

**THIRUVALLUVAR UNIVERSITY**

**BACHELOR OF SCIENCE**

**B.Sc. BIOCHEMISTRY**

**UNDER CBCS**

**(With effect from 2020 - 2021)**

**The Course of Study and the Scheme of Examinations**

S. No.	Part	Study Components		Ins. Hrs / week	Credit	Title of the Paper	Maximum Marks		
		Course Title					CIA	Uni. Exam	Total
<b>SEMESTER I</b>									
1	I	Language	Paper-1	6	4	Tamil/Other Languages	25	75	100
2	II	English (CE)	Paper-1	6	4	<b>Communicative English I</b>	25	75	100
3	III	Core Theory	Paper-1	6	4	Cell biology	25	75	100
4	III	Core Practical	Practical-1	4	0	Titrimetric and Qualitative analysis	0	0	0
5	III	Allied -1	Paper-1	4	3	Chemistry I	25	75	100
6	III	Allied- 1	Practical-1	2	0	Chemistry I & II	0	0	0
7	III	<b>PE</b>	<b>Paper 1</b>	<b>6</b>	<b>3</b>	<b>Professional English I</b>	<b>25</b>	<b>75</b>	<b>100</b>
8	IV	Environmental Studies		2	2	Environmental studies	25	75	100
		<b>Sem. Total</b>		<b>36</b>	<b>20</b>		<b>150</b>	<b>450</b>	<b>600</b>
<b>SEMESTER II</b>									
8	I	Language	Paper-2	6	4	Tamil/Other Languages	25	75	100
9	II	English (CE)	Paper-2	6	4	<b>Communicative English II</b>	25	75	100
10	III	Core Theory	Paper-2	5	4	Biomolecules	25	75	100
11	III	Core Practical	Practical-1	3	2	Titrimetric and Qualitative analysis	25	75	100
12	III	Allied-1	Paper-2	4	3	Chemistry II	25	75	100
13	III	Allied Practical - 1	Practical-1	2	2	Chemistry I & II	25	75	100
14	III	<b>PE</b>	<b>Paper 1</b>	<b>6</b>	<b>3</b>	<b>Professional English II</b>	25	75	100
15	IV	Value Education		2	2	Value Education	25	75	100
16	IV	Soft Skill		2	1	Soft Skill	25	75	100
		<b>Sem. Total</b>		<b>36</b>	<b>25</b>		<b>225</b>	<b>675</b>	<b>900</b>

**THIRUVALLUVAR UNIVERSITY**  
**B.Sc. BIOCHEMISTRY**

**SYLLABUS**  
**UNDER CBCS**  
**(With effect from 2020-2021)**

**SEMESTER I**

**PAPER - 1**

**CELL BIOLOGY**

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**At the end of the course, the student will be able to**

<b>CO NUMBER</b>	<b>CO Statement</b>
CO1	Explain the structures and functions of basic components of prokaryotic and eukaryotic cells
CO2	Describe the structure, function and composition of cell membrane and communicate the types and mechanism of membrane transport
CO3	Discuss the structure and functions of cellular organelles
CO4	Understand the types of microfilaments and mitochondria
CO5	Describe nucleus and nucleolus ,Illustrate the phases of cell cycle; in particular mitosis and describe the significance of meiosis in genetic diversity
	Relate the structure and biological role of extra cellular matrix and cell -cell junction with physiological processes

**UNIT - I**

**15 hrs**

An overall view of cells - origin and evolution of cells. Cell theory. Classifications of cell - Prokaryotic and Eukaryotic cells. Differences between prokaryotic and eukaryotic cells. Scope of cell biology

**UNIT - II**

**15 hrs**

Cell membrane- Evolution, Fluid Mosaic Model of membrane structure. Membrane proteins and their properties. Membrane carbohydrates and their role. Transport mechanism –Uniport, Symport and Antiport. Simple, facilitated diffusion, active and passive transport.

### **UNIT – III**

**15 hrs**

Endoplasmic reticulum - types, structure and functions. Golgi apparatus- structures and functions. Ribosomes - types, structure and functions. Lysosomes- structure and functions.

### **UNIT - IV**

**15 hrs**

Cytoskeleton: Types of filaments and their functions. Microfilaments and Microtubules: Chemistry and function (esp. cilia and flagella). Actin and Myosin. Mitochondria: Structure and function

### **UNIT – V**

**15 hrs**

Nucleus and nucleolus- structure and functions .Chromosome-chromatin structure, the cell cycle - phases of cell cycle. Meiotic and mitotic cell divisions, cell- cell communications, cell recognition, cell adhesion and cell functions.

### **REFERENCES**

1. Rastogi . S.C. Cell Biology. Newage Publishers, (2008).
2. Devasena.T, Cell Biology, Oxford University Press India First edition (2012).
3. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach Sinauer Associates, Inc 6<sup>th</sup> edition (February 1, 2013)
4. Verma.P.S and Agarwal.V.K. Cell biology, Genetics, Molecular biology, Evolution and Ecology, S.Chand & Co Ltd, 2004

## SEMESTER I

### CORE PRACTICAL-1 PRACTICAL-1

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**Course Outcomes: At the end of the Course, the Student will be able to:**

<b>CO NUMBER</b>	<b>CO STATEMENT</b>
CO1	Qualitatively analyze the carbohydrates and amino acids and report the type of carbohydrate based on specific tests
CO2	Differentiate the carbohydrates based microscopic examination of the crystal structure.
CO3	Quantify glucose by benedicts method
CO4	Quantify ascorbic acid in lemon by Dichlorophenol indo phenol dye method
CO5	Quantify glycine by Sorenson's formol titration method
CO6	Determine lipid properties of unsaturation and fatty acid content by SAP number and iodine number

### **I. QUALITATIVE ANALYSIS**

#### **A) Qualitative analysis of Carbohydrates**

1. Qualitative analysis of Glucose,
2. Qualitative analysis of Fructose,
3. Qualitative analysis of Arabinose/Xylose,
4. Qualitative analysis of Maltose,
5. Qualitative analysis of Sucrose
6. Qualitative analysis of Starch
7. Qualitative analysis of unknown sugar.

#### **B) Qualitative analysis of Amino acids**

1. Qualitative analysis of Arginine,
2. Qualitative analysis of Cysteine,
3. Qualitative analysis of Tryptophan
4. Qualitative analysis of Tyrosine
5. Qualitative analysis of unknown amino acids.

### **II. QUANTITATIVE ANALYSIS:**

1. Estimation of ascorbic acid using 2, 6 – dichlorophenol indophenol as link solution, present in unknown solution

2. Estimation of Glycine by Sorenson formal titration.
3. Determination of glucose by Benedict's method.

### **DEMONSTRATION EXPERIMENTS**

1. Determination of SAP number.
2. Determination of Acid number.

### **TEXT BOOKS/ REFERENCE BOOKS**

1. J. Jayaraman, Laboratory Manual in Biochemistry, New Age International Pvt Ltd Publishers, 2011.
2. S. K. Sawhney Randhir Singh, Introductory Practical Biochemistry, Alpha Science International, Ltd 2 edition, 2005.
3. Irwin H.Saegal, Biochemical calculations, Liss, Newyork, 1991

**ALLIED - 1  
PAPER - 1**

**CHEMISTRY I**

**OBJECTIVE:**

- Basic knowledge on Metallurgy, Cycloalkanes, Polarising Effects, Stereochemistry, Chemical Kinetics, Catalysis, Photochemistry, VSEPR Theory, Fuels, Osmosis, Nuclear Chemistry, Petroleum Chemistry, Chemistry of Naphthalene, Conductors and Applications wherever necessary are to be taught for I- Semester.

**UNIT – I**

1.1 General Metallurgy - Extraction of Metals - Minerals and Ores- Difference between Minerals and Ores – Minerals of Iron, Aluminum and Copper - Ore Dressing or Concentration of Ores - Types of Ore Dressing- Froth Floatation process, Gravity separation and Magnetic separation.

1.2 Calcination, Smelting, Roasting, Flux, Slag - Definition - Reduction methods - Goldschmidt Aluminothermic process and Carbon Reduction method - Refining of Metals - Electrolytic, Van Arkel and Zone Refining.

1.3 Ores of Titanium and Cobalt - Extraction of Titanium and Cobalt.

**UNIT – II**

1. Cycloalkanes - Preparation – Wurtz reaction and Dieckmann's condensation - Properties of Cycloalkanes – Substitution and Ring opening reactions.

2.2 Polarisation - Inductive effect, Mesomeric effect and Steric effect (Acid and Base Strength).

2.3 Stereoisomerism – Types - Cause of Optical Activity – Enantiomers - Diastereomers - Meso form - Optical Activity of Lactic acid and Tartaric acid - Racemisation and Resolution – Definition and Methods - Geometrical isomerism – Definition and example - Maleic and Fumaric acid – Differences.

**UNIT – III**

3.1 Chemical Kinetics – Rate of a reaction – Definition of Order and Molecularity – Distinction between Order and Molecularity - Derivation of First order rate equation - Half Life Period of first order reaction.

3.2 Catalysis - Catalyst - Autocatalyst - Enzyme catalyst - Promoters - Catalytic poisons –

Active Centre - Differences between Homogeneous and Heterogeneous Catalysis - Industrial Applications of Catalysts.

3.3 Photochemistry – Grothus-Draper's law – Stark-Einstein's law - Quantum yield – Photosynthesis - Phosphorescence – Fluorescence.

#### **UNIT – IV**

4.1 VSEPR Theory – Hybridisation and Shapes of simple molecules  $\text{BF}_3$ ,  $\text{PCl}_5$ ,  $\text{SF}_6$  and  $\text{XeF}_6$ .

4.2 Fuels – Classification of Fuels - Calorific value of Fuels – Water gas, Carbureted Water gas and Producer gas – Composition and Uses - Non-Conventional fuels - Need of Solar Energy - Applications - Biofuels – Oil gas, Natural gas and LPG – Uses.

4.3 Osmosis - Osmotic pressure - Reverse osmosis – Definition - Desalination of Sea water.

#### **UNIT – V**

5.1 Nuclear Chemistry – Atomic number, Mass number - Isotopes, Isobars and Isotones – Definition and Examples - Definition of Half life period - Nuclear Binding Energy, Mass Defect and N/P ratio - Nuclear Fission and Nuclear Fusion (Elementary idea) - Applications of Radioisotopes in Medicine, Agriculture and Industries – Carbon Dating.

5.2 Crude Oil - Petroleum - Petroleum Refining - Cracking - Applications of Cracking –  
Naphthalene – Preparation – Haworth's method – Properties – Oxidation, Reduction and Uses of Naphthalene - Structure of Naphthalene (Structural elucidation not necessary).

5.3 Conductors, Insulators, Semiconductors, N- and P- Type Semiconductors – Definitions and Examples.

## SEMESTER II

### CORE THEORY PAPER – 2

## BIOMOLECULES

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### OBJECTIVE

To understand the importance, structure, properties and functions of various biomolecules.

### COURSE OUTCOMES

#### CO NUMBER

#### CO STATEMENT

- |            |  |
|------------|--|
| <b>CO1</b> | To gain the knowledge about the classification, structure, properties and functions of carbohydrates.                                    |
| <b>CO2</b> | Able to understand the classification, structure, properties and importance of amino acids.  |
| <b>CO3</b> | To understand and gain knowledge about the classification of proteins, levels of structural organization of proteins and its properties. |
| <b>CO4</b> | To gain insights about the types, structure and properties of nucleic acids.   |
| <b>CO5</b> | To acquire knowledge about the classification, structure and properties of different types of lipids.                                    |

### UNIT I: CHEMISTRY OF CARBOHYDRATES

**15 hrs**

Introduction -Definition of carbohydrates, classification – monosaccharide, oligosaccharides and polysaccharides; occurrence, structure and functions of monosaccharide (glucose and fructose).General properties with reference to glucose, anomer, epimer, enantiomer and mutarotation. Structure, occurrence, properties and biological importance of disaccharides (sucrose, lactose, maltose) and Polysaccharides-Storage polysaccharides (starch, glycogen), Structural polysaccharides (cellulose, chitin), Heteropolysaccharides (hyaluronic acid, heparin).

### UNIT II: CHEMISTRY OF AMINOACIDS

**15 hrs**

Amino acids- structure and classification based on structure. Standard and non standard amino acids, Essential and non essential amino acid. Physical properties: isoelectric points and zwitter ion. General reactions of amino acids – Edman's reaction, Sanger's reaction, reaction with Dansyl chloride and Ninhydrin reaction.



### **UNIT III: CHEMISTRY OF PROTEINS**

**15 hrs**

Definition, classification of proteins based on size, solubility, chemical composition functions, structure of proteins- peptide bond, primary, secondary, tertiary and quaternary structure of proteins, forces that determine folding and conformation and structural organization, Physical properties: salting in and salting out and denaturation.

### **UNIT IV: CHEMISTRY OF NUCLEIC ACIDS**

**15 hrs**

Nucleic acids – Definition, bases, Nucleotides and Nucleosides, phosphodiester linkage; Nucleic acid types –DNA and RNA; structure- double helical structure of DNA; Properties of DNA – Denaturation, Renaturation,  $T_m$  and hyperchromicity, structure of RNA and its major types -tRNA, mRNA and rRNA.

### **UNIT V: CHEMISTRY OF LIPIDS**

**15 hrs**

Introduction, definition and classification of lipids- simple, compound (phospholipids) and derived lipids (cholesterol). Classification of fatty acids – saturated fatty acids, unsaturated fatty acids. Physical property-emulsification. Chemical properties- saponification number, Rancidity, acid number, Iodine number and Reichert – Meissl number.

### **REFERENCES**

1. Ambika shunmugam, “Fundamentals of Biochemistry(8<sup>th</sup> Edition)2016, Wolters Kluwer India Pvt Ltd
2. Dr.A.C.Deb, “Fundamentals of Biochemistry” (8<sup>th</sup> edition), Kolkata, New Central Book Agency
3. Nelson, D. L. & Cox, M. M. Lehninger Principles of Biochemistry. Freeman, 5th edn, 2008.
4. Harper’s Illustrated Biochemistry.30<sup>th</sup> edition -McGraw Hill
5. U.Sathayanarayana,(2006). Biochemistry. 3rd Edition by Books and Allied (P) Ltd., India.
6. Donald Voet and Judith Voet,”Biochemistry”,2nd edition,John Wiley & Sons,Inc,NY

**ALLIED - 1**  
**PAPER - 2**

**CHEMISTRY II**

**OBJECTIVE:**

- Basic knowledge on Coordination Chemistry, Industrial Chemistry, Carbohydrates, Aminoacids, Proteins, Electrochemistry, Paints and Pigments, dyes, Vitamins, Medicinal Chemistry, Corrosion and Applications wherever necessary are to be taught for II- semester.

**UNIT – I**

1.1 Coordination Chemistry - Nomenclature of Coordination Compounds - Ligands, Central Metal Ion and Complex Ion – Definition and Examples – Coordination Number - Werner’s Theory of Coordination Compounds - Chelates - Functions and Structure of Haemoglobin and Chlorophyll.

1.2 Industrial Chemistry - Fertilisers and Manures – Biofertilisers - Organic Manures and their importance - Role of NPK in plants - Preparation and Uses of Urea, Ammonium Nitrate, Potassium Nitrite and Super Phosphate of Lime.

1.3 Contents in Match Sticks and Match Box - Industrial making of Safety Matches – Preparation and Uses of Chloroform, DDT, Gammexane and Freons.

**UNIT – II**

2.1 Carbohydrates - Definition and Examples - Classification – Oxidation and Reduction Reactions of Glucose - Structure of Glucose (Structural elucidation not necessary) - Uses of Starch - Uses of Cellulose Nitrate and Cellulose Acetate.

2.2 Amino Acids – Definition and Examples - Classification of Amino Acids - Preparation - Gabriel Phthalimide Synthesis – Properties – zwitterion and Isoelectric point - Structure of Glycine.

2.3 Proteins – Definition - Classification of Proteins based on Physical properties and Biological functions - Primary and Secondary Structure of Proteins (Elementary Treatment only) – Composition of RNA and DNA and their Biological role - Tanning of Leather - Alum (Aluminum chloride tanning ) - Vegetable tanning – Chrome Tanning.

**UNIT – III**

3.1 Electrochemistry - Electrolytes – Definition and Examples – Classification - Specific and Equivalent Conductance - their determination – Variation of Specific and Equivalent conductance with Dilution – Ostwald’s Dilution Law and its Limitations.

3.2 Kohlrausch's Law - Determination of Dissociation Constant of weak Electrolytes using Conductance measurement - Conductometric titrations.

3.3 pH – Definition and pH determination by indicator method - Buffer solutions - Buffer action - Importance of buffers in the living systems.

#### **UNIT – IV**

4.1 Paints - Components of Paint – Requisites of a Good Paint - Pigments – Classification of Pigments on the basis of Colour – Examples - Dyes – Definition – Chromophores and Auxochromes – Examples - Colour and Dyes - Classification based on Constitution and Application – Examples.

4.2 Vitamins – Definition – Classification – Water Soluble and Fat Soluble – Occurrence - Biological Activities and Deficiency Diseases caused by Vitamin A, B, C, D, E and K - Hormones – Definition and Examples – Biological Functions of Insulin and Adrenaline.

4.3 Chromatography - Principles and Applications of Column and Paper chromatography-  $R_f$  value.

#### **UNIT – V**

5.1 Drugs - Sulpha Drugs – Preparation and Uses of Sulphapyridine and Sulphadiazine - Mode of Action of Sulpha Drugs - Antibiotics - Uses of Penicillin, Chloramphenicol and Streptomycin - Drug Abuse and Their Implication - Alcohol – LSD.

5.2 Anaesthetics - General and Local Anaesthetics - Antiseptics - Examples and their Applications - Definition and One Example each for Analgesics, Antipyretics, Tranquilizers, Sedatives - Causes, Symptoms and Treatment of Diabetes, Cancer and AIDS.

5.3 Electrochemical Corrosion and its Prevention – Electroplating – Applications.

## ALLIED PRACTICAL

### CHEMISTRY

#### VOLUMETRIC ANALYSIS

1. Estimation of HCl – Standard sulphuric acid.
2. Estimation of Borax - Standard Sodium Carbonate.
3. Estimation of NaOH – Standard Oxalic Acid.
4. Estimation of FeSO<sub>4</sub> – Standard FAS.
5. Estimation of Oxalic acid – Standard FeSO<sub>4</sub>.
6. Estimation of FAS – Standard Oxalic Acid.
7. Estimation of Oxalic acid – Standard Oxalic Acid.
8. Estimation of Fe<sup>2+</sup> using Diphenylamine / N- Phenyl Anthranilic acid as indicator.

#### ORGANIC ANALYSIS

Systematic Analysis of Organic Compounds containing One Functional Group and Characterisation by Confirmatory Tests.

Reactions of Aromatic Aldehyde, Carbohydrates, Mono and Dicarboxylic acids,  
Phenol, Aromatic Primary Amine, Amide and Diamide.

#### REFERENCE BOOKS

- ❖ Inorganic Chemistry - P. L. Soni - Sultan Chand (2006).
- ❖ Inorganic Chemistry - B. R. Puri, L. R. Sharma and K. C. Kallia – Milestone Publications (2013).
- ❖ Selected Topics in Inorganic Chemistry - W. U. Malik, G. D. Tuli and R. D. Madan - S. Chand Publications (2008).
- ❖ Text Book of Inorganic Chemistry – R. Gopalan, Universities Press – 2012.
- ❖ Text Book of Organic Chemistry - P. L. Soni - Sultan Chand & Sons - 2007.
- ❖ Advanced Organic Chemistry - Bahl and Arun Bahl - Sultan Chand and Co. Ltd – 2012.
- ❖ Organic Reaction Mechanisms - Gurdeep Chatwal- Himalaya Publishing House.
- ❖ A Text Book of Organic Chemistry K. S. Tewari, N. K. Vishol, S. N. Mehrotra-Vikas Publishing House – 2011.
- ❖ Principles of Physical Chemistry - B. R. Puri, Sharma and Madan S. Pathania, Vishal Publishing Company – 2013.
- ❖ Text Book of Physical Chemistry - P. L. Soni, O. P. Dharmarha and U. N. Dash - Sultan Chand & Co – 2006.
- ❖ Understanding Chemistry – C. N. R. Rao, Universities Press – 2011.

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