



**R.E. Society's  
R.P. Gogate College of Arts & Science  
and R.V. Joglekar College of Commerce,  
Ratnagiri (Autonomous)**

**Bachelor of Science (B.Sc.) Biochemistry  
Programme  
Three Year Integrated Programme  
Six Semesters  
*Course Structure***

**Under Choice Based Credit System (CBCS)**

**To be implemented from Academic Year-  
2024-2025**

Name of Programme	<b>B.Sc. Biochemistry</b>
Level	UG
No of Semesters	06
Year of Implementation	<b>2024-25</b>
Programme Specific Outcomes (PSO)	<ol style="list-style-type: none"> <li>1. Biochemistry is central to all areas of the “biological” and “life” science. It aims to provide an understanding of every aspect of the structure and function of living things at cellular level.</li> <li>2. Being an interdisciplinary subject, it is spanning a wide range of areas like microbiology, plant and animal sciences, genetics, tissue culture, pharmacology, instrumentation, metabolism, environmental science, pathology of diseases and nutrition.</li> <li>3. This program able one to plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods.</li> <li>4. It applies contextual knowledge and modern tools of biochemical research for solving problems.</li> <li>5. It generates ability to engage students in lifelong learning to foster their growth as a successful researcher and establish as an entrepreneur in field of Biochemistry.</li> </ol>
Relevance of PSOs to the local, regional, national, and global developmental needs.	<ol style="list-style-type: none"> <li>1. B.Sc. Biochemistry students can do their masters in Forensic Science, Genetics, Toxicology, Biotechnology, Nutrition and Dietetics, Immunology, Biostatistics and Bioinformatics, Biophysics, etc.</li> <li>2. The program helps to develop scientific temper and thus can be proved more beneficial for society as scientific development can make a nation or society grow at rapid pace through research.</li> <li>3. The curriculum offers variety of interdisciplinary subjects and practical exposures which would equip the students to face modern day challenges in science and technology.</li> <li>4. The learners will be able to recognize features and role of civil services, consultant in medical field, researcher, academician, environmentalist.</li> </ol>

	<ol style="list-style-type: none"> <li>5. This course inclines students towards pharmacology where they can do drug designing.</li> <li>6. The data in medical field can be enriched by doing medical coding.</li> <li>7. Agriculture will be benefitted by their work in developing new plant breeds, biofertilizers, biopesticides, etc.</li> <li>8. Biochemistry plays an important role in nutrition and health and is considered to be a powerful and sustainable tool for the improvement of health, reduction of poverty and hunger in the world.</li> <li>9. Learning about environmental science develops harmonious relationship between nature and human and need of conserving the resources on Earth.</li> <li>10. This course cultivates skills for successful career, entrepreneurship and higher studies.</li> </ol>
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The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40% marks in the first part and by conducting the Semester End Examinations with 60% marks in the second part. The allocation of marks for the Internal Assessment and Semester End Examinations are as shown below-

**A) Internal Evaluation (20M)**

Method	Marks
Class test (written)	10
Assignment	05
Class performance	05
Question Paper Pattern for Class Test (20M) Duration: 40 Minutes <b>Match the Column / Fill in the Blanks / Multiple Choice Questions/ True or False / Answer in One or Two Lines/ Short answers (Concept based Questions) (1/2/3/4 Marks)</b>	

**B) Semester End Evaluation: Paper Pattern-30M (Duration: 1hr)**

Question No	Unit	Type of Question	Marks	
Q.1	a)	1	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	1	Answer the following/ Write a note on (Any 1)	04
Q.2	a)	2	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	2	Answer the following/ Write a note on (Any 1)	04
Q.3	a)	3	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	3	Answer the following/ Write a note on (Any 1)	04

**Standard of Passing**

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment & Semester End Examination. The learner shall obtain minimum of 40% marks (i.e. 08 out of 20) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 12 out of 30) separately, to pass the course and minimum of Letter Grade “P” in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment & Semester End Examination together.

**Performance Grading:****Letter Grades and Grade Points**

Semester GPA/ Program CGPA Semester/Program	% of Marks	Alpha-Sign / Letter Grade Result
9.00-10.00	90.0 -100	O (Outstanding)
8.00 ≤ 9.00	80.0 ≤ 90.0	A+ (Excellent)
7.00 ≤ 8.00	70.0 ≤ 80.0	A (Very Good)
6.00 ≤ 7.00	60.0 ≤ 70.0	B+ (Good)
5.50 ≤ 6.00	55.0 ≤ 60.0	B (Above Average)
5.00 ≤ 5.50	50.0 ≤ 55.0	C (Average)
4.00 ≤ 5.00	40.0 ≤ 50.0	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)	-	Absent

**B.Sc. Programme**  
**Under Choice Based Credit System (CBCS)**  
**FYBSc Course Structure (Autonomous)**  
**Major: Biochemistry Minor : Chemistry**  
*(To be implemented from Academic Year- 2024-25)*

Course Code	Semester I	Credits	Course Code	Semester II	Credits
<i>Discipline Specific Course (DSC)</i>			<i>Discipline Specific Course (DSC)</i>		
<i>Subject 1</i>			<i>Subject 1</i>		
USBCH101	Biomolecules I	02	USBCH201	Biomolecules II	02
USBCH102	Introduction to cell biology	02	USBCH202	Introduction to physiology	02
USBCH103	Biochemistry practical I	02	USBCH203	Biochemistry practical II	02
<i>Subject 2</i>			<i>Subject 2</i>		
USCH101	Physical and Inorganic Chemistry I	02	USCH201	Physical and Inorganic Chemistry II	02
USCH102	Organic and Inorganic Chemistry I	02	USCH202	Organic and Inorganic Chemistry II	02
			USCH203	Chemistry Practical II	02
<i>Generic / Open Elective</i>			<i>Generic / Open Elective</i>		
	To be selected from OE list	02		To be selected from OE list	02
<i>Indian Knowledge System ( IKS)</i>					
USIKS101	Development of science and Technology in India	02			---
<i>Vocational Skill Course (VSC)</i>					
USCHV104	Laboratory skills in Chemical science	02			---
			<i>Skill Enhancement Course (SEC)</i>		
		---		To be selected from SEC list	02
<i>Ability Enhancement Course (AEC)</i>			<i>Ability Enhancement Course (AEC)</i>		
USAECENG 101	English: Communication Skills I	02	USAECENG 201	English: Communication Skills II	02
<i>Value Education Course (VEC)</i>					
USVECBOT 101	Environmental Studies - I	02	USVECBOT 201	Environmental Studies - II	02
<i>Co-Curricular</i>			<i>Co-Curricular</i>		
	Any one course from the Table 1 given below	02		Any one course from the Table 1 given below	02
<b>Total Credits</b>		<b>22</b>	<b>Total Credits</b>		<b>22</b>

Bachelor of Science (B.Sc) Biochemistry Programme  
Under Choice Based Credit System  
Course Structure

F.Y.B.Sc.

(To be implemented from Academic Year- 2024-25)

Course Code	Semester I	Credits	Course Code	Semester II	Credits
<i>Discipline Specific Course (DSC)</i>			<i>Discipline Specific Course (DSC)</i>		
<b>Major: Mandatory</b>			<b>Major: Mandatory</b>		
USBCH101	Biomolecules I	<b>02</b>	USBCH201	Biomolecules II	<b>02</b>
USBCH102	Introduction to cell biology	<b>02</b>	USBCH 202	Introduction to physiology	<b>02</b>
USBCH 103	Biochemistry Practical I	<b>02</b>	USBCH203	Biochemistry Practical II	<b>02</b>

SMART Criteria for Course Outcomes:

**Specific:** Each course outcome is specific, outlining the knowledge and skills students are expected to acquire in relation to the specific topics covered.

**Measurable:** Each outcome can be measured through assessments, tests, or projects to determine the level of understanding and proficiency achieved by the students.

**Achievable:** The outcomes are achievable within the duration of the course, considering the number of lectures allocated to each topic.

**Relevant:** The outcomes are relevant to the subject of financial services and capital market, addressing important concepts, types, and mechanisms involved.

**Time-bound:** The outcomes are expected to be achieved by the end of the course, providing a clear timeline for assessment and evaluation.

No. of Courses	Semester I	Credits
<b>Major: Mandatory</b>		
<b>USBCH 101</b>	<b>Biomolecules I</b>	<b>02</b>
<b>USBCH 102</b>	<b>Introduction to cell biology</b>	<b>02</b>
<b>USBCH 103</b>	<b>Biochemistry Practical I</b>	<b>02</b>
	<b>TOTAL</b>	<b>06</b>

***Revised Syllabus of Courses of Bachelor of Science (B.Sc.)  
Biochemistry Program at Semester I with Effect from the  
Academic Year 2024-2025***

Name of the Course	Biomolecules I
Course Code	USBCH101
Class	F.Y.B.Sc.
Semester	I
No of Credits	2
Nature	Theory
Type	Major: Mandatory
Highlight revision specific to employability/ entrepreneurship/skill development	Learner will get acquainted with unique physical and chemical characteristics of water. Also, they will understand its structure and how it enables to function in ways essential to human and other life processes. Students will get idea about how coordinately protein structure is built to support a life. Carbohydrates are primary source of energy. Learning the basic structures of carbohydrate, learner will understand their different functions as a fuel, structural component in a body.

**Biomolecules I**

***Modules at a Glance***

Sr. No.	Modules	No. of Lectures
1.	Water	10
2.	Amino acids and protein	10
3.	Carbohydrates	10
<b>Total</b>		<b>30</b>

**Course Outcomes:**

At the end of the course, students will be able to-

1. Acquaint the unique properties of the universal solvent - water, essential for life processes.
2. Understand the life constituting bio molecules: proteins, carbohydrates.
3. Familiarize with the structural properties of the biomolecules.



**Curriculum:**

Unit	Title	Learning Points	No of Lectures
1	Water	<p>1.1 Water: Its effect on Biomolecules Structure and properties of water (hydrogen bonding)</p> <p>1.1.1 Entropy and dissolution of solute</p> <p>1.1.2 Effect of non-polar compounds on the structure of water</p> <p>1.1.3 Weak interactions of biomolecules in aqueous solutions</p> <p>1.2 Ionization of water, weak acids and weak bases</p> <p>1.2.1 pH: pH scale, H<sup>+</sup> and OH<sup>-</sup> concentrations</p> <p>1.2.2 Weak acids and bases and their dissociation constants K<sub>a</sub> &amp; K<sub>b</sub></p> <p>1.2.3 Buffers- definition, action, physiological buffers-any 2 examples</p> <p>1.3 Solutions: Problems based on solution preparation</p>	10
2.	Amino acids and protein	<p>2.1 Amino acids</p> <p>2.1.1 Amino acid structure- D &amp; L forms of all 20 amino acids</p> <p>2.1.2 Detailed classification based on polarity, essential and non-essential amino acids</p> <p>2.1.3 Physical and chemical properties, Chemical reactions of amino acids with Ninhydrin</p> <p>2.2 Peptides and Proteins</p> <p>2.2.1 ASBC- APS classification on the basis of shape and function</p> <p>2.2.2 Primary structure -Formation and characterization of the peptide bond</p> <p>2.2.3 Secondary structure -Alpha helix and beta sheet</p> <p>2.2.4 Tertiary and Quaternary structures- an introduction with one example of each</p> <p>2.2.5 Protein denaturation</p>	10

3.	Carbohydrates	<p>3.1 Definition, Classification, and functions of carbohydrates (mono-, oligo-, polysaccharides)</p> <p>3.2 Monosaccharides</p> <p>3.2.1 Classification in terms of aldoses and ketoses</p> <p>3.2.2 Structures of glucose, fructose, galactose, mannose, and ribose</p> <p>3.2.3 Properties:</p> <p>a) Physical- isomerism D &amp; L, optical; epimers; anomers</p> <p>b) Chemical reactions –</p> <p>i) oxidation to produce aldonic. Aldaric and uronic acids (with respect to glucose); ii) Benedict's test, enediol formation (with respect to glucose and fructose)</p> <p>iii) osazone formation (with respect to glucose) iv) orcinol (with respect to ribose)</p> <p>3.3 Disaccharides</p> <p>3.3.1 Occurrence and structure of maltose, lactose and sucrose</p> <p>3.3.2 Formation of glycosidic bonds</p> <p>3.4 Polysaccharides</p> <p>3.4.1 Classification based on function. storage and structure</p> <p>a) Composition: homo &amp; hetero. with examples</p> <p>b) Storage: starch and glycogen - action of amylase on starch</p> <p>c) Structural: cellulose. Chitin</p>	10
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**Learning Resources recommended:**

1. Lehninger Principles of Biochemistry. M.M. Cox. 7<sup>th</sup> edition, 2017.
2. Biochemistry. U. Sathyanarayana, U. Chakrapani. 4<sup>th</sup> edition, 2014.
3. Biochemistry. Garrett and Grishman. 6<sup>th</sup> edition. 2016
4. Harper's Illustrated Biochemistry. 31<sup>st</sup> Edition. by Rodwell, Bender, et al. 2018.
5. Biochemistry. Gregory Gatto Jeremy M. Berg, Lubert Stryer, John Tymoczko, 9<sup>th</sup> edition, 2019

## Evaluation Pattern:

### A. Continuous Internal Evaluation (20M)

Method	Marks
<b>Class test (written)</b> Match the Column / Fill in the Blanks / Multiple Choice Questions/ True or False / Answer in One or Two Lines/ Short answers (Concept based Questions) (1/2/3/ 4 Marks)	<b>10</b>
<b>Assignment/ Presentation/ Open Book Test/ Chart Preparation</b>	<b>05</b>
<b>Class performance and attendance</b>	<b>05</b>

### B. Semester End Evaluation (Paper Pattern) (30M)

Question No	Unit	Type of Question	Marks	
Q.1	a)	1	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	1	Answer the following/ Write a note on (Any 1)	04
Q.2	a)	2	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	2	Answer the following/ Write a note on (Any 1)	04
Q.3	a)	3	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	3	Answer the following/ Write a note on (Any 1)	04

#### Guidelines for paper pattern for semester end evaluation:

1. All questions will be compulsory and may be divided into sub-questions.
2. Descriptive type of questions, problem solving / numerical based questions, etc., will contain internal options.
3. MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc., type of questions.
4. Diagrams or flowcharts should be drawn wherever necessary.

Name of the Course	Introduction to cell biology
Course Code	USBCH102
Class	F.Y.B.Sc.
Semester	I
No of Credits	2
Nature	Theory
Type	Major: Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Origin of Life is considered as one of the most important phenomena that happened in the history of biology. Studying this phenomenon, learners will get to know about the existence of atmosphere, special gases, different forms of species. They also understand how the Earth became habitable step by step. Studying structure of cell will help them understand how different cells can cope with differing circumstances or handle similar circumstances using different approaches.

## Introduction to Cell Biology

### *Modules at a Glance*

Sr. No.	Modules	No. of Lectures
1.	Origin of Life & Evolution	10
2.	The cell	10
3.	Cell Cycle and cell division	10
<b>Total</b>		<b>30</b>

**Course Outcomes:**

At the end of the course, students will be able to-

CO1: Familiarize about the origin of life and take them through the process of evolution.

CO2: Focus on Cell as the basic unit of life which is the center for all biochemical processes.

CO3: understand that cell division is a key to life. It focuses on growth, development and repair is maintained by cell division.



**Curriculum:**

Unit	Title	Learning Points	No of Lectures
1	Origin of Life & Evolution	<p>1.1 Big bang theory, Theories on the origin of life: Abiogenesis, Heterotroph hypothesis, RNA world, protein world, Miller's experiment, Formation of the first cell, endosymbiotic theory</p> <p>1.2 Evolution - Darwinian theory, Modern synthetic theory of evolution and its factors: Gene mutations (recombination), heredity, natural selection and isolation</p> <p>1.3 Biological evidences: Fossil record, chemical and anatomical similarities of related life forms, geographic distribution of related species, genetic changes in living organisms over generations and Mechanism of evolution, Gene flow and genetic drift</p> <p>1.4 Hardy-Weinberg Equation</p>	10

2	The cell	<p>2.1 Structural organization of cells</p> <p>2.1.1 Prokaryotic, Eukaryotic (plant &amp; animal) and yeast cells- comparative overview</p> <p>2.2 Cell wall structure (plant), cell membrane (fluid mosaic model) Cytoskeleton: microtubules &amp; microfilaments</p> <p>2.3 Cell organelles: Structure and function</p> <p>2.3.1 Mitochondrion: Organization of the mitochondria genome</p> <p>2.3.2 Chloroplast: Organization of the chloroplast genome, other plastids</p> <p>2.3.3 Ribosome:</p> <p>2.3.4 Endoplasmic reticulum</p> <p>2.3.5 Golgi apparatus</p> <p>2.3.6 Peroxisome &amp; Lysosome</p> <p>2.3.7 Nucleus: nuclear envelope, nuclear pores, nuclear matrix and Nucleolus</p>	10
3	Cell Cycle and cell division	<p>3.1 Cell cycle and regulation</p> <p>3.2 Cell division</p> <p>3.2.1 Binary fission</p> <p>3.2.2 Mitosis and Meiosis- Different phases and Comparative overview of mitosis and meiosis</p> <p>3.3 Apoptosis</p> <p>3.4 Cell-cell interactions</p>	10

**Learning Resources recommended:**

1. Biology, Genetics, Molecular Biology: Evolution and Ecology P.S. Verma.2012.
2. Molecular Biology of the Cell Bruce Alberts. 4<sup>th</sup> edition.2002
3. The cell: A molecular approach. Geoffrey M. Cooper, Robert E. Hausman. 7<sup>th</sup> edition, 2015
4. Karp's Cell Biology Paperback .Gerald Karp, Janet Iwasa. Global edition, 2018

## Evaluation Pattern

### A. Continuous Internal Evaluation (20M)

Method	Marks
<b>Class test (written)</b> Match the Column / Fill in the Blanks / Multiple Choice Questions/ True or False / Answer in One or Two Lines/ Short answers (Concept based Questions) (1/2/3/4 Marks)	<b>10</b>
<b>Assignment/ Presentation/ Open Book Test/ Chart Preparation</b>	<b>05</b>
<b>Class performance and attendance</b>	<b>05</b>

### B. Semester End Evaluation (Paper Pattern) (30M)

Question No	Unit	Type of Question	Marks	
Q.1	a)	1	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	1	Answer the following/ Write a note on (Any 1)	04
Q.2	a)	2	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	2	Answer the following/ Write a note on (Any 1)	04
Q.3	a)	3	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	3	Answer the following/ Write a note on (Any 1)	04

#### Guidelines for paper pattern for semester end evaluation:

1. All questions will be compulsory and may be divided into sub-questions.
2. Descriptive type of questions, problem solving / numerical based questions, etc., will contain internal options.
3. MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc., type of questions.
4. Diagrams or flowcharts should be drawn wherever necessary.

Name of the Course	Practicals based on USBCH101 and USBCH102
Course Code	USBCH103
Class	F.Y.B.Sc.
Semester	I
No of Credits	2
Nature	Practical
Type	Major: Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will be acquainted with good laboratory practices. Upon successful completion, student develops skills in handling instruments and understands its applications in laboratory and research work.

**Course Outcomes:**

At the end of the course, students will be able to-

CO1: Provide familiarity with basic biochemistry laboratory techniques.

CO2: Understand the characteristics of different biomolecules with different reagents.

CO3: Familiarize with different staining methods.

**Instructions for learners:**

- 1. All measurements and readings should be written with proper units.**
- 2. Skill of doing the experiment and understanding Biochemistry concepts should be more important than the accuracy of final result.**
- 3. In order to appear for Semester End Examination of this course, 75% of all the experiments should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Biochemistry practical journal of first semester).**
- 4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Biochemistry department and produce the certified journal at the time of Semester End Examination of this course.**
- 5. A learner will be allowed to appear for the Semester End Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Biochemistry department that the learner has completed this practical course as per the minimum requirements.**
- 6. For Semester End Examination, the learner will be separately examined for two groups: A and B from this course.**
- 7. Semester End Practical Examination will be of 6 hours.**
- 8. Evaluation in viva voce will be based on all practicals from this course.**
- 9. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.**

**Curriculum:**

Group	Title	Learning Points	No of Lectures
A	Basic Biochemistry	<ol style="list-style-type: none"><li>1. Numericals based on ways of expressing concentration of solution.</li><li>2. Introduction to laboratory glassware.</li><li>3. Preparation &amp; Standardization of laboratory reagents<ol style="list-style-type: none"><li>i. Primary standards - 0.1N oxalic acid</li><li>ii. Secondary standards - 0.1N NaOH, 0.1N HCl</li></ol></li><li>4. Preparation of buffers –<ol style="list-style-type: none"><li>i. acetate buffer</li><li>ii. phosphate buffer</li></ol></li><li>5. Determination of pKa of glycine</li><li>6. Qualitative tests for Carbohydrates<ol style="list-style-type: none"><li>i. Monosaccharides (glucose and fructose),</li><li>ii. Disaccharides (lactose, maltose and sucrose)</li><li>iii. Polysaccharides (starch and dextrin)</li></ol></li><li>7. Qualitative test for amino acids</li><li>8. Effect of heat, organic solvents and ammonium sulphate on proteins</li></ol>	25
B	Cell Biology	<ol style="list-style-type: none"><li>1. Effect of isotonic, hypertonic and hypotonic solutions on cells – onion peel</li><li>2. Staining of bacterial yeast cells (negative staining)</li><li>3. Gram staining</li><li>4. Observation of fungi and algae</li><li>5. Permanent slides/ diagrams or electron micrograph of organelles-nucleus, mitochondria and chloroplast</li><li>6. Study of stages of mitosis using onion root tips</li><li>7. Permanent slides of mitosis and meiosis</li><li>8. Observation and study of V.S. and T.S. of cells of plant's stem</li></ol>	25
C	Demonstration Experiment	<ol style="list-style-type: none"><li>1. pH meter – working of a pH meter and Determination of pH of different samples</li><li>2. Demonstration of weighing balance.</li><li>3. Introduction to Compound microscope and Parts and maintenance of Microscope</li></ol>	10

**Learning Resources recommended:**

1. Biochemical Calculation by Segel, 2<sup>nd</sup> edition (2010)
2. Biochemical Methods by Sadashivam, 2<sup>nd</sup> edition (2005)
3. Introductory Practical Biochemistry by Sawhney and Singh (2001)
4. Practical Biochemistry by David Plummer, 3<sup>rd</sup> edition (2007)

## Evaluation Pattern

### A. Continuous Internal Evaluation (20M)

Method	Marks
Performance and engagement during practical sessions: <ul style="list-style-type: none"><li>• Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical</li><li>• Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments</li><li>• Submission of journal within a week after every practical session</li></ul> Based on above criteria, each experiment of this course will be assessed during regular practical session	10
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

### B. Semester End Evaluation (Exam Pattern) (30 Marks - 4 hours)

Q.No	Group	Title	Method	Marks
1	A	Basic Biochemistry	Experiment performance as per practical exam paper	15
2	B	Cell Biology	Experiment performance as per practical exam paper	15

**Revised Syllabus of Courses of Bachelor of Science (B.Sc.)  
Biochemistry Program at Semester II with Effect from the  
Academic Year 2024-2025**

No. of Courses	Semester II	Credits
	<b>Major: Mandatory</b>	
<b>USBCH201</b>	<b>Biomolecules II</b>	<b>02</b>
<b>USBCH202</b>	<b>Introduction to Physiology</b>	<b>02</b>
<b>USBCH203</b>	<b>Biochemistry Practical II</b>	<b>02</b>
	<b>TOTAL</b>	<b>06</b>

Name of the Course	Biomolecules II
Course Code	USBCH201
Class	F.Y.B.Sc.
Semester	II
No of Credits	2
Nature	Theory
Type	Major: Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	<p>Lipids play such an essential role in the body; it is very important to understand the structure and function of lipids. This understanding helps in solving several metabolism-related problems.</p> <p>DNA is molecule which contains genetic information. An understanding and appreciation of the structure and function of DNA has opened up many areas of research, such as genetic engineering, forensic science.</p>

**Biomolecules II**  
*Modules at a Glance*

<b>Sr. No.</b>	<b>Modules</b>	<b>No. of Lectures</b>
<b>1.</b>	<b>Lipids</b>	<b>10</b>
<b>2.</b>	<b>Nucleic acid and RNA</b>	<b>10</b>
<b>3.</b>	<b>DNA</b>	<b>10</b>
<b>Total</b>		<b>30</b>

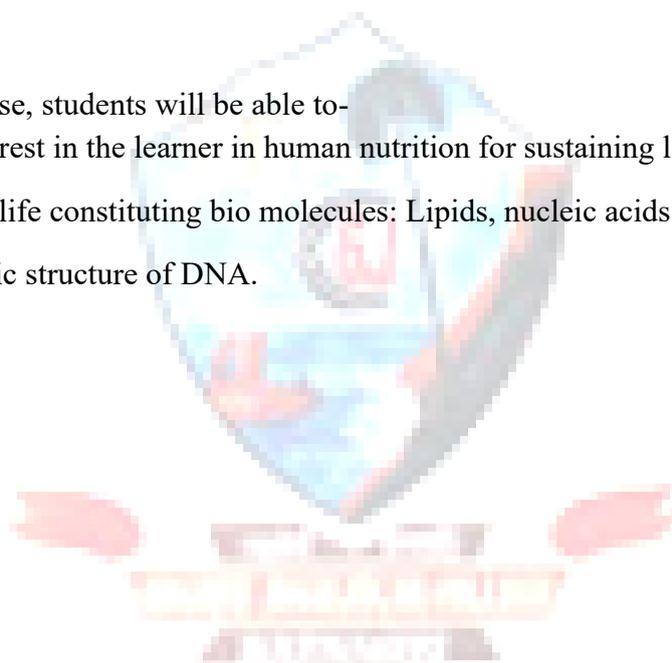
**Course Outcomes:**

At the end of the course, students will be able to-

CO1: Develop an interest in the learner in human nutrition for sustaining life.

CO2: Understand the life constituting bio molecules: Lipids, nucleic acids.

CO2: Understand basic structure of DNA.



**Curriculum:**

Unit	Title	Learning Points	No of Lectures
1	Lipids	<p>1.1 Definition, Bloor's classification, functions of Lipids</p> <p>1.2 Fatty acids and Triacylglycerol</p> <p>1.2.1 Classification &amp; Chemistry, Saturated fatty acids - classification of C2 to C20: even carbon: Common and IUPAC names. Unsaturated fatty acids MUFA, PUFA (2.3.4 double bonds)</p> <p>Omega – 3, 6, 9 fatty acids. Triacyl glycerol - simple and mixed - names and structure</p> <p>1.2.2 Chemical Reactions of fats</p> <p>Saponification, Iodination, Ozonolysis, Auto-oxidation, Rancidity Definition &amp; significance - Acid number, Saponification number, Iodine number, Reichert - Meissl number</p> <p>1.3 Compound Lipids</p> <p>Functions of glycerophospholipids (PE, PC, PL)</p> <p>Phosphosphingolipids (ceramide, sphingomyelin), Glycolipids /Cerebrosides (gluco- &amp; galactocerebrosides)</p> <p>1.4 Steroids Cholesterol structure and biochemical significance.</p>	10
2	Nucleic Acid and RNA	<p>2.1 Structure - Purine &amp; Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) Formation of polynucleotide strand with its shorthand Representation</p> <p>2.2 RNAs (various types in prokaryotes and eukaryotes) mRNA &amp; rRNA - general account, tRNA - clover leaf model, Ribozymes</p> <p>2.3 Reaction of RNA with Orcinol</p>	10
3	DNA	<p>3.1 Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA &amp; its features</p> <p>3.2 Physical properties of DNA - Effect of heat on physical properties of DNA (Viscosity, buoyant density, UV absorption), Hypochromism, hyperchromism, denaturation of DNA.</p> <p>3.3 Reaction of DNA with DPA</p>	10

### Learning Resources recommended:

1. Lehninger Principles of Biochemistry M.M. Cox. 7th edition, 2017.
2. Biochemistry. U. Sathyanarayana, U. Chakrapani. 4<sup>th</sup> edition, 2014.
3. Fundamentals of Biochemistry by J. L. Jain, 7<sup>th</sup> edition, 2016.
4. Harper's Illustrated Biochemistry by Rodwell, et.al 31<sup>st</sup> edition, 2018.

### Evaluation Pattern

#### A. Continuous Internal Evaluation (20M)

Method	Marks
Class test (written) Match the Column / Fill in the Blanks / Multiple Choice Questions/ True or False / Answer in One or Two Lines/ Short answers (Concept based Questions) (1/2/3/4 Marks)	10
Assignment/ Presentation/ Open Book Test/ Chart Preparation	05
Class performance and attendance	05

#### B. Semester End Evaluation (Paper Pattern) (30M)

Question No	Unit	Type of Question	Marks	
Q.1	a)	1	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	1	Answer the following/ Write a note on (Any 1)	04
Q.2	a)	2	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	2	Answer the following/ Write a note on (Any 1)	04
Q.3	a)	3	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	3	Answer the following/ Write a note on (Any 1)	04

### Guidelines for paper pattern for semester end evaluation:

1. All questions will be compulsory and may be divided into sub-questions.
2. Descriptive type of questions, problem solving / numerical based questions, etc., will contain internal options.
3. MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc., type of questions.
4. Diagrams or flowcharts should be drawn wherever necessary.

Name of the Course	Introduction to physiology
Course Code	USBCH202
Class	F.Y.B.Sc.
Semester	II
No of Credits	2
Nature	Theory
Type	Major: Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Physiology is an experimental scientific discipline and is of central importance in medicine and related health sciences. It provides a thorough understanding of normal body function, enabling more effective treatment of abnormal or disease states.

### Introduction to physiology

#### *Modules at a Glance*

Sr. No.	Modules	No. of Lectures
1.	Physiology of digestion and absorption	10
2.	Physiology of respiration	10
3.	Physiology of Excretion	10
<b>Total</b>		<b>30</b>

**Course Outcomes:**

At the end of the course, students will be able to-

CO1: Understand biological process in human body.

CO2: Learn Anatomy and physiology of vital systems.

CO3: Understand the possible diseases related to digestion, respiration and excretion.



**Curriculum:**

Unit	Title	Learning Points	No of Lectures
1	Physiology of digestion and absorption	1.1 Parts and Functions of gastrointestinal tract (GIT) 1.2 Organs and Glands associated with GIT Secretions and Juices of GIT (Saliva, Gastric juice, Intestinal juice, pancreatic and Bile juice) 1.3 Digestion and Absorption of carbohydrates 1.4 Digestion and Absorption of Lipids 1.5 Digestion and Absorption of Proteins 1.6 Disorders-Peptic ulcer, Lactose Intolerance	10
2	Physiology of respiration	2.1 Respiratory system, 2.2 Breathing - inspiration and expiration, 2.3 Composition of air and partial pressure of gases 2.4 Physical exchange of gases 2.4.1 Transport of oxygen 2.4.2 Transport of carbon dioxide 2.5 Respiratory disorders – cyanosis, respiratory acidosis and alkalosis	10
3	Physiology of Excretion	3.1 Excretory system in different animals 3.2 Structure of the nephron: 3.2.1 Bowman's capsule & glomerulus - Structure & function, (ultrafiltration, pressures involved, GFR, regulation of GFR); 3.2.2 Renal tubule - structure & function (proximal and distal convoluted tubules and Henle's loop) 3.3 Urine formation: Reabsorption / Secretion of glucose, Na <sup>+</sup> , K <sup>+</sup> , HCO <sub>3</sub> <sup>-</sup> , Cl <sup>-</sup> and H <sup>+</sup> renal threshold, 3.4 Excretory disorder: Nephritis	10

### Learning Resources recommended:

1. Guyton and Hall Textbook of medical Physiology. John E. Hall 4<sup>th</sup> edition.2015
2. Harper's Illustrated Biochemistry. 31<sup>st</sup> Edition. by Rodwell, Bender, et al. 2018.
3. Tortora's principles and physiology. Gerard Tortora and Bryan Derrickson Global edition 2016

### Evaluation Pattern

#### A. Continuous Internal Evaluation (20M)

Method	Marks
<b>Class test (written)</b> Match the Column / Fill in the Blanks / Multiple Choice Questions/ True or False / Answer in One or Two Lines/ Short answers (Concept based Questions) (1/2/3/ 4 Marks)	<b>10</b>
<b>Assignment/ Presentation/ Open Book Test/ Chart Preparation</b>	<b>05</b>
<b>Class performance and attendance</b>	<b>05</b>

#### B. Semester End Evaluation (Paper Pattern) (30M)

Question No	Unit	Type of Question	Marks	
Q.1	a)	1	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	1	Answer the following/ Write a note on (Any 1)	04
Q.2	a)	2	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	2	Answer the following/ Write a note on (Any 1)	04
Q.3	a)	3	Answer the following/ Write a note on (Any 2) 3M each	06
	b)	3	Answer the following/ Write a note on (Any 1)	04

### Guidelines for paper pattern for semester end evaluation:

1. All questions will be compulsory and may be divided into sub-questions.
2. Descriptive type of questions, problem solving / numerical based questions, etc., will contain internal options.
3. MCQs, fill in the blanks, answer in one or two lines, match the following, true or false, etc., type of questions.
4. Diagrams or flowcharts should be drawn wherever necessary.

Name of the Course	Practicals based on USBCH201 and USBCH202
Course Code	USBCH203
Class	F.Y.B.Sc.
Semester	II
No of Credits	2
Nature	Practical
Type	Major: Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	The course objective is to provide experimental practice of qualitative, quantitative analysis of Biomolecules. This is also to give skills in handling basic instruments. Students will understand their principle and applications.

**Nomenclature:** Practical based on USBCH201 and USBCH202

**Course Outcomes:**

CO1: Understand good laboratory practices.

CO2: Prepare charts and models of vital systems of human body for better understanding.

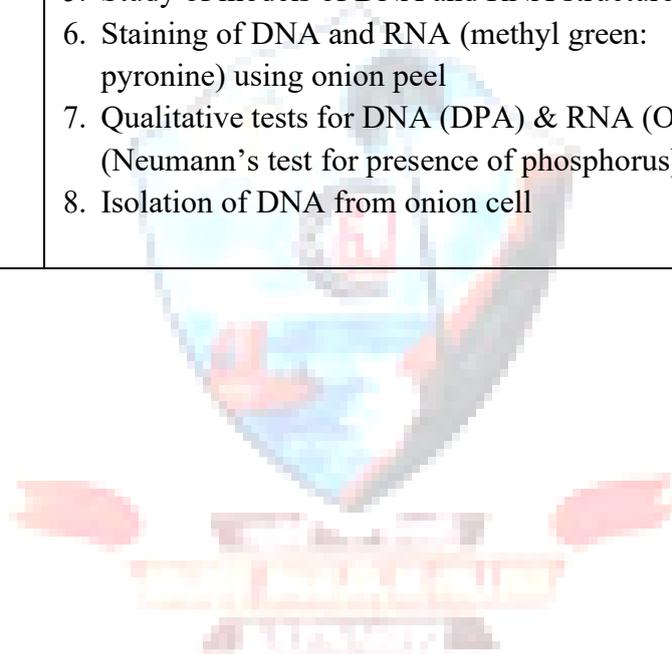
CO3: Understand qualitative estimation of body fluids.

**Instructions for learners:**

- 1. All measurements and readings should be written with proper units.**
- 2. Skill of doing the experiment and understanding Biochemistry concepts should be more important than the accuracy of final result.**
- 3. In order to appear for Semester End Examination of this course, 75% of all the experiments should be completed compulsorily and learners are required to report all these experiments in the journal of this course (Biochemistry practical journal of Second semester).**
- 4. After completing all required number of experiments of this course and recording them in journal, learner will have to get their journal certified from the head of the Biochemistry department and produce the certified journal at the time of Semester End Examination of this course.**
- 5. A learner will be allowed to appear for the Semester End Examination of this course, only if learner submits a certified journal of this course or a certificate from the head of the Biochemistry department that the learner has completed this practical course as per the minimum requirements.**
- 6. For Semester End Examination, the learner will be separately examined for two groups: A and B from this course.**
- 7. Semester End Practical Examination will be of 6 hours.**
- 8. Evaluation in viva voce will be based on all practicals from this course.**
- 9. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.**

**Curriculum:**

Group	Title	Learning Points	No of Lectures
A	Study of Biomolecules	<ol style="list-style-type: none"><li>1. Qualitative tests for lipids<ol style="list-style-type: none"><li>a) Miscibility test</li><li>b) Saponification test</li><li>c) Unsaturation test</li><li>d) Sudan black dye test</li><li>e) Salkowski test for cholesterol</li></ol></li><li>2. Determination of SAP value of given oil sample</li><li>3. Determination of Acid value of give oil sample</li><li>4. Formation of soap.</li><li>5. Study of models of DNA and RNA structure</li><li>6. Staining of DNA and RNA (methyl green: pyronine) using onion peel</li><li>7. Qualitative tests for DNA (DPA) &amp; RNA (Orcinol) (Neumann's test for presence of phosphorus)</li><li>8. Isolation of DNA from onion cell</li></ol>	25



B	Physiology	<ol style="list-style-type: none"> <li>1. Identification of organs / parts of digestive system</li> <li>2. Qualitative analysis for Proteins (albumin, peptone, gelatin and casein - any four proteins)</li> <li>3. Estimation of total acidity of gastric juice</li> <li>4. Identification of organs / parts of respiratory system</li> <li>5. Identification of organs / parts of excretory system</li> <li>6. Analysis of the action of salivary <math>\alpha</math> - amylase action on starch</li> <li>7. Concept of Dialysis: <ol style="list-style-type: none"> <li>i. Ammonium sulphate precipitation</li> <li>ii. Dialysis (Test with <math>\text{BaCl}_2</math> for presence of sulphate in the buffer or water outside)</li> </ol> </li> <li>8. Urine analysis: <ol style="list-style-type: none"> <li>i. Normal Constituents - <ol style="list-style-type: none"> <li>a. Inorganic constituents: <math>\text{SO}_4^{-2}</math> (<math>\text{BaCl}_2</math>), <math>\text{Cl}^-</math> (<math>\text{AgNO}_3</math>),</li> <li>b. Organic constituents: Urea, Uric acid, Creatinine</li> </ol> </li> <li>ii. Abnormal constituents - <ol style="list-style-type: none"> <li>a. Glucose by Benedict's test</li> <li>b. Proteins</li> <li>c. y Hellers ring test</li> <li>d. Bile salts by Smith's test</li> <li>e. Ketone Bodies by Rotheras test</li> <li>f. Blood by microscopic examination</li> </ol> </li> </ol> </li> </ol>	25
C	Demonstration Experiment	<ol style="list-style-type: none"> <li>1. Introduction to Colorimeter</li> <li>2. Introduction to Phase Contrast Microscopy</li> </ol>	10

**Learning Resources recommended:**

1. Biochemical Calculation by Segel, 2<sup>nd</sup> edition (2010)
2. Biochemical Methods by Sadashivan, 2<sup>nd</sup> edition (2005)
3. Introductory Practical Biochemistry by Sawhney and Singh (2001)
4. Practical Biochemistry by David Plummer, 3<sup>rd</sup> edition (2007)
5. Guyton and Hall Textbook of medical Physiology by John E. Hall 13<sup>th</sup> edition (2015)

## Evaluation Pattern

### A. Continuous Internal Evaluation (20M)

Method	Marks
Performance and engagement during practical sessions: <ul style="list-style-type: none"><li>• Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical</li><li>• Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments</li><li>• Submission of journal within a week after every practical session</li></ul> Based on above criteria, each experiment of this course will be assessed during regular practical session	10
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

### B. Semester End Evaluation (Exam Pattern) (30 Marks - 4 hours)

Q. No	Group	Title	Method	Marks
1	A	Study of Biomolecules	Experiment performance as per practical exam paper	15
2	B	Physiology	Experiment performance as per practical exam paper	15

Bachelor of Science (B.Sc.) Biochemistry Programme revised for 2025-26 was approved by BoS members and Academic council.

  
Signature of Chairperson  
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