

**DEPARTMENT OF CHEMISTRY**  
**COURSE CURRICULUM & MARKING SCHEME**

**B.Sc. I, II, III, IV Semester**

**BIOCHEMISTRY**

**(Based on Choice Based Credit System)**

**SESSION : 2023-24**



**ESTD : 1958**

**GOVT. V.Y.T. PG AUTONOMOUS COLLEGE,  
DURG, 491001 (C.G.)**

**(Former Name – Govt. Arts & Science College, Durg)**

**NAAC Accredited Grade A<sup>+</sup>, College with CPE - Phase III (UGC), STAR COLLEGE (DBT)**

**Phone : 0788-2212030**

**Website - [www.govtsciencecollegedurg.ac.in](http://www.govtsciencecollegedurg.ac.in), Email – [autonomousdurg2013@gmail.com](mailto:autonomousdurg2013@gmail.com)**

**GOVT.V.Y.T.PG AUTONOMOUS COLLEGE,  
DURG (CHHATTISGARH)**

Proposed Scheme for 4 yr UG program (B.Sc. Biochemistry along with Chemistry & Zoology)

Semester	Core	Discipline Specific Elective	Generic Elective	Ability Enhancement course	Skill Enhancement course	Internship/ project	Value Added courses	Total credits
1	Biochemistry-1 (Th=3,P =1)		Choose 1 from a pool of Generic Elective Course -1 (Th=3,P =1)	Hindi language (Th-2)	Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach (NCC/NSS/Sports/Yoga)(2) (Th=1,P =1)	Choose 1 from pool of SEC	Choose 1 from a pool of Value Added courses -1(2)	22
	Chemistry - 1 (Th=3,P =1)							
	Zoology - 1 (Th=3,P =1)							
2	Biochemistry-2			English language (Th-2)	Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach (NCC/NSS/Sports/Yoga) (2) (Th=1,P =1)	Choose 1 from pool of SEC		22
	Chemistry - 2 (Th=3,P =1)							
	Zoology - 2 (Th=3,P =1)							
<b>Students on exit shall be awarded undergraduate certificate ( in the field of Multidisciplinary Study) after securing the requisite 44 credits in semester 1 and 2</b>								

**DEPARTMENT OF CHEMISTRY**

**GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG**

Approved syllabus for B.Sc. BIOCHEMISTRY by the members  
of Board of Studies for the Session

**2023-24**

The syllabus with the paper combinations is as under

**B.Sc. (BIOCHEMISTRY) SEMESTER - I**

<b>CORE COURSE</b>	<b>BIOCHEMISTRY - I</b>
<b>TITLE</b>	<b>BIOMOLECULES</b>
<b>PAPER CODE</b>	<b>BBC 101</b>
<b>PRACTICAL</b>	<b>LAB COURSE BIOCHEMISTRY-I</b>
<b>PAPER CODE</b>	<b>BBCL 01</b>

The syllabus for B.Sc. Bio-Chemistry SEMESTER-I is hereby approved for the session 2023-24. In case any change or modification is prescribed by Central Board of Studies or Higher Education Department, Govt. of Chhattisgarh with respect to content or distribution of marks for undergraduate syllabi, it will be implemented accordingly.

**NAME AND SIGNATURE:**

		Departmental members	
Chairperson /H.O.D .....			
Subject Expert .....		1.....	8.....
(University Nominee)			
Subject Expert.....		2.....	9.....
Representative .....		3.....	10.....
(Industry)			
Representative .....		4.....	11.....
(Alumni)			
Representative .....		5.....	12.....
(Professor Science Faculty Other Dept.)			
		6.....	13.....
		7.....	14.....

**B.Sc. BIOCHEMISTRY SEMESTER - I**

**2023-24**

**DIRECTIVES FOR STUDENTS OF B.Sc. BIOCHEMISTRY SEMESTER - I**

**EVALUATION PATTERN**

**Theory Paper : 60 marks**

**Internal ; 15 marks**

**Practical [lab course-III] : 25 marks**

**Question Paper Format and Distribution of Marks for  
B.Sc. (Biochemistry) Semester-I**

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple choice questions, No 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely and the answer should not exceed the limit of 350 words.
5. The scheme of marks should be as follows :

<b>Question Type</b>	<b>MM 60 (Marks x No. of Questions)</b>
A (Very short Answer)	1x10 = 10
B (Short Answer)	3 x 5 = 15
C (Long Answer)	7 x 5 = 35

6. The scheme of marks for **Assignment** should be as follows :

<b>Question Type</b>	<b>MM 75 (Marks x No. of Questions)</b>
A (Very short Answer)	1 x 10 = 10
B (Short Answer)	4 x 05 = 20
C (Long Answer)	9 x 05 = 45
<b>Total</b>	<b>75</b>

## Syllabus and Marking Scheme for FIRST SEMESTER (BIOCHEMISTRY)

2023-24

PAPER NO.	TITLE OF THE PAPER	MARKS ALLOTTED
		MAX
I	BIOMOLECULES	60
II	INTERNAL	15
II	LAB COURSE BIOCHEMISTRY - I	25
<b>TOTAL</b>		<b>100</b>

Lab Course		
Duration: 5 Hrs Total Marks: 25	TWO EXPERIMENTS	15
	VIVA	03
	PROJECT/FIELD WORK	04
	SESSIONAL	03
<b>TOTAL</b>		<b>25</b>

EXAM SCHEME	
<b>Theory paper - 01</b>	<b>60 Marks</b>
<b>Internal - 01</b>	<b>15 Marks</b>
<b>Practical - 01</b>	<b>25 Marks</b>
<b>TOTAL</b>	<b>100 Marks</b>

**B.Sc. (BIOCHEMISTRY) SEMESTER - I**

**2023-24**

**Program Specific Outcome (PSO):**

Upon completion of B.Sc. Degree (with Biochemistry) , the students will be able to:

<b>PSO1:</b>	Explain concept of molecular biology, nutritional, clinical, Environmental biochemistry, etc.
<b>PSO2:</b>	Discuss application of the physical and biochemical principals and techniques.
<b>PSO3:</b>	Describe and understand various biochemical aspects through theory and industrial visits.
<b>PSO4:</b>	Carry out experiments, present effectively through presentations and project work.

**B. Sc. (BIOCHEMISTRY)**

**2023-24**

**BIOCHEMISTRY - I**

**BIOMOLECULES**

**Course Outcome (CO):**

After completion of the course, the students would be able:

<b>CO1.</b>	To compare and explain the structure, occurrence and function of the carbohydrates.
<b>CO2.</b>	To recognize the structure of an amino acid, summarize the function of proteins and explain protein denaturation and the effect of heat on protein structure and function.
<b>CO3.</b>	To identify lipids chemical elements, compare saturated, mono-unsaturated and poly-unsaturated fatty acids, explain the importance and sources of poly-unsaturated fatty acids.
<b>CO4</b>	To describe chemical elements and components of a nucleotide. function of DNA and compare DNA and RNA.
<b>CO5.</b>	To classify porphyrins, explain detection methods, chemical nature and physiological significance of Bile pigments..

**B.Sc. (BIOCHEMISTRY) SEMESTER - I**  
**2023-24**  
**BIOCHEMISTRY - I**  
**BBCT - 101**  
**BIOMOLECULES**

**Max. Marks - 60**

**UNIT -I Introduction**

Introduction to Biochemistry, water as a biological solvent, weak acids and bases, pH, buffers, Henderson-Hasselbalch equation, physiological buffers, fitness of the aqueous environment for living organisms.

**Carbohydrates**

Structure of monosaccharides. Stereoisomerism and optical isomerism of sugars. Reactions of aldehyde and ketone groups. Ring structure and anomeric forms, mutarotation. Reactions of sugar due to hydroxyl groups. Important derivatives of monosaccharides, disaccharides and trisaccharides (structure, occurrence and functions of important ones). Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides e.g. cellulose, chitin, agar, alginic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides etc. Glycoproteins.

**UNIT-II Lipids**

Definition and classification. Fatty acids: Introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats - hydrolysis, saponification value, rancidity of fats, Reichert - Meissel number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens), sphingomyelins, glycolipids - cerebrosides, gangliosides. Properties and functions of phospholipids, isoprenoids and sterols.

### **UNIT-III Proteins**

Peptides: structure of peptide bond, chemical synthesis of polypeptides – protection and deprotection of N-terminal, C-terminal ends and functional groups in the side-chains, formation of peptide bonds, condensing agents, strategy of chemical synthesis, Merrifield solid-phase peptide synthesis. Determination of the amino acid sequence of a polypeptide chain, specific chemical and enzymatic cleavage of a polypeptide chains and separation of peptides. Protein structure: levels of structure in protein architecture, primary structure of proteins, secondary structure of proteins – helix and pleated sheets, tertiary structure of proteins, forces stabilizing the tertiary structure and quaternary structure of proteins. Denaturation and renaturation of proteins. Behaviour of proteins in solutions, salting in and salting out of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (hemoglobin, myoglobin), lipoproteins, metalloproteins, glycoproteins and nucleoproteins.

### **UNIT-IV Nucleic acids**

Nature of genetic material; evidence that DNA is the genetic material, Composition of RNA and DNA, generalized structural plan of nucleic acids, nomenclature used in writing structure of nucleic acids, features of DNA double helix. Denaturation and annealing of DNA, structure and roles of different types of RNA. Size of DNA in prokaryotic and eukaryotic cells, central dogma of molecular biology. Gene, genome, chromosome.

### **UNIT-V Porphyrins**

Porphyrins: Porphyrin nucleus and classification of porphyrins. Important Metalloporphyrins occurring in nature. Detection of porphyrins spectrophotometrically and by fluorescence. Bile pigments – chemical nature and their physiological significance

#### **LIST OF REFERENCE BOOKS:**

1. Lehninger's Principles of biochemistry by Nelson , David L and Cox M.M. Macmillan, NY.
2. Fundamental of biochemistry by Donald Voet, Judith G Voet and Charlotte W Pratt, John Willey & sons, NY.
3. Biochemistry III ed by Lubert Stryer, WH Freeman and Co , San Francisco.



**B.Sc. (BIOCHEMISTRY) SEMESTER - I**  
**2023-24**  
**LAB COURSE BIOCHEMISTRY-I**  
**BBCL - 01**

**Course Outcome (CO):**

*After completion of the course, the students would be able:*

<b>CO1.</b>	To have practical knowledge of buffers and determination of pH.
<b>CO2.</b>	To learn preparation of standard solution.
<b>CO3.</b>	To understand Beer-Lambert's law.
<b>CO4</b>	To learn about Qualitative test of carbohydrate, protein, amino acid and lipids.
<b>CO5.</b>	To have practical knowledge of titration curve and determination of pK value..

**LAB COURSE BIOCHEMISTRY-I**  
**BIOCHEMISTRY PRACTICAL [BBCL01]**

**Max.Marks - 25**

**Min.Marks - 10**

1. Preparation of standard buffers and determination of pH of a solution.
2. Qualitative test for :
  - a. Carbohydrates
  - b. Proteins and amino acids
  - c. Lipids
3. Determination of saponification value and iodine number of fats.
4. Estimation of ascorbic acid.
5. Titration curve for amino acids and determination of pK value.
6. Verification of Beer-Lambert's law

**B.Sc. (BIOCHEMISTRY) SEMESTER - I**  
**2023-24**  
**SKILL ENHANCEMENT COURSE - 1**  
**BCHS 01:**  
**GOOD LAB PRACTICES IN CHEMISTRY THEORY AND PRACTICAL**  
**[Credits -02, 30 hrs.]**

**Course outcome:**  
***After completing the course students will be able to:***

<b>CO1.</b>	Understand general laboratory practices.
<b>CO2.</b>	Prepare solutions.
<b>CO3.</b>	Handle glasswares and chemicals.
<b>CO4</b>	Explore various research issues and their solutions.
<b>CO5.</b>	Apply practical skills in chemistry.

**Theory**

- A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.
- B. Inorganic and organic reagents (Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H<sub>2</sub>S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis
- C. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, molal and normal solutions, Dilutions. Percentage solutions.

**Practical**

- A. Technique and uses of handling glasswares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.
- B. Qualitative test of CO<sub>3</sub><sup>2-</sup>, CH<sub>3</sub>COO<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup>, Cu<sub>2</sub><sup>+</sup>, Fe<sup>3+</sup>, Ni<sup>2+</sup>, Ba<sup>2+</sup>, Mg<sup>2+</sup>.

**Or**

Preparation of standard solutions of solids and liquids- Normal molar and % solutions, dilutions.

- C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

**Or**

Preparation of inorganic and organic reagents - Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, and their application in analysis.

### Reference Books

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

### B.Sc. (BIOCHEMISTRY) SEMESTER - III 2023-24

#### SKILL ENHANCEMENT COURSE - 2

#### BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES THEORY AND PRACTICAL [Credits -02, 30 hrs.]

#### Course outcome:

*After completing the course students will be able to:*

CO1.	Understand about Sources and Effect Water
CO2.	Learn about various control technique

### Water Pollution

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

### Remediation Techniques

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonada techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

### Water Conservation

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

### Practical:-

Water analysis ( pH, Conductivity, hardness, Acidity, Alkalinity etc.)

### Case study/Project

Case study/Project on water pollution, water conservation and water quality.

**Recommended Books/references:**

1. Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G. , Water treatment: Principles and Design MWH publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. Clarson D., Dara S. S. A text book of Environmental chemistry and pollution control, S Chand Co. Soil and water analytical method
4. Edzwald J., Water Quality & Treatment: A Handbook on Drinking Water (WaterResources and Environmental Engineering Series)

**NAME AND SIGNATURE:**

	Departmental members	
Chairperson /H.O.D .....		
Subject Expert ..... (University Nominee)	1.....	8.....
Subject Expert.....	2.....	9.....
Subject Expert.....	3.....	10.....
Representative ..... (Industry)	4..... <i>Divasta</i>	11.....
Representative ..... (Alumni)	5.....	12.....
Representative ..... (Professor Science Faculty Other Dept.)	6.....	13.....
	7.....	14.....

**GOVT.V.Y.T.PG AUTONOMOUS COLLEGE,**

**DURG (CHHATTISGARH)**

Proposed Scheme for 4 yr UG program (B.Sc. Biochemistry along with Chemistry & Zoology)

Semester	Core	Discipline Specific Elective	Generic Elective	Ability Enhancement course	Skill Enhancement course	Internship/ project	Value Added courses	Total credits
1	Biochemistry-1 (Th=3,P =1)		Choose 1 from a pool of Generic Elective Course -1 (Th=3,P =1)	Hindi language (Th-2)	Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach (NCC/NSS/Sports/Yoga)(2) (Th=1,P =1)	Choose 1 from pool of SEC	Choose 1 from a pool of Value Added courses	22
	Chemistry - 1 (Th=3,P =1)							
	Zoology - 1 (Th=3,P =1)							
2	Biochemistry-2		Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach (NCC/NSS/Sports/Yoga) (2) (Th=1,P =1)	English language (Th-2)	Choose 1 from pool of SEC	Choose 1 from pool of SEC	-1(2)	22
	Chemistry - 2 (Th=3,P =1)							
	Zoology - 2 (Th=3,P =1)							
<b>Students on exit shall be awarded undergraduate certificate ( in the field of Multidisciplinary Study) after securing the requisite 44 credits in semester 1 and 2</b>								

**DEPARTMENT OF CHEMISTRY**

**GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG**

Approved syllabus for B.Sc. BIOCHEMISTRY by the members  
of Board of Studies for the Session

**2023-24**



The syllabus with the paper combinations is as under

**B.Sc. (BIOCHEMISTRY) SEMESTER - II**

<b>CORE COURSE</b>	<b>BIOCHEMISTRY - II</b>
<b>TITLE</b>	<b>BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES</b>
<b>PAPER CODE</b>	<b>BBC 102</b>
<b>PRACTICAL</b>	<b>LAB COURSE BIOCHEMISTRY-II</b>
<b>PAPER CODE</b>	<b>BBCL 02</b>

The syllabus for B.Sc. Bio-Chemistry SEMESTER-II is hereby approved for the session 2023-24. In case any change or modification is prescribed by Central Board of Studies or Higher Education Department, Govt. of Chhattisgarh with respect to content or distribution of marks for undergraduate syllabi, it will be implemented accordingly.

**NAME AND SIGNATURE:**

	Departmental members	
Chairperson /H.O.D .....		
Subject Expert .....	1.....	8.....
(University Nominee)	2.....	9.....
Subject Expert.....	3..... 	10.....
Representative .....	4.....	11.....
(Industry)	5..... 	12.....
Representative .....	6.....	13.....
(Alumni)	7.....	14.....
Representative .....		
(Professor Science Faculty/Other Dept.)		

## B.Sc. BIOCHEMISTRY SEMESTER - II

2023-24

### DIRECTIVES FOR STUDENTS OF B.Sc. BIOCHEMISTRY SEMESTER - II

#### EVALUATION PATTERN

**Theory Paper : 60 marks**

**Internal ; 15 marks**

**Practical [lab course-III] : 25 marks**

#### **Question Paper Format and Distribution of Marks for B.Sc. (Biochemistry) Semester-II**

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple choice questions, No 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely and the answer should not exceed the limit of 350 words.
5. The scheme of marks should be as follows :

<b>Question Type</b>	<b>MM 60 (Marks x No. of Questions)</b>
A (Very short Answer)	1x10 = 10
B (Short Answer)	3 x 5 = 15
C (Long Answer)	7 x 5 = 35

6. The scheme of marks for **Assignment** should be as follows :

<b>Question Type</b>	<b>MM 75 (Marks x No. of Questions)</b>
A (Very short Answer)	1 x 10 = 10
B (Short Answer)	4 x 05 = 20
C (Long Answer)	9 x 05 = 45
<b>Total</b>	<b>75</b>

## Syllabus and Marking Scheme for SECOND SEMESTER (BIOCHEMISTRY)

2023-24

PAPER NO.	TITLE OF THE PAPER	MARKS ALLOTTED
		MAX
I	BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES	60
II	INTERNAL	15
II	LAB COURSE BIOCHEMISTRY - II	25
<b>TOTAL</b>		<b>100</b>

Lab Course		
Duration: 5 Hrs Total Marks: 25	TWO EXPERIMENTS	15
	VIVA	03
	PROJECT/FIELD WORK	04
	SESSIONAL	03
<b>TOTAL</b>		<b>25</b>

EXAM SCHEME	
<b>Theory paper - 01</b>	<b>60 Marks</b>
<b>Internal - 01</b>	<b>15 Marks</b>
<b>Practical - 01</b>	<b>25 Marks</b>
<b>TOTAL</b>	<b>100 Marks</b>



**B.Sc. (BIOCHEMISTRY) SEMESTER - II**

**2023-24**

**Program Specific Outcome (PSO):**

Upon completion of B.Sc. Degree (with Biochemistry) , the students will be able to:

<b>PSO1:</b>	Explain concept of molecular biology, nutritional, clinical, Environmental biochemistry, etc.
<b>PSO2:</b>	Discuss application of the physical and biochemical principals and techniques.
<b>PSO3:</b>	Describe and understand various biochemical aspects through theory and industrial visits.
<b>PSO4:</b>	Carry out experiments, present effectively through presentations and project work.

**B. Sc. (BIOCHEMISTRY)**

**2023-24**

**BIOCHEMISTRY - II**

**BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES**

**Course Outcome (CO):**

After completion of the course, the students would be able:

<b>CO1.</b>	To explain the principles of thermodynamics and their applications in biochemistry.
<b>CO2.</b>	To determine the molecular weight by hydrodynamic method and explain the method for pH measurement.
<b>CO3.</b>	To discuss types of radio isotopes, biological applications, biological hazards andafety measures.
<b>CO4</b>	To discuss the theory, types of various chromatography, electrophoresis and their applications.
<b>CO5</b>	To elaborate the principles and applications of Spectroscopic and immunological techniques.

**B.Sc. (BIOCHEMISTRY) SEMESTER - II**  
**2023-24**  
**BIOCHEMISTRY - II**  
**BBCT - 102**  
**BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES**

**Max. Marks - 60**

**UNIT-I Concepts of Bioenergetics**

[12Hrs]

concept of free energy, standard free energy, determination of  $\Delta G$  for a reaction, relation between equilibrium constant and standard free energy change, biological standard state and standard free energy change in coupled reactions. Biological oxidation-reduction reactions - introduction, redox potentials, relation between standard reduction potentials and free energy change (derivations and numericals included). High-energy phosphate compounds-introduction, phosphate group transfer-free energy of hydrolysis of ATP and sugar phosphates along with reasons for high  $\Delta G$ .

**UNIT-II Radio Isotopic Techniques**

[10Hrs]

Types of radioisotopes used in Biochemistry, units of radioactivity measurements, techniques used to measure radioactivity (gas ionization and liquid scintillation counting), nuclear emulsions used in biological studies (pre-mounted, liquid and stripping), isotopes commonly used in biochemical studies -  $^{32}\text{P}$ ,  $^{35}\text{S}$ ,  $^{14}\text{C}$  and  $^3\text{H}$ , Autoradiography. Biological hazards of radiation and safety measures in handling radioisotopes. Biological applications.

**UNIT-III Chromatography**

[10Hrs]

General principles and application of:

1. Paper chromatography
2. Thin-layer chromatography
3. Adsorption chromatography
4. Ion-exchange chromatography
5. Molecular-sieve chromatography

**UNIT-IV Measurement of pH**

[06Hrs]

Principles of glass and reference electrodes, types of electrodes, complications of pH measurement (dependence of pH on ionic strength electrode contamination and sodium error) and use of pH paper.

**Electrophoresis**

[06Hrs]

Basic principles of agarose electrophoresis, PAGE and SDS-PAGE, Two-dimensional electrophoresis, its importance. Isoelectrofocussing.

**UNIT-V****Spectroscopic Techniques**

[06Hrs]

Beer-Lambert law, light absorption and its transmittance, determination and application of extinction coefficient, application of visible and UV spectroscopic techniques (structure elucidation and numericals excluded)

Immunological Techniques

[04hrs]

Immunodiffusion, immunoelectrophoresis, radioimmunoassay, ELISA, immunofluorescence.

**List of Reference Books:**

1. Physical Biochemistry by van Holde KE, Prentice hall Inc., New jersey.
2. Physical biochemistry by D Friefelder , WH Freeman & Co., USA..
3. Outlines of biochemistry by Eric E Conn, PK Stumpf, G Bruening and Ray H Doi , John Wiley & sons NY
4. Chromatography : A laboratory handbook of chromatography and electrophoretic methods by Erich Heftman, van Nostrand Reinhold, NY.

**B.Sc. (BIOCHEMISTRY) SEMESTER - II**  
**2023-24**  
**LAB COURSE BIOCHEMISTRY-II**  
**BBCL - 02**

**Course Outcome (CO):**

*After completion of the course, the students would be able:*

<b>CO1.</b>	To know how to Isolation and assay of glycogen from rat liver.
<b>CO2.</b>	To know how to estimate Carbohydrate.
<b>CO3.</b>	To understand Beer-Lambert's law.
<b>CO4</b>	To know how to estimate DNA and RNA.
<b>CO5.</b>	To learn about separation of sugar using paper chromatography.

**LAB COURSE BIOCHEMISTRY-II**

**BIOCHEMISTRY PRACTICAL [BBCL02]**

**Max.Marks - 25**

**Min.Marks - 10**

1. Estimation of
  - i) Carbohydrate by anthrone method.
  - ii) Blood glucose by the methods
    - (a) Folin-Wu,
    - (b) Nelson-Somogyi
2. Estimation of amino acids by ninhydrin method.
3. Isolation and assay of glycogen from rat liver.
4. i) Extraction of total lipids by Folch method  
ii) Estimation of food adulterant.
5. Estimation of DNA and RNA.
6. Separation of sugars using paper chromatography.

**B.Sc. (BIOCHEMISTRY) SEMESTER - II**  
**2023-24**  
**SKILL ENHANCEMENT COURSE - 1**  
**BCHS 01:**  
**GOOD LAB PRACTICES IN CHEMISTRY THEORY AND PRACTICAL**  
**[Credits -02, 30 hrs.]**

**Course outcome:**

*After completing the course students will be able to:*

<b>CO1.</b>	Understand general laboratory practices.
<b>CO2.</b>	Prepare solutions.
<b>CO3.</b>	Handle glasswares and chemicals.
<b>CO4</b>	Explore various research issues and their solutions.
<b>CO5.</b>	Apply practical skills in chemistry.

**Theory**

- A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.
- B. Inorganic and organic reagents (Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H<sub>2</sub>S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis
- C. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, molal and normal solutions, Dilutions. Percentage solutions.

**Practical**

- A. Technique and uses of handling glasswares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.
- B. Qualitative test of CO<sub>3</sub><sup>2-</sup>, CH<sub>3</sub>COO<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup>, Cu<sub>2</sub><sup>+</sup>, Fe<sup>3+</sup>, Ni<sup>2+</sup>, Ba<sup>2+</sup>, Mg<sup>2+</sup>.

**Or**

Preparation of standard solutions of solids and liquids- Normal molar and % solutions, dilutions.

- C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

**Or**

Preparation of inorganic and organic reagents - Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, and their application in analysis.

**Reference Books**

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

**B.Sc. (BIOCHEMISTRY) SEMESTER - II**  
**2023-24**  
**SKILL ENHANCEMENT COURSE - 2**  
**BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES**  
**THEORY AND PRACTICAL**

**Course outcome:**

*After completing the course students will be able to:*

<b>CO1.</b>	Understand about Sources and Effect Water
<b>CO2.</b>	Learn about various control technique

### **Water Pollution**

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

### **Remediation Techniques**

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonda techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

### **Water Conservation**

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

### **Practical:-**

Water analysis ( pH, Conductivity, hardness, Acidity, Alkalinity etc.)

### **Case study/Project**

Case study/Project on water pollution, water conservation and water quality.

### **Recommended Books/references:**

1. CITTENDEN J. C. , TRUSSELL J. R., HAND D. W., HOWE K. J.,  
TCHOBANOGLOUS G. , Water treatment: Principles and Design MWH  
publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. CLARSON D., DARA S. S. A text book of Environmental chemistry and  
pollution control, S Chand Co. Soil and water analytical method
4. EDZWALD J., Water Quality & Treatment: A Handbook on Drinking  
Water (Water Resources and Environmental Engineering Series)

**NAME AND SIGNATURE:**

Departmental members		
Chairperson /H.O.D .....		
Subject Expert ..... (University Nominee)	1.....	8.....
Subject Expert.....	2.....	9.....
Representative ..... (Industry)	3.....	10.....
Representative ..... (Alumni)	4.....	11.....
Representative ..... (Professor Science Faculty Other Dept.)	5.....	12.....
	6.....	13.....
	7.....	14.....

## DEPARTMENT OF CHEMISTRY

### GOVT. V. Y. T. PG AUTONOMOUS COLLEGE, DURG (CHHATTISGARH)

Approved syllabus for B.Sc. BIOCHEMISTRY by the members of Board of studies for the session 2023-24  
Scheme and syllabus for B.Sc. Year II (Semester III and IV) with Biochemistry along Chemistry & Zoology

Sem	DSC	DSE	Generic Elective	Ability Enhancement course	Skill Enhancement course	Internship/ project	Value Added courses	Total credits
3	Biochemistry-3 Chemistry - 3 (Th=3,P =1)	Choose 1 from a pool of Discipline Specific Elective Course -1(4) OR Choose 1 from a pool of Generic Elective Course -1(4)		Environmental studies-I	Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach		Choose 1 from a pool of Value Added courses - 1(4)	22
	Zoology - 3 (Th=4,P =2)							
4	Biochemistry-4 Chemistry - 4 (Th=3,P =1)	Choose 1 from a pool of Discipline Specific Elective Course -1(4) OR Choose 1 from a pool of Generic Elective Course -1(4)		Environmental studies - Project	Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach		Choose 1 from a pool of Value Added courses - 1(4)	22
	Zoology - 4 (Th=3,P =1)							
<b>Students on exit shall be awarded undergraduate Diploma ( in the field of Multidisciplinary Study) after securing the requisite 88 credits in semester 4</b>								



## DEPARTMENT OF CHEMISTRY

### GOVT.V.Y.T.PG AUTONOMOUS COLLEGE,DURG (CHHATTISGARH)

Approved syllabus for B.Sc. BIOCHEMISTRY by the members of Board of studies for the session 2023-24  
Scheme and syllabus for B.Sc. Year II (Semester III and IV)  
Course and Marking Scheme for B.Sc. B.Sc. with Biochemistry along Chemistry & Zoology

<b>Certificate in Science</b>						
<b>Discipline Specific Courses – DSC (Core Courses)</b>						
Year	Sem	Course Code	Paper Title	Theory/ Practical	Credits	Marks
						Sem End exam      Internal/As signment      Total
	III	BBCT – 301	Biochemistry – III (Enzymology)	Theory	3	60      15      75
	IV	BBCL - 03	Lab Course Biochemistry - III	Practical	1	25           25
	IV	BBCT – 302	Biochemistry – VI (intermediary metabolism)	Theory	3	60      15      75
		BBCL - 04	Lab Course Biochemistry - VI	Practical	1	25           25
<b>Discipline Specific Elective – DSE</b>						
	III	BBDT - 801	Biochemistry - VII Plant Biochemistry	Theory	3	60      15      75
	IV	BBDL - 803	Lab Course Biochemistry- VII	Practical	1	25           25
	IV	BBDT - 802	Biochemistry – VIIMicrobiology	Theory	3	60      15      75
		BBDL - 804	Lab Course Biochemistry-VIII	Practical	1	25           25
<b>Skill Enhancement Courses - SEC</b>						
	III	BCHS - 01	Good lab practices in chemistry	Theory	1	20      05      25
	IV	BCHS - 02	Water remediation and conservation studies	Theory	1	20      05      25
				Practical	1	20      05      25

**Note:-** Semester End – 80% and Internal Assessment-20%(Weightage of marks internal examination will be included as per guideline of Autonomous Examination Cell)

**DEPARTMENT OF CHEMISTRY**

**GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG**

Approved syllabus for B.Sc. BIOCHEMISTRY by the members  
of Board of Studies for the Session

**2023-24**






The syllabus with the paper combinations is as under

**B.Sc. (BIOCHEMISTRY) SEMESTER - III**

<b>CORE COURSE</b>	<b>BIOCHEMISTRY - III</b>
<b>TITLE</b>	<b>ENZYMOLOGY</b>
<b>PAPER CODE</b>	<b>BBCT 301</b>
<b>PRACTICAL</b>	<b>LAB COURSE BIOCHEMISTRY-III</b>
<b>PAPER CODE</b>	<b>BBCL 03</b>

The syllabus for B.Sc. Bio-Chemistry SEMESTER-III is hereby approved for the session 2023-24. In case any change or modification is prescribed by Central Board of Studies or Higher Education Department, Govt. of Chhattisgarh with respect to content or distribution of marks for undergraduate syllabi, it will be implemented accordingly.

**NAME AND SIGNATURE:**

	Departmental members	
Chairperson /H.O.D .....		
Subject Expert .....	1.....	8.....
(University Nominee)		9.....
Subject Expert.....	2.....	
		10.....
Representative .....	3.....	
(Industry)	4.....	11.....
		12.....
Representative .....	5.....	
(Alumni)	6.....	13.....
		
Representative .....	7.....	14.....
(Professor Science Faculty Other Dept.)		

**B.Sc. BIOCHEMISTRY SEMESTER - III**

**2023-24**

**DIRECTIVES FOR STUDENTS OF B.Sc. BIOCHEMISTRY SEMESTER - III**

**EVALUATION PATTERN**

**Theory Paper : 60 marks**

**Internal ; 15 marks**

**Practical [lab course-III] : 25 marks**

**Question Paper Format and Distribution of Marks for  
B.Sc. (Biochemistry) Semester-III**

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple choice questions, No 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely and the answer should not exceed the limit of 350 words.
5. The scheme of marks should be as follows :

<b>Question Type</b>	<b>MM 60 (Marks x No. of Questions)</b>
A (Very short Answer)	1x10 = 10
B (Short Answer)	3 x 5 = 15
C (Long Answer)	7 x 5 = 35

6. The scheme of marks for **Assignment** should be as follows :

<b>Question Type</b>	<b>MM 75 (Marks x No. of Questions)</b>
A (Very short Answer)	1 x 10 = 10
B (Short Answer)	4 x 05 = 20
C (Long Answer)	9 x 05 = 45
<b>Total</b>	<b>75</b>

**Syllabus and Marking Scheme for THIRD SEMESTER (BIOCHEMISTRY)****2023-24**

PAPER NO.	TITLE OF THE PAPER	MARKS ALLOTTED
		MAX
I	ENZYMOLGY	60
II	INTERNAL	15
II	LAB COURSE BIOCHEMISTRY - III	25
<b>TOTAL</b>		<b>100</b>

Lab Course		
Duration: 5 Hrs Total Marks: 25	TWO EXPERIMENTS	15
	VIVA	03
	PROJECT/FIELD WORK	04
	SESSIONAL	03
<b>TOTAL</b>		<b>25</b>

EXAM SCHEME	
<b>Theory paper - 01</b>	<b>60 Marks</b>
<b>Internal - 01</b>	<b>15 Marks</b>
<b>Practical - 01</b>	<b>25 Marks</b>
<b>TOTAL</b>	<b>100 Marks</b>

**B.Sc. (BIOCHEMISTRY) SEMESTER - III**

**2023-24**

**Program Specific Outcome (PSO):**

Upon completion of B.Sc. Degree (with Biochemistry) , the students will be able to:

<b>PSO1:</b>	Explain concept of molecular biology, nutritional, clinical, Environmental biochemistry, etc.
<b>PSO2:</b>	Discuss application of the physical and biochemical principals and techniques.
<b>PSO3:</b>	Describe and understand various biochemical aspects through theory and industrial visits.
<b>PSO4:</b>	Carry out experiments, present effectively through presentations and project work.

**B. Sc. (BIOCHEMISTRY)**

**2023-24**

**BIOCHEMISTRY - III  
ENZYMOLGY**

**Course Outcome (CO):**

After completion of the course, the students would be able:

<b>CO1.</b>	To acquire fundamental knowledge on enzymes and their importance in biological reactions.
<b>CO2.</b>	To understand ability to difference between a chemical catalyst and biocatalyst.
<b>CO3.</b>	To understand the concept of activation energy and its importance in biological reactions.
<b>CO4</b>	To understand the nature of non-protein enzymes such as ribozymes.
<b>CO5.</b>	To understand the role of enzymesin clinical diagnosis and industries. Biochemistry Core .

**B.Sc. (BIOCHEMISTRY) SEMESTER - III**  
**2023-24**  
**BIOCHEMISTRY - III**  
**BBCT - 301**  
**ENZYMOLGY**

**Max. Marks - 60**

**UNIT-I Introduction**

History general characteristics, nomenclature, IUB enzyme classification (rational, overview and specific examples), significance of numbering system. Definitions with examples of holoenzyme, apoenzyme, coenzymes, cofactors, activators, inhibitors, active site (identification of groups excluded), metallo-enzymes, units of enzyme activity, specific enzymes, isoenzymes, monomeric, enzymes, oligomeric enzymes and multi-enzyme complexes. Enzyme specificity.

Historical perspective, nature of non-enzymatic and enzymatic catalysis. Measurement and expression of enzyme activity-enzyme assays. Definition of IU, Katal enzyme turn over number and specific activity. Role of non-protein organic molecules and inorganic ions-coenzyme, prosthetic groups. Role of Vitamins as coenzymes precursors (general treatment).

**UNIT-II Enzyme Catalysis**

Role of cofactors in enzyme catalysis : NAD/NADP<sup>+</sup>, FMN/FAD, coenzyme A, biocytin, cobamide, lipoamide, TPP, pyridoxal phosphate, tetrahydrofolate and metal ions with special emphasis on coenzyme functions. Acid-base catalysis, covalent catalysis, proximity and orientation effects, strain and distortion theory. Mechanism of action of chymotrypsin, carboxypeptidase, ribonuclease and lysozyme.

**UNIT-III Enzyme Purification**

Method for isolation, purification and characterization of enzymes.

**UNIT-IV Enzyme Kinetics**

Factors affecting enzyme activity, enzyme concentration, substrate concentration, pH and temperature. Derivation of Michaelis- Menten equation for uni-substrate reactions.  $K_m$  and its significance. Line Weaver - Burk plot and its limitations. Importance of  $K_{cat}/K_m$ . Bi-substrate reactions - brief introduction to sequential and ping-pong mechanisms with examples.

Kinetics of zero and first order reactions. Significance and evaluation of energy of activation and free energy.

Reversible and irreversible inhibition, competitive, non competitive and uncompetitive inhibitions. Determination of  $K_m$  &  $V_{max}$  in presence and absence of inhibitor. Allosteric enzymes.

## **UNIT-V Industrial and Clinical Application of Enzymes**

Immobilization of enzyme and their industrial applications. Production of glucose from starch, cellulose and dextran, use of lactose in dairy industry, production of glucose fructose syrup from sucrose, use of proteases in food. Detergent and leather industry, medical application of enzymes use of glucose oxidase in enzyme electrodes.

### **List of Reference Books:**

1. Fundamental of Enzymology Nicholas C Price and Lewis Stevens , Oxford university Press.
2. Principles of Enzymology for food Science by JR Whitkar , M Dekker Publishers.
3. Biochemistry by Lubert Stryer , WH Freeman and Co., San Francisco .
4. Enzyme Dixon Mand Webb , EC, Longmans, London .
5. The chemical kinetics of enzymes action by KJ Laidler and PS Buntinf , Oxford Univercity Press, London.
6. Enzyme stucture and function by S Blackburn , Marcel Dekker , Inc., NY.

**B.Sc. (BIOCHEMISTRY) SEMESTER - III**  
**2023-24**  
**LAB COURSE BIOCHEMISTRY-III**  
**BBCL - 03**

**Course Outcome (CO):**

*After completion of the course, the students would be able:*

<b>CO1.</b>	To have practical knowledge of estimation of SGPT and SGOT in serum.
<b>CO2.</b>	To learn about preparation of starch from potato and its hydrolysis by salivary amylase.
<b>CO3.</b>	To learn about effect of enzyme concentration on enzyme activity.
<b>CO4</b>	To learn about separation and identification of amino acid by (a) paper chromatography and (b) thin layer chromatography
<b>CO5.</b>	To learn about determination of achromatic point in salivary amylase.

**LAB COURSE BIOCHEMISTRY-III**

**BIOCHEMISTRY PRACTICAL [BBCL03]**

**Max.Marks – 25**

**Min.Marks – 10**

01. Separation and identification of amino acid by (a) paper chromatography and (b) thin layer chromatography
02. Separation of polar and non polar lipids by thin layer chromatography.
03. a) Assay of serum alkaline phosphatase activity.  
b) Inhibition of alkaline phosphatase activity by EDTA.  
c) Effect of substrate concentration on alkaline phosphatase activity and determination of its  $K_m$  value.
04. a) Effect of temperature on enzyme activity and determination of activation energy.  
b) Effect of pH on enzyme activity and determination of optimum pH.  
c) Effect of enzyme concentration on enzyme activity.
05. a) Preparation of starch from potato and its hydrolysis by salivary amylase.  
b) Determination of achromatic point in salivary amylase.  
c) Effect of sodium chloride on amylases.



**B.Sc. (BIOCHEMISTRY) SEMESTER - III**  
**2023-24**  
**BIOCHEMISTRY - VI**  
**DISCIPLINE SPECIFIC ELECTIVE COURSE**  
**BBDT - 801**  
**PLANT BIOCHEMISTRY**

**Max. Marks - 60**

**Course outcome:**

***After completing the course students will be able to:***

<b>CO1.</b>	Understand metabolic processes specific for plants such as nitrate assimilation.
<b>CO2.</b>	Understand photosynthesis, respiration, nitrogen fixation.
<b>CO3.</b>	Understand role of different metabolic pathways in plant growth and development.
<b>CO4</b>	Students will also gain insight to various stressful conditions of the environment that affect plant growth and productivity.
<b>CO5.</b>	Students gain insight to defence mechanisms in plants due to which plants survive under stresses.

- UNIT-I** Electron transport system in plants: oxidative phosphorylation, mitochondrial respiratory complexes, order and organization of electron carriers, electrochemical gradient, chemiosmotic theory, ATP synthase and mechanism of ATP synthesis.
- UNIT-II** Nitrogen metabolism: assimilation of nitrate, structural features of nitrate reductase and nitrite reductase, incorporation of ammonia into organic compounds, regulation of nitrate assimilation. Biological nitrogen fixation by free living and in symbiotic association; structure and function of the enzyme nitrogenase.
- UNIT-III** Photosynthesis – Photosynthetic apparatus, pigments of photosynthesis, role of carotenoids, photosystems I and II, their location; Hill reaction, photosynthetic electron transport and generation of NADPH & ATP, cyclic and non-cyclic photophosphorylations, complexes associated with thylakoid membranes; light harvesting complexes, path of carbon in photosynthesis – C3 and C4 pathway of carbon reduction and its regulation, Photorespiration.
- UNIT-IV** Special features of secondary plant metabolism, terpenes (classification, biosynthesis), lignin, tannins, pigments, phytochrome, waxes, alkaloids, biosynthesis of nicotine, functions of alkaloids, cell wall components.

Toxins of plant origin – mycotoxins, phytohemagglutinins, lathrogens, nitriles, protease inhibitors, protein toxins.

**UNIT-V** Stress metabolism in plants – Environmental stresses, salinity, water stress, heat, chilling, anaerobiosis, pathogenesis, heavy metals, radiations and their impact on plant growth and metabolism, criteria of stress tolerance.

Antioxidative defense system in plants – reactive oxygen species and their generation, enzymic and non-enzymic components of antioxidative defense mechanism.

Suggested readings:

1. Buchann (2015), Biochemistry and Molecular Biology of Plants, 2nd ed. Publisher: I K International. ISBN-10: 8188237116, ISBN-978047 0714218
2. Taiz and Zeiger, Plant Physiology, 5th edition, Sinauer Associates Inc. ISBN-13: 978-0878938667, ISBN-10: 0878938664 Caroline Bowsher, Martin Steer, Alyson Tobin (2008), Plant Biochemistry, Garland Science ISBN 978-0-8153-4121-5.
3. P.M Dey and J.B. Harborne (Editors) (1997), Plant Biochemistry, Publisher: Academic Press ISBN-10: 0122146743, ISBN-13: 978-0122146749

**B.Sc. (BIOCHEMISTRY) SEMESTER - III**  
**2023-24**  
**BIOCHEMISTRY - VI**  
**DISCIPLINE SPECIFIC ELECTIVE COURSE**  
**BBDL - 803**  
**LAB COURSE BIOCHEMISTRY - VII**

**Course outcome:**

***After completing the course students will be able to:***

<b>CO1.</b>	Students will gain expertise to determine the contents of photosynthetic pigments, ascorbic acid in plant samples.
<b>CO2.</b>	Students will gain expertise to determine the contents of phenols, tannins, hydrogen peroxide in plant samples.
<b>CO3.</b>	They will understand the spectral patterns of photosynthetic pigments
<b>CO4</b>	They will get training to extract and assay enzymes like urease from Jack bean.

**Practical content:**

1. Estimation of chlorophylls and carotenoids from grass/spinach leaves
2. Estimation of ascorbic acid, phenols, tannins in fruits and vegetables
3. Determination of radical scavenging activity of plant extracts
4. Estimation of hydrogen peroxide in tissue extracts
5. Extraction and assay of urease from Jackbean
6. Separation of photosynthetic pigments by TLC and determination of absorption Spectra

**B.Sc. (BIOCHEMISTRY) SEMESTER - III**  
**2023-24**  
**SKILL ENHANCEMENT COURSE - 1**  
**BCHS 01:**  
**GOOD LAB PRACTICES IN CHEMISTRY THEORY AND PRACTICAL**  
**[Credits -02, 30 hrs.]**

**Course outcome:**

*After completing the course students will be able to:*

<b>CO1.</b>	Understand general laboratory practices.
<b>CO2.</b>	Prepare solutions.
<b>CO3.</b>	Handle glasswares and chemicals.
<b>CO4</b>	Explore various research issues and their solutions.
<b>CO5.</b>	Apply practical skills in chemistry.

**Theory**

- A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.
- B. Inorganic and organic reagents (Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H<sub>2</sub>S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis
- C. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, molal and normal solutions, Dilutions. Percentage solutions.

**Practical**

- A. Technique and uses of handling glasswares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.
- B. Qualitative test of CO<sub>3</sub><sup>2-</sup>, CH<sub>3</sub>COO<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup>, Cu<sub>2</sub><sup>+</sup>, Fe<sup>3+</sup>, Ni<sup>2+</sup>, Ba<sup>2+</sup>, Mg<sup>2+</sup>.

**Or**

Preparation of standard solutions of solids and liquids- Normal molar and % solutions, dilutions.

- C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

**Or**

Preparation of inorganic and organic reagents - Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, and their application in analysis.

**Reference Books**

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

**B.Sc. (BIOCHEMISTRY) SEMESTER - III  
2023-24**

**SKILL ENHANCEMENT COURSE - 2**

**BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES  
THEORY AND PRACTICAL [Credits -02, 30 hrs.]**

**Course outcome:**

***After completing the course students will be able to:***

<b>CO1.</b>	Understand about Sources and Effect Water
<b>CO2.</b>	Learn about various control technique

**Water Pollution**

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

**Remediation Techniques**

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonda techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

**Water Conservation**

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

**Practical:-**

Water analysis ( pH, Conductivity, hardness, Acidity, Alkalinity etc.)

**Case study/Project**

Case study/Project on water pollution, water conservation and water quality.

**Recommended Books/references:**

1. Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G. , Water treatment: Principles and Design MWH publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. Clarson D., Dara S. S. A text book of Environmental chemistry and pollution control, S Chand Co. Soil and water analytical method
4. Edzwald J., Water Quality & Treatment: A Handbook on Drinking Water (WaterResources and Environmental Engineering Series)

**NAME AND SIGNATURE:**

	Departmental members	
Chairperson /H.O.D .....		
Subject Expert ..... (University Nominee)	1.....	8.....
Subject Expert.....	2.....	9.....
	3.....	10.....
Representative ..... (Industry)	4.....	11.....
Representative ..... (Alumni)	5.....	12.....
	6..... <i>Divastu</i>	13.....
Representative ..... (Professor Science Faculty Other Dept.)	7.....	14.....

## DEPARTMENT OF CHEMISTRY

### GOVT. V. Y. T. PG AUTONOMOUS COLLEGE, DURG (CHHATTISGARH)

Approved syllabus for B.Sc. BIOCHEMISTRY by the members of Board of studies for the session 2023-24  
Scheme and syllabus for B.Sc. Year II (Semester III and IV) with Biochemistry along Chemistry & Zoology

Sem	DSC	DSE	Generic Elective	Ability Enhancement course	Skill Enhancement course	Internship/ project	Value Added courses	Total credits
3	Biochemistry-3 Chemistry - 3 (Th=3,P =1)	Choose 1 from a pool of Discipline Specific Elective Course -1(4) OR Choose 1 from a pool of Generic Elective Course -1(4)		Environmental studies-I	Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach		Choose 1 from a pool of Value Added courses - 1(4)	22
	Zoology - 3 (Th=4,P =2)							
4	Biochemistry-4 Chemistry - 4 (Th=3,P =1)	Choose 1 from a pool of Discipline Specific Elective Course -1(4) OR Choose 1 from a pool of Generic Elective Course -1(4)		Environmental studies - Project	Choose 1 from pool of SEC (offered by Biochemistry/ Chemistry/Zoology/Community Outreach		Choose 1 from a pool of Value Added courses - 1(4)	22
	Zoology - 4 (Th=3,P =1)							
<b>Students on exit shall be awarded undergraduate Diploma ( in the field of Multidisciplinary Study) after securing the requisite 44 credits in semester 4</b>								

## DEPARTMENT OF CHEMISTRY

### GOVT. V. Y. T. PG AUTONOMOUS COLLEGE, DURG (CHHATTISGARH)

Approved syllabus for B.Sc. BIOCHEMISTRY by the members of Board of studies for the session 2023-24  
Scheme and syllabus for B.Sc. Year II (Semester III and IV)  
Course and Marking Scheme for B.Sc. B.Sc. with Biochemistry along Chemistry & Zoology

<b>Certificate in Science</b>								
<b>Discipline Specific Courses – DSC (Core Courses)</b>								
Year	Sem	Course Code	Paper Title	Theory/ Practical	Credits	Marks		
						Sem End exam	Internal/As signment	Total
	III	BBCT – 301	Biochemistry – III (Enzymology)	Theory	3	60	15	75
		BBCL - 03	Lab Course Biochemistry - III	Practical	1	25		25
	IV	BBCT – 302	Biochemistry – VI (intermediary metabolism)	Theory	3	60	15	75
		BBCL - 04	Lab Course Biochemistry - VI	Practical	1	25		25
<b>Discipline Specific Elective – DSE</b>								
	III	BBDT - 801	Biochemistry - VII Plant Biochemistry	Theory	3	60	15	75
	III	BBDL - 803	Lab Course Biochemistry- VII	Practical	1	25		25
	IV	BBDT - 802	Biochemistry - VIII Microbiology	Theory	3	60	15	75
	IV	BBDL - 804	Lab Course Biochemistry-VIII	Practical	1	25		25
<b>Skill Enhancement Courses - SEC</b>								
	III	BCHS - 01	Good lab practices in chemistry	Theory	1	20	05	25
				Practical	1	20	05	25
	IV	BCHS - 02	Water remediation and conservation studies	Theory	1	20	05	25
				Practical	1	20	05	25

**Note:-** Semester End – 80% and Internal Assessment-20%(Weightage of marks internal examination will be included as per guideline of Autonomous Examination Cell)



**DEPARTMENT OF CHEMISTRY**

**GOVT. V.Y.T. PG AUTONOMOUS COLLEGE, DURG**

Approved syllabus for B.Sc. BIOCHEMISTRY by the members  
of Board of Studies for the Session



**2023-24**

The syllabus with the paper combinations is as under  
B.Sc. (BIOCHEMISTRY) SEMESTER – IV

<b>CORE COURSE</b>	<b>BIOCHEMISTRY - IV</b>
<b>TITLE</b>	<b>INTERMEDIARY METABOLISM</b>
<b>PAPER CODE</b>	<b>BBCT 302</b>
<b>PRACTICAL</b>	<b>LAB COURSE BIOCHEMISTRY-IV</b>
<b>PAPER CODE</b>	<b>BBCL 04</b>

The syllabus for B.Sc. Bio-Chemistry SEMESTER-IV is hereby approved for the session 2023-24. In case any change or modification is prescribed by Central Board of Studies or Higher Education Department, Govt. of Chhattisgarh with respect to content or distribution of marks for undergraduate syllabi, it will be implemented accordingly.

**NAME AND SIGNATURE:**

	Departmental members	
Chairperson /H.O.D .....		
Subject Expert .....	1.....	8.....
(University Nominee)		9.....
Subject Expert.....	2.....	
	3.....	10.....
Representative .....	4.....	11.....
(Industry)		12.....
Representative .....		13.....
(Alumni)	6.....	14.....
Representative .....	7.....	
(Professor Science Faculty Other Dept.)		

**B.Sc. BIOCHEMISTRY SEMESTER - IV**

**2023-24**

**DIRECTIVES FOR STUDENTS OF B.Sc. BIOCHEMISTRY SEMESTER - IV**

**EVALUATION PATTERN**

**Theory Paper : 60 marks**

**Internal ; 15 marks**

**Practical [lab course-III] : 25 marks**

**Question Paper Format and Distribution of Marks for  
B.Sc. (Biochemistry) Semester-IV**

1. The question paper will be divided into three Sections - A, B & C.
2. Section A shall contain very short answer type questions (answer in one or two sentences) or objective type questions. (**No Multiple choice questions, No 'Fill in the blank' type Questions**)
3. Section B shall contain short answer type questions with the limit of 150 words.
4. Section C shall contain long answer/descriptive type questions. The students are required to answer precisely and the answer should not exceed the limit of 350 words.
5. The scheme of marks should be as follows :

<b>Question Type</b>	<b>MM 60 (Marks x No. of Questions)</b>
A (Very short Answer)	1x10 = 10
B (Short Answer)	3 x 5 = 15
C (Long Answer)	7 x 5 = 35

6. The scheme of marks for **Assignment** should be as follows :

<b>Question Type</b>	<b>MM 75 (Marks x No. of Questions)</b>
A (Very short Answer)	1 x 10 = 10
B (Short Answer)	4 x 05 = 20
C (Long Answer)	9 x 05 = 45
<b>Total</b>	<b>75</b>

## Syllabus and Marking Scheme for FOURTH SEMESTER (BIOCHEMISTRY)

2023-24

PAPER NO.	TITLE OF THE PAPER	MARKS ALLOTTED
		MAX
I	INTERMEDIARY METABOLISM	60
II	INTERNAL	15
II	LAB COURSE BIOCHEMISTRY - IV	25
<b>TOTAL</b>		<b>100</b>

Lab Course		
Duration: 5 Hrs Total Marks: 25	TWO EXPERIMENTS	15
	VIVA	03
	PROJECT/FIELD WORK	04
	SESSIONAL	03
<b>TOTAL</b>		<b>25</b>

EXAM SCHEME	
<b>Theory paper - 01</b>	<b>60 Marks</b>
<b>Internal - 01</b>	<b>15 Marks</b>
<b>Practical - 01</b>	<b>25 Marks</b>
<b>TOTAL</b>	<b>100 Marks</b>

**B.Sc. (BIOCHEMISTRY) SEMESTER - IV**

**2023-24**

**Program Specific Outcome (PSO):**

Upon completion of B.Sc. Degree (with Biochemistry) , the students will be able to:

<b>PSO1:</b>	Explain concept of molecular biology, nutritional, clinical, Environmental biochemistry, etc.
<b>PSO2:</b>	Discuss application of the physical and biochemical principals and techniques.
<b>PSO3:</b>	Describe and understand various biochemical aspects through theory and industrial visits.
<b>PSO4:</b>	Carry out experiments, present effectively through presentations and project work.

**B.Sc. (BIOCHEMISTRY) SEMESTER - IV 2023-24**

**BIOCHEMISTRY - IV  
INTERMEDIARY METABOLISM**

**Course Outcome (CO):**

After completion of the course, the students would be able:

<b>CO1.</b>	To understand the importance of Carbohydrate Metabolism
<b>CO2.</b>	To understand the Electron Transport Chain and Oxidative Phosphorylation
<b>CO3.</b>	To acquire knowledge related to Lipid Metabolism
<b>CO4</b>	To understand the nature Amino Acid Metabolism
<b>CO5.</b>	To understand Nucleotide Metabolism.

**B.Sc. (BIOCHEMISTRY) SEMESTER - IV**  
**2023-24**  
**BIOCHEMISTRY - IV**  
**BBCT - 302**  
**INTERMEDIARY METABOLISM**

**Max. Marks - 60**

**UNIT-I Introduction to Metabolism**

General features of metabolism, experimental approaches to study metabolism: use of intact organism. Bacterial mutants, tissue slices, stable and radioactive isotopes.

**Carbohydrate Metabolism**

Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Entry of fructose, galactose, mannose etc. Reactions and energetics of TCA cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway. Regulation of glycolysis and TCA cycle. Photosynthesis. A brief review.

**UNIT-II Electron Transport Chain and Oxidative Phosphorylation**

Structure of mitochondria, sequence of electron carriers, sites of ATP production, inhibitors of electron transport chain, Hypothesis of mitochondrial oxidative phosphorylation (basic concepts). Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing potentials into mitochondria.

**UNIT-III Lipid Metabolism**

Introduction, hydrolysis of triacylglycerols, transport of fatty acids into mitochondria  $\beta$  oxidation of saturated fatty acids. ATP yield from fatty acid oxidation, Biosynthesis of saturated and unsaturated fatty acids, Metabolism of ketone bodies, oxidation of unsaturated and odd chain fatty acids, Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism.

**UNIT-IV Amino Acid Metabolism**

General reactions of amino acid metabolism: Transamination, oxidative deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of amino acids. Glycogenic and ketogenic amino acids.

**UNIT-V Nucleotide Metabolism**

Sources of the atoms in the purine and pyrimidine molecules. Biosynthesis and degradation of purines and pyrimidines. Regulation of purine and pyrimidine biosynthesis.

**Porphyrin Metabolism**

Biosynthesis and degradation of porphyrins production of bile pigments.

**List of Reference Books:**

1. Fundamental of biochemistry by Donald Voet , JG Voet and CW Pratt , John Willey & Sons, NY.
2. Biochemistry by Geoffrey L Zubay , Mc Graw Hill.
3. Biochemistry Lubert Stryer , WH Freeman and Co., San Francisco.

**B.Sc. (BIOCHEMISTRY) SEMESTER - IV**  
**2023-24**  
**LAB COURSE BIOCHEMISTRY-IV**  
**BBCL - 04**

**Course Outcome (CO):**

*After completion of the course, the students would be able:*

<b>CO1.</b>	To have practical knowledge of Determination of albumin and A/G ratio in serum.
<b>CO2.</b>	To learn about Estimation of creatinine in urine
<b>CO3.</b>	Estimation of cholesterol in serum.
<b>CO4</b>	To learn about Separation and identification of amino acid by (a) paper chromatography and (b) thin layer chromatography
<b>CO5.</b>	To learn about Estimation of protein from serum by biuret and Lowry methods.

**LAB COURSE BIOCHEMISTRY-IV**

**BIOCHEMISTRY PRACTICAL [BBCL04]**

**Max.Marks - 25**

**Min.Marks - 10**

1. Separation of Blood Plasma and Serum.
2. Estimation of protein from serum by biuret and Lowry methods.
3. Determination of albumin and A/G ratio in serum.
4. Estimation of bilirubin (conjugated and unconjugated) in serum.
5. Estimation of total lipids in serum by vanillin method.
6. Estimation of cholesterol in serum.
7. Estimation of lipoprotein in plasma.
8. Estimation of lactic acid in blood before and after exercise.
9. Estimation of blood urea nitrogen from plasma.
10. Separation and identification of amino acid by  
(a) paper chromatography and  
(b) thin layer chromatography
11. Separation of polar and non polar lipids by thin layer chromatography.
12. Estimation of SGPT and SGOT in serum.
13. Estimation of creatinine in urine.
14. Estimation of creatinine in urine

**B.Sc. (BIOCHEMISTRY) SEMESTER - IV**  
**2023-24**  
**BIOCHEMISTRY – VIII**  
**DISCIPLINE SPECIFIC ELECTIVE COURSE**  
**BBDT – 802**  
**MICROBIOLOGY**

**Max. Marks – 60**

**Course outcome:**

***After completing the course students will be able to:***

<b>CO1.</b>	The students will get acquainted with the contributions of Louis Pasteur, Edward Jenner and Robert Koch in microbiology.
<b>CO2.</b>	Discovery of antibiotics and their targets, drug/antibiotic resistance, preventive and therapeutic approaches of infectious diseases, hospital acquired infections will be studied.
<b>CO3.</b>	The importance of microorganisms as model systems in genetics and biochemistry will be explained.
<b>CO4</b>	The contribution of gut microbiome to human health will be discussed.
<b>CO5.</b>	Students will be exposed to basic concepts of metabolic engineering and synthetic biology. The fight against major killer diseases – tuberculosis, HIV and malaria will be discussed.

- UNIT-I** Morphology and structure of bacteria, gram positive and gram negative organisms. Microscopy (Bright field, Dark field, Phase contrast and Fluorescence microscopy), sterilization, nutritional requirements and growth characteristics of bacteria, media for growing bacteria and fungi.
- UNIT-II** Microbial nutrition: Growth of micro-organisms, measurement of growth, factors influencing growth – Nutrition, carbon source, nitrogen source, temperature, pH and oxygen. Batch and continuous culture. Growth curve, phases of growth curve. Synchronous growth.
- UNIT-III** Staining of micro-organisms – principle and procedure of gram stain and acid fast stain.  
 Bacterial toxins – Classification, structure and mode of action of bacterial protein toxins
- UNIT-IV** Industrial microbiology: Production and importance – Alcoholic beverages (Beer and wine), fermented products of milk cheese, antibiotic production – penicillin, single cell protein – Spirulina. Fermentors – types and components.
- UNIT-V** Antibiotics: Definition, mechanism of action of penicillin streptomycin, and chloramphenicol, antibiotic resistance in brief.  
 Viruses: Classification based on genetic material with examples. Plant viruses – TMV, morphology, general characteristics and its replication.

Suggested readings:

1. Buchann (2015), Biochemistry and Molecular Biology of Plants, 2nd ed. Publisher: I K International. ISBN-10: 8188237116, ISBN-978047 0714218
2. Taiz and Zeiger, Plant Physiology, 5th edition, Sinauer Associates Inc. ISBN-13: 978- 0878938667, ISBN-10: 0878938664  
Caroline Bowsher, Martin Steer, Alyson Tobin (2008), Plant Biochemistry, Garland Science ISBN 978-0-8153-4121-5.
3. P.M Dey and J.B. Harborne (Editors) (1997), Plant Biochemistry, Publisher: Academic Press ISBN-10: 0122146743, ISBN-13: 978-0122146749



**B.Sc. (BIOCHEMISTRY) SEMESTER - IV**  
**2023-24**  
**BIOCHEMISTRY - VIII**  
**DISCIPLINE SPECIFIC ELECTIVE COURSE**  
**BBDL - 804**  
**LAB COURSE BIOCHEMISTRY - VIII**

**Course outcome:**

***After completing the course students will be able to:***

<b>CO1.</b>	Students will acquire knowledge to identify different microbes and to perform bacterial cultures in different media.
<b>CO2.</b>	They will get acquainted with routine microbiological practices including sterilization, media preparation, maintenance of microbial culture, staining etc.
<b>CO3.</b>	They will acquire expertise to culture and screen microbes for antibiotic resistance.

Practical content :

1. Preparation and sterilization of culture media
2. To perform culture transfer techniques: Solid to solid (streaking), liquid to solid (spreading), liquid to liquid, solid to liquid and determine CFU/ml
3. To stain bacteria using methylene blue.
4. To perform gram staining
5. Isolation of microbes from soil and sewage water.
6. To prepare temporary mount of algae (Spirogyra)
7. To prepare temporary mount of fungi (Penicillium)
8. Study of different shapes of bacteria, fungi, algae, protozoa using permanent Slides.
9. To prepare growth curve of bacteria.

**B.Sc. (BIOCHEMISTRY) SEMESTER - IV**  
**2023-24**  
**SKILL ENHANCEMENT COURSE - 1**  
**BCHS 01:**  
**GOOD LAB PRACTICES IN CHEMISTRY THEORY AND PRACTICAL**  
**[Credits -02, 30 hrs.]**

**Course outcome:**  
***After completing the course students will be able to:***

<b>CO1.</b>	Understand general laboratory practices.
<b>CO2.</b>	Prepare solutions.
<b>CO3.</b>	Handle glasswares and chemicals.
<b>CO4</b>	Explore various research issues and their solutions.
<b>CO5.</b>	Apply practical skills in chemistry.

### **Theory**

- A. Common calculations in chemistry laboratories. Understanding the details on the label of reagent bottles.
- B. Inorganic and organic reagents (Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, Dimethyl glyoxime, H<sub>2</sub>S gas); chemicals such as acids, bases, indicators, etc. used in chemistry lab for qualitative analysis
- C. Molarity and normality of common acids and bases. Preparation of solutions – solid and liquids, Molar, molal and normal solutions, Dilutions. Percentage solutions.

### **Practical**

- A. Technique and uses of handling glasswares; calibrations, knowledge about common toxic chemicals and safety measures in their handling.
- B. Qualitative test of CO<sub>3</sub><sup>2-</sup>, CH<sub>3</sub>COO<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, NH<sub>4</sub><sup>+</sup>, Cu<sub>2</sub><sup>+</sup>, Fe<sup>3+</sup>, Ni<sup>2+</sup>, Ba<sup>2+</sup>, Mg<sup>2+</sup>.

**Or**

Preparation of standard solutions of solids and liquids- Normal molar and % solutions, dilutions.

- C. Qualitative elemental analysis for Nitrogen, Sulphur, Halogen in organic compounds.

**Or**

Preparation of inorganic and organic reagents - Baeyer's reagent, nessler's reagent, fehling solution A and B, shiff reagents, Tollen's reagent, Mollish's reagent, Neutral ferric chloride, Nitrating Mixture, Aqua regia, and their application in analysis.

### **Reference Books**

1. Seiler, J.P. (2005). Good Laboratory Practices: the why and how. Springer-Verlag Berlin and Heidelberg GmbH & Co. K; 2nd ed.
2. Garner, W.Y., Barge M.S., Ussary. P.J. (1992). Good Laboratory Practice Standards: Application for field and Laboratory studies. Wiley VCH.

**B.Sc. (BIOCHEMISTRY) SEMESTER - IV  
2023-24**

**SKILL ENHANCEMENT COURSE - 2**

**BCHS 02: WATER REMEDIATION AND CONSERVATION STUDIES  
THEORY AND PRACTICAL [Credits -02, 30 hrs.]**

**Course outcome:**

*After completing the course students will be able to:*

<b>CO1.</b>	Understand about Sources and Effect Water
<b>CO2.</b>	Learn about various control technique

**Water Pollution**

Sources of water pollutants, pollutants, Industrial and human contribution, WHO recommendation about potable water, current scenario of drinking water quality.

**Remediation Techniques**

Remediation, techniques involved such as adsorption, coagulation-filtration, Nalgonda techniques, reverse osmosis, activated charcoal detoxification, mechanisms of detoxification, bio-remediation, need of green chemistry, future scope.

**Water Conservation**

Introduction to water conservation and erosion of soil, forms of water erosion, factors affecting water erosion, types of water erosion, mechanics of water erosion control,

**Practical:-**

Water analysis ( pH, Conductivity, hardness, Acidity, Alkalinity etc.)

**Case study/Project**

Case study/Project on water pollution, water conservation and water quality.

**Recommended Books/references:**

1. Cittenden J. C. , Trussell J. R., Hand D. W., Howe K. J., Tchobanoglous G. , Water treatment: Principles and Design MWH publication.
2. De A. K. Environmental Chemistry, Wiley Eastern
3. Clarson D., Dara S. S. A text book of Environmental chemistry and pollution control, S Chand Co. Soil and water analytical method
4. Edzwald J., Water Quality & Treatment: A Handbook on Drinking Water (WaterResources and Environmental Engineering Series)

**NAME AND SIGNATURE:**

		Departmental members	
Chairperson /H.O.D .....	<i>A. Khan</i>		
Subject Expert .....	<i>H. H. Mabey</i>	1. <i>[Signature]</i>	8.....
(University Nominee)		2. <i>[Signature]</i>	9.....
Subject Expert.....	<i>S. S.</i>	3. <i>[Signature]</i>	10.....
Representative .....		4.....	11.....
(Industry)		5. <i>[Signature]</i>	12.....
Representative .....	<i>[Signature]</i>	6.....	13.....
(Alumni)		7. <i>[Signature]</i>	14.....
Representative .....	<i>[Signature]</i>		
(Professor Science Faculty Other Dept.)			