



**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.Sc. Biochemistry
Level	UG
No of Semesters	06
Year of Implementation	2024-25
Programme Specific Outcomes (PSO)	<ol style="list-style-type: none"> 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. 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. 3. This program able one to plan and execute experiments or investigations, analyze and interpret data information collected using appropriate methods. 4. It applies contextual knowledge and modern tools of biochemical research for solving problems. 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.
Relevance of PSOs to the local, regional, national, and global developmental needs.	<ol style="list-style-type: none"> 1. B.Sc. Biochemistry students can do their masters in Forensic Science, Genetics, Toxicology, Biotechnology, Nutrition and Dietetics, Immunology, Biostatistics and Bioinformatics, Biophysics, etc. 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. 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. 4. The learners will be able to recognize features and role of civil services, consultant in medical field, researcher, academician, environmentalist.

	<ol style="list-style-type: none"> 5. This course inclines students towards pharmacology where they can do drug designing. 6. The data in medical field can be enriched by doing medical coding. 7. Agriculture will be benefitted by their work in developing new plant breeds, biofertilizers, biopesticides, etc. 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. 9. Learning about environmental science develops harmonious relationship between nature and human and need of conserving the resources on Earth. 10. This course cultivates skills for successful career, entrepreneurship and higher studies.
--	--

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 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) 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

Major: Biochemistry Minor: Chemistry

(To be implemented from Academic Year 2024-25)

Course Code	Semester III	Credits	Course Code	Semester IV	Credits
<i>Discipline Specific Courses (DSC)</i>			<i>Discipline Specific Courses (DSC)</i>		
<i>Major</i>			<i>Major</i>		
USBCH301	Enzymology	02	USBCH401	Genetics	02
USBCH302	Pharmacology	02	USBCH402	Introduction to microbiology and virology	02
USBCH303	Endocrinology	02	USBCH403	Biological transport mechanisms and muscle physiology	02
USBCHP03	Practical P3	02	USBCHP04	Practical P 4	02
<i>Minor</i>			<i>Minor</i>		
USCH305	Basics in Analytical Chemistry I	02	USCH405	Basics in Analytical Chemistry II	02
USCH306	Chemistry Minor Practical III	02	USCH406	Chemistry Minor Practical IV	02
<i>Generic / Open Elective Course (OE)</i>			<i>Generic / Open Elective Course (OE)</i>		
	Any one course from Open Elective Basket	02		Any one course from Open Elective Basket	02
	Any one course from Open Elective Basket	02			
<i>Skill Enhancement Course (SEC)</i>			<i>Skill Enhancement Course (SEC)</i>		
USBCH307	Clinical Biochemistry	02	USBCH407	Soil and water analysis	02
<i>Ability Enhancement Course (AEC) Any 1</i>			<i>Ability Enhancement Course (AEC) Any 1</i>		
UAAECMAR 301	Marathi: Communication Skill-I	02	UAAECMAR 301	Marathi: Communication Skill-II	02
UAAECHIN 302	Hindi: Communication Skill-I		UAAECHIN 302	Hindi: Communication Skill-II	
UAAECSAN 303	Sanskrit: Communication Skill-I		UAAECSAN 303	Sanskrit: Communication Skill-II	
UAAECURD 304	Urdu: Communication Skill-I		UAAECURD 304	Urdu: Communication Skill-II	
<i>Co-Curricular Course (CC)</i>			<i>Co-Curricular Course (CC)</i>		
	Any one course from the	02		Any one course from the	02
	List given below of CC			List given below of CC	
				Community Engagement and Service (CEP)	02
Total Credits		22	Total Credits		22

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

S.Y.B.Sc.

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

No. of Courses	Semester III	Credits
USBCH 301	Enzymology	02
USBCH 302	Pharmacology	02
USBCH 303	Endocrinology	02
USBCH 304	Practical P3	02
	TOTAL	08

Name of the Course	Enzymology
Course Code (Refer to student handbook)	USBCH301
Class	S.Y.B.Sc.
Semester	III
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Chemical reactions within the cells occur in presence of biocatalyst i.e., enzyme. Course gives review of basic enzymatic concepts, enzyme kinetics and enzyme regulation. Develop new ideas for the development of enzyme-based diagnostic kits. Student will discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

Enzymology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	INTRODUCTION TO ENZYME	10
2.	ENZYME KINETICS, REGULATION AND INHIBITION	10
3.	IMMOBILIZED ENZYMES AND APPLICATION OF ENZYMES	10
	TOTAL	30

Nomenclature: Enzymology

Course Outcomes:

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

CO1: Have a deeper insight in to the fundamental's enzyme properties, nomenclatures, characteristics and mechanisms

CO2: Describe structure, functions and the mechanism of action of enzymes. Learning kinetics of enzyme catalyzed reactions and enzyme inhibitions and regulatory process, Enzyme activity, Enzyme Units, Specific activity

CO3: Apply biochemical calculation for enzyme kinetics.

CO 4 :Discuss the factors affecting enzymatic reactions.

CO 5 :Describe the concepts of co-operative behavior, enzyme inhibition and allosteric regulation

CO 6 :Compare methods for production, purification, characterization and immobilization of enzymes.

CO 7: Describe the major applications of enzymes in industry, understand the principles of enzyme immobilization techniques and enzyme extraction procedures

CO8 :Discuss various application of enzymes that can benefit human life

Curriculum:

UNIT	TITLE AND LEARNING POINTS	NO. OF LECTURES
Unit I:	Introduction to Enzyme	10
1.1	Understanding the terminology– Enzyme, coenzyme, cofactor, apoenzyme, holoenzyme, prosthetic group, active site, enzyme activity, zymogen. Turnover number, specific activity, Katal, IU.	
1.2	IUB / EC classification up to one digit.	
1.3	Mechanism of enzyme action (concept of active site, single and bi-substrate reaction),	
1.4	Enzyme specificity Fischer's lock & key and Koshland's induced fit theories	
1.5	Factors affecting enzyme activity – substrate concentration, pH, temperature, enzyme concentration	
1.6	Concept of activation energy and transition state	
2.	Enzyme kinetics, regulation and inhibition	10
2.1	Enzyme kinetics – Derivation of Michaelis - Menten equation and Lineweaver Burk plot for mono-substratereactions and numerical problems based on them.	
2.2	Significance of Vmax and Km	
2.3	Enzyme regulation, Types of regulatory mechanism- product inhibition, feedback	
2.4	Enzyme inhibition – Reversible and Irreversible; competitiveand non-competitive, (one example of each) Graphical understanding of effect of different inhibitors on enzyme kinetics	
2.5	Numerical problems on above.	
3.	Immobilized enzymes and Application of enzymes	10
3.1.1	Introduction to immobilized enzymes. Importance of immobilization	
3.1.2	Methods of immobilization- Ionic bonding, Adsorption, Covalent bonding (based on R group of amino acids), Microencapsulation and Gel entrapment	
3.1.3	Industrial examples related to the technique. Problems associated with enzyme immobilization	
3.2	Application of enzyme	
3.2.1	Isoenzymes. Applications of enzymes in research	
3.2.2	Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases),	

Learning Resources recommended:

1. Lehninger's- Principles of Biochemistry by David L. Nelson, 4th edition (2017)
2. Biochemistry by Donald Voet, 3rd Edition (2004)
3. Fundamentals of Biochemistry by Jain and Jain, 1st multicolor edition (2009)
4. Principles and techniques of Biochemistry and molecular biology by Wilson and Walker 6th edition (2005)

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	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	Pharmacology
Course Code (Refer to student handbook)	USBCH302
Class	S.Y.B.Sc.
Semester	III
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will be acquainted with interdisciplinary field of pharmacology where they explore many aspects of drug discovery, development and preclinical drug safety. They will get to know about the different aspects of pharmacokinetics and pharmacodynamics.

Pharmacology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	INTRODUCTION TO PHARMACOLOGY	10
2.	PHARMACOKINETICS	10
3.	PHARMACODYNAMICS	10
Total		30

Nomenclature: Pharmacology**Course Outcomes:**

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

CO1: General concepts in pharmacology, routes of drug administration and novel drug delivery systems.

CO2: Mechanism of drug action and its relevance in treatment.

CO3: Process of absorption, distribution, metabolism and excretion of drugs.

CO4: Drug toxicity and safe administration of different drugs.

Curriculum:

UNIT	TITLE AND LEARNING POINTS	No. Of Lectures
UNIT I	INTRODUCTION TO PHARMACOLOGY	10
1.1	Scope of pharmacology.	
1.2	Sources, classification, nomenclature of drugs.	
1.3	Dosage form of drug: Factors affecting drug dosage form.	
1.4	Routes of drug administration.	
1.5	Novel drug delivery system: (Only definition and examples) 1) Transdermal patches 2) Liposomes 3) Nanomaterials	
1.6	Pharmacopoeias.	
UNIT II	PHARMACOKINETICS	10
2.1	Drug and cell membrane: Transport systems for drug.	
2.2	Drug absorption: Site of drug absorption-GI, parenteral, lung, topical sites. Bioavailability, bioequivalence.	
2.3	Drug distribution, blood brain barriers, placental barrier.	
2.4	Drug metabolism: Phase I and phase II reactions.	
2.5	Drug excretion: Renal, biliary, pulmonary.	
2.6	Pharmacokinetics: Drug plasma concentration, volume of distribution, half-life, LD ₅₀ , ED ₅₀ , TD ₅₀ , therapeutic index.	
2.7	Therapeutic drug monitoring, Loading dose and maintenance dose.	
Unit III	PHARMACODYNAMICS	10
3.1	Pharmacodynamics: Drugs acts via receptor and non-receptor mediated mechanism. Concept of drug-receptor interaction.	
3.2	Receptor theory of drug action: Agonist, antagonist.	
3.3	Location and types of drug receptors, Receptor regulation.	
3.4	Affinity and intrinsic activity of drug, drug potency and efficacy, placebo effect.	
3.5	Mechanism of action of aspirin.	
3.6	Bioassay: Types of bioassays.	

Learning Resources recommended:

1. Textbook of pharmacology by FSK Barar, 4th edition (2012)
2. Textbook of Medical Biochemistry by M.N. Chatterjee & Rana Shinde, 6th edition (2007)
3. Guyton and Hall Textbook of medical Physiology. John E. Hall 13th edition.2015

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	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., types of questions
4. Diagrams or flowcharts should be drawn wherever necessary.

Name of the Course	Endocrinology
Course Code (Refer to student handbook)	USBCH303
Class	S.Y.B.Sc.
Semester	III
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	The course illustrates how endocrine system work in normal physiology and disease condition. Learner will also learn about endocrine pathways controlling reproduction, growth, development, stress and metabolism. Students will understand different animal and plant hormones and their regulation.

Endocrinology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	INTRODUCTION TO HUMAN ENDOCRINE SYSTEM	10
2.	ENDOCRINOLOGY I	10
3.	ENDOCRINOLOGY II	10
TOTAL		30

Nomenclature: Endocrinology**Course Outcomes:**

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

CO1: understand about the mechanism of working of the human endocrine system.

CO2: Get an idea about the hormones secreted by hypothalamus, anterior pituitary gland, posterior pituitary gland and pancreas and major organs along with major endocrine disorders.

CO3: get how the plant growth regulators and pheromones work.

Curriculum:

Unit	Learning Points	No. of lectures
Unit I	Introduction to human Endocrine system	10
1.1	Structure of hypothalamus and pituitary gland: Anterior and Posterior	
1.2	Types of glands: Exocrine, Endocrine	
1.3	Definition of Hormone, Hormone receptors	
1.4	Classification of hormones: Based on target tissue: Autocrine, Paracrine, Endocrine Based on Chemical nature: Peptide or protein, Steroid	
1.5	Mode of action of Group I and Group II hormones	
1.6	Hierarchical organization of mammalian endocrine system	
1.7	Feedback mechanism for the regulation of hormone release	
Unit II	Endocrinology I	10
2.1	Hypothalamic hormones	
2.2	Hormones of Anterior pituitary gland: TSH, ACTH, GH, Prolactin	
2.3	Hormones of Thyroid gland: T3 and T4	
2.4	Hormones of Adrenal gland: Adrenal Cortex: Glucocorticoids, Mineralocorticoids Adrenal Medulla: Epinephrine, Norepinephrine	
2.5	Hormones of Gonads: Estrogen, Progesterone, Testosterone Gonadotropins: FSH, LH, hCG	
2.6	The menstrual cycle	
Unit II	Endocrinology II	10
3.1	Hormones of Posterior pituitary gland: Oxytocin, Vasopressin	
3.2	Hormones of Pancreas: Insulin and Glucagon	
3.3	Concept of Pheromones	
3.4	Plant growth regulators: Structure and function of Auxin, gibberellins, cytokinin, ethylene and abscisic acid	
3.5	Endocrine disorders and diseases: Hypothyroidism, Hyperthyroidism, Cushing syndrome, Acromegaly, Diabetes mellitus, Diabetes insipidus, PCOS	

Learning Resources recommended:

- 1) Guyton and Hall Textbook of medical Physiology. John E. Hall 13th edition.2015
- 2) Biochemistry. U. Sathyanarayana, U. Chakrapani. 4th edition, 2014.
- 3) Endocrinology, M.E. Hadley, J.E. Levine, 6th Edition, 2009
- 4) Plant physiology and biochemistry. H.S. Shrivastava. 2005

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	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	Practicals based on USBCH301, USBCH302 and USBCH303
Course Code (Refer to student handbook)	USBCH304
Class	S.Y.B.Sc.
Semester	III
No of Credits	2
Nature	Practical
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	<p>In this practical course, learners will get hands on training on</p> <ul style="list-style-type: none"> • Enzymology • Pharmacology • Endocrinology

Nomenclature: Practical based on USBCH301, USBCH302 and USBCH303

Course Outcomes:

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

CO1: Learn to develop a plan of work based on aim and objectives.

CO2: Perform the practical work effectively using oral and written means.

CO3: Understand the concept behind the practical and analyze and conclude the results.

CO4: Understand the basic of impurity profiling of pharma product.

CO5: Learn enzyme kinetics and basic endocrinology.

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 Third 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 three groups: P301, P302 and P303 from this course.**
- 7. Semester End Practical Examination will be of 9 hours and it is scheduled in 1 and a half day.**
- 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 is applicable.**

Curriculum:

	Title	Learning Points	No of Lectures
Course Code (refer to student handbook)	P301	1) Preparation of aspirin 2) Determination of percentage purity of aspirin 3) Determination of LD50 of drug 4) Qualitative analysis of Functional group 5) Preparation of medicinal oils by using herbs 6) Isolation of lipid by percolation method 7) Determination of glucose by GOD POD kit 8) Determination of glycated Hb. 9) Effect of hormones on plant growth	30
	P302	1) Extraction of beta amylase and urease from suitable sources 2) Determination of optimum pH of beta amylase 3) Determination of optimum temperature of beta amylase 4) Determination of <i>K_m</i> of beta amylase 5) Study of effect of inhibitor on beta amylase 6) Determination of enzyme activity and specific activity . 7) Immobilization of yeast and determination of invertase activity 8) Problems based on enzyme activity	30

Learning Resources recommended:

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

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	Marks
Performance and engagement during practical sessions: <ul style="list-style-type: none">• Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical• Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments• Submission of journal within a week after every practical session Based on above criteria, each experiment of this course assessed for internal marks 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.	Title	Method	Marks
1	P301 and P302	Experiment performance as per practical exam paper	30

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

S.Y.B.Sc.

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

No. of Courses	Semester IV	Credits
USBCH 401	Genetics	02
USBCH 402	Introduction to Microbiology and Virology	02
USBCH 403	Biological Transport Mechanism and Muscle Physiology	02
USBCH 404	Practical P4	02
	TOTAL	08

Name of the Course	Genetics
Course Code (Refer to student handbook)	USBCH401
Class	S.Y.B.Sc.
Semester	IV
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Genetics is concerned with heredity and variation. It occupies central position in modern biology. Basic genetic study can be implemented in designing therapies and genetic investigation.

Genetics

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	MENDELIAN INHERITANCE	10
2.	GENOME ORGANIZATION	10
3.	CHROMOSOMAL ABNORMALITIES AND HUMAN PEDIGREE	10
TOTAL		30

Nomenclature: Genetics

Course Outcomes:

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

CO1: Learn basic concepts of genetics and transmission of genetic information.

CO2: Explain derivatives from Mendel's model of the inheritance of traits.

CO3: Study of Human Pedigree analysis in understanding the inheritance of genes in humans CO

CO4: Critically understand the components of DNA and the process of sequencing structural properties of chromosome.

CO5: Recognize normal and abnormal karyotypes, describing the abnormalities in chromosomal number

Curriculum:

UNIT	TITLE AND LEARNING POINTS	No. Of Lectures
Unit I:	Mendelian inheritance	10
1.1	Concept of alleles, genotype and Phenotype	
1.2	Mendelian genetics: Mendel's experiments - Monohybrid, Dihybrid crosses, Laws of inheritance	
1.3	Dominance, recessivity, co-dominance, incomplete(semi) dominance, lethal genes	
1.4	Gene interaction -Epistasis, types of epistasis,multiple alleles, Relation of multiple alleles with molecular genetics. Maternal effects	
1.5	Numerical on above concepts	
Unit II:	Genome organization	10
2.1	Prokaryotic Genome: Organization of circular chromosome	
2.2	Eukaryotic chromosomes: Organization of DNA into chromosomes (up to Solenoid structure)	
2.3	DNA supercoiling, Topoisomerase, Chromatin structure, Euchromatin, Heterochromatin, structure of condensed chromatin, Nucleosomes [Centromere, kinetochore, telomere], Acetylation & deacetylation of histones, Role of Telomerase	
2.4	Comparison of chromosomal structure in prokaryotes and eukaryotes	
2.5	Transformation: Definition and transformation in <i>S.pneumoniae</i>	
2.6	Transduction: Definition; explain general features with one example	
2.7	Conjugation: Mechanism, F+, F- and Hfr strain	
Unit III:	Chromosomal Abnormalities and Human pedigree	10
3.1.	Concept of gene and chromosomes	
3.1.2	Chromosomal abnormalities (Down's Syndrome, Klinefelter's Syndrome, Turner's Syndrome, Cri-duchat syndrome, Philadelphia Chromosome)	
3.2	Human Pedigree Analysis	
3.2.1	Standard symbols used in pedigree analysis	
3.2.3	Applications of pedigree analysis – Autosomal recessive and dominant traits, X-linked recessive and dominant traits, Y-linked traits	
3.2.4	Problems/case study on above concepts	

Learning Resources recommended:

- 1) i-Genetics by Russel, 3rd edition (2016)
- 2) Principles of Genetics by Snustad and Simmons, 6th edition
- 3) Molecular Population Genetics by Matthew Hahn, 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	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 Microbiology and Virology
Course Code (Refer to student handbook)	USBCH402
Class	S.Y.B.Sc.
Semester	IV
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Microorganisms are independent cellular units and their study is nothing but microbiology. Learners will understand appearance, classification, types, applications of different microbes and their role in human life. They will get to know about industry level applications of microbiology and microbes.

Introduction to Microbiology and Virology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	INTRODUCTION TO MICROBIOLOGY	10
2.	VIROLOGY	10
3.	APPLIED MICROBIOLOGY	10
Total		30

Nomenclature: Introduction to Microbiology and Virology

Course Outcomes:

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

CO1: Student will gain knowledge about different methods of microbial classification, staining techniques, sterilization methods and history of microbiology.

CO2: Student will able to learn virus architecture, classification and mechanism of action virus.

CO3: Familiarized with industrial production of microbial products, fermentation and immobilization techniques.



Curriculum:

UNIT	TITLE AND LEARNING POINTS	No. Of Lectures
UNIT I	INTRODUCTION TO MICROBIOLOGY	10
1.1	History of Microbiology (Contribution of A. V. Leeuwenhoek & Pasteur).	
1.2	General characteristics of bacteria: Size, Shape & structure of bacteria.	
1.3	Microbial taxonomy: Concept of species & strain.	
1.4	Classification of Bacteria: On the basis of 1) Morphology 2) Nutrition 3) Staining pattern 4) Extreme environment	
1.5	Introduction of bacterial cell wall (Structure & chemical composition): 1) Gram positive bacteria 2) Gram negative bacteria.	
1.6	Introduction of staining methods & types of stains: 1) Acid fast staining 2) Weight mount 3) Hanging drop method 4) Capsule staining	
1.7	Bacterial growth curve & measurement of growth of bacteria.	
1.8	Introduction of Culture media (N, C, Special requirements) Natural and Synthetic media	
1.9	Physical Agent of sterilization- Temperature- Pressure (Hot Air Oven, Autoclave), Radiations (UV, Gamma) (examples with mechanism) Chemical agents of sterilization –Alcohol, Halogens, Formaldehyde.	
UNIT II	VIROLOGY	10
2.1	Introduction to virus: General structure of virus,	
2.2	Classification of viruses: 1) On the basis of genome (DNA & RNA), 2) Symmetry (Helical & icosahedral) 3) Host (bacteria, plants, animal) 4) phases of viral life cycle (Lytic and Lysogenic)	
2.3	Structure and mechanism of replication in : 1) HIV virus 2) Influenza virus 3) Hepatitis 4) Tobacco mosaic virus	
Unit III	APPLIED MICROBIOLOGY	10
3.1	Antiviral drugs- ART therapy, anti-influenza drugs.	
3.2	Use of genetically engineered strains for bioremediation. 1) Hydrocarbon degrading bacteria. 2) Plastic degrading microorganisms	
3.3	Introduction of fermentation: General structure of fermenter.	
3.4	Preparation of wine and penicillin by fermentation.	
3.5	Production single cell protein: Spirulina	
3.6	Biosensors: Types, applications.	

Learning Resources recommended:

1. Microbiology TMH, Pelczar Michael J. Chan, Crig, Noel, 5th edition.
2. Textbook of Microbiology, Ananthanarayan and Panniker 5th edition, 1996
3. Guyton and Hall Textbook of medical Physiology. John E. Hall 13th edition.2015
4. Biochemical Methods of analysis.; theory and applications. Saroj Dua and Neera Garg. 2010.

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	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	Biological Transport Mechanisms and Muscle physiology
Course Code (Refer to student handbook)	USBCH403
Class	S.Y.B.Sc.
Semester	IV
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Learners will be well acquainted with the transport mechanisms in both animals and plants. They will understand different biomolecules as transporters and their role. Learners will get brief idea about structure of muscles, their contraction and relaxation and disorders related to muscle physiology.

Biological Transport Mechanisms and Muscle physiology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	TRANSPORT IN PLANTS	10
2.	TRANSPORT IN ANIMAL CELL	10
3.	MUSCLE PHYSIOLOGY	10
TOTAL		30

Nomenclature: Biological Transport Mechanisms and Muscle physiology

Course Outcomes:

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

CO1: understand about the transport mechanism and movements in plants.

CO2: familiarize with different ways of transport of different biomolecules in the animal cell.

CO3: understand the muscle physiology along with the related disorders.

Curriculum:

Unit	Learning Points	No. of lectures
Unit I	Transport in plants	10
1.1	Transport of water and nutrients through xylem and phloem	
1.2	Stomatal opening and closing	
1.3	Concept of turgor pressure	
1.4	Factors affecting transport: Diffusion, Osmosis, Viscosity, Surface tension	
1.5	Induced movements in plants: Tropic movements: Geotropism, Phototropism Nastic movements: Seismonasty, Nyctynasty Chemotaxis, Phototaxis, Thermotaxis	
Unit II	Transport in animal cell	10
2.1	Transport in blood	
2.1.1	O ₂ and CO ₂ transport	
2.1.2	Iron and calcium transport	
2.1.3	Role of plasm protein and albumin in transport of metabolites and drugs	
2.2	Transport across cell membrane	
2.2.1	Channel proteins and carrier proteins	
2.2.2	Passive transport: Simple and facilitated diffusion	
2.2.3	Concept of Symport, Antiport, Uniport, Endocytosis, Exocytosis	
2.2.4	Active transport: Primary (Na ⁺ /K ⁺ ATPase pump) and Secondary (Na ⁺ -Glucose)	
2.2.5	Aquaporins, Types of glucose transporters (GLUT1 to GLUT4)	
Unit II	Muscle Physiology	10
3.1	Structural organization of muscle fiber and myofibril	
3.2	Mechanism of contraction and relaxation of muscles	
3.3	Regulation of muscle contraction	
3.4	Neuromuscular junction and Role of neurotransmitters	
3.5	Other types of contractions: Twitch, tetanus, isotonic, isometric	
3.6	Disorder of muscular system: Muscular Dystrophy	

Learning Resources recommended:

1. Textbook of Plant Physiology, V. Verma, Student edition 2007
2. Textbook of Medical Biochemistry by M.N. Chatterjee & Rana Shinde, 6th edition (2007)
3. Guyton and Hall Textbook of medical Physiology. John E. Hall 13th edition.2015
4. Karp's Cell and Molecular Biology by Iwasa and Marshall, 8th edition (2015)

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	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 options.
4. Diagrams or flowcharts should be drawn wherever necessary

Name of the Course	Practicals based on USBCH401, USBCH402 and USBCH403
Course Code (Refer to student handbook)	USBCH404
Class	S.Y.B.Sc.
Semester	IV
No of Credits	2
Nature	Practical
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will be acquainted with the basic techniques of microbiology. They will learn about the factors affecting transport in plants such as viscosity and osmosis. Course will also improve their microbial techniques and learn how to connect these skills in industrial applications.

Nomenclature: Practical based on USBCH401, USBCH402 and USBCH403

Course Outcomes:

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

CO1: understand basic microbiological techniques.

CO2: use of microscopes efficiently in differentiating features of muscle tissues.

CO3: understand role of some physicochemical principles for transport in plants.

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 fourth 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 three groups: P401, P402 and P403 from this course.**
- 7. Semester End Practical Examination will be of 9 hours and it is scheduled in 1 and a half day.**
- 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 is applicable.**

Curriculum:

Unit	Title	Learning Points	No of Lectures
USBCH404	P401	<ol style="list-style-type: none">1) Determination of viscosity of sucrose and mango pulp using Ostwald viscometer2) Determination of osmosis through semipermeable membrane: Potato osmometer3) Effect of organic solvents on cell rupture4) Study of phototropism in plants5) Permanent slides of Striated and non-striated muscles6) Smear technique to demonstrate sex chromatin in buccal epithelial cell7) Induction of polyploidy in onion roots8) Study of bacterial transformation	30
	P402	<ol style="list-style-type: none">1) Study of laminar air flow, autoclave and hot air oven2) Preparation of sterile media, sterilization of glassware3) Testing of air and tap water by plate exposure technique4) Study of culture inoculation methods<ol style="list-style-type: none">i. Pour plateii. Streak plateiii. Spread plate5) Determination of minimum inhibitory concentration of disinfectant and food preservative6) Bioassay of penicillin by agar diffusion method7) Study of microbial growth curve8) Flowsheet / model preparation of a vitamin and alcohol preparation in industry.	30

Learning Resources recommended:

1. Biochemical Calculation by Segel, 2nd edition (2010)
2. Biochemical Methods by Sadashivam, 2nd edition (2005)
3. Introductory Practical Biochemistry by Sawhney and Singh (2001)
4. Practical Biochemistry by David Plummer, 3rd edition (2007)
5. Principles of Genetics by Snustad and Simmons, 6th edition

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	Marks
Performance and engagement during practical sessions: <ul style="list-style-type: none">• Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical• Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments• Submission of journal within a week after every practical session Based on above criteria, each experiment of this course will be assessed	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.	Title	Method	Marks
1	P401 and P402	Experiment performance as per practical exam paper	30



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

Department of Biochemistry

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

S.Y.B.Sc.

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

Course Code	Semester III	Credits	Course Code	Semester IV	Credits
	<i>Open Elective</i>				
USBCHOE301	Nutrition and diet management	02	USBCHOE401	Nutrition and diet management	02

Name of the Course	Nutrition and diet management
Course Code (refer to student handbook)	USBCHOE301/USBCHOE401
Class	S.Y.B.Sc.
Semester	III and IV
No of Credits	2
Nature	Theory
Type (applicable to NEP only)	OE
Highlight revision specific to employability/ entrepreneurship/ skill development	Study is mainly focused on food, health and management of diseases. Learners will understand how health issues are attributed to poor diet and nutrition. It summarizes science of food.

Nomenclature: Nutrition and diet management

Course Outcomes:

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

CO1: learn and understand the basic concepts of nutrition, and nutritional values of foods, and Basal metabolic rate and measurement of energy requirements.

CO2: deduce the dietary requirement of carbohydrates, lipids and proteins and their biological significance

CO:3 learn the nutritional requirement and significance of dietary minerals like macro elements and microelements and recommended dietary allowances.

CO4: be familiarize with dietary management in different stages of life and diseased state.

Curriculum:

Unit	Learning Points	No of Lectures	
I	Nutrition		
1.1	Introduction to Human nutrition & energy supply	15	
1.1.1	Measurement of energy content of food		
1.1.2	Calorific value of different biomolecules & mixed diet, Determination of calorific value using bomb Calorimeter (Principle & Working)		
1.1.3	Respiratory quotient of food		
1.2	Measurement of energy expenditure		
1.2.1	Basal metabolic rate- Definition, Measurement, factors affecting BMR & its significance		
1.2.2	Specific dynamic action of food- Definition, Mechanism & its significance		
1.3	Sources, Daily requirement & Nutritional importance of biomolecules		
1.3.1	Carbohydrates- Concept of Glycemic Index of food (Graph), Importance of fiber (Complex carbohydrate) in nutrition		
1.3.2	Lipids-Role of essential fatty acids		
1.3.3	Proteins- Essential amino acids, Nitrogen Balance (Positive, Negative Nitrogen balance & factors affecting)		
II	Diet Management		
2.1	Recommended Dietary allowances (RDA)- Definition, Factors affecting RDA, RDA for adult		15
2.2	Balance diet – Concept & significance, Meal planning		
2.2.1	Macro-elements and Microelements		
2.3	Diet management in different conditions		
2.3.1	Different Age groups: infants, toddlers, adolescents, adults, geriatric, pregnancy and lactation		
2.3.2	Diseased state: Diabetes mellitus, Hypertension, Peptic ulcer, obesity		
2.4	Eating disorders – Bulimia nervosa, Anorexia nervosa		

Learning Resources recommended:

- Nutritional Biochemistry: Tom Brody.
- Nutrition Science by Srilakshmi, B.; New Age International publishers

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.



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

Department of Biochemistry

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

S.Y.B.Sc.

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

Course Code	Semester III	Credits	Course Code	Semester IV	Credits
	<i>Skill Enhancement Course</i>			<i>Skill Enhancement Course</i>	
USBCHS307	Clinical Biochemistry	02	USBCHS407	Soil and Water Analysis	02

Name of the Course	Clinical Biochemistry
Course Code (refer to student handbook)	USBCHS307
Class	S.Y.B.Sc.
Semester	III
No of Credits	2
Nature	Practical
Type (applicable to NEP only)	SEC
Highlight revision specific to employability/ entrepreneurship/ skill development	Biochemical markers are substances found in body that can indicate presence of a particular disease or condition. Markers found in blood, urine and other body fluids can provide important information about health status. Biochemical markers have become important in clinical practice as they help physicians make accurate diagnosis, monitor disease progression and evaluate effectiveness of treatments. For the learners who are interested in this medical diagnosis field, this course is a pioneer step.

Nomenclature: Clinical Biochemistry

Course Outcomes:

At the end of the course the learner should be able to-

CO1: examine and understand parts and function of microscope and incubator.

CO2: understand various properties of blood and significance of them in detecting diseases.

CO3: get acquainted with the role of enzymes in diagnosis of various diseases.

CO4: interpret the disease condition and its clinical significance.

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 third 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. Semester End Practical Examination will be of 9 hours and it is scheduled in 1 and a half day.**
- 7. Evaluation in viva voce will be based on all practicals from this course.**
- 8. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever is applicable.**

Curriculum:

Unit	Title	Learning Points	No of Lectures
SEC	Clinical Biochemistry	1) Study of microscope 2) Study of incubator 3) Determination and interpretation of total RBC count 4) Determination and interpretation of total WBC count 5) Determination and interpretation of Packed Cell Volume 6) Determination and interpretation of Erythrocyte Sedimentation Rate 7) Determination and interpretation of Bleeding time 8) Determination and interpretation of Clotting time 9) Estimation of serum acid and alkaline phosphatase 10) Estimation of lipid profile: HDL, LDL, VLDL, cholesterol, triglyceride 11) Study of Gram staining, Capsule staining, Acid fast staining 12) Determination and interpretation of blood groups 13) Determination and interpretation of Hemoglobin content by Sahli's hemoglobinometer and Drabkin's method 14) Estimation of blood urea by Diacetyl monoxime method 15) Comparative study of blood glucose by GOD-POD method and glucometer 16) Study of blood pressure through case study	60

Learning Resources recommended:

1. Medical Biochemistry-A Comprehensive Clinical Approach with theory and practical, Praful Godkar
2. Guyton and Hall Textbook of medical Physiology. John E. Hall 4th edition.2015
3. Practical Biochemistry by Geetha Damodaran K. 1st edition 2011
4. Manual of Laboratory and diagnostic tests by Frances Fischbach and M.B. Dunning, 9th edition 2015

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	Marks
Performance and engagement during practical sessions: <ul style="list-style-type: none">• Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical• Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments• Submission of journal within a week after every practical session 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	Title	Method	Marks
1	Clinical Biochemistry	Experiment performance as per practical exam paper	30

Name of the Course	Soil and Water Analysis
Course Code (refer to student handbook)	USBCHS407
Class	S.Y.B.Sc.
Semester	IV
No of Credits	2
Nature	Practical
Type (applicable to NEP only)	SEC
Highlight revision specific to employability/ entrepreneurship/ skill development	In modern agriculture, soil testing is an important practice to manage fertilizer application and crop production. Soil analysis is one of the most important tools to determine plant nutrients. Learners will know ISO methods of soil analysis and able to manage quantity of fertilizers. This course intends students to acquire skill in analysis of water quality parameters and thus monitoring water quality in Konkan region where scarcity of good quality water is at its peak.

Nomenclature: Soil and Water Analysis

Course Outcomes:

At the end of the course the learner should be able to-

CO1: learn to develop a plan of work based on aim and objectives.

CO2: perform the practical work effectively using oral and written means.

CO3: understand the concept behind the practical and analyze and conclude the results.

CO4: get hands on training on volumetric estimation for testing water and soil quality.

CO5: aware about various quality parameters, their determination and impact of quality on public health and environment.

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 fourth 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. Semester End Practical Examination will be of 9 hours and it is scheduled in 1 and a half day.**
- 7. Evaluation in viva voce will be based on all practicals from this course.**
- 8. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever is applicable.**

Curriculum:

Unit	Title	Learning Points	No of Lectures
SEC	Water Analysis	1) Sample collection and processing 2) Determination of pH and conductivity of water 3) Determination of Total Dissolved Solids of water 4) Determination of Alkalinity of water as CaCO ₃ 5) Determination of chloride content of water 6) Determination of total hardness of water 7) Determination of Calcium of water 8) Determination of magnesium of water by calculative method 9) Determination of Sulphates from water 10) Determination of COD and BOD of water	30
	Soil Analysis	1) Sample collection and processing 2) Determination of pH of soil 3) Determination of Carbon content of soil 4) Determination of Phosphorus content of soil 5) Determination of Nitrogen content of soil 6) Determination of Potassium content of soil using flame photometry 7) Determination of Water holding capacity of soil 8) Project	30

Learning Resources recommended:

1. IS 3025 1983, 1984, 1991, 1994- Methods of sampling and test (physical and chemical method)
2. Methods Manual- Soil Testing in India, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, New Delhi, January, 2011
3. Fundamental of soil analysis, Foth H.D. Wiley books.
4. Soil and Water Chemistry by Anu Gopinath 2019

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	Marks
Performance and engagement during practical sessions: <ul style="list-style-type: none">• Skills, precision, accuracy, safety measures, individual and/or collaborative working while performing practical• Ability to record proper observations, to analyze data, to plot graph and to draw meaningful conclusions of experiments• Submission of journal within a week after every practical session 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	Title	Method	Marks
1.	Water Analysis	Experiment performance as per practical exam paper	15
2.	Soil Analysis	Experiment performance as per practical exam paper	15

Field Project (FP)

Nomenclature of the Course	Field Project
Class	SYBSc
Semester	IV
Course Code	USBCHF408
No. of Credits	02
Nature	Project
Type	Elective Course
Course Outcomes:	
After successful completion of this course the learner will be able to	
CO1: Enhance their ability to identify and address scientific problems or challenges using creative and analytical approaches.	
CO2: Acquire practical research skills, including literature review, experimental design, data collection, analysis and interpretation essential for pursuing further studies or careers in scientific research.	
CO3: Improve their scientific communication skills by writing comprehensive project reports, presenting their findings orally and effectively conveying complex scientific concepts to diverse audiences.	
CO4: Develop critical thinking skills by analyzing data, identifying patterns, and drawing evidence-based conclusions from their observations in the field.	
CO5: Enhance their employability by acquiring practical skills and experiences valued by employers in scientific fields, preparing them for future careers or further studies	
Guidelines for Field Project	
This course requires learners to participate in field-based learning projects generally under the supervision of faculty.	

Learner has to work 60 hours in a semester for Field Project.

20 hours for classroom activities

- Classroom activities include preparation for field activity, independent reading and study, analysis of data and preparation of report etc.

40 hours for Field work

- Field work includes implementation of the planned activities according to the programme schedule, collection of data
- Engagement activities may include events, workshops, meetings or door-to-door outreach.

A minimum of 4-6 weeks of summer work, either on college campus in activities related to conservation of environment / biodiversity or community-based work in the neighboring community (through NCC/NSS unit) or field level work with a recognized NGO or regional case studies programme at Villages may be undertaken as a part of Field projects.

In rare cases field visits may be included in the Field project. In such case, field visits need to be arranged meticulously so that there is a graded sequence and the submission is a compliance of all visits to make it a unified activity.

Evaluation Pattern

Continuous Internal Evaluation: Maximum Marks (20):

Method	Marks
Field Project Report	10
Viva-voce	10

Semester End Examination: Maximum Marks (30):

Method	Marks
Field work	15
Presentation	15

Community Engagement Project (CEP)

Nomenclature of the Course	Community Engagement and Service
Class	SYBSc
Semester	IV
Course Code	USBCHC408
No. of Credits	02
Nature	Project
Type	Elective Course
Course Outcomes:	
After successful completion of this course the learner will be able to	
CO1: Contribute positively to the community by addressing local needs and challenges through science-based activities such as conservation of environment, promotion of good health and STEM education initiatives.	
CO2: Develop a sense of social responsibility and civic engagement by actively participating in community-based projects and understanding the importance of giving back to society.	
CO3: Gain interdisciplinary perspectives by applying scientific knowledge and skills to real-world issues, collaborating with individuals from diverse backgrounds, including community members, educators and professionals.	
CO4: Reflect on their experiences, challenges and accomplishments which will contribute to their personal growth, self-awareness and resilience.	
CO5: Enhance their employability and career readiness by gaining practical experience, networking opportunities and exposure to real-world applications of scientific knowledge.	
CO6: Cultivate a lifelong commitment to community continuing to apply their scientific expertise and skills to address societal issues and contribute to positive change throughout their lives.	

Guidelines for Community Engagement and Service (CEP)

This course requires learners to participate in field based learning /projects generally under the supervision of faculty. It will involve activities that expose learners to the socio-economic issues in the society.

Learner has to work 90 hours in a semester for Community Engagement and Service Project.

30 hours for classroom activities

- Classroom activities include preparation for community engagement and service, independent reading and study, analysis of data and preparation of report etc.

60 hours for Field work

- Field work includes implementation of the planned community engagement activities according to the programme schedule, collection of data
- Engagement activities may include events, workshops, meetings or door-to-door outreach.

Learners can participate in activities related to National Service Scheme (NCC), National Cadet Corps (NCC), Adult education / Literacy initiatives, Mentoring of school learners / Organization of Open Day/ Celebration of day on various national and international days like National Science Day, International day of women and Girls in Science etc

Evaluation Pattern

Continuous Internal Evaluation: Maximum Marks (20):

Method	Marks
CEP report	15
Active Participation	05

Semester End Examination: Maximum Marks (30):

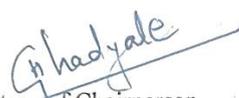
Method	Marks
Field work Undertaking and completing community engagement and service	30

- Learners can participate in any one activity from the list given below.
- Learners should engage 90 / 60 Hours of work for CEP / FP respectively.

Sr. No.	<i>Activities for Field Project and Community Engagement and Service</i>
1	Host science talks or webinars open to the public on topics of scientific interest
2	Anti-Drug awareness campaign in an urban/ rural area
3	Engage community members in citizen science projects
4	Organize a science fair or exhibition
5	Aids awareness campaign in an urban/ rural area
6	Environment awareness campaign
7	Water Conservation Awareness program in an urban/ rural area
8	Design and execute a waste management initiative in an urban neighbourhood
9	Conduct surveys on access to clean water and sanitation facilities in both rural and urban settings
10	Conduct / participate in workshops or seminars to provide guidance and information about career opportunities in STEM fields
11	Organize science outreach workshops for local schools or community centres on various science topics
12	Create educational materials on environmental conservation and distribute them in schools and communities.
13	Conduct research projects on fruit processing and value added products.
14	Conduct research projects on fish industry and its impact on communities.
15	Conduct research projects on fruit industry and its impact on communities.
16	Organize events for building scientific temper
17	Implement initiatives to promote sustainable energy practices in rural environment.
18	Establish community-driven initiatives for disaster preparedness and response.
19	Organize community clean-up drives in both rural and urban areas.

20	Collaborate with local businesses to provide vocational training and job opportunities.
21	Conduct workshops on digital literacy and technology skills for community members.
22	Establish community-led initiatives for environmental conservation and biodiversity preservation.
23	Organize campaigns to promote responsible consumption and waste reduction.
24	Implement initiatives to address food insecurity and malnutrition in both settings.
25	Establish community-based initiatives for urban agriculture projects.
26	Organize capacity-building workshops for community-based environmental organizations.
27	Establish community-led initiatives for waste reduction and recycling.
28	Survey on quality and availability of water
29	Survey on quality of soil and soil fertility
30	Conduct research on the impact of pollution on marine ecosystem.
31	Conduct research projects on the environmental issues.
32	Conduct research on the impact of pollution on biodiversity.
33	Any other subjects of your choice and get it approved by the field project or CEP guide

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


 Signature of Chairperson
 Department of Biochemistry
 P.Gogate College of Arts and Science
 R.V.Jogalekar College of Commerce
 Ratnagiri-415612