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- 2023-2024

Name of Programme	**B.Sc. Biochemistry**
Level	UG
No of Semesters	06
Year of Implementation	**2023-24**
Programme Specific Outcomes (PSO)	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.	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.

	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 (40M)

Method	**Marks**
Class test (written)	20
Assignment	10
Class performance	10
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-60M (Duration: 2hrs)

Question No	Unit	Marks
Q.1	1	15
Q.2	2	15
Q.3	3	15
Q.4	Based on all units	15

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. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i.e. 24 out of 60) 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

Bachelor of Science (B.Sc.) Biochemistry Program

Under Choice Based Credit System

Course Structure

S.Y.B.Sc.

(To be implemented from Academic Year- 2023-24)

No. of Courses	Semester III	Credits
USBCH301	**Bio-organic Chemistry and Biophysical methods-I**	**02**
USBCH302	**Fundamentals of Genetics and Physiology**	**02**
USBCH303	**Applied Biochemistry I**	**02**
USBCHP304	**Practical P3**	**03**
	TOTAL	**09**

Name of the Course	Bio-organic Chemistry and Biophysical methods-I
Course Code (Refer to student handbook)	USBCH301
Class	S.Y.B.Sc.
Semester	III
No of Credits	3
Nature	Theory
Type (Applicable to NEP only)	Core
Highlight revision specific to employability/ entrepreneurship/ skill development	Bioorganic chemistry focuses on implanting physical and chemical methods in the study of biological process. After studying bioorganic and biophysical methods, students will get acquainted about how a biomolecule structure is studied and how investigation of biochemical reaction is studied.

Bio-organic Chemistry and Biophysical methods-I

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**Acids, bases, buffers and ionic equilibria**	**15**
2.	**Physicochemical principles**	**15**
3.	**Microscopy**	**15**
	Total	**45**

Nomenclature: Bio-organic Chemistry and Biophysical methods-I

Course Outcomes:

At the end of the course, students will be able to-
CO1: Understand the concept of acids, bases, importance of buffer system in humans.
CO2: Acquire the knowledge and understanding of the physicochemical principles and their role in human physiology.
CO3: Identify and describe the parts of microscope. To study the distinguishing features, principal components and applications of various types of light and electron microscope

Curriculum:

UNIT	TITLE AND LEARNING POINTS	NO. OF LECTURES
Unit I:	**Acids, bases, buffers and ionic equilibria**	**15 Lectures**
1.1	Definition – pH, pK, pKw, isoelectric pH, buffer, buffering capacity	
1.2	Derivations: Ionic product of water, Hendersen–Hasselbalch equation,	
1.3	Relation between pI, pKa_1 and pKa_2 for a neutral, acidic and basic amino acid	
1.3.1	Ionization and titration curves of glycine, lysine and aspartic acid; pKa, pHm, and pI values of these amino acids	
1.3.2	Sorensen's reaction and formol titration of amino acids	
1.4	Physiological buffers: Hb - HHb, carbonate-bicarbonate, phosphate and protein	
1.5	Numerical on above concepts.	
Unit II:	**Physicochemical principles**	**15 Lectures**
2.1	Diffusion and osmosis	
2.1.1	Ways of expressing solute concentration - mole, molal, normal, percent, activity & ionic strength.	
2.1.2	Diffusion & diffusion coefficient and factors affecting diffusion of solute in solution	
2.1.3	Osmosis - Vant Hoff's law of osmotic pressure law &mathematical expression (no derivation), mechanism of osmosis, role of osmosis in physiology.	
2.1.4	Renal dialysis: Principles and process	
2.2	Colloids and viscosity	
2.2.1	Colloidal state in relation to surface forces, surface area, electrical charge, precipitation and	

	flocculation.	
2.2.2	Surface tension and its measurement, factors affecting surface tension Eg. Role of bile in digestion	
2.2.3	Viscosity - definition, measurement; Donnan membrane equilibrium, relation between Donnan equilibrium and osmotic pressure.	
Unit III:	**Microscopy**	**15 Lectures**
3.1	History, Basic principles of microscopy, of light and colour.	
3.2	Dissection and compound microscope: Construction and parts of a microscope, function of each part, levels of magnification, concept of refractive index and role of oil in magnification	
3.3	Specialized microscopy I	
3.3.1	Differential interference contrast (DIC),	
3.3.2	Phase contrast,	
3.3.3	Dark Field	
3.4	Specialized Microscopy II	
3.4.1	Simple fluorescence microscopy	
3.4.2	Confocal microscopy	
3.4.3	Electron microscopy • Principle, applications and comparative study • Types - SEM and TEM	

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 Biochdemistry 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 (40M)

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)	**20**
Assignment	**10**
Class performance and attendance	**10**

B. Semester End Evaluation (Paper Pattern) (60M)

Question No	**Unit**	**Marks**
Q.1	1	15
Q.2	2	15
Q.3	3	15
Q.4	Based on all units	15

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	Fundamentals of genetics and physiology-I
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	Genetics is concerned with heredity and variation. I t occupies central position in modern biology. Basic genetic study can be implemented in designing therapies and genetic investigation. Clinical biochemistry studies help in diagnosis and management of disease. Learning body fluids may be useful in solving medical case studies. Students will learn how the vital components are transported in the body with respect to their structure, function and regulation.

Fundamentals of genetics and physiology-I

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**Genetics: I**	**15**
2.	**Blood and Body Fluids**	**15**
3.	**Biological transport mechanisms**	**15**
	Total	**45**

Nomenclature: Fundamentals of genetics and physiology-I

Course Outcomes:

At the end of the course, students will be able to-
CO1: Explain derivatives from Mendel's model of the inheritance of traits. Understands deviation of Mendel's genetics.
CO2: Understand composition of blood and body fluids and their functions.
CO3: Illustrate the mechanism of membrane transport in plant and animal cell.

Curriculum:

UNIT	TITLE AND LEARNING POINTS	NO. OF LECTURES
Unit I:	**Genetics: I**	**15 lectures**
1.1	**History**: Contributions of Mendel, Bateson, Hardy-Weinberg, Garrod, Morgan, Griffith, Beadle and Tatum, Avery, Mac Leod, Mc Carthy, Lederberg, Tatum, Barbara Mclintock, Hershey & Chase, Watson &Crick.	
1.2	**Mendelian genetics**: Mendel's experiments - Monohybrid, Dihybrid crosses, Laws of inheritance	
1.3	Dominance, recessivity, codominance, incomplete semi-dominance, lethal genes	
1.4	Gene interaction -Epistasis, types of epistasis, multiple alleles, maternal effects	
1.5	Numerical on above concepts	
Unit II:	**Blood and Body Fluids**	**15 lectures**
2.1	**Fluid compartments of the body**–ICF and ECF	
2.2	**Blood**: Composition, characteristics and function; roleof plasma proteins, Starlings hypothesis; blood clotting and factors involved	
2.3	**Bile**: Composition, characteristics and function; storage	
2.4	**Urine**: Composition–normal and abnormal constituents; formation of urine.	
2.5	**Lymph**: Composition, Formation and Circulation	

Unit III:	**Biological transport mechanisms**	**15 lectures**
3.1	**Transport in plants**: Role of xylem and phloem	
3.2	**Transport in blood:**	
3.2.1	Transport of gases CO_2 and O_2, Role of hemoglobin,O_2 dissociation curves, Bohr effect Chloride shift	
3.2.2	Transport of Metabolites: transport of lipids – lipoproteins and their types, role of plasma protein, albumin in transport of metabolites and drugs	
3.2.3	Transport of Ions: Fe -Ferritin and transferrin and calcium	
3.3	**Transport across cell membranes**	
3.3.1	Channel proteins and Carrier proteins	
3.3.2	Passive transport (simple and facilitated diffusion) with suitable examples; concept of symport, antiport,uniport, Endocytosis and Exocytosis – with one example each	
3.3.3	Active transport: primary–Na^+&K^+ pump, secondary Glucose-amino acid transport, types of glucose transporters (GLUT 1 to GLUT 4), aquaporins, ion channel inhibitors like gramicidin and valinomycin	

Learning Resources recommended:

1) IGenetics by Russel, 3rd edition (2016)
2) Advance in Biotechnology by Jogdand, 2nd edition (2007)
3) Guyton and Hall Textbook of medical Physiology. John E. Hall 13th edition.2015

Evaluation Pattern

A. Continuous Internal Evaluation (40M)

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)	**20**
Assignment	**10**
Class performance and attendance	**10**

B. Semester End Evaluation (Paper Pattern) (60M)

Question No	**Unit**	**Marks**
Q.1	1	15
Q.2	2	15
Q.3	3	15
Q.4	Based on all units	15

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	Applied Biochemistry-I
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	Infections have played a central role in the lives of humans. Studying the characteristics of these infections and causative agents will help in improving public health. Tissue culture has wide range of applications, plant tissue culture technique and its utility as a research tool will impart knowledge to the learner. Various industrial products are formed by the fermentation technology. Students will understand the basics of one these most important industrial technique.

Applied Biochemistry-I

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**Microbiology in Human Health and Diseases**	**15**
2.	**Cell and Tissue Culture**	**15**
3.	**Industrial Biochemistry**	**15**
	Total	**45**

Nomenclature: Applied Biochemistry-I

Course Outcomes:

At the end of the course, students will be able to-
CO1: Course gives knowledge of medical microbiology, and introduction to virology. learner will learn about different microbial disease, their pathophysiology and clinical manifestation.
CO2: Introduce students to the principles and practical considerations of animal and plant tissue culture.
CO3: Student will learn structure function of fermenter, biosensors. Learners also get acquainted with Application and immobilized techniques of enzymes.

Curriculum:

UNIT	TITLE AND LEARNING POINTS	NO. OF LECTURES
Unit I:	**Microbiology in Human Health and Diseases**	**15 lectures**
1.1	Beneficial Microorganism: Lactobacillus, Normal flora of human gut, Probiotics, Yeast, Nitrogen fixing bacteria (Rhizobium and Azotobacter)	
1.2	Harmful microorganisms:	
1.2.1	Air borne- *Mycobacterium tuberculae*(Tuberculosis), *Corynebacterium diptheriae*(Diptheria), *Candida* sp.,*Haemophilus influenza*e (Influenza), morbillivirus (measles)	
1.2.2	Water borne- *Shigella sp.* (Dysentery), *Vibrio cholerae* (Cholera), *Salmonella sp.* (Enteric fever), *Hepatitis virus*	
1.2.3	Food borne- *Staphylococcus aureus, Clostridiumbotulinum (Botulism)*	
1.2.4	Soil borne- *Clostridium tetani*	
1.3	Virology- General structure of a typical virus, classification of viruses based on genome (DNA, RNA); symmetry (helical, icosahedral, complex), host (bacteria, plant, animal, insect); Lytic and Lysogenic cycle	
Unit II:	**Cell and Tissue Culture**	
2.1	Plant Tissue Culture:	
2.1.1	History, Introduction or definition (explants, callus, dedifferentiation, re-differentiation) concept of totipotency	
2.1.2	Culture techniques; Types of culture (Callus culture, Organ culture, protoplast culture, cell culture)	

2.1.3	Applications: secondary metabolites in plant culture, Micropropagation	**15 lectures**
2.2	Animal Cell Culture:	
2.2.1	History, Introduction to Primary cell culture, Celllines (Finite and continuous)	
2.2.2	Culture techniques used for primary culture,	
2.2.3	Stem cell culture, Animal Organ Culture, Whole embryoculture	
2.2.4	Applications: hybridoma (monoclonal antibody), production of Vaccines	

Unit III:	**Industrial Biochemistry**	**15 lectures**
3.1	Basics of fermentation	
3.1.1	Typical Fermenter, Types of Fermenters (CSTF, Bubblecap, Airlift, Fluidized Bed reactor)	
3.1.2	Industrial production of wine, penicillin	
3.2	Immobilized Enzyme: Introduction, Methods of immobilization (entrapment, adsorption, covalent binding, microencapsulation, cross linking)	
3.2.1	Stabilization of soluble enzyme (solvent and substrate stabilization, enzyme stabilization by polymer. Salts and chemical modification)	
3.3.2	Applications	
3.3	Biosensors: Features of Biosensors, classification based on transducers, applications	
3.4	Single Cell proteins and their applications	

Learning Resources recommended:

1 General Microbiology. Roger Stainer 5th edition .1999
2 Introduction to modern virology. Dimmock and et.al.6th edition 2007
3 Biotechnology Expanding Horizons by B.D. Singh, 4th edition 2014
4 Advance in Biotechnology by Jogdand, 2nd edition 2007

Evaluation Pattern

A. Continuous Internal Evaluation (40M)

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)	**20**
Assignment	**10**
Class performance and attendance	**10**

B. Semester End Evaluation (Paper Pattern) (60M)

Question No	**Unit**	**Marks**
Q.1	1	15
Q.2	2	15
Q.3	3	15
Q.4	Based on all units	15

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)	USBCHP03
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	Students will be acquainted with the basic techniques of enzyme isolation. They will learn to handle pH meter and viscometer. Learner will also learn case studies based on Mendel's law. Course will also improve their microbial techniques and learn how to connect these skills in industrial applications.

Nomenclature: Practicals based on USBCH301, USBCH302 and USBCH303

Course Outcomes:

At the end of the course, students will be able to
CO1: Perform experiments successfully and use safe lab practices.
CO2: Acquire knowledge and skills for development of analytical approach for problem solving in the lab and also at the actual field.
CO3: Get hands on training of basic microbiological techniques.

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 three groups: P301, P302 and P303 from this course.

7. Semester End Practical Examination will be of 9 hours and it is scheduled in 1and 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
USBCHP03	P301	1. a] Preparation of beta Amylase/Urease/Invertase extract demonstration of theactivity Qualitatively. b] Determination of the Achromic point of Salivary Amylase. 2. Preparation of Buffers and measurement of pH using pH papers and pH meter. 3. Acid – Base titration of a polyprotic acid [H_2CO_3/H_3PO_4/Glycine hydrochloride] 4. a] A study of some methods of cell rupture: effect of hypo, hyper and isotonicsolutions on cells of the onion peel /plant cell (Hydrilla/ Vallisneria/ Spirogyra) b] Effect of organic solvents on cell rupture 5. Determination of the Viscosity of sucrose solution using Ostwald's Viscometer. 6. Demonstration: Potato Osmometer: Osmosis through semipermeable membrane	**15**
	P302	1. Mendel's Laws: a] Problems based on the laws b] case studies based on the laws 2. A study of Human Karyotypes. 3. Isoelectric precipitation of Casein using an indicator. Field visit /Assignment on vermiculture, organic farming, composting, biogas plant followed by a detailed report of at least one [the visit is recommended with the report, but in case it is not possible an assignment is mandatory	**15**
	P303	1. Demonstration of the working of an autoclave and a hot air oven. 2. Optimization of curd – a demonstration. 3. Sterility testing of air by plate exposure technique. [in sterile zone, in lab] and of tapwater. 4. A study of various culture inoculation methods. (Streak plate, pour plate and spreadplate methods).	**15**

		5. Cell count in a culture medium using optical density 6. Determination of the zone of inhibition of microorganisms using the agar wellmethod and disc method. 7. Flow sheet diagrams of industrial preparation of: a vitamin, an antibiotic, a fooditem, an enzyme and an alcohol.	

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 (60M)

Method	**Marks**
Performance and engagement during practical sessions: • 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	**30**
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	**15**
Viva	**15**

B. Semester End Evaluation (Exam Pattern) (90 Marks - 4 hours)

Q. No.	**Title**	**Method**	**Marks**
1	P301	Experiment performance as per practical exam paper	30
2	P302	Experiment performance as per practical exam paper	30
3	P303	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- 2023-24)

No. of Courses	Semester IV	Credits
USBCH401	**Bio-organic Chemistry and Biophysical methods-II**	**02**
USBCH402	**Fundamentals of Genetics and PhysiologyII**	**02**
USBCH 403	**Applied Biochemistry II**	**02**
US BCH P404	**Practical P4**	**03**
	TOTAL	**09**

Name of the Course	Bio-organic Chemistry and Biophysical methods-II
Course Code (Refer to student handbook)	USBCH401
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. 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 understand different animal and plant models used in the scientific study and also get idea about cell fractionation methods used in biotechnology.

Bio-organic Chemistry and Biophysical methods-II

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**Enzymology**	**15**
2.	**Plant growth regulators and endocrinology**	**15**
3.	**Approaches to Biochemical investigations**	**15**
	Total	**45**

Nomenclature: Bio-organic Chemistry and Biophysical methods-II

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 catalysed reactions and enzyme inhibitions and regulatory process, Enzyme activity, Enzyme Units, Specific activity
CO3: Overview human endocrinology and plant growth regulators.
CO4: Acquire knowledge about the basics and latest developments in Biochemical investigation tools and importance of plant and animal model in biochemical investigation

Curriculum:

UNIT	TITLE AND LEARNING POINTS	NO. OF LECTURES
Unit I:	**Enzymology**	15 lectures
1.1	Definition – Enzyme, coenzyme, cofactor, apoenzyme, holoenzyme, prosthetic group, active site , enzyme specificity, Turnover number, specific activity, Katal, IU.	
1.2	IUB / EC classification upto one digit. Enzyme specificity Fischers lock & key and Koshlands induced fit theories	
1.3	Activation energy, mechanism of enzyme action (concept of active site, single and bi- substrate reaction), factors affecting enzyme activity – substrate concentration, pH, temperature	

1.4	Enzyme kinetics – Derivation of Michaelis - Menten equation and Lineweaver Burk plot for mono-substrate reactions and numerical problems based on them.	
1.5	Enzyme inhibition – Reversible and Irreversible; competitiveand noncompetitive, (one example of each) Numerical problems on above.	
Unit II:	**Plant growth regulators and endocrinology**	15 lectures
2.1	Plant growth regulators- Structure and function of- auxins, gibberellins, cytokinin's, ethylene and abscisic acid.	
2.2	Definition of hormones, hormone receptor, endocrine & exocrine glands	
2.3	Classification of hormones on the basis of:	
2.3.1	Distance of target tissue - autocrine, paracrine, endocrine. Hierarchal organization of the mammalian endocrine system	
2.3.2	Chemistry - One example for each sub class.	
2.4	Chemistry & physiological role of thyroxine, oxytocin & vasopressin, Physiological role of glucocorticoids, FSH, LH, Estrogen, Progesterone (Reproductive cycle) Mode of action of steroid hormones and epinephrine. (Amplification cascade Only till the level of protein kinase A) G protein not to be covered.	
Unit III:	**Approaches to Biochemical investigations**	15 lectures
3.1	Whole animal and plant studies - the advantages and disadvantages of any four model systems for biochemical investigation (e.g. *E.coli*, yeast, *Dictyostelium*, *C. elegans*, Drosophila, *Arabidopsis)*	
3.2	Organ & tissue studies	
3.3	Isolated and cultured tissue and cell techniques: isolation, culture and counting of cells.	
3.4	*Cell Fractionation*	
3.4. 1	Cell rupture – solid shear, liquid shear, high pressure, ultrasound, osmotic shock, chemical treatment (enzyme,organic solvent), temperature.	
3.4. 2	Choice of suspension medium (Isotonic & hypotonicsolution, PBS) and separation methods.	

Learning Resources recommended:

1. Lehninger's- Principles of Biochemistry by David L. Nelson, 4th edition (2017)
2. Enzymes: Biochemistry, Biotechnology, cilincal biochemistry. Plummer and Bonner. 2nd edition 2007
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 (40M)

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)	**20**
Assignment	**10**
Class performance and attendance	**10**

B. Semester End Evaluation (Paper Pattern) (60M)

Question No	**Unit**	**Marks**
Q.1	1	15
Q.2	2	15
Q.3	3	15
Q.4	Based on all units	15

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	Fundamentals of genetics and physiology-II
Course Code (Refer to student handbook)	USBCH402
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	Learner will understand basic structure of chromosome and different modes of gene recombination. Students will get integrated aspects of physiology, anatomy and biochemistry of muscles and nervous system.

Fundamentals of genetics and physiology-II

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**Genetics: II**	**15**
2.	**Movement and locomotion**	**15**
3.	**Neurophysiology**	**15**
	Total	**45**

Nomenclature: Fundamentals of genetics and physiology-I

Course Outcomes:

At the end of the course, students will be able to-
CO1: Critically understand the components of DNA and the process of sequencing structural properties of chromosome. Learners will also get an overview about recombination in prokaryotes.
CO2: Learners will understand movement and locomotion in plant and human body as well as well as structure and functions of muscle in posture joint stability and heat production.
CO3: Course covers basic principle of nervous system, neuron signaling, interactions and structure and functions of neurotransmitters.

Curriculum:

UNIT	TITLE AND LEARNING POINTS	NO. OF LECTURES
Unit I:	**Genetics: II**	15 lectures
1.1	**Genome organization**	
1.1.1	Prokaryotic Genome: Nucleoid structure	
1.1.2	Eukaryotic chromosomes: Packaging of DNA(upto Solenoid structure), DNA supercoiling, Topoisomerase, Chromatin structure -Euchromatin, Heterochromatin, structure of condensed chromatin, Centromere, kinetochore, telomere, Comparison of chromosomal structure in prokaryotes and Eukaryotes	
1.2	**Recombination in prokaryotes**	
1.2.1	Transformation: Transformation in *S. pneumoniae*	
1.2.2	Transduction: General features with one example	
1.2.3	Conjugation: Mechanism F+, F- and Hfr strain	
Unit II:	**Movement and locomotion**	
2.1	**Movement in plants**	
2.1.1	Movements of Locomotion Spontaneous: Ciliary, Amoeboid,Cyclosis (Rotation, Circulation) Induced: Chemotaxis, Phototaxis, Thermotaxis	

2.1.2	Movements of Curvature: Mechanical: hygroscopic movements Vital:i)Spontaneous-movements of growth(nutation, circumutation, Hyponasty, epinasty); movements of variation ii)Induced–Tropic-hapto/geo/hydrotropism; Nastic–seismonasty, Nyctynasty	15 lectures
2.2	**Muscle contraction**	
2.2.1	Structural organization of a muscle fibre, myofibril	
2.2.2	Contraction and Relaxation of Muscles; -mechanisms, other types of contractions, twitch, tetanus, Isotonic, Isometric regulation of Muscle contraction	
Unit III:	**Neurophysiology**	15 lectures
3.1	**Nervous System Classification:** CNS, PNS; Components: Neurons (3types) and Neuroglia(6types)–structure andfunction, Axonal transport	
3.2	**Nerve impulse transmission:** Resting Membrane Potential, ion channels [voltage and ligand gated], Action Potential (depolarization, polarizationand refraction period), propagation of action potential (salutatory & continuous conduction)	
3.3	**Synaptic transmission**: Physiological anatomy of a synapse: – Electrical & Chemical synapses, Excitatory & inhibitory postsynaptic potentials, Agonists & Antagonists, inactivation of neurotransmitter	
3.4	**Neurotransmitters**: Structure and function of acetylcholine, catecholamines, GABA, glutamate, glycine	

Learning Resources recommended:

1) IGenetics by Russel, 3rd edition (2016)
2) Tortora' s principles and physiology. Gerard Toratora and Bryan Derrickson Global edition 2016
3) Plant physiology and biochemistry. H.S. Shrivastava. 2005.

Evaluation Pattern

A. Continuous Internal Evaluation (40M)

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)	**20**
Assignment	**10**
Class performance and attendance	**10**

B. Semester End Evaluation (Paper Pattern) (60M)

Question No	**Unit**	**Marks**
Q.1	1	15
Q.2	2	15
Q.3	3	15
Q.4	Based on all units	15

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	Applied Biochemistry-II
Course Code (Refer to student handbook)	USBCH403
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	This course will expand the knowledge of soil and water treatment that can sustainably remediate pollution issue. This course will give idea about basic principle, ideal characteristics and evaluation technique of pharmacology.

Applied Biochemistry-II

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**Trends in Biotechnology**	**15**
2.	**Introduction to Pharmacology**	**15**
3.	**Resource management**	**15**
	Total	**45**

Nomenclature: Applied Biochemistry-II

Course Outcomes:

At the end of the course, students will be able to-
CO1: This course is intended to expand learner's knowledge of alternative methods of soil and ground water treatment that can sustainably remediate the issue.
CO2: Learners will understand the basic concepts of pharmacology which forms the basis for making clinical decisions in pharmacological management of commonly occurring health issues.
CO3: The course deals with various environmental issues and solutions to treat those problems using innovative and sustainable ideas.

Curriculum:

UNIT	TITLE AND LEARNING POINTS	NO. OF LECTURES
Unit I:	**Trends in Biotechnology:**	**15 lectures**
1.1	*Bioremediation:*	
1.1.1	Introduction to terms – Bioremediation, Biotransformation, Xenobiotics, Recalcitrant xenobiotics, Biomagnification, Factors affectingbioremediation	
1.1.2	Types of Bioremediations (*Insitu*, *Exsitu)*; Types of reactions (Aerobic, anaerobic, sequential)	
1.1.3	Applications of Biodegradation - hydrocarbons, (Oil spills) Pesticides and herbicides, Heavy metals (Uranium) contaminated soil and waste land, Ground Water; Genetically Engineered Microbes in bioremediation.	
1.2	Biopesticides:	
1.2.1	Introduction; Types of Biological Control (Classical,inoculation, Inundation);	
1.2.2	Examples each of Bacterial, Viral, Fungal and Protozoal	
1.3	Biofungicide: Examples and applications	
1.4	Biofertilizers: Examples and applications	

Unit II:	**Introduction to Pharmacology**	**15 lectures**
2.1	Scope of pharmacology	
2.2	Sources, Classification, Chemical & physical properties of drug and Nomenclature of drugs	
2.3	Dosage forms and routes of drug administration; Factors affecting dosage and drug delivery	
2.4	Pharmacokinetics: LD_{50}, ED_{50}, Half Life, Loading dose, Maintenance dose (Explanation of terms only); Therapeutic index	
2.5	Novel Drug delivery system (NDDS):	
2.5.1	2.5.1 Transdermal and oral modes	
2.5.2	2.5.2 Liposomes and nanoparticles	
Unit III:	**Resource management**	**15 lectures**
3.1	Solid waste: Types of waste, treatment, recycling	
3.2	Waste water- sewage-	
3.2.1	Composition of sewage, types of sewage, detection of pathogenic organism of sewage; preliminary treatment, primary treatment	
3.2.2	Secondary treatment; tertiary treatment, disinfectant	
3.2.3	Sludge treatment and disposal; waste water collectionvs sewage treatment in developing countries	
3.3	Biomass and Bio energy production	
3.3.1	Biofuel and Biomass: Fossil fuel; Energy rich crops (sugar and starch; wood-rich; petroleum plants); Animal energy; Sources of biofuel, its cultivation andextraction process	
3.3.2	Biogas: Production, Composition, Applications. Gobar gas. [MSW and LFG, Renewable natural gas, NG vehicle]	

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. Industrial waste water treatment. A.D. Patwardhan. 1st edition 2017.

Evaluation Pattern

A. Continuous Internal Evaluation (40M)

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)	**20**
Assignment	**10**
Class performance and attendance	**10**

B. Semester End Evaluation (Paper Pattern) (60M)

Question No	**Unit**	**Marks**
Q.1	1	15
Q.2	2	15
Q.3	3	15
Q.4	Based on all units	15

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)	USBCHP04
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	Student will learn about fundamentals of clinical biochemistry. They will get to know about significance of clinical lab tests and how abnormal sample can be estimated. Different water quality analysis should be performed to decide portability of water.

Nomenclature: Practicals based on USBCH401, USBCH402 and USBCH403

Course Outcomes:

At the end of the course, students will be able to
CO1: understand basic principles of microbiology and its use in differentiating features of muscle tissues.
CO2: know normal and abnormal hematological lab findings to predict the diagnosis of hematological disorders and diseases.
CO3: get hands on training on isolation, immobilization of enzyme technique and microbiological techniques for analyzing the properties of effluent.

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 three groups: P401, P402 and P403 from this course.

7. Semester End Practical Examination will be of 9 hours and it is scheduled in 1and 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
USBCHP04	P401	1) Parts and maintenance of a microscope. 2) A study of electron micrographs of cell organelles. 3) Permanent slides of Muscle tissue 4) Recrystallization of Benzoic acid and determination of its yield. 5) Ammonium sulphate fractionation of protein and its estimation by a suitablemethod. 6) Field visit/ assignment on any topic from the syllabus.
	P402	1) Blood Experiments: i. Determination of total RBC count ii. Determination of total WBC count 2) Urine analysis : i] Normal constituents - Urea, Uric acid, Chloride ii] Abnormal constituents – Glucose, Protein Ketone bodies, bile salts and bilepigments. iii] Titratable acidity [using neutral red or phenol red] 3) Bile : ***i] Detection of Bilirubin [Iodine test / Gmelin's Nitric acid test / Fouchet's test]ii] Detection of Bile salt [Pettenkofer's test. Hays sulphur test]*** 4) A demonstration of online muscle twitch. 5) Demonstration of plant movement. [A project to be handled in a group. Each group to plan and execute the experiment in any way they choose. Results to be presentedto the class during a practical turn.]
	P403	1) Isolation of DNA from Onions and confirmation by DPA test 2) Determination of the Minimum Inhibitory Concentration of any one disinfectant. 3) Determination of the potability of water by conducting a coliform count. [MPN] 4) Gram stain of sewage. 5) Determination of the Chemical Oxygen demand of an effluent / sewage. 6) Preparation of immobilized yeast/ amylase and determination of enzyme activity.

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 (60M)

Method	**Marks**
Performance and engagement during practical sessions: • 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	**30**
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	**15**
Viva	**15**

B. Semester End Evaluation (Exam Pattern) (90 Marks - 4 hours)

Q.No.	**Title**	**Method**	**Marks**
1	P401	Experiment performance as per practical exam paper	30
2	P402	Experiment performance as per practical exam paper	30
3	P403	Experiment performance as per practical exam paper	30

Bachelor of Science (B.Sc.) Biochemistry Programme with six semesters course structure curriculum was approved by following BoS members in the hybrid mode meeting held on 14/10/2023 at 2.30 p.m.

Ratnagiri Education Society's
R. P. Gogate College of Arts and Science and R. V. Jogalekar College of Commerce
(Autonomous), Ratnagiri

Meeting of BoS in Biochemistry

Date	14/10/2023
Time	2.30 p.m.
Venue	Meeting hall
Mode	Hybrid

Attendance

Sr. No.	Name and type of the Member	Present mode Online / Offline	Signature
1	Name: Dr. Varsha A. Ghadyale Head of the Department (Chairman)	Offline	Ghadyale
2	Name:Dr. Prashant S. Ratnaparkhi (VC nominee)	Online	
3	Name: Dr. Ashok D. Chougale (outside the parent university)	Online	
4	Name: Dr. Rhishikesh S. Dhanve (outside the parent university)	Online	
5	Name:Mr. Ganesh R. Ankush Representative from industry/corporate sector/ any other organisation	Online	
6	Name: Mr. Prathamesh G. Tarve Alumnus	Online	
7	Name: Mr. Sudhir B. Gadgil Department faculty member (1)	offline	
8	Name: Mrs. Shweta O. Patwardhan Department faculty member (2)	Offline	14.10.23
9	Name: Mr. Pratik Shitut expert for special courses	Offline	Shitut 14/10/23