.

## **Reference Books:**

- 1) Biochemistry by U. Satyanarayan
- 2) Physical biochemistry by Vanholde K.E., Practice Hall Inc. New Jersey.
- 3) Principles and techniques of practical biochemistry by K.Wilson and Walker, Cambridge University press.
- 4) Biophysical biochemistry by Upadhyay and Nath.
- 5) Tools of biochemistry by Cooper.
- 6) Outlines of biochemistry by Eric Conn., P.K.Stumpf. John Wiley and Sons.
- 7) Lehninger's Principles of Biochemistry by Nelson, David & Cox., Macmillan NY.
- 8) Fundamentals of Biochemistry by Donald Voet, Judith Voet and Charlotte Pratt. John Willey and Sons.
- 9) Biochemistry by Lubert Stryer, W.H.Freeman and Co.
- 10) Standard methods of biochemical analysis by S.R.Thimmaiah, Kalyani Publishers Delhi, India.
- 11) Instant Notes in Chemistry for Biologists by J.Fisher and J.R.P. Arnold.
- 12) Chemical Principles, the quest for insight by Atkins Jones
- 13) Biochemical Calculations by Irwin H. Segel.
- 14) Physical biochemistry by D.Frifelder, W.H.Freeman and Co.

## **Instruments required for the Practicals**

1. Microscope.
2. Balance

- 3.Vortex Mixer
- 4.Magnetic stirrer
- 5.Refrigerator
- 6.Water Bath
- 7.Incubator
- 8.Hot Air Oven
- 9.pH Meter

**One laboratory to accommodate 30-35 students in one batch to perform the practical**

**Saurashtra University**  
**Semester 2<sup>nd</sup> Syllabus of Biochemistry(CBCS)**  
**New Proposed Syllabus – December 2016**  
**Biochemistry – 201**  
**CELL BIOLOGY AND PLANT BIOCHEMISTRY**  
**Paper Code - 16031200010202**

**COURSE STRUCTURE FOR UG PROGRAMME**  
**BIOCHEMISTRY- 201**  
**SEMESTER 2**

Semester	Course	Title	Hours/week	Credit	Exam hours	Internal marks	External Marks	Total Marks
2 <sup>nd</sup>	201	Cell biology and Plant Biochemistry	6	4	3	25	75	100
2 <sup>nd</sup>	201	Practicals	6	3			25	25

**Credit: 4**

**Theory: 6 lectures/ week Total Lectures: 60**

**Unit I: Introduction to Cell, Cell morphology and Cell theories [12 hours]**

1. Definition of Cell, History of cell biology and levels of organizations in biology
2. Structural organization of prokaryotic and eukaryotic cells.
3. Structural and functional diversities in eukaryotic cells, plant Vs animal cell.  
Overview on viruses, viroids and prions.
4. Structure and functions of cytoskeleton elements.

**Unit II: Structure, chemical composition, enzymes and functions of different cell organelles: [12 hours]**

1. Cell wall, Plasma membrane and cytoplasm.
2. Mitochondria. Endosymbiosis hypothesis regarding origin of mitochondria and chloroplasts. Maternal origin of mitochondria.
3. Endoplasmic reticulum, Golgi complex, Lysozomes and Microbodies (Glyoxyzomes and peroxyzomes).
4. Homogenization methods and isolation of cell organelles by differential centrifugation and marker enzymes.

### **Unit III: Cell cycle and cell division: [12 hours]**

1. Cell cycle and its stages.
2. Basic concepts of cell division and cell differentiation.
3. Process of mitotic type cell division and its physiological importance.
4. Process of meiotic type cell division and its significance.

### **Unit IV: Biological membranes and Membrane Transport: [12 hours]**

1. Chemical composition of biological membranes. Singer and Nicholson model of plasma membrane structure
2. Concept of membrane asymmetry, Lateral movement and flip-flop movement of phospholipids and proteins in biological membranes. FRAP experiment.
3. Transport of ions and molecules across the biological membranes: Simple diffusion, Facilitated diffusion and Active transport.
4. Sodium potassium ATPase structure and mechanism and its significance. General introduction to ionophores and their applications.

### **UNIT V: Plant Biochemistry [12 hours]**

1. Photosynthesis- Light and Dark reactions, Hill reaction.
2. C<sub>3</sub>, C<sub>4</sub> Plants and CAM metabolism. Photorespiration.
3. Plant Hormones and their functions.
4. Biological nitrogen fixation and ammonia assimilation

### **Practicals for paper no- 201- (Cell Biology and Plant Biochemistry):**

Credit: 3

6 Hours / Week

1. Slide observation of different stages of Mitosis cell division.
2. Slide observation of different stages of Meiosis (Meiosis I and II) cell division.
3. Preparation of liver homogenate using glass-Teflon homogenizer and Isolation of sub cellular organelles from liver homogenate by differential centrifugation
4. Isolation of symbiotic nitrogen fixing microorganisms from root nodules.
5. Characterization of *Rhizobium* species by studying colony characteristics, Gram staining and Capsule staining.
6. Extraction and spectrophotometric estimation of chlorophylls from spinach leaves.
7. Preparation and Observation of Bacterial Protoplast.
8. Power point presentation/ Scientific Essay / poster making (Card Sheet).

### **Reference Books for paper no 201(Cell Biology and Plant Biochemistry):**

1. Molecular biology of the Cell by Albert's et al., Garland publication Inc NY and London.
2. Molecular biology by Lodish, scientific American books.
3. Cell and Molecular biology (8th Ed) by De Robertis & Robertis. Lippincot Williams & Wilkins, Philadelphia.
4. Biochemistry by Donald Voet & Judith Voet, John Wiley & sons.inc, NY.
5. Biochemistry by Geoffrey Zubay, McGraw Hill.
6. Plant Physiology by Devlin.

### **Instruments required for the Practicals-201 paper**

- |   |                             |
|---|-----------------------------|
| 1. Microscope.  | 2. Electronic Balance       |
| 3 .Mortar /Pestle   | 4. Glass/Teflon homogenizer |
| 5. Refrigerator   | 6. High speed centrifuge    |
| 7. Laminar air flow                                       | 8. UV-Vis Spectrophotometer |
| 9. Projector (if power point presentation is to be given) |                             |

### **Other Requirements:**

Permanent Slides of different stages of Mitosis and Meiosis Cell division