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

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- 2025-2026

Name of Programme	**B.Sc. Biochemistry**
Level	UG
No of Semesters	06
Year of Implementation	**2025-26**
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 (20M)

Method	**Marks**
Class test (online/offline)	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

Revised Syllabus of Courses of

Bachelor of Science (B.Sc.) Biochemistry Program

Under Choice Based Credit System

Course Structure

T.Y.B.Sc.

(To be implemented from Academic Year- 2025-26)

Course Code	Semester V	Credits		Course Code	Semester VI	Credits	
	Discipline Specific Course (DSC)				***Discipline Specific Course (DSC)***		
	Major Mandatory				**Major Mandatory**		
25_USBCM501	Metabolism I	**02**		25_USBCM601	Metabolism II	**02**	
25_USBCM502	Fundamental processes of Molecular Biology	**02**		25_USBCM602	Recombinant DNA Technology	**02**	
25_USBCM503	Immunology I and Cancer	**02**		25_USBCM603	Immunology II and Pathophysiology	**02**	
25_USBCM504	Biochemistry Practical V	**02**		25_USBCM604	Biochemistry Practical VII	**02**	
25_USBCM505	Biochemistry Practical VI	**02**		25_USBCM605	Biochemistry Practical VIII	**02**	
	Major Elective (Any1)				**Major Elective (Any 1)**		
25_USBCE506	Bioanalytical techniques I	**02**	**04**	25_USBCE606	Bioanalytical techniques II	**02**	**04**
25_USBCE507	Practicals based on Bioanalytical techniques I	**02**		25_USBCE607	Practicals based on Bioanalytical techniques II	**02**	
OR				**OR**			
25_USCHE506	Drugs and Dyes	**02**	**04**	25_USCHE606	Drugs and Dyes	**02**	**04**
25_USCHE507	Drugs and Dyes Practical	**02**		25_USCHE607	Drugs and Dyes Practical	**02**	
	Vocational Skill Course				**Vocational Skill Course**		
25_USBCV508	Human Nutrition	**02**		25_USBCV608	Biostatistics and Bioinformatics	**02**	
25_USBCV509	Practicals based on Food Analysis	**02**		25_USBCV609	Practicals based on Biostatistics and Bioinformatics	**02**	
	Field Project				**On Job Training**		
25_USBCF510	Field Project	**04**		25_USBCJ610	On Job Training	**04**	
	Total Credits	**22**			**Total Credits**	**22**	

T.Y.B.Sc. Semester V

No. of Courses	Semester V	Credits
USBCM501	**Metabolism I**	**2**
USBCM502	**Fundamental Processes of Molecular Biology**	**2**
USBCM503	**Immunology I and Cancer**	**2**
USBCM504	**Biochemistry Practical V**	**2**
USBCM505	**Biochemistry Practical VI**	**2**

Name of the Course	Metabolism I
Course Code (refer to student handbook)	25_USBCM501
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Theory
Type (applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Metabolism impacts all cellular functions and plays a fundamental role in biology. Electron transport chain provides energy currency i.e. ATP to the cell to carry out these functions. In this course, learner will understand the carbohydrate and nucleic acid metabolism along with their components and regulation. They will also learn how the change in carbohydrates and nucleic acids metabolites are involved in various diseases such as lactose intolerance, gout.

Metabolism I

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**BIOENERGETICS AND OXIDATIVE PHOSPHORYLATION**	**10**
2.	**CARBOHYDRATE METABOLISM**	**10**
3.	**NUCLEIC ACID METABOLISM**	**10**
	TOTAL	**30**

Nomenclature: Metabolism I

Course Outcomes:

At the end of the course the learner should:

CO1: Understand simple concepts related with metabolism, free energy and synthesis of ATP by mitochondrial oxidative phosphorylation process.

CO2: Comprehend the catabolism and anabolism of carbohydrates and disorders associated with it.

CO3: Understand the biosynthesis and degradation of purines and pyrimidine nucleotides and their disorders.

Curriculum:

Unit	Learning Points	No. of lectures
Unit I	**Bioenergetics and oxidative phosphorylation**	
1.1	Concepts of free energy	
1.2	Mitochondrial electron transport chain- Carriers [Basic chemistry, redox potential and orientation on the membrane]	
1.3	Q Cycle in complex III	
1.4	Inhibitors of electron transport chain- Antimycin A, Amytal, Rotenone, CN, Azide, CO.	**10**
1.5	Malate aspartate and glycerol-3-phosphate shuttle.	
1.6	Chemiosmotic hypothesis- Proton motive force, structure of ATP synthase complex, rotational catalysis mechanism.	
1.7	Uncouplers of electron transport chain and oxidative phosphorylation (DNP)	
Unit II	**Carbohydrate metabolism**	
2.1	Catabolism: Cellular location, sequence of reactions and energetics of: Glycolysis (aerobic and anaerobic), Oxidation of pyruvate, Krebs cycle.	
2.2	Glycogenolysis [Only schematic representation with enzyme names, no structures required]	**10**
2.3	Anabolism- HMP pathway, gluconeogenesis, glycogen synthesis.	
2.4	Disorders of carbohydrate metabolism: 1) Galactosemia 2) Fructosemia 3) Lactose intolerance	
Unit III	**Nucleic acid metabolism**	
3.1	Biosynthesis of purines and pyrimidines by *de novo* [Only schematic representation with enzyme names, no structures required]	
3.2	Inhibitors of purine synthesis, Synthesis of AMP, GMP, ATP, GTP	
3.3	Salvage pathway for purines, regulation of purines biosynthesis.	**10**
3.4	Degradation of purine nucleotides.	
3.5	Disorders of purine nucleotides: 1) Hyperuricemia and Gout 2) Lesch- Nyhan syndrome 3) Immunodeficiency diseases	

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 (Online/ Offline) 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 each)	**10**
Assignment/ Presentation/ Open Book Test/ Chart Preparation	**05**
Class performance and attendance	**05**

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

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

Guidelines for paper pattern for semester end evaluation:

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

Name of the Course	Fundamental Processes of Molecular Biology
Course Code (Refer to student handbook)	25_USBCM502
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	The course gives idea about central dogma of life. This course covers mechanism of the fundamental process like replication, transcription and translation along with involved components. Learners will also understand the role of inhibitors of these processes.

Fundamental processes of Molecular Biology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	REPLICATION AND REPAIR	10
2.	TRANSCRIPTION (IN PROKARYOTES)	10
3.	TRANSLATION (IN PROKARYOTES)	10
	TOTAL	30

Nomenclature: Fundamental Processes of Molecular Biology

Course Outcomes:

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

CO1: understand the mechanism of DNA replication and comprehend how DNA damage can lead to detrimental effects and how DNA repair system in the cells try to prevent mutations before being inherited.

CO2: understand the mechanism of DNA transcription along with processing of different types of RNAs in the cell.

CO3: understand the mechanism of DNA translation along with post translational modifications.

Curriculum:

Unit	Learning Points	No. of lectures
Unit I	**Replication and Repair**	**10**
1.1	**Replication of DNA (in prokaryotes)**	
1.1.1	Models of DNA replication: Semi-conservative, Dispersive & Conservative	
1.1.2	Modes of DNA replication: Theta & rolling circle	
1.1.3	Enzymes (pol I, II and III) and accessory proteins	
1.1.4	Mechanism of semiconservative replication	
1.2	**Mutations**	
1.2.1	Point and Gross- Structural (Deletion, Duplication, Inversion, Translocation, insertion)	
1.2.2	Numerical (Euploidy, Aneuploidy)	
1.3	**DNA repair**	
1.3.1	Direct, Photoreactivation O6 - methyl guanine DNA methyl transferase	
1.3.2	Excision repair and Mismatch repair	
1.3.3	Recombination repair, SOS-error prone repair	
Unit II	**Transcription (in prokaryotes)**	**10**
2.1	Prokaryotic RNA polymerase and promoter	
2.2	Mechanism of RNA transcription: Initiation, elongation and termination	
2.3	Processing of tRNA, rRNA	
2.4	Processing of mRNA(prokaryotes and eukaryotes), Concept of split genes	
2.5	Reverse transcription	
2.6	Role of Inhibitor: Rifampicin, Actinomycin D	
Unit III	**Translation (in prokaryotes)**	**10**
3.1	Characteristics of Genetic code	
3.2	Mechanism of translation: Activation of amino acids, initiation, elongation & termination	
3.3	Post translational modifications of proteins	
3.4	Inhibitors and mode of action: Puromycin, Chloramphenicol, cycloheximide, tetracycline	

Learning Resources recommended:

1. Lehninger's- Principles of Biochemistry by David L. Nelson, 4th edition (2017)
2. IGenetics by Russel, 3rd edition (2016)

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	**Marks**
Class test (Online/ Offline) 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 each)	**10**
Assignment/ Presentation/ Open Book Test/ Chart Preparation	**05**
Class performance and attendance	**05**

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

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

Guidelines for paper pattern for semester end evaluation:

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

Name of the Course	Immunology-I and Cancer
Course Code (Refer to student handbook)	25_USBCM503
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Undergraduate immunology course provides students with basic idea about immunology, different cells and organs involved in immunology and how it protects us from various life-threatening infectious diseases. Learners will get acquainted with causes and progression of cancer. They will learn about safe method of prevention and detection.

Immunology-I and Cancer

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**HUMAN IMMUNE SYSTEM**	**10**
2.	**ANTIGEN- ANTIBODY INTERACTIONS**	**10**
3.	**CANCER**	**10**
	TOTAL	**30**

Nomenclature: Immunology-I and Cancer

Course Outcomes:

At the end of the course the learner should:

CO1: understand the overall organization of the immune system, relationship between innate and adaptive systems and humoral and cell mediated immunity.

CO2: appreciate the structure and function of antibodies.

CO3: understand basic aspects of cancer biology and familiarize with elementary facets of carcinogenesis and types of cancer along with therapy to treat the cancer.

Curriculum:

UNIT	TITLE AND LEARNING POINT	No. of Lectures
Unit I	**Human Immune System**	**10**
1.1 1.1.1 1.1.2 1.1.3 1.1.4	Types of Immunity Innate immunity – Anatomical barriers, physiological barriers, Characteristics of Inflammation, phagocytosis [no mechanism] Adaptive immunity – Active & Passive Humoral & Cell mediated immunity	
1.2 1.2.1 1.2.2	Organs of the immune system: Primary lymphoid organs: Thymus, Bone marrow Secondary lymphoid organs: Lymphatic system, Lymph nodes, Spleen, MALT.	
1.3 1.3.1 1.3.2	Cells of the immune system: Lymphocytes – B cells and T cells, Natural killer cells – Mononuclear phagocytes, Granulocytes, Antigen presenting cells. Clonal selection & immunologic memory.	
1.3.3	Cytokines: biological functions of IL1, tumor necrosis factor-alpha, interferon – alpha, IL2, interferon-gamma.	
Unit II	**Antigen- Antibody interactions**	**10**
2.1	Antigens: Antigenicity, immunogenicity, epitope, factors determining immunogenicity, Haptens. Antibodies: Fine structure of immunoglobulin, Antibody- mediated functions, Antibody classes, Monoclonal antibodies(concept, production and applications)	
2.2	Antibody diversity*:* Multigene organization of immunoglobulingenes – Lambda, kappa & heavy chain Light chain DNA – VJ rearrangements Heavy chain DNA - VDJ rearrangements	
Unit III	**Cancer**	**10**
3.1 3.2 3.3 3.4 3.5 3.6	Biology of Cancer Physiology of Cancer cells Causes of cancer Carcinogens: Types (Physical, Chemical and Biological, Environmental Factor); AMES test Oncogenes and activation of oncogenes Genetics of cancer with reference to p53 Cancer therapy (Chemo – purine, pyrimidine and folate analogs)	

Learning Resources recommended:

1. Immunology by Goldsby and Kuby, 3rd edition (2003)
2. Roitt,s essential immunology by Martin and et.al. 13th edition (2019)
3. Karp's Cell and Molecular Biology by Iwasa and Marshall, 8th edition (2015)

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	**Marks**
Class test (Online/ Offline) 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 each)	**10**
Assignment/ Presentation/ Open Book Test/ Chart Preparation	**05**
Class performance and attendance	**05**

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

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

Guidelines for paper pattern for semester end evaluation:

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

Name of the Course	Biochemistry Practical V
Course Code (Refer to student handbook)	25_USBCM504
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Practical
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	In this practical course, learners will get hands on training on a. Isolation techniques b. Colorimetric Estimation techniques c. Hematology techniques

Nomenclature: Biochemistry Practical V and VI

Course Outcomes:

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 different isolation and estimation techniques related to carbohydrates and nucleic acids

CO5: Get to know different immunology and hematology 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).

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 25_USBCP504 and 25_USBCP505.

7. Semester End Practical Examination will be of 4 hours.

8. Evaluation in viva voce will be based on all practicals from this course.

9. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Title	Learning Points
25_USBCM504	1) Estimation of glucose by DNSA method 2) Estimation of glucose by Folin-Wu method 3) Estimation of glucose by Benedict's method 4) Estimation of glucose iodometric method 5) Estimation of lactose by ferric cyanide method 6) Isolation of starch from plant source 7) Isolation of glycogen from liver 8) Isolation of cellulose from plant parts 9) Isolation of chitin from fish/ insect 10) Isolation of pectin from fruit peel 11) Observation of starch granules 12) Problems based on bioenergetics

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: • 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 (30M)

Q. No.	Title	Method	Marks
1	Biochemistry Practical V	Experiment performance as per practical exam paper	30

Name of the Course	Biochemistry Practical VI
Course Code (Refer to student handbook)	25_USBCM505
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Practical
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	In this practical course, learners will get hands on training on a. Isolation techniques b. Colorimetric Estimation techniques c. Hematology techniques

Nomenclature: Biochemistry Practical V and VI

Course Outcomes:

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 different isolation and estimation techniques related to carbohydrates and nucleic acids

CO5: Get to know different immunology 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).

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 25_USBCP504 and 25_USBCP505.

7. Semester End Practical Examination will be of 4 hours.

8. Evaluation in viva voce will be based on all practicals from this course.

9. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Title	Learning Points
25_USBCM504	1) Isolation of DNA from plant cell 2) Isolation of DNA from animal cell 3) Isolation of RNA from plant cell 4) Isolation of RNA from yeast 5) Estimation of DNA by DPA method 6) Estimation of RNA by orcinol method 7) Estimation of DNA using spectrophotometer 8) Estimation of total leukocyte count 9) Observation of histological slides of thymus and spleen 10) Determination of ABO blood group 11) Differential count of WBC 12) Problems based on blood grouping 13) Demonstration experiment -AIMS test

Learning Resources recommended:

1. Biochemical Calculation by Segel, 2nd edition (2010)
2. Biochemical Methods by Sadashivam, 2nd edition (2005)
3. Practical Biochemistry by David Plummer, 3rd edition (2007)

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

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 during regular practical session	10
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (30M)

Q. No.	Title	Method	Marks
1	Biochemistry Practical VI	Experiment performance as per practical exam paper	30

T.Y.B.Sc. Semester VI

No. of Courses	Semester VI	Credits
25_USBCM601	**Metabolism II**	**2**
25_USBCM602	**Recombinant DNA Technology**	**2**
25_USBCM603	**Immunology-II and Pathophysiology**	**2**
25_USBCM604	**Biochemistry Practical VII**	**2**
25_USBCM605	**Biochemistry Practical VIII**	**2**

Name of the Course	Metabolism II
Course Code (Refer to student handbook)	25_USBCM601
Class	T.Y.B.Sc.
Semester	VI
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Metabolism impacts all cellular functions and plays a fundamental role in biology. Learners will understand the metabolic pathways of lipids and nucleic acids. Spectrophotometry is an important biophysical technique that enables separation, identification and purification of the components of a mixture from quantitative and qualitative analysis. Electrophoresis technique is used for detection of protein and nucleic acids.

Metabolism and Analytical techniques-II

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	PHOTOSYNTHESIS AND BIOLUMINESCENCE	10
2.	LIPID METABOLISM	10
3.	AMINO ACID & PROTEIN METABOLISM	10
	TOTAL	30

Nomenclature: Metabolism II

Course Outcomes:

At the end of the course the learner should:

CO1: Understand process of photophosphorylation in plants and bacteria.

CO2: Understand breakdown and synthesis of fatty acids and appreciate experiments carried out by scientist to enable pathways.

CO3: Understand amino acid metabolism, various reactions associated with amino acids and utilization of ammonia in urea cycle.

Curriculum:

Unit	Learning Points	No. of lectures
Unit I	**Photosynthesis and bioluminescence**	
1.1	Chlorophyll and accessory pigment.	
1.2	Fate of light energy absorbed by photosynthetic pigments, concept of pigment system	
1.3	Stages of photosynthesis	
1.4	Light reaction [non-cyclic electron flow and ATP synthesis, cyclic electron flow]	**10**
1.5	Bacterial photosynthesis-Purple photosynthetic bacteria and green photosynthetic bacteria	
1.6	Dark reaction: Calvin cycle [Only schematic representation]	
1.7	Photorespiration process	
Unit II	**Lipid metabolism**	
2.1	Catabolism-Knoop's experiment; Beta-oxidation of even carbon saturated fatty acid (C_4 to C_{20}), energetics of beta oxidation process	
2.2	Beta oxidation of carbon fatty acid and its significance	**10**
2.3	Anabolism-FAS complex, Fatty acid biosynthesis (Palmitic acid)	
2.4	Ketone body formation and degradation	
2.5	Physiological significance of ketone bodies (Diabetes mellitus, starvation, pregnancy and alcoholism)	
Unit III	**Amino acid and protein metabolism**	
3.1	Metabolism of amino acid- Transamination [Mechanism, reactions and enzymes], Decarboxylation [His, Trp, Glu and mechanism of decarboxylation]	
3.2	Deamination- (Oxidative- NAD(P) linked dehydrogenases, Non-oxidative- Asp, Cys, Ser	**10**
3.3	Glucogenic and ketogenic amino acids	
3.4	Urea cycle- Cellular location, sequence of reactions, formation and transport of NH_3, Functions and toxicity of ammonia	
3.5	Metabolic disorders of urea-clinical significance	

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. Biophysical Chemistry by Nath and Upadhyay, Revised edition (2009)

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	**Marks**
Class test (Online/ Offline) 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 each)	**10**
Assignment/ Presentation/ Open Book Test/ Chart Preparation	**05**
Class performance and attendance	**05**

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

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

Guidelines for paper pattern for semester end evaluation:

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

Name of the Course	Recombinant DNA Technology
Course Code (Refer to student handbook)	25_USBCM602
Class	T.Y.B.Sc.
Semester	VI
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	This course will help learners to understand about different tools and methods used in genetic engineering and how recombinant DNA technology is playing a vital role in improving health conditions by developing new vaccines and pharmaceuticals.

Recombinant DNA Technology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**RECOMBINANT DNA TECHNOLOGY: THE BASICS**	**10**
2.	**RECOMBINANT DNA TECHNOLOGY: ISOLATION AND SCREENING TECHNIQUES**	**10**
3.	**RECOMBINANT DNA TECHNOLOGY: APPLICATIONS**	**10**
	TOTAL	**30**

Nomenclature: Recombinant DNA Technology

Course Outcomes:

At the end of the course the learner should:
CO1: Understand the basic tools required for recombinant DNA technology, its procedure and various gene transfer methods.

CO2: understand the principles behind the techniques used in RDT.

CO3: understand various applications and the use of technology for the benefit of society.

Curriculum:

Unit	Learning Points	No. of lectures
Unit I	**Recombinant DNA Technology: The basics**	**10**
1.1	Introduction to Recombinant DNA Technology (Schematic representation)	
1.2	Enzymes used in RDT: Restriction endonucleases, Ligases, Terminal transferases, Reverse transcriptase	
1.3	Cloning vectors: Plasmid, pBR322, pUC19, Bacteriophage lambda, Cosmid Expression vectors: Artificial chromosomes (BAC and YAC), Shuttle vectors, pET vector	
1.4	Gene transfer methods: Transformation, Transfection, Electroporation, Microinjection, Microprojectile, Liposome mediated gene transfer (in brief)	
Unit II	**Recombinant DNA Technology: Isolation and screening techniques**	**10**
2.1	Isolation of gene: Genomic library, cDNA library, Southern blotting technique	
2.2	Selection technique: Antibiotic resistance genes and Colony hybridization	
2.3	DNA amplification by Polymerase Chain Reaction (Steps, Types, Applications)	
2.4	Screening technique with applications: DNA fingerprinting	
2.5	DNA sequencing techniques: Sanger's method, Maxam-Gilbert method	
Unit III	**Recombinant DNA Technology: Applications**	**10**
3.1	In medicine: Gene therapy, Vaccines, Protein therapies, Gene cloning Example: GM Insulin	
3.2	In agriculture: Crop resistance, Increase in crop yield, Environmental stress resistance, Delayed ripening, Reduced pesticide use, Example: *Bt* cotton	
3.3	Genetically modified foods: Canola, Cotton, Corn, Papaya, Fish, Golden rice	
3.4	RDT in forensic science and Environmental remediation	

Learning Resources recommended:

1. Biotechnology Expanding Horizons by B.D. Singh, 4th edition (2014)
2. Advance in Biotechnology by Jogdand, 2nd edition (2007)

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	**Marks**
Class test (Online/ Offline) 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 each)	**10**
Assignment/ Presentation/ Open Book Test/ Chart Preparation	**05**
Class performance and attendance	**05**

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

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

Guidelines for paper pattern for semester end evaluation:

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

Name of the Course	Immunology-II and Pathophysiology
Course Code (Refer to student handbook)	25_USBCM603
Class	T.Y.B.Sc.
Semester	VI
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	Undergraduate immunology course provides students with basic idea about immunology, different cells and organs involved in immunology and how it protects us from various life-threatening infectious diseases. Course also deals with how abnormal chemical reactions cause metabolic disorders. Learners will know about clinical manifestations of these diseases. They will learn about safe method of prevention and detection.

Immunology-II and Pathophysiology

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	ANTIGEN- ANTIBODY INTERACTIONS & COMPLEMENT SYSTEM	10
2.	MAJOR HISTOCOMPATIBILITY COMPLEX &TRANSPLANT IMMUNOLOGY	10
3.	PATHOPHYSIOLOGY OF DISEASES	10
	TOTAL	30

Nomenclature: Immunology-II and Pathophysiology

Course Outcomes: At the end of the course the learner should:
CO1: understand the pathways that activate the complement system.
CO2: be familiar with the MHC; its structure and classes, specific role of each class of MHC and importance in immune response and graft rejection.
CO3: understand the basic concepts of demography and epidemiology of aging and pathophysiology and issues in common diseases of older people.

Curriculum:

Unit No.	Topics	No. of Lectures
I	**Antigen- Antibody interactions & Complement system**	**10**
1.1 1.1.1 1.1.2 1.1.3 1.1.4 1.1.5	Antigen- Antibody interactions: Forces involved, antibody affinity, antibody avidity Precipitation reactions – Oudins, Ouchterlony Agglutination reactions: Blood typing, bacterial agglutination, Passive agglutination, agglutination inhibition, Coomb's test, Immunoelectrophoretic. Principles of Radioimmunoassay, ELISA Immunofluorescence	
1.2 1.2.1 1.2.2 1.2.3	Complement Components of complement; Complement activation – Classical & alternate pathway; formation of membrane attack complex. Biological consequences of complement activation. [in brief]	
II	**Major histocompatibility complex &Transplant immunology**	**10**
2.1. 2.1. 1 2.1.2	Major histocompatibility complex: MHC polymorphism & organization of MHC genes- class I & class II; Cellular distribution & structure of class I & II molecules;Self MHC restriction of T cells. Role of antigen presenting cells.	
2.2	Transplant immunology: Types of transplants; immunological basis of allograft rejection.	
2.3	Autoimmunity: Organ specific –Myasthenia gravis; Hashimoto's thyroiditis, Insulin dependent diabetes mellitus Systemic – Rheumatoid arthritis, Multiple sclerosis, Systemiclupus erythematosus (immunological basis of these autoimmune diseases)	
III	**Pathophysiology of metabolic and other disorders**	**10**
3.1	Inborn error: with respect to etiology and clinical manifestations Carbohydrate Metabolism: Glycogen Storage Disease I	
3.2	Amino Acid metabolism: Albinism , Phenylketonuria,	
3.3	Lipid Metabolism: Tay Sach's disease, Niemann-Pick diseases	
3.4 3.4.1 3.4.2	Blood related diseases: Iron deficiency anemia. Sickle cell anemia. Thalassemia	
3.5	Ageing: Definition of ageing. Molecular changes during ageing.Theories of Ageing.	
3.6	Alzheimer's disease,Parkinson's diseases	

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	**Marks**
Class test (Online/ Offline) 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 each)	**10**
Assignment/ Presentation/ Open Book Test/ Chart Preparation	**05**
Class performance and attendance	**05**

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

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

Guidelines for paper pattern for semester end evaluation:

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

Name of the Course	Biochemistry Practical VII
Course Code (Refer to student handbook)	25_USBCP604
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Practical
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	In this practical course, learners will get hands on training on a. Isolation techniques b. Colorimetric Estimation techniques c. Volumetric technique d. Separation technique

Nomenclature: Biochemistry Practical VII

Course Outcomes:

At the end of the course the learner should:
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 different isolation and estimation techniques related to carbohydrates and nucleic acids
CO5: Get to know different immunology and hematology 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).

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 25_USBCP604 and 25_USBCP605.

7. Semester End Practical Examination will be of 4 hours.

8. Evaluation in viva voce will be based on all practicals from this course.

9. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Title	Learning Points
25_USBCP504	1) Estimation of protein by biuret method 2) Estimation of protein by Folin-Lowry method 3) Estimation of protein by Bradford method 4) Estimation of amino acids by ninhydrin test 5) Titration curve of amino acid 6) Isolation of proteins from germinating seeds 7) Isolation of carotene from carrots 8) Isolation of casein from milk 9) Isolation of albumin from egg yolk 10) Isolation of cholesterol and lecithin from egg white 11) Estimation of cholesterol by Zak's method 12) Separation of oils by thin layer chromatography

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: • 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 (30M)

Q. No.	Title	Method	Marks
1	Biochemistry Practical V	Experiment performance as per practical exam paper	30

Name of the Course	Biochemistry Practical VIII
Course Code (Refer to student handbook)	25_USBCP605
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Practical
Type (Applicable to NEP only)	Major Mandatory
Highlight revision specific to employability/ entrepreneurship/ skill development	In this practical course, learners will get hands on training on a. Isolation techniques b. Colorimetric Estimation techniques c. Immunology techniques d. Instrumentation e. Problem solving based upon theory

Nomenclature: Biochemistry Practical VIII

Course Outcomes:

At the end of the course the learner should:
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 different isolation and estimation techniques related to Amino acids, proteins and lipids.
CO5: Get to know different immunology 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).

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 25_USBCP604 and 25_USBCP605.

7. Semester End Practical Examination will be of 4 hours.

8. Evaluation in viva voce will be based on all practicals from this course.

9. While evaluating practical, weightage will be given to observations, diagram, tabular representation, experimental skills and procedure, graph, calculation and result, whichever applicable.

Curriculum:

Title	Learning Points
25_USBCP504	1) Isolation of plasmid 2) Problems based on DNA sequencing 3) Problems based on DNA fingerprinting 4) Bacterial Conjugation 5) Bacterial Transformation 6) Simulation of Southern blotting 7) Problems based on MHC typing 8) RPR test 9) DOT ELISA 10) Immunoprecipitation reaction of antigen and antibody 11) Diagnostic test for typhoid: WIDAL Qualitative 12) Diagnostic test for typhoid: WIDAL Quantitative 13) Demonstration of PCR

Learning Resources recommended:

1. Biochemical Calculation by Segel, 2nd edition (2010)
2. Biochemical Methods by Sadashivam, 2nd edition (2005)
3. Practical Biochemistry by David Plummer, 3rd edition (2007)

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

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 during regular practical session	10
Overall performance (attendance, punctuality, sincerity for practical sessions throughout semester)	05
Viva	05

B. Semester End Evaluation (30M)

Q. No.	Title	Method	Marks
1	Biochemistry Practical VI	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

T.Y.B.Sc.

(To be implemented from Academic Year- 2025-26)

Course Code	Semester V	Credits	CourseCode	Semester VI	Credits
	Major Elective			***Major Elective***	
25_USBCE506	Bioanalytical techniques I	**02**	25_USBCE606	Bioanalytical techniques II	**02**
25_USBCE507	Practicals based on Bioanalytical techniques I	**02**	25_USBCE607	Practicals based on Bioanalytical techniques II	**02**

Name of the Course	Bioanalytical techniques I
Course Code (refer to student handbook)	25_USBCE506
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Theory
Type (applicable to NEP only)	Major elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will gain knowledge of using spectroscopic and colorimetric and centrifugation techniques to ensure product quality in industries like food, cosmetics, pharmaceuticals, and textiles. Ensuring color consistency, detecting impurities, and validating product formulations are common tasks.

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**COLORIMETRY**	**10**
2.	**SPECTROPHOTOMETRY**	**10**
3.	**CENTRIFUGATION**	**10**
	TOTAL	**30**

Nomenclature: Bioanalytical technique I

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

CO1: Gain proficiency in using various colorimetric and spectroscopic instruments, such as spectrophotometers, colorimeters, UV-Visible spectrometers, and fluorometers.

CO2: Understand the working principles, components, and applications of these instrument in industries such as textiles, pharmaceuticals, food and beverages, cosmetics, and environmental monitoring

CO3: Gain familiarity with different types of centrifuges, including bench-top, high-speed, and ultracentrifuges. Understand the components, working mechanisms, and safety features of centrifuge equipment.

Curriculum:

Unit	Learning Points	No. of Lectures
Unit I	**Colorimetry**	**10**
1.1	Introduction to colorimeter	
1.2	Beer-Lambert law, derivation, limitations & applications	
1.3	Concepts of Lambda max; determination of molar extinction coefficient	
1.4	Construction and working of a simple colorimeter	
1.5	Applications of colorimeter	
Unit II	**Spectrophotometry**	**10**
2.1	Introduction to spectroscopy	
2.2	Construction and working of a spectrophotometer	
2.3	Types of spectrophotometers: Single beam, Double beam, Fluorescence spectrophotometer, atomic absorption spectrophotometer	
Unit III	**Centrifugation**	**10**
3.1	Introduction to centrifugation	
3.2	RCF, RPM and derivation of an equation relating the two; Nomogram; Sedimentation coefficient and factors affecting; Derivation of sedimentation velocity, Wall effect	
3.3	Types and applications of centrifuges – Clinical, High speed, Ultra centrifuge - preparative and analytical.	
3.4	Types and applications of centrifugation –Differential, Rate zonal, Isopycnic	
3.5	Types of rotors	
3.6	Preparation of density gradient, Sample application, choice of rotors, Recovery of sample.	

Learning Resources recommended:

1. Biophysical Chemistry by Nath and Upadhyay, Revised edition (2009)
2. Principle and techniques of biochemistry and molecular biology 7th edition. Wilson and walker
3. Biomolecular and bioanalytical techniques. Theory methodology and application By Vasudevan Ramesh (2019).

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	**Marks**
Class test (online /offline) 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**	**Marks**
Q.1	1	10
Q.2	2	10
Q.3	3	10

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 Bioanalytical technique I
Course Code (refer to student handbook)	25_USBCE507
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Practical
Type (applicable to NEP only)	Major elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will understand how colorimetry and spectroscopy is applied in industries like textiles, paints, food, cosmetics, and printing and also perform practical experiments to measure and match colours, ensuring adherence to industry standards. Course will also apply problem-solving strategies to handle variations in color perception and measurement inconsistencies.

Nomenclature: Practicals based on bioanalytical techniques I

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: Students will get idea about work in chemical, biological, and environmental laboratories, conducting experiments, analyzing samples, and interpreting data using spectroscopy and colorimetry equipment.

Curriculum:

Unit	Title	Learning Points	No of Lectures
Major elective		1. Cleaning and maintenance of instruments: spectrophotometer and centrifuge 2. Determination of λ max 3. Calibration of Spectrophotometer 4. Demonstration of fluorescence Spectrophotometer 5. Demonstration of atomic adsorption Spectrophotometer 6. Determination of quercetin content using fluorescence Spectrophotometer 7. Determination of chlorophyll content using fluorescence Spectrophotometer 8. Study of enzyme kinetics using spectrophotometer 9. Demonstration of cooling centrifuge 10. Preparation of density gradient using sucrose 11. Numerical problems based on Beer-Lamberts law 12. Problems based on centrifugation techniques	**60**

Learning Resources recommended:

1. Biophysical Chemistry by Nath and Upadhyay, Revised edition (2009)
2. Principle and techniques of biochemistry and molecular biology 7th edition. Wilson and walker
3. Biomolecular and bioanalytical techniques. Theory methodology and application By Vasudevan Ramesh (2019).

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

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 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 - 3 hours)

Q. No	Title	Method	Marks
1	Practicals based on Bioanalytical technique I	Experiment performance as per practical exam paper	30

Name of the Course	Bioanalytical techniques II
Course Code (refer to student handbook)	25_USBCE606
Class	T.Y.B.Sc.
Semester	VI
No of Credits	2
Nature	Theory
Type (applicable to NEP only)	Major elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will work in analytical labs to perform chromatography and electrophoresis (gel, capillary) techniques for separating, identifying, and quantifying compounds. Students will understand roles of these techniques which are routinely used in research labs, clinical diagnostics, and industrial labs.

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**INTRODUCTION TO CHROMATOGRAPHY**	**10**
2.	**INTRODUCTION TO ADVANCED CHROMATOGRAPHY**	**10**
3.	**ELECROPHORESIS**	**10**
	TOTAL	**30**

Nomenclature: Bioanalytical techniques II

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

CO1: Explain the basic principles of chromatography and electrophoresis, including the mechanisms of separation, interaction between solutes, and the stationary and mobile phases.

CO2: Understand the components, setup, and maintenance of chromatographic and electrophoretic instruments, including columns, buffers, gels, and detectors.

CO3: Analyze chromatograms, electropherograms, and gel images to identify, quantify, and characterize compounds.

Curriculum:

Unit	Learning Points	No. of Lectures
Unit I	**Introduction to Chromatography**	**10**
	Principle, technique and applications of -	
1.1	Paper Chromatography	
1.2	TLC	
1.3	HPTLC	
Unit II	**Introduction to Advanced Chromatography**	**10**
	Principle, technique and applications of -	
2.1	HPLC; Preparative and Analytical	
2.2	GLC	
2.3	Ion Exchange chromatography	
Unit III	**Electrophoresis**	**10**
3.1	Principle and Factors affecting the rate of migration of sample in an electric field	
3.2	Components of electrophoresis unit/apparatus and various support media - paper, agarose and polyacrylamide	
3.3	Technique of electrophoresis	
3.4	Technique of electrophoresis with staining/visualization method • agarose electrophoresis for separation of DNA • Native PAGE for separation of proteins • SDS PAGE for molecular weight determination	
3.5	Other applications of electrophoresis: blotting techniques- Southern, Northern, and Western	

Learning Resources recommended:

1. Biophysical Chemistry by Nath and Upadhyay, Revised edition (2009)
2. Principle and techniques of biochemistry and molecular biology 7th edition. Wilson and walker
3. Biomolecular and bioanalytical techniques. Theory methodology and application By Vasudevan Ramesh. (2019).

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

Method	**Marks**
Class test (online /offline) 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**	**Marks**
Q.1	1	10
Q.2	2	10
Q.3	3	10

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 Bioanalytical technique II
Course Code (refer to student handbook)	25_USBCE607
Class	T.Y.B.Sc.
Semester	VI
No of Credits	2
Nature	Practical
Type (applicable to NEP only)	Major elective
Highlight revision specific to employability/ entrepreneurship/ skill development	Develop hands-on skills with basic chromatographic (Paper, TLC,adsorption) and electrophoretic (SDS-PAGE, techniques. Learn how to operate, troubleshoot, and maintain equipment

Nomenclature: Practicals based on Bioanalytical technique II

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 Chromatography and electrophoresis for testing different products

Curriculum:

Unit	Title	Learning Points	No of Lectures
Major elective	Practicals based on Bioanalytical technique II	1. Separation of amino acids by circular paper chromatography 2. Separation of sugars by ascending paper chromatography 3. 2D chromatography of plant components 4. Preparation of TLC plates 5. Separation of plant pigments using TLC 6. Separation of oils using TLC 7. Separation of sugars using Gel Chromatography 8. Demonstration of HPLC 9. Introduction to vertical electrophoresis 10. Introduction to Horizontal electrophoresis 11. Agarose gel electrophoresis of plasmid and chromosomal DNA 12. Serum electrophoresis 13. Sepeation of proteins by SDS PAGE **Demonstration experiment:** 14. Separation of plant pigments using adsorption chromatography	**60**

Learning Resources recommended:

1. Biophysical Chemistry by Nath and Upadhyay, Revised edition (2009)
2. Principle and techniques of biochemistry and molecular biology 7th edition. Wilson and walker
3. Biomolecular and bioanalytical techniques. Theory methodology and application By Vasudevan Ramesh. (2019).

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

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 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 - 3 hours)

Q. No	Title	Method	Marks
1	Practicals based on Bioanalytical technique II	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

T.Y.B.Sc.

(To be implemented from Academic Year- 2025-26)

Course Code	Semester V	Credits	Course Code	Semester VI	Credits
	Vocational Skill Course				
25_USBCV508	Human Nutrition	**02**	25_USBCV608	Biostatistics and Bioinformatics	**02**
25_USBCV509	Practicals based on Food Analysis	**02**	25_USBCV609	Practicals based on Biostatistics and Bioinformatics	**02**

Name of the Course	Human Nutrition
Course Code (refer to student handbook)	25_USBCV508
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Theory
Type (applicable to NEP only)	Vocational Skill Course
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will be able to analyze calorific energy content of major biomolecules, macronutrients and micronutrients and their requirement in the body so as to develop a meal plan (RDA). They will gain skills in measuring body composition and growth metrics (e.g., BMI, waist-to-hip ratio). They will be able to suggest a balanced diet for particular age group or for diseased case.

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	HUMAN NUTRITION	10
2.	BIOMOLECULES IN NUTRITION	10
3.	DIET MANAGEMENT	10
	TOTAL	30

Nomenclature: Human Nutrition

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.
CO3: learn the nutritional requirement and significance of dietary minerals like macro elements and microelements and recommended dietary allowances.
CO4: learn about diet management in different disorders related to the nutrition.

Curriculum:

Unit	Learning Points	No. of Lectures
UNIT I	**Human nutrition**	**10**
1.1	Introduction to & energy supply	
1.2	Measurement of energy content of food	
	Calorific value of different biomolecules & mixed diet, Determination of calorific value using bomb Calorimeter (Principle & Working)	
1.3	Respiratory quotient of food	
1.4	Measurement of energy expenditure	
	Basal metabolic rate- Definition, Measurement, factors affecting BMR & its significance	
	Specific dynamic action of food- Definition, Mechanism & its significance	
UNIT II	**Biomolecules in nutrition**	**10**
2.1	Sources, Daily requirement & Nutritional importance of biomolecules	
2.2	Carbohydrates- Concept of Glycemic Index of food (Graph), Importance of fiber (Complex carbohydrate) in nutrition	
2.3	Lipids-Role of essential fatty acids	
2.4	Proteins- Essential amino acids, Nitrogen Balance (Positive, Negative Nitrogen balance & factors affecting)	
2.5	Assessment of nutritive value of protein 1) Protein efficiency ratio 2) Biological value of protein 3) Net protein utilization 4) Chemical score 5) Mutual supplementation of protein	
2.6	Macro-elements and Microelements	
UNIT III	**Diet management**	**10**
3.1	Recommended Dietary allowances (RDA)- Definition, Factors affecting RDA, RDA for adult	
3.2	Balance diet – Concept & significance	
3.3	Diet management in different conditions (diseased state)	
	Diseased state: Diabetes mellitus, Hypertension, Peptic ulcer, Jaundice	
3.4	Different Age groups: infants, toddlers, adolescents, adults, geriatric	
3.5	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 (online /offline) 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**	**Marks**
Q.1	1	10
Q.2	2	10
Q.3	3	10

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 Food Analysis
Course Code (refer to student handbook)	25_USBCV509
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Practical
Type (applicable to NEP only)	Vocational Skill Course
Highlight revision specific to employability/ entrepreneurship/ skill development	Students will develop skills in designing controlled experiments to test specific biochemical properties and perform nutritional analysis using proper biochemical methods. They will understand regulations related to biochemical testing in food safety and food contamination. Their ability to critically evaluate biochemical analysis results and troubleshoot unexpected findings will be enhanced.

Nomenclature: Practicals based on Food 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, colorimetric estimation for testing different food products

Curriculum:

Unit	Title	Learning Points	No of Lectures
VSC	Food Analysis	1) Introduction to Good Laboratory Practices (GLP) and Good Distribution Practices (GDP) 2) Calibration of glassware 3) Infrastructure of food laboratory 4) Isolation of gluten from wheat floor 5) Estimation of protein content by Kjeldahl method 6) Estimation of lipid content by Soxhlet apparatus 7) Determination of Vit. C by DCPIP method 8) Determination of ash content and acid soluble ash content in food products 9) Determination of moisture content of food product by hot air oven drying method 10) Determination of crude fiber from food product 11) Determination of reducing sugar and total reducing sugar content from food product 12) Determination of iodine number and saponification number of oil 13) Determination of foreign matter, mineral matter, insect damaged grains and rodent excreta, hair in food grains 14) Determination of alcoholic acidity in cereals and grain floor 15) Determination of acidity of extracted fat from cereal grains 16) Introduction to Hedonic Rating Test	**60**

Learning Resources recommended:

- Principles of Nutritional Assessment (2005) Rosalind Gibson. Oxford University Press.
- Nutritional Biochemistry: Tom Brody.
- Nutrition Science by Srilakshmi, B.; New Age International publishers
- FSSAI manual 3 and 5

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

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 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 - 3 hours)

Q. No	Title	Method	Marks
1	Practicals based on Food Analysis	Experiment performance as per practical exam paper	30

Name of the Course	Biostatistics and Bioinformatics
Course Code (Refer to student handbook)	25_USBCV608
Class	T.Y.B.Sc.
Semester	VI
No of Credits	2
Nature	Theory
Type (Applicable to NEP only)	Vocational Skill Course
Highlight revision specific to employability/ entrepreneurship/ skill development	Introduction to Basic concepts of Biostatistics is aim at making learners familiar to various treatments that an experimental data can be given which will help build the foundation for the future research studies that they may pursue in future career. In this course, elementary level understanding of the tools and methods of assessment are covered. Bioinformatics in the given course helps learners in utilizing data mining techniques and enhancing its applications in acquiring biological data.

Biostatistics and Bioinformatics

Modules at a Glance

Sr. No.	Modules	No. of Lectures
1.	**DESCRIPTIVE BIOSTATISTICS**	**10**
2.	**HYPOTHESIS TESTING**	**10**
3.	**BIOINFORMATICS**	**10**
	TOTAL	**30**

Nomenclature: Biostatistics and Bioinformatics

Course Outcomes:

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

CO1: become familiar with the mathematical and statistical theory underlying the applications of biostatistical methods to interpret statistical results correctly, effectively and in context.

CO2: be able to interpret relationships among living things and analyze and solve biological problems, using basic biological concepts, grounded in foundational theories with the help of bioinformatics tools.

CO3: be able to apply existing software effectively to extract information from large databases and to use this information in biological sciences.

Curriculum:

UNIT	TOPIC AND LEARNIMG POINTS	No. of Lectures
UNIT I	**DESCRIPTIVE BIOSTATISTICS**	**10**
1.1	Introduction: scope and applications of biostatistics	
1.2	Common statistical terms: Sources, nature and presentation of data; Measurement and scales of measurement	
1.3	Measures of central tendency- Mean, Median and mode	
1.4	Measures of dispersion- Range, variance, SD, Meandeviation	
1.5	Concept of probability	
UNIT II	**HYPOTHESIS TESTING**	**10**
2.1	Introduction to hypothesis testing	
2.2	Single population mean, difference between population means	
2.3	Type I and Type II errors	
2.4	One-tailed and two tailed tests	
2.5	Z-test	
2.6	t-test- Paired and unpaired	
2.7	Chi-square test	
UNIT III	**BIOINFORMATICS**	**10**
3.1	Definition and History of Bioinformatics	
3.2	Applications of Bioinformatics: Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, medical informatics and agriculture.	
3.3	Introduction to Genomics and Proteomics	
3.4	Databases- Definition & types: Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database. Fullform & function in brief of - GenBank, EMBL, PIR, SWISS PROT, PDB, GDB.	
3.5	Sequence analysis Tools (in brief) -BLAST, FASTA, L-ALIGN, CLUSTAL- X & W, RASMOL,	
3.6	Software for protein sequencing - PROSPECT, AMMP, COPIA(Explanation of the terms in brief	

Learning Resources recommended:

1. Introduction to biostatistics (A textbook of Biometry) by Dr. Pranab Kumar Banerjee, 4th edition (2022)
2. Biostatistics by Arora, revised edition (2016)
3. Methods in Biostatistics by BK Mahajan, 7th edition (2010)
4. Bioinformatics Methods and Applications by Rastogi, 5th edition (2022)

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 each)	**10**
Assignment	**05**
Class performance	**05**

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

Question No	**Unit**	**Marks**
Q.1	1	10
Q.2	2	10
Q.3	3	10

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 Biostatistics and Bioinformatics
Course Code (refer to student handbook)	25_USBCV609
Class	T.Y.B.Sc.
Semester	V
No of Credits	2
Nature	Practical
Type (applicable to NEP only)	Vocational Skill Course
Highlight revision specific to employability/ entrepreneurship/ skill development	In this course, students will learn to apply biostatistical methods to understand and try to solve real-world research questions in fields such as public health, epidemiology, and environmental science. They will also be able to apply bioinformatics approaches to various fields, such as genomics, proteomics, and systems biology.

Nomenclature: Practicals based on Biostatistics and Bioinformatics

Course Outcomes:

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

CO1: Develop skills in designing experiments and surveys to collect biological data effectively.

CO2: Apply appropriate statistical tests (e.g., t-tests, chi-square test) to analyse biological data.

CO3: Interpret and summarize statistical results in the context of biological research.

CO4: Understand the significance of statistical findings and how they apply to real-world biological problems.

CO5: Develop critical thinking skills to assess statistical methods and their appropriateness for specific biological questions.

Curriculum:

Unit	Title	Learning Points	No of Lectures
VSC	Practicals based on Biostatistics and Bioinformatics	1. Problems based on data collection 2. Problems based on graphical representation of data 3. Problems based on frequency distribution 4. Problems based on measures of central tendency 5. Problems based on measures of dispersion 6. Problems based on z test 7. Problems based on unpaired t test 8. Problems based on paired t test 9. Problems based on chi square test: test for goodness of fit 10. Problems based on chi square test: test for independence of attributes 11. Problems based on probability 12. Introduction to Microsoft excel 13. Project	**60**

Learning Resources recommended:

1. Introduction to biostatistics (A textbook of Biometry) by Dr. Pranab Kumar Banerjee, 4th edition (2022)
2. Biostatistics by Arora, revised edition (2016)
3. Methods in Biostatistics by BK Mahajan, 7th edition (2010)
4. Bioinformatics Methods and Applications by Rastogi, 5th edition (2022)

Evaluation Pattern

A. Continuous Internal Evaluation (20M)

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 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 - 3 hours)

Q. No	Title	Method	Marks
1	Practicals based on Biostatistics and Bioinformatics	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

T.Y.B.Sc.

(To be implemented from Academic Year- 2025-26)

Course Code	Semester V	Credits	CourseCode	Semester VI	Credits
	Field Project			**On Job Training**	
25_USBCF510	Field Project	**04**	25_USBCJ610	On Job Training	**04**

Introduction:

Inclusion of On Job Training/ Field Project in the course curriculum of the B.Sc. programme is one of the ambitious aspects in the programme structure. The main objective of inclusion of On Job Training/ Field Project is to inculcate ability to interpret particular aspect of the study in his/ her own words.

Name of the Course	Field Project
Course Code (refer to student handbook)	25_USBCF510
Class	T.Y.B.Sc.
Semester	V
No of Credits	4
Nature	Practical
Type (applicable to NEP only)	Field Project
Highlight revision specific to employability/ entrepreneurship/ skill development	It bridges the gap between theoretical knowledge and the practical requirements for doing any research. Projects often present unique challenges, fostering critical thinking and innovative solutions. They can develop specific technical skills, lab techniques. Successful project outcomes can be showcased in a portfolio, demonstrating competence to potential employers. Gaining exposure to practical skills can make students more knowledgeable and adaptable in job roles.

Guidelines and Evaluation pattern for Field Project (100 Marks)

Guidelines for Field Project:

Course Outcomes:

By the end of the course, learners should be able to:

CO1: Understand the ethics and research methodology.
CO2: Do a literature review.
CO3: Do basic research.
CO4: Analyze the research work data.
CO5: Write project report.

Course Duration: One Semester Minimum 120 hours of field project work.

Course Outline:

1. Identifying problem for project work (2 weeks).
2. Literature survey (2 weeks).
3. Designing and implementing the project through necessary experimental work (4 weeks).
4. Data collection and its analysis and interpretation. (2 weeks).
5. Report writing and presentation (2 weeks).

Format of Project Report:

a) **Title Page:**

Mentioning the title of the report, name of the student, program, institution, and the period of training / project.

b) **Certificate of Completion:**

A certificate issued by the organization or supervisor confirming the successful completion of the training/project.

c) **Declaration:**

A statement by the student declaring that the report is their original work and acknowledging any assistance or references used.

d) **Acknowledgments:**

Recognizing individuals or organizations that provided support, guidance, or resources during the training/project.

e) **Table of Contents:**

Providing a clear outline of the report's sections and page numbers.

f) **Abstract**

birds eye view of learners entire presentation has to be A precisely offered under this category. A brief overview of the project, its objectives and key findings should be mentioned.

g) **Introduction:**

Background information about the field project and its significance. Objectives and scope of the project.

h) **Literature Review:**

Overview of relevant literature and studies related to the chosen field and development issues.

i) **Methodology:**

Description of Planning of experimental procedure as per the need of the project.

Designing and implementation of the project as per the objectives through theoretical, experimental methods.

j) **Observations and data analysis:**

Data collection and analysis

k) **Conclusion:**

Summary of the key findings and outcomes of the project.

l) **References and Appendices:**

List of all sources cited in the project report. Additional supporting material.

The project report based on 'Field Project' shall be prepared as pe rthe broad guidelines given below:

- Font type: Times New Roman
- Font size: 12-For content, 14-for Title
- Line Space: 1.5-for content and 1-for in table work
- Paper Size: A4
- Margin: in Left-1.5, Up-Down-Right-1
- The Project Report shall be bounded.

Evaluation Pattern: Field Project

Evaluation of field project will be done at the end of semester for 100 marks.

Evaluation / Marking Scheme:

Sr. No.	Criteria	Marks
1	Research Project theme/objective	10
2	Literature Survey/ References	10
3	Experimental/Theoretical methodology/Working condition of project.	30
4	Depth of knowledge in the subject / Results and Discussion	20
5	Project report	15
6	Presentation	15
	Total Marks	**100**

Name of the Course	On Job Training
Course Code (refer to student handbook)	25_USBCJ610
Class	T.Y.B.Sc.
Semester	VI
No of Credits	4
Nature	Practical
Type (applicable to NEP only)	On Job Training
Highlight revision specific to employability/ entrepreneurship/ skill development	On job training provides learner with the opportunity to acquire hands on experience and practical skills required for specific job roles. It bridges the gap between theoretical knowledge and the practical requirements of the job. Learner can gain valuable insights into the industry practice, company culture, this experience makes them confidentand competent candidate when applying for the position increasing the employability prospects. OJT is instrumental in skill development as it focuses on practical job specific competencies like technical skills, soft skills. Overall OJT enhances employability, foster entrepreneurship by providing valuable industry exposure.

Guidelines for On Job Training

On-the-Job Training: Students will be required to undertake a designated project or tasks in an organization or industry relevant to their field of study. The course aims to provide students with practical exposure and hands-on experience in a professional work environment related to their field of study.

Course Objectives:

By the end of the course, students should be able to:

1. Gain exposure to real-world insights and apply theoretical knowledge to practical situations
2. Enhance skills regarding problem-solving, decision-making, and communication skills.
3. Understand organizational dynamics and work culture.
4. Build industry connections and networking opportunities.

Course Duration:

- ✓ Minimum 15 days / 120 hours of On Job Training with an Organization /Private firm.
- ✓ The theme of the internship should be based on any study area of the Major course.
- ✓ Project Report should be of minimum 30 pages.
- ✓ Experience Certificate is Mandatory.

Report Structure:

The students will be required to submit a comprehensive report at the end of the On-Job Training. A project report has to be brief in content and must include the following aspects:

a) Title Page:

Mentioning the title of the report, name of the student, program, institution, and the period of training.

b) Certificate of Completion:

A certificate issued by the organization or supervisor confirming the successful completion of the training

c) Declaration:

A statement by the student declaring that the report is their original work and acknowledging any assistance or references used.

d) Acknowledgments:

Recognizing individuals or organizations that provided support, guidance, or resources during the training.

e) Table of Contents:

Providing a clear outline of the report's sections and page numbers.

f) Executive Summary:

A bird's eye view of your entire presentation has to be precisely offered under this category.

g) Introduction on the Company:

A concise representation of company/ organization defining its scope, products/ services.

h) Your Role in the Organization during the On Job Training:

The key aspects handled, the department under which you were deployed and brief Summary report duly acknowledged by the reporting head.

i) Challenges:

The challenges confronted while churning out theoretical knowledge into practical world.

j) Conclusion:

A brief overview of your experience and suggestions to bridge the gap between theory and practice.

Evaluation Pattern: On Job Training

Evaluation of On Job Training will be done at the end of semester for 100 marks.

Evaluation / Marking Scheme:

Sr. No.	Criteria	Marks
1	OTT Report	30
2	Content Understanding	15
3	Application Learning	15
4	Reflection and Critical thinking	15
5	Writing and presentation	15
6	Overall performance	10
	Total Marks	**100**

Format

1st page (Main Page)

Title of the problem of the Project

A Project Submitted to

R. P. Gogate college of Arts and Science and

R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri

Under

University of Mumbai

For partial completion of the degree of

Bachelor of Science (Biochemistry)

Under the Faculty of Science

By

Name of the Student

Under the Guidance of

Name of the Guiding Teacher

R. P. Gogate college of Arts and Science and

R.V. Jogalekar College of Commerce (Autonomous),

Near District Court, Ratnagiri

Month and Year

Index

DECLARATION BY LEARNER

I undersigned, Ms / Mr._____ [Name of the learner] hereby declare that work embodied in this project work titled _____ forms my own contribution to the research work carried out under the guidance of _____ [Name of the guiding teacher] is a result of my own research work and has not been previously submitted to any other Universityfor any other Degree/ Diploma to this or any other University. Wherever reference has been made to previous works of others, it has been clearly indicated as such and included in the bibliography. I, hereby further declare that all information of this document has been obtained and presented in accordance with academic rules and ethical conduct.

Name and Signature of the learner

Certified by

Name and signature of the Guiding Teacher

On separate page

Acknowledgement

I would like to express my sincere gratitude to all those who have supported and guided me throughout the course of this project.

First and foremost, I would like to express sincere gratitude to my project guide, **[Project Guide's Name]**, for his/her invaluable guidance, encouragement, and insightful feedback throughout this project. His/ her expertise and support has been instrumental in shaping the direction and quality of this project.

My heartfelt thanks go to R. P. Gogate college of Arts and Science and R.V. Jogalekar College of Commerce (Autonomous), Ratnagiri for their generous support and resources, without which this project would not have been possible.

I would like to thank the principal of the college Dr. Makarand Sakhalkar for providing necessary facilities for completion of this project.

Finely, I would like to thank each and every person who directly or indirectly supported and encouraged me especially my family and friends in completion of this project. Their support has been a source of strength and motivation.

[Your Name]
[Date]

Signature of Chairperson BOS

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
R.P.Gogate College of Arts and Science
R.V.Jogalekar College of Commerce
Ratnagiri-415612