Academic Council Meeting No. and Date: 10 / April 26, 2025

Agenda Number: 3 **Resolution Number: 46, 47 / 3.1, 3.6**

Vidya Prasarak Mandal's
B. N. Bandodkar College of Science
(Autonomous), Thane

Syllabus for

Programme Code: BUBC

Programme: Bachelor of Science

Specific Programme: Biochemistry

[T.Y.B.Sc. Biochemistry]

LEVEL 5.5

Choice Based Grading System

Revised under NEP and Autonomy

From academic year 2025-26

Preamble

Biochemistry forms the foundation of understanding life at the molecular level and serves as a bridge between basic biological sciences and their applied domains. In the Third Year of the B.Sc. Biochemistry programme (Level 5.5), learners advance from fundamental concepts acquired in earlier years to an in-depth and application-oriented understanding of biochemical processes governing metabolism, genetics, immunology and molecular biology. This stage of the programme aims to strengthen conceptual clarity while fostering analytical thinking, experimental competence and professional preparedness.

At this level, students are exposed to core metabolic pathways, including carbohydrate, lipid, amino acid and protein metabolism, enabling them to correlate biochemical reactions with physiological states and metabolic disorders. Advanced topics in cell signalling, gene expression, recombinant DNA technology, immunology, and bioenergetics equip learners with a comprehensive understanding of cellular regulation and molecular mechanisms underlying health and disease. The programme emphasizes advanced analytical techniques, including electrophoresis, spectroscopy, chromatography, molecular diagnostic tools and immunological assays, preparing students for laboratory-based careers in research, diagnostics, pharmaceuticals, biotechnology and allied industries. Discipline Specific Electives such as Virology and Cancer Biology, Environmental Toxicology, Pharmacology, Ecology and Climate Change allow learners to explore interdisciplinary and emerging areas relevant to societal and environmental challenges.

Skill development is a central focus of the TYBSc curriculum. Through Vocational and Skill Enhancement Courses, learners gain exposure to clinical biochemistry, advanced biostatistics, data analysis and interpretation of laboratory and field data. Extensive practical training, laboratory visits, industry exposure and hands-on experimentation ensure experiential learning and reinforce the application of theoretical knowledge. In alignment with the National Education Policy (NEP), the programme integrates field projects / on-job training, enabling students to implement biochemical concepts in real-life scenarios and enhancing their employability.

Thus, the T.Y.B.Sc. Biochemistry programme is designed to produce competent graduates with strong scientific foundations, practical proficiency, ethical awareness, and confidence to pursue higher education, research, entrepreneurship, or careers in industry, healthcare, and environmental sciences.

Sayali Daptardar

Chairperson, BOS

PROGRAMME OUTCOMES (POs) OF BACHELOR OF SCIENCE (B. Sc.)

The Undergraduate Programmes of Science are intended to cater quality education and attain holistic development of learners through the following programme outcomes:

PO1 - Disciplinary Knowledge

Lay a strong foundation of conceptual learning in science. Instil ability to apply science in professional, social and personal life.

PO2 - Inculcation of Research Aptitude

Ignite spirit of inquiry, critical thinking, analytical skills and problem-solving approach which will help learners to grasp concepts related to research methodology and execute budding research ideas.

PO3 - Digital Literacy

Enhance ability to access, select and use a variety of relevant information e-resources for curricular, co-curricular and extracurricular learning processes.

PO4 - Sensitization towards Environment

Build a cohesive bond with nature by respecting natural resources, encouraging eco-friendly practices and creating awareness about sustainable development.

PO5 - Individuality and Teamwork

Encourage learners to work independently or in collaboration for achieving effective results through practical experiments, project work and research activities.

PO6 - Social and Ethical Awareness

Foster ethical principles which will help in developing rational thinking and becoming socially aware citizens. Build an attitude of unbiased, truthful actions and avoid unethical behaviour in all aspects of life.

Eligibility: Studied Biochemistry as Major at level 5.0
Degree Program: B.Sc.
Duration: 1 Year (includes SEM V and SEM VI)
Mode of Conduct: Offline (Offline lectures & Laboratory Practicals), Online courses
Total Credits for the Program: 132
Specific Programme: T. Y. B. Sc. Biochemistry (Major)

Discipline/Subject: Biochemistry

Program Specific Outcomes

By the end of the program, the students will be able to:

PSO1	Explain the structure, properties, and functions of biomolecules and describe fundamental biochemical pathways and their regulation.	L1
PSO2	Relate biochemical concepts to allied fields such as molecular biology, biotechnology, microbiology, and clinical biochemistry, and apply knowledge to real-world applications such as diagnostics, industry, and environmental science.	L2
PSO3	Analyse biochemical data, interpret experimental results, troubleshoot laboratory problems, and apply biochemical principles to describe metabolic disorders or physiological processes.	L3
PSO4	Demonstrate competence in standard biochemical laboratory techniques, including preparation of buffers, quantification of biomolecules, enzyme assays, chromatography, and spectrophotometric analyses.	L4
PSO5	Demonstrate effective scientific communication skills, work collaboratively in laboratory and project settings, and exhibit professional ethics, safety awareness, and responsibility.	L5
PSO6	Design basic experiments, follow ethical research practices, maintain accurate laboratory records, and prepare scientific reports or presentations based on literature and experimental findings.	L6

Pedagogy: Constructivism, Flipped Classroom, Collaborative Learning, Integrative approach, Enquiry based learning

Assessment: Weightage for assessments (in percentage) For Major and Minor

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	**40 %**	**60 %**

VPM's B. N. Bandodkar College of Science (Autonomous), Thane

T. Y. B. Sc. (Biochemistry)

Structure of Programme

Semester V

Course code	Unit	Topics	Credits	Lectures
Discipline Specific Course (DSC) Major in Biochemistry				
25BUBC5T01	Biochemistry of Metabolism I			
	I	Carbohydrate Metabolism	2	15
	II	Bioenergetics & Oxidative Phosphorylation		15
25BUBC5T02	Cell Signalling & Chromatography			
	I	Cell Signalling	2	15
	II	Chromatography		15
25BUBC5T03	Fundamentals of Genetics I			
	I	Transcription in Prokaryotes & Eukaryotes	2	15
	II	Mutation & Repair		15
25BUBC5P01	Practicals based on 25BUBC5T01		6	180
25BUBC5P02	Practicals based on 25BUBC5T02			
25BUBC5P03	Practicals based on 25BUBC5T03			
Discipline Specific Elective (DSE) in Biochemistry Note: Students will select 25BUBC5TE1 (Credit 2) and 25BUBC5PE1 (Credit 2) OR 25BUBC5TE2 (Credit 2) and 25BUBC5PE2 (Credit 2)				
25BUBC5TE1	Virology, Cancer & Diagnostic Immunology		2	30

25BUBC5PE1	**Practicals based on 25BUBC5TE1**	**2**	**60**
OR			
25BUBC5TE2	**Environmental Pollutants & Toxicology**	**2**	**30**
25BUBC5PE2	**Practicals based on 25BUBC5TE2**	**2**	**60**
Vocational and Skill Enhancement Course (VSEC)			
25BUBC5VSC	**Clinical Biochemistry**	**1**	**15**
	Practicals based on 25BUBC5VSC	**1**	**30**
OJT / FPR			
25BUBC5OJT / 25BUBC5FPR	**On Job Training in Biochemistry I / Field Project in Biochemistry III**	**2**	**60**

Semester VI

Course code	Unit	Topics	Credits	Lectures
Discipline Specific Course (DSC) Major in Biochemistry				
25BUBC6T01	Biochemistry of Metabolism II			
	I	Lipid Metabolism	2	15
	II	Amino acid & Protein Metabolism		15
25BUBC6T02	Advanced Analytical Techniques			
	I	Advanced Instrumentation	2	15
	II	Fundamentals and applications of RDT		15
25BUBC6T03	Fundamentals of Genetics II			
	I	Translation in Pro & Eukaryotes	2	15
	II	Regulation of Gene Expression		15
25BUBC6T04	Immunology			
	I	Essentials of Immunology	2	15
	II	Vaccines		15
25BUBC6P01	Practicals based on 25BUBC6T01		6	180
25BUBC6P02	Practicals based on 25BUBC6T02			
25BUBC6P03	Practicals based on 25BUBC6T03 & 25BUBC6T04			

Discipline Specific Elective (DSE) in Biochemistry Note: Students will select 25BUBC6TE1 (Credit 2) and 25BUBC6PE1 (Credit 2) OR 25BUBC6TE2 (Credit 2) and 25BUBC6PE2 (Credit 2)			
25BUBC6TE1	**Pharmacology**	**2**	**30**
25BUBC6PE1	**Practicals based on 25BUBC6TE1**	**2**	**60**
OR			
25BUBC6TE2	**Ecology & Climate Change**	**2**	**30**
25BUBC6PE2	**Practicals based on 25BUBC6TE2**	**2**	**60**
Vocational and Skill Enhancement Course (VSEC)			
25BUBC6VSC	**Advanced Biostatistics**	**1**	**15**
	Practicals based on 25BUBC6VSC	**1**	**30**
OJT / FPR			
25BUBC6OJT / 25BUBC6FPR	**On Job Training in Biochemistry II / Field Project in Biochemistry IV**	**2**	**60**

Semester V

Course Code 25BUBC5T01	Course Title Biochemistry of Metabolism I	Credits 2	No. of lectures

CO1	Analyze major catabolic pathways—glycolysis, pyruvate oxidation, Krebs cycle, glyoxylate pathway, and glycogenolysis—with emphasis on their energetics and physiological significance.	L4
CO2	Describe the HMP shunt, cori cycle, glucose-alanine cycle, gluconeogenesis, and associated cycles in carbohydrate metabolism and assess the physiological importance of carbohydrate metabolic pathways and their link to metabolic disorders.	L2
CO3	Apply knowledge of bioenergetics to interpret free energy changes, electron transport chain mechanisms, and the impact of inhibitors.	L3
CO4	Explain and analyze cellular energy transfer mechanisms, including shuttle systems and oxidative phosphorylation, associated mitochondrial disorders, and the phenomenon of bioluminescence with its applications.	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**0**	**1**	**0**	**0**	**0**
CO2	**3**	**0**	**1**	**0**	**0**	**0**
CO3	**3**	**0**	**1**	**0**	**0**	**0**
CO4	**3**	**0**	**1**	**0**	**0**	**0**

Unit I Carbohydrate Metabolism	1. Catabolism – Cellular location, sequence of reactions, labelling of carbon atoms, and energetics of: Glycolysis, (aerobic and anaerobic); Fate of Pyruvate, Rapoport- Luebering Cycle 2. Oxidation of pyruvate, PDH complex reactions, Krebs cycle; Glyoxylate pathway; Glycogenolysis – [schematic – no structures, but with enzymes and coenzymes] 3. Anabolism – HMP shunt & its Importance (Cellular location, sequence of reactions, multifunctional nature); Gluconeogenesis, Cori cycle, Glucose alanine cycle 4. Glycogenesis – [schematic – no structures, but with enzymes and coenzymes] Metabolism of different sugars - starch fructose and cellulose 5. Disorders of carbohydrate metabolism: Lactose Intolerance, Lactic Acidosis	**15**

Unit II Bioenergetics & Oxidative Phosphorylation	1. Bioenergetics: Concept of free energy; Respiratory electron transport chain – Carriers (basic chemistry, redox potentials, orientation on the membrane, sequence); Reaction of the Electron transport chain, Q cycle in Complex III 2. Inhibitors of electron transport – Antimycin A, Amytal, Rotenone, CN, Azide, CO 3. Malate-Aspartate shuttle, Glycerol phosphate shuttle, Creatine Phosphate shuttle 4. Oxidative phosphorylation – Chemiosmotic hypothesis, Proton motive force; Structure of ATP synthase, Uncoupler of ETC and Oxidative phosphorylation [DNP], Significance of uncoupling, Diseases associated with mitochondria 5. Bioluminescence. Phenomenon (in jellyfish and fireflies) and significance, applications of Bioluminescence	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Lehninger's Principles of Biochemistry - Nelson & Cox	6th	2012
2	Fundamentals of Biochemistry - Voet & Voet	4th	2010
3	Zubay's Principles of Biochemistry- Rastogi & Aneja	5th	2017
4	Biochemistry – David E. Metzler	3rd	2001
5	Textbook of Biochemistry for Medical Students- Vasudevan	9th	2019

Course Code 25BUBC5T02	Course Title Cell signalling & Chromatography	Credits 2	No. of lectures

CO1	Describe cellular signaling mechanisms, including modes of signaling, extracellular messengers, receptor types, and second messenger systems with their functional roles	L2
CO2	Analyze major signal transduction pathways, including GPCR, RTK, JAK/STAT, and MAPK and their links to disease	L4
CO3	Summarize the principles and applications of planar and column chromatography for biomolecule separation	L2
CO4	Apply the principle of advanced chromatographic techniques for biomolecule quantification and purification	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**0**	**0**	**0**
CO2	**3**	**1**	**1**	**0**	**0**	**0**
CO3	**3**	**1**	**1**	**0**	**0**	**0**
CO4	**3**	**1**	**1**	**0**	**0**	**0**

Unit I **Cell Signalling**	1. Cellular Signaling: General principles of signaling by cell surface receptors, endocrine, paracrine and autocrine signaling, components of intracellular signal-transduction pathways, types of cellular responses induced by signaling molecules. 2. Extracellular messengers- amino acids and their derivatives, peptides and proteins, gases, steroids, and eicosanoids. Receptors: GPCRs, RTKs, ligand-gated channels, intracellular receptors, and others. 3. Second messengers: cAMP, cGMP, IP3, diacylglycerol and Ca –their role and associated proteins 4. G-protein coupled receptor system: Mechanism of activation of effector molecules; Action of glucagon and epinephrine Examples of physiologic processes mediated by GPCRs that activate phospholipase C, and GPCRs that regulate ion channels. 5. Signaling of insulin/EGF via activation of RTKs. Cytokine/growth hormone signaling via JAK/STAT pathway. Ras proteins- MAPK pathway Diseases related to defects in signaling pathways	**15**

Unit II Chromatography	1. Chromatography Principle, Technique and Applications of the following kinds of chromatography: a. Partition chromatography (Paper), b. Adsorption Chromatography (TLC and column); c. Ion exchange chromatography, d. Affinity chromatography e. Gel filtration 2. Basic principles and applications of GLC, HPLC, HPTLC 3. Numerical problems based on above concept	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Molecular Biology of the Cell - Bruce Alberts	6th	2015
2	Cell and Molecular Biology: Concepts and Experiments- Gerard Karp	6th	2009
3	Molecular Cell Biology - Harvey Lodish	8th	2016
4	Harper's Illustrated Biochemistry- Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell	26th	2003
5	Biophysical Chemistry - Upadhyay & Nath	1st	2009
6	Principles and Techniques of Biochemistry and Molecular Biology- Wilson & Walker	7th	2010

Course Code 25BUBC5T03	Course Title Fundamentals of Genetics I	Credits 2	No. of lectures

CO1	Describe the mechanisms of transcription in prokaryotes and eukaryotes, highlighting the role of RNA polymerases, promoter recognition, and unique features such as sigma factor, TATA box, split genes, and reverse transcription	L2
CO2	Analyze post-transcriptional RNA processing events—including splicing, capping, polyadenylation, and maturation of rRNA and tRNA—and evaluate the impact of transcriptional inhibitors on gene expression	L4
CO3	Distinguish the types of mutations—including point, structural, numerical, spontaneous and induced—and interpret their detection methods	L4
CO4	Compare diverse DNA repair pathways such as direct repair, photoreactivation, excision, mismatch, recombination, NHEJ, and SOS repair	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**0**	**1**	**0**	**0**	**0**
CO2	**3**	**0**	**1**	**0**	**0**	**0**
CO3	**3**	**1**	**1**	**0**	**0**	**0**
CO4	**3**	**1**	**1**	**0**	**0**	**0**

Unit I Transcription in Pro & Eukaryotes	1. Transcription- prokaryotic RNA polymerases- role of sigma factor., promoter, closed and open promoter complexes- initiation, elongation and termination of transcription 2. Transcription- eukaryotic RNA polymerases, TATA box, initiation, elongation and termination of transcription 3. Prokaryotes and eukaryotes - concept of split genes, reverse transcription 4. Post-transcriptional processing; maturation of rRNA & tRNA, RNA splicing mechanism, poly A tail and 5 capping, noncoding sequences 5. Inhibitors of transcription - Rifampicin, Actinomycin D	**15**

Unit II Mutation & Repair	1. Mutations: point and its types (Transition, transversion, missense, nonsense, neutral, silent, frameshift mutation) 2. Reverse and suppressor mutation, Spontaneous and induced mutations, Gross- structural (deletion, duplication, inversion, translocation, insertion) 3. Numerical (euploidy, aneuploidy), Detecting mutations (Visible, nutritional, conditional and resistant mutants) 4. DNA repair: Direct, Photoreactivation, O6 methyl guanine, DNA methyltransferase, Excision repair- Base, Nucleotide excision, Mismatch repair, Recombination repair, NHEJ Repair, SOS-error prone repair	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	iGenetics: A molecular approach - Russell	3rd	2016
2	Genetics: A Conceptual Approach - Benjamin Pierce	6th	2016
3	Cell Biology, Genetics, Molecular Biology, Evolution and Ecology - Verma and Agarwal	1st	2015
4	Cell and Molecular Biology: Concepts and Experiments- Gerard Karp	6th	2009
5	Principles of Genetics – Robert H. Tamarin	7th	2001

Course Code 25BUBC5P01	Course Title Practicals based on 25BUBC5T01	Credits 2	No. of lectures

CO1	Plan and perform extraction of starch from plant sources and estimation by Willstater's methods	L5
CO2	Estimate sugars by Folin-Wu and GOD-POD methods	L6
CO3	Evaluate phosphorus content by using Fiske Subbarao method and sugars by Cole's and Benedict's methods	L5
CO4	Determine reducing sugars by Nelson-Somogyi method and isolate bioluminescent organisms and assess their significance in biological systems and research applications	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**1**	**1**	**3**	**1**
CO2	**1**	**3**	**1**	**1**	**3**	**1**
CO3	**1**	**3**	**1**	**0**	**3**	**1**
CO4	**1**	**3**	**1**	**0**	**3**	**1**

25BUBC5P01	1. Estimation of sugar by Folin-Wu method 2. Estimation of phosphorus by Fiske and Subbarao method 3. Estimation of glucose by Benedict's method 4. Extraction of starch from plant source 5. Estimation of sugar by Cole's method 6. Estimation of starch by Willstater's method 7. Glucose by GOD-POD Method 8. Determination of reducing sugars by Nelson -Somogyi method 9. Isolation of bioluminescent organisms	**60**

Course Code **25BUBC5P02**	**Course Title** **Practicals based on 25BUBC5T02**	**Credits** **2**	**No. of lectures**

CO1	Assess chromatography techniques to separate and analyze complex mixtures of biomolecules, such as proteins, amino acids, or sugars	L5
CO2	Plan and perform qualitative and quantitative estimation of phospholipid using Bartlette's method and investigate galactose transport in microorganisms	L6
CO3	Conduct two-dimensional ascending paper chromatography to separate and identify amino acids and sugars in a given sample	L6
CO4	Explain the use of laboratory instruments and analytical tools during the visit to the instrumentation laboratory	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**3**	**1**	**1**	**3**	**1**
CO2	**1**	**3**	**1**	**1**	**3**	**1**
CO3	**1**	**3**	**1**	**1**	**3**	**1**
CO4	**1**	**3**	**1**	**0**	**3**	**1**

25BUBC5P02	1. Estimation of phospholipid by Bartlette's method (Lecithin/Cephalin) 2. To study galactose transport in micro-organism 3. Separation of sugars by circular paper chromatography 4. Identification of Synthetic food colour by using chromatography 5. Separation of amino acids by ascending chromatography 6. Separation and purify components of a mixture using column chromatography. 7. Two-dimensional Ascending paper chromatography of amino acids 8. Two-dimensional Ascending paper chromatography of sugars 9. Visit to the instrumentation laboratory (HPLC, HPTLC, GLC)	**60**

Course Code 25BUBC5P03	Course Title Practicals based on 25BUBC5T03	Credits 2	No. of lectures

CO1	Inspect the effects of UV radiation on DNA, plot survival curves and study repair mechanisms	L5
CO2	Plan and perform UV-induced mutagenesis leading to antibiotic resistance	L5
CO3	Test the isolates for being mutants using replica plate and gradient plate techniques	L5
CO4	Estimate DNA and RNA using colorimeter methods to quantify nucleic acid and relate the nucleic acid related studies with practical application through visits to genetic diagnostic centers	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**1**	**2**	**3**	**1**
CO2	**1**	**3**	**1**	**2**	**3**	**1**
CO3	**1**	**3**	**1**	**1**	**3**	**1**
CO4	**1**	**3**	**1**	**1**	**3**	**1**

25BUBC5P03	1. Effect of UV on DNA with respect to time of exposure and distance 2. UV survival curve determination of exposure time leading to 90% reduction 3. Study of dark repair mechanism of bacteria in response to DNA damage by UV 4. UV Mutagenesis leading to antibiotic resistance 5. Estimation of DNA by DPA method 6. Estimation of RNA by Orcinol method 7. Replica plate technique for mutant isolation 8. Isolation of dye resistant mutants by Gradient plate technique 9. Visit to Genetic diagnostic center	**60**

Course Code 25BUBC5TE1	**Course Title Virology, Cancer biology & Diagnostic Immunology**	**Credits 2**	**No. of lectures**

CO1	Explain basic virology and diagnostic methods, structure and pathogenesis of major viruses and of viroids and prions	L2
CO2	Describe cancer cell biology, causes and carcinogens, viral roles in cancer, and basics of antiviral chemotherapy	L2
CO3	Discuss the principles and types of antigen–antibody reactions, including precipitation and agglutination techniques, and their applications in immunological analysis	L5
CO4	Explain the principles and applications of immunodiagnostic techniques including complement fixation, immunoassays, blotting, immunofluorescence, and flow cytometry	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**0**	**1**	**1**
CO3	**1**	**3**	**1**	**0**	**1**	**1**
CO4	**1**	**3**	**1**	**0**	**1**	**1**

Unit I Virology & Cancer	1. Introduction to virology, Diagnostic methods in Virology: Purification, Cultivation, Enumeration, Detection. 2. Viroid and Prions, Structure and Pathophysiology of viruses: AIDS, Dengue, Influenza, T4, TMV 3. Biology of Cancer, Physiology of Cancer cells 4. Causes of cancer Carcinogens: Types (Physical, Chemical and Biological, Environmental Factor); AMES test 5. Role of viruses in cancer: Viral oncogenes, Examples of viruses involved in cancers: EB, HPV, HBV, Kaposi's Sarcoma 6. Antiviral chemotherapy	**15**

Unit II Diagnostic Immunology	1. Antigen-Antibody Reactions: properties and types-Precipitation Reactions: Immunoprecipitation, Immuno-electrophoresis, CIEP, Rocket Electrophoresis and 2-D Immuno-electrophoresis 2. Agglutination Reactions: Hemagglutination, Bacterial agglutination, Passive agglutination, Agglutination Inhibition 3. Complement Fixation Tests, RIA, ELISA, ELISPOT, Western Blot, Immunofluorescence, Flow Cytometry	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Prescott's Microbiology- Willey, Sherwood, Woolverton	10th	2016
2	Microbiology - Pelczar Michael J.; Chan Jr., E.C.S. , Krieg ,Noel R.	5th	2002
3	Foundations in Microbiology - Talaro & chess	8th	2001
4	Fundamental Principles of Bacteriology	2nd	1973
5	Kuby’s Immunology- Kindt, Osborne, Goldsby	6th	2006
6	Roitt’s Essential Immunology - Delves	11th	2010
7	Janeway’s Immunobiology - Murphy & Weaver	9th	2017

Course Code 25BUBC5PE1	**Course Title Practicals Based on 25BUBC5TE1**	**Credits 2**	**No. of lectures**

CO1	Compare immunological techniques such as Ouchterlony and Mancini's methods to detect and quantify antigen-antibody interactions	L5
CO2	Inspect diagnostic outcomes from forward and reverse blood typing to confirm blood group identity	L4
CO3	Interpret WIDAL test for confirming O and H antigens of Salmonella in clinical samples	L5
CO4	Evaluate the role of diagnostic centers and cancer research laboratories in applying immunological and molecular techniques for disease detection	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**3**	**1**	**0**	**3**	**1**
CO2	**1**	**3**	**1**	**0**	**3**	**1**
CO3	**1**	**3**	**1**	**0**	**3**	**1**
CO4	**1**	**3**	**1**	**0**	**3**	**1**

1. Phage assay (Demo)
2. Visit to Cancer research Laboratory
3. Ouchterlony's method for understanding similarity between antigens.
4. Identifying concentration of unknown antigen using Mancini's method.
5. Identification of Blood group by Forward typing
6. Identification of Blood group by Reverse typing
7. Confirmation of O & H antigen of Salmonella by WIDAL.
8. Visit to a Diagnostic Center
9. Analysis of Precipitation Curve Using Electrophoresis for Protein Characterization.

60

Course Code 25BUBC5TE2	Course Title Environmental Pollution & Toxicology	Credits 2	No. of lectures

CO1	Identify major types of environmental pollution and apply principles of air, water, and soil monitoring to evaluate their significance	L3
CO2	Summarize key environmental laws in India and apply the Twelve Principles of Green Chemistry to promote sustainable practices	L2
CO3	Explain general principles of toxicology, properties and diversity of natural toxins and venoms, and interpret their major sites and mechanisms of toxic action including acute and organ toxicity	L2
CO4	Apply knowledge of toxins and venoms to understand therapeutic uses and evaluate applications of toxicology in forensic, cosmetic, clinical, occupational, and industrial contexts	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**3**	**0**	**1**
CO2	**3**	**1**	**1**	**3**	**0**	**1**
CO3	**3**	**1**	**1**	**3**	**0**	**1**
CO4	**3**	**1**	**1**	**3**	**0**	**1**

Unit I Environmental Pollution	1. Types of pollution:Water pollution: Pesticides and heavy metals, Air pollution: Challenges posed by present day pollutants, Soil Pollution, Noise and nuclear pollution. 2. Environmental monitoring: Approaches used to monitor the environment-air, water and soil. [Principles and Significance only. Protocols for each factor – not required] 3. Environmental laws in India: Wildlife Protection Act, 1972, Water Prevention & Control of Pollution Act, 1974, Air Prevention & Control of Pollution Act, 1981, Environment Protection Act, 1986 & Biological Diversity Act, 2002 4. The Twelve Principles of Green Chemistry	**15**
Unit II Toxicology	1. General Principles of Toxicology 2. Properties and Effects of Natural Toxins, Poisons and Venoms, Molecular & Functional Diversity of Natural Toxins and Venoms	**15**

	3. Major Sites and Mechanisms of Toxic Action 4. Toxins in Unicellular Organisms, Higher Plants, Animal Venoms and Toxins, Toxin and Venom Therapy 5. Toxicity a. Acute Toxicity- Introduction, Acute Exposure and Effect, Dose-response Relationships, Mechanisms of Acute Toxicity b. Organ toxicity 6. Applications of toxicology: forensic, cosmetics, clinical and occupational health and industrial hygiene	

Course Code 25BUBC5PE2	**Course Title Practicals Based on 25BUBC5TE2**	**Credits 2**	**No. of lectures**

CO1	Analyze standard methods to assess physico-chemical properties of environmental water samples	L4
CO2	Evaluate physicochemical and microbiological parameters of soil and air	L5
CO3	Interpret results from chemical estimation methods to assess the presence and impact of toxic substances	L5
CO4	Plan and perform analytical techniques to estimate methanol, cyanide, arsenic and alcohol concentrations in given samples	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**3**	**1**	**3**	**3**	**1**
CO2	**1**	**3**	**1**	**3**	**3**	**1**
CO3	**1**	**3**	**1**	**3**	**3**	**1**
CO4	**1**	**3**	**1**	**3**	**3**	**1**

	1. Study of Physico-chemical properties of sewage/ effluent water: conductivity,turbidity 2. Determination of pH and temperature of water sample. 3. Visit to the waste management plant. 4. Determination of Air Pollution tolerance index	**60**

	5. Study of soil microflora and determination of sedimentation rate. 6. Determination of hardness of water 7. Study of physical properties of soil: pH, Temperature, moisture, & texture of soil. 8. Measurement of intensity of light by Lux meter in various fields. 9. Determine the TDS of water. 10. Study of Chemical properties of soil 11. Estimation of Methanol in the given sample using Chromotropic Acid Method. 12. Estimation of Cyanide in the given sample using Pyridine-Barbituric Acid Method 13. Estimation of Arsenic (As^{3+}) by Iodometric Titration Method 14. Extraction of Toxins from plants. (Soxhlet Extraction) 15. Qualitative Phytochemical analysis of plant toxin 16. Antifeedant activity of plant toxin on larva by leaf dip assay 17. Case study on toxicity and poisoning. 18. Visit to toxicity testing lab 19. Estimation of alcohol by potassium dichromate method	

References

Sr. No.	Title & Author	Edition	Published in
1	Environmental Biotechnology: Basic Concepts and Applications - Indu Shekar Thakur	2nd	2011
2	Biotechnology - B.D. Singh	4th	2012
3	A Textbook of Biotechnology- R.C. Dubey	4th	2012
4	Casarett & Doull's Essentials of Toxicology - Klaassen	3rd	2015
5	Environmental Biotechnology - T. Srinivas	1st	2008

Course Code 25BUBC5VSC	Course Title Clinical Biochemistry	Credits 2	No. of lectures

CO1	Explain the biochemical principles behind various diagnostic organ function tests & interpret the diagnostic significance of enzymes in assessing organ dysfunction	L2
CO2	Describe the pathophysiology and biochemical classification of common hematological diseases	L2
CO3	Evaluate blood parameters including glucose tolerance, bilirubin, and hemoglobin content	L5
CO4	Examine physiological tests such as urea clearance and gastric juice analysis and assess organ function test reports to solve clinical problems	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**0**	**0**	**0**
CO2	**3**	**1**	**1**	**0**	**0**	**0**
CO3	**2**	**3**	**1**	**0**	**3**	**1**
CO4	**2**	**3**	**1**	**0**	**3**	**1**

Clinical Biochemistry	1. Basic concepts of Clinical Biochemistry: Scope of clinical biochemistry 2. Diagnostic importance of enzymes: Biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, alkaline phosphatase, Creatine kinase, cholinesterase, LDH, Acid phosphatase, Gamma Glutamic Transpeptidase 3. Organ function tests: Kidney function tests -Urea, creatinine, urea clearance test, creatinine clearance test, Liver function test, Gastric function test 4. Abnormal hemoglobin & Haemoglobinopathies: Sickle Cell Anemia, Thalassemia, Polycythaemia, Aplastic anemia -definition, Pathophysiology, classification -morphologic and Etiologic classification and clinical features	**15**
	1. Glucose tolerance test 2. Interpretation of Organ Function Test reports and Problems based on them 3. Estimation of bilirubin in blood sample to detect jaundice 4. Urea Clearance Test 5. Estimation of Hemoglobin by Drabkin's Method 6. Gastric juice analysis - Estimation Of Total Free Acidity 7. Visit to pathology lab	**30**

References

Sr. No.	Title & Author	Edition	Published in
1	Textbook of Medical Biochemistry- M. N. Chatterjea & Rana Shinde	8th	2011
2	Biochemistry - U. Satyanarayana & U. Chakrapani	4th	2013
3	Clinical Biochemistry - Michael J. Murphy, Rajeev Srivastava & Kevin Deans	7th	2023
4	Textbook of Biochemistry for Medical Students- Vasudevan	9th	2019

Course Code 25BUBC5OJT	Course Title On Job Training in Biochemistry I	Credits 2	No. of lectures

CO1	Apply core biochemistry concepts and laboratory/field techniques during on-the-job training at a recognized professional organization.	L3
CO2	Plan and execute assigned professional tasks responsibly, following standard operating procedures, safety norms, and ethical practices.	L6
CO3	Analyze and interpret observations and data generated during training using appropriate scientific reasoning and basic analytical tools.	L4
CO4	Elaborate on training outcomes effectively through a structured document, visual and oral presentation, and viva demonstrating professional competence.	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**3**	**1**	**3**	**3**
CO2	**1**	**3**	**3**	**1**	**3**	**3**
CO3	**1**	**3**	**3**	**1**	**3**	**3**
CO4	**1**	**3**	**3**	**1**	**3**	**3**

On Job Training in Biochemistry I	The learner is required to undergo on-the-job training at a recognized professional institute or organization related to the field of Biochemistry. During this training, the learner is expected to develop practical, field-based skills and gain experience in professional planning, execution and analysis of activities carried out by the organization. The learner must complete a total of 60 hours of training. As part of the assessment, the learner will be required to document the outcomes and logically interpret observations through a written report, visual and oral presentation and viva.	**60**

OR

Course Code 25BUBC5FPR	Course Title Field Project in Biochemistry III	Credits 2	No. of lectures

CO1	Apply fundamental principles of biochemistry to address real-life problems in healthcare, environmental sustainability, food and nutrition, agriculture or biotechnology through a field-based project.	L3
CO2	Plan and perform appropriate experimental or field methodologies in laboratories following safety and ethical guidelines.	L6
CO3	Analyze and interpret experimental or field data logically using scientific reasoning to draw valid conclusions.	L4
CO4	Build a report on project objectives, methods, results, and implications effectively through a structured written document, audio-visual presentation, oral presentation and viva.	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**3**	**1**	**3**	**3**
CO2	**1**	**3**	**3**	**1**	**3**	**3**
CO3	**1**	**3**	**3**	**1**	**3**	**3**
CO4	**1**	**3**	**3**	**1**	**3**	**3**

Field Project in Biochemistry III	The learner will be engaged in a field project designed to apply fundamental principles of Biochemistry to real-life challenges in areas such as healthcare, environmental sustainability, food and nutrition, agriculture and biotechnology. This can be taken up in department laboratory or laboratories of any research institute. The assessment will evaluate the learner's ability to logically analyze and interpret results and to clearly present findings through a written report, audio-visual aids, oral presentation and viva.	**60**

Semester VI

Course Code 25BUBC6T01	Course Title Biochemistry of Metabolism II	Credits 2	No. of lectures

CO1	Describe the process of fatty acid oxidation and its role in energy production	L2
CO2	Interpret lipid biosynthesis and ketone metabolism to explain energy production during fasting, metabolic disorders and inborn errors of lipid metabolism	L2
CO3	Apply knowledge of amino acid reactions—including transamination, decarboxylation, and deamination—to interpret the formation of key biomolecules such as GABA, serotonin, and melatonin, and distinguish glucogenic from ketogenic amino acids in metabolic pathways	L3
CO4	Explain ammonia detoxification, urea cycle regulation, and metabolic disorders linked to amino acid catabolism	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**0**	**1**	**0**	**0**	**0**
CO2	**3**	**0**	**1**	**0**	**0**	**0**
CO3	**3**	**0**	**1**	**0**	**0**	**0**
CO4	**3**	**0**	**1**	**0**	**0**	**0**

Unit I Lipid Metabolism	1. Catabolism - Knoop's experiment; Fatty acid Oxidation: transport to mitochondria, activation of fatty acids, Role of carnitine 2. Beta oxidation of even carbon saturated fatty acids (C4 to C20) & its Energetics, Oxidation of odd numbered fatty acids – fate of propionate, ω oxidation and α oxidation , Oxidation of unsaturated fatty acids 3. Anabolism – Fatty acid biosynthesis (palmitic acid), FAS complex Enzymes, Biosynthesis of unsaturated fatty acids 4. Ketone body formation, utilization, and the physiological significance of Ketone bodies in Diabetes mellitus, Starvation, Pregnancy and Alcoholism 5. Inborn errors of lipid metabolism: Tay Sach's disease, Zellweger syndrome	**15**

Unit II Amino Acid & Protein Metabolism	1. Reactions of amino acids – Transamination [GOT/GPT and mechanism of transamination]; Decarboxylation [His, Trp, Glu, and mechanism of decarboxylation], Deamination [oxidative – NAD(P) linked dehydrogenases and D & L - Amino acid oxidases, non-oxidative – Asp, Cys, Ser] 2. Formation & Significance of GABA, serotonin, melatonin. Glucogenic and ketogenic amino acids 3. Meister cycle, Detoxification of ammonia, Urea cycle – Cellular location, sequence of reactions, Regulation 4. Disorders of amino acid metabolism- Albinism, Phenylketonuria, Maple syrup urine disease	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Outlines of Biochemistry - Conn & Stumpf	5th	2009
2	Lehninger's Principles of Biochemistry - Nelson & Cox	6th	2012
3	Principles of Biochemistry- Voet & Voet	4th	2010
4	Fundamentals of Biochemistry - Jain & Jain	1st	2016
5	Textbook of Biochemistry for Medical Students- Vasudevan	9th	2019
6	Essentials of Biochemistry - Pankaja Naik	2nd	2017

Course Code 25BUBC6T02	Course Title Advanced Analytical Techniques	Credits 2	No. of lectures

CO1	Describe the working principle and types of electrophoresis, including the role of media and buffer in the separation of molecules.	L2
CO2	Compare principles, instrumentation, and applications of spectroscopic and photometric techniques used in biochemical analysis.	L4
CO3	Analyze the roles of molecular tools and vectors in recombinant DNA technology for gene cloning and expression.	L4
CO4	Examine PCR-based and hybridization techniques for gene amplification, sequencing, and expression analysis in molecular diagnostics.	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**0**	**0**	**0**
CO2	**3**	**1**	**1**	**0**	**0**	**0**
CO3	**3**	**1**	**1**	**0**	**0**	**0**
CO4	**3**	**1**	**1**	**0**	**0**	**0**

Unit I Advanced Instrumentation	1. Electrophoresis: Principle, Factors affecting the rate of migration of sample in an electric field, Buffer system used, Staining Methods for protein & nucleic acid 2. Supporting media used – paper, cellulose acetate, agar, agarose and polyacrylamide 3. Instrumentation, working and applications of Discontinuous electrophoresis, Native PAGE, SDS PAGE,Immuno-electrophoresis, Isoelectric Focusing 4. Principle, Instrumentation, working, applications, advantages and disadvantages of UV Visible spectrophotometry, Fluorescence spectroscopy, Luminometry, Flame spectrophotometry, Atomic Absorption Spectroscopy 5. Basic Principle of Nephelometry and turbidometry	**15**

Unit II Fundamentals & Applications of RDT	1. Introduction to RDT, Tools for RDT- Enzymes- Restriction endonucleases, ligases, terminal transferases, reverse transcriptase 2. Cloning and Expression Vectors- Plasmid, pBR 322, PUC-19, Bacteriophage – Lambda phage; Cosmid; Artificial Chromosomes (BAC and YAC); Shuttle vectors 3. Gene library and cDNA library; DNA Amplification by PCR, RT-PCR, RAPD 4. DNA fingerprinting, DNA sequencing: Sanger, Pyrosequencing 5. Blotting techniques - Southern, Northern,and Western	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Biophysical Chemistry - Upadhyay & Nath	1st	2009
2	Principles and Techniques of Biochemistry and Molecular Biology- Wilson & Walker	7th	2010
3	Molecular Biotechnology: Principles and application of recombinant DNA - Glick	3rd	2002
4	Molecular Biology of the Cell – Bruce Alberts	7th	2022
5	Principles of Gene Manipulation and Genomics- Sandy B. Primrose & Richard Twyman	7th	2006

Course Code 25BUBC6T03	Course Title Fundamentals of Genetics II	Credits 2	No. of lectures

CO1	Describe the steps of translation and the role of ribosomes and translation factors in prokaryotic cells	L2
CO2	Analyze eukaryotic translation mechanisms, post-translational modifications and the action of protein synthesis inhibitors	L4
CO3	Interpret transcriptional control mechanisms in prokaryotes and bacteriophages, including operon models and regulatory switches	L2
CO4	Apply regulatory principles to interpret gene expression control across transcriptional, post-transcriptional, epigenetic levels and other regulatory factors in eukaryotes	L3

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**0**	**1**	**0**	**0**	**0**
CO2	**3**	**0**	**1**	**0**	**0**	**0**
CO3	**3**	**0**	**1**	**0**	**0**	**0**
CO4	**3**	**0**	**1**	**0**	**0**	**0**

Unit I Translation in Pro & Eu	1. Introduction to Translation 2. Translation (protein biosynthesis) in prokaryotes – Genetic code, mechanism of translation: Activation of amino acids, chain initiation, elongation & termination 3. Post translational modifications of proteins 4. Inhibitors and mode of action: Puromycin, Chloramphenicol, cycloheximide, tetracycline 5. Translation in Eukaryotes: Initiation , Elongation, Termination	**15**
Unit II Regulation of Gene Expression	1. Transcriptional Control in Prokaryotes a. Lac Operon b. Trp Operon 2. Transcriptional Control in bacteriophages: Phage Lambda 3. Regulation of Gene Expression in Eukaryotes a. Levels of Control of Gene Expression in Eukaryotes b. Control of Transcription Initiation by Regulatory Proteins	**15**

	c. The Role of Chromatin in Regulating Gene Transcription d. Gene Silencing and Genomic Imprinting e. RNA Processing Control: Alternative Polyadenylation and Alternative Splicing f. mRNA Translation Control by Ribosome Selection 4. Introduction to other regulatory factors:Introduction to RNA interference, Signal Transduction, Transposons	

References

Sr. No.	Title & Author	Edition	Published in
1	iGenetics: A molecular approach - Russell	3rd	2016
2	Genetics: A Conceptual Approach - Benjamin Pierce	6th	2016
3	The Cell: A Molecular Approach - Geoffrey Cooper	8th	2018
4	Fundamentals of Biochemistry - Jain & Jain	1st	2016
5	Essential Biochemistry - Pratt	5th	2021

Course Code 25BUBC6T04	**Course Title Immunology**	**Credits 2**	**No. of lectures**

CO1	Describe complement pathways and MHC structure-function in immune regulation	L2
CO2	Identify the roles of cytokines, antigen-presenting cells, and immune mechanisms in transplantation immunology	L3
CO3	Outline the significance of immunization and various types of vaccines	L2
CO4	Explain how vaccines work, vaccine strategies and their importance in preventing infectious diseases	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**1**	**1**	**0**	**0**	**0**
CO2	**3**	**1**	**1**	**0**	**0**	**0**
CO3	**3**	**1**	**1**	**0**	**0**	**1**
CO4	**3**	**1**	**1**	**0**	**0**	**1**

Unit I Essentials of Immunology	1. Complement: Nomenclature, activation pathways (Classical, alternative, lectin), biological function and regulation overview 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 3. Transplantation Immunology 4. Cytokines: Concept, Types, Properties & Attributes of Cytokines, biological functions of IL-1, TNF, alpha, INF –alpha, INF -gamma, IL-2 5. Antigen presenting cells: Types, Endogenous (Cytosolic) Pathway & Exogenous (Endocytic) Pathway	**15**
Unit II Vaccines	1. Vaccines: Introduction, significance, use of adjuvants, active and passive immunization 2. Types of vaccines - Killed and attenuated vaccines, Whole organism vaccines, Purified macromolecules as vaccines, recombinant viral vector vaccines, DNA vaccines 3. New vaccine strategies, Ideal vaccine 4. Vaccine strategies for emerging infections/ illness: HIV, COVID 19	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Kuby's Immunology- Kindt, Osborne, Goldsby	6th	2006
2	Roitt's Essential Immunology - Delves	11th	2010
3	Janeway's Immunobiology - Murphy & Weaver	9th	2017
4	Cellular and Molecular Immunology - Abbas	7th	2012
5	An introduction to Immunology- C.V. Rao	1st	2003
6	A textbook of Biotechnology - Dr. R.C. Dubey	4th	2007
7	Biotechnology: Expanding Horizons - BD Singh	4th	2014

Course Code 25BUBC6P01	Course Title Practicals based on 25BUBC6T01	Credits 2	No. of lectures

CO1	Estimate amino acids, enzymes, and proteins using ninhydrin, Nessler's reagent, and turbidimetric assays	L5
CO2	Determine clinically relevant biomolecules—including SGOT, SGPT, and cholesterol—using colorimetric methods and interpret their diagnostic significance	L5
CO3	Isolate lecithin, cholesterol, albumin and globulin from egg and analyze oils using isolation techniques and TLC profiling to study lipid composition and diversity	L5
CO4	Plan and perform extraction of proteins from germinating seeds and milk and inspect protein structural changes through denaturation	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**1**	**0**	**3**	**1**
CO2	**1**	**3**	**1**	**0**	**3**	**1**
CO3	**1**	**3**	**1**	**0**	**3**	**1**
CO4	**1**	**3**	**1**	**0**	**3**	**1**

25BUBC6P01	1. Extraction of proteins from germinating seeds 2. Estimation of amino acids by ninhydrin method 3. Estimation of asparaginase by using nessler's reagent 4. Estimation of proteins in CSF by Turbidimetric method 5. Estimation of SGOT & SGPT in blood sample 6. Estimation of Cholesterol by Zak's method 7. Isolation of Lecithin from egg yolk 8. Isolation of cholesterol from egg yolk 9. TLC of Oils 10. Protein structural changes by denaturation 11. Isolation of casein from milk 12. Estimation of blood cholesterol by Liebermann-Burchard method 13. Extraction of lipid from oil seeds by the cold percolation method 14. Isolation of egg albumin & globulin	**60**

Course Code 25BUBC6P02	Course Title Practicals based on 25BUBC6T02	Credits 2	No. of lectures

CO1	Assess genetic material using PCR, Blue-White screening, Western blotting, and DNA fingerprinting to understand molecular diagnostics	L5
CO2	Plan and perform and evaluate biochemical assays including vitamin C quantification, and caffeine analysis in beverages	L5
CO3	Evaluate environmental samples by determining calcium and soil quality through flame photometry and turbidity through colorimeter	L5
CO4	Estimate protein content by Bradford's method and rate of photodegradation under varying conditions to assess stability and environmental impact of compounds	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**1**	**0**	**3**	**1**
CO2	**1**	**3**	**1**	**0**	**3**	**1**
CO3	**1**	**3**	**1**	**0**	**3**	**1**
CO4	**1**	**3**	**1**	**0**	**3**	**1**

25BUBC6P02	1. Demonstration of PCR 2. Determination of the rate of photodegradation 3. Determination of calcium using flame photometry 4. Analysis of soil quality by using flame photometry 5. Determination of vitamin C content in juice by UV-Vis 6. Estimation of protein by the Bradford's method 7. Analysis of turbidity in water sample 8. Quantitative Analysis of caffeine in beverages 9. Blue-White screening technique for transformants 10. Western Blotting (Demo) 11. Case study on DNA Fingerprinting	**60**

Course Code 25BUBC6P03	Course Title Practicals based on 25BUBC6T03 & 25BUBC6T04	Credits 2	No. of lectures

CO1	Plan and perform plasmid DNA and yeast RNA extractions and assess sample quality using UV-Vis absorbance readings and agarose gel electrophoresis	L5
CO2	Conduct PAGE to separate serum proteins through precipitation and differential solubility	L5
CO3	Evaluate sterility of pharmaceutical preparations and analyze immunological reactions through complement fixation to ensure safety and diagnostic accuracy	L5
CO4	Determine the function of β-galactosidase and its relevance in molecular biology and microbial gene expression studies	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**1**	**1**	**3**	**1**
CO2	**1**	**3**	**1**	**1**	**3**	**1**
CO3	**1**	**3**	**1**	**1**	**3**	**1**
CO4	**1**	**3**	**1**	**0**	**3**	**1**

25BUBC6P03	1. Extraction of plasmid DNA from bacteria. 2. To check purity of DNA By using UV -Vis spectrophotometer 3. Separation of DNA by AGE 4. Extraction of RNA from yeast. 5. Separation of RNA by AGE 6. Separation of serum proteins by using PAGE 7. Study β-galactosidase activity 8. Sterility testing of injectables 9. Complement fixation (Demo)	**60**

Course Code 25BUBC6TE1	**Course Title Pharmacology**	**Credits 2**	**No. of lectures**

CO1	Explain dosage forms, administration routes, and factors affecting drug action and therapeutic outcomes	L2
CO2	Apply principles of pharmacodynamics and physicochemical properties to interpret drug absorption, bioavailability, distribution, metabolism, and excretion in relation to therapeutic effectiveness and safety	L3
CO3	Interpret drug mechanisms and therapeutic actions across specific, nonspecific, and antibody-mediated interactions, including major drug classes	L2
CO4	Analyze pharmacokinetic principles and bioassay data to evaluate drug dosing strategies, safety profiles, and clinical effectiveness	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**3**	**1**	**1**	**1**	**0**	**0**
CO2	**3**	**1**	**1**	**0**	**0**	**0**
CO3	**3**	**1**	**1**	**0**	**0**	**0**
CO4	**3**	**1**	**1**	**0**	**0**	**0**

Unit I ADME	1. Definitions & Historical Development, Sources, Nature & Nomenclature of drugs, Dosage forms & Routes of Administration of drugs 2. Factors influencing Dosage & Drug action 3. Pharmacodynamics, Physicochemical properties of drugs 4. Drug absorption: through-GIT, pulmonary, renal, placental and blood-brain barrier 5. Bioavailability and Bioequivalence Drug Distribution, Metabolism and Excretion	**15**
Unit II Drugs & Their Action	1. Mechanism of action of drugs a. Specific interaction – receptor mediated b. Partially specific – drugs via enzymes c. Nonspecific interactions – antimetabolites and antiseptics d. Through Antibodies	**15**

	e. Placebo effects 2. Therapeutic drugs: Mechanism of action and adverse effects a. Anti-inflammatory – non-steroid anti-inflammatory NSAID [Ibuprofen], Salicylates – [Aspirins] b. Cardiovascular drugs- CVS [Ca channel blocker-Amlodipine, and Beta blocker – Propranolol c. Antibiotic – Penicillin and Sulfonamide, Cephalosporins (Overview of generations) d. Antacid- Proton pump blocker –Omeprazole 3. Bioassays: Preclinical and clinical evaluation, Therapeutic drug monitoring 4. Pharmacokinetics: LD50, ED50, Half Life, Loading dose, Maintenance dose, Therapeutic dose, Therapeutic Index, Drug plasma concentration, Volume of distribution, Clearance	

References

Sr. No.	Title & Author	Edition	Published in
1	Essentials of Pharmacotherapeutics - F.S.K Barar	1st	2000
2	Katzung's Basic and Clinical Pharmacology - Todd W. Wanderah	16th	2023
3	Lippincott Illustrated Reviews: Pharmacology - Karen Whalen	8th	2022
4	Essentials of Medical Pharmacology - RD Tripathi	9th	2024
5	Biopharmaceutics and Pharmacokinetics - A Treatise- D.M. Brahmankar and S.B Jaiswal	3rd	2019

Course Code 25BUBC6PE1	Course Title Practicals based on 25BUBC6TE1	Credits 2	No. of lectures

CO1	Formulate herbal tablets/capsules, antacid preparations, oral suspensions, and topical ointments using natural and synthetic agents, and evaluate their stability and effectiveness by performing bioassay and MIC	L6
CO2	Analyze pharmaceutical industry processes to laboratory practice and perform limit tests for inorganic impurities to ensure compliance with drug standards	L5
CO3	Conduct microscopic study of crude drugs such as ginger, clove, and senna, and determine drug purity to understand pharmacognostic and quality attributes	L5
CO4	Assess antibiotic sensitivity using disc diffusion, agar cup, and LD50 to evaluate drug potency and microbial resistance	L5

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**1**	**0**	**3**	**1**
CO2	**1**	**3**	**1**	**0**	**3**	**1**
CO3	**1**	**3**	**1**	**0**	**3**	**1**
CO4	**1**	**3**	**1**	**0**	**3**	**1**

	1. Formulation of Herbal Tablets/ capsule Using Natural Plant Extracts 2. Visit to the pharmaceutical industry 3. Performing Limit Tests for Inorganic Impurities – Chloride, Sulfate, and Iron in Pharmaceutical Substances 4. Preparation of Antacid Tablets/ powder Using Common Alkaline Agents 5. Microscopic Study of Crude Drugs – Ginger, Clove, Senna etc 6. Determination of purity of a drug 7. Bioassay of an antibiotic	**60**

	8. Determination of LD 50 of a drug 9. Antibiotic Sensitivity Test by disc diffusion method 10. Antibiotic Sensitivity Test By agar cup method 11. Determining MIC of a drug 12. Preparation of a Stable Oral Suspension Using Suspending Agents 13. Formulation and Evaluation of Emollient Topical Ointment from Petroleum Jelly and Lanolin	

Course Code 25BUBC6TE2	Course Title Ecology & Climate Change	Credits 2	No. of lectures

CO1	Analyze population dynamics, keystone species, and interpret biodiversity hotspots, conservation strategies	L4
CO2	Describe community interactions including predation, parasitism, and invasions and appraise the role of agencies such as CITES, EPA, IUCN, and MAB	L2
CO3	Explain climate change, global warming and their effects, and demonstrate the role of geospatial tools such as Remote Sensing and GIS in environmental monitoring	L2
CO4	Infer international protocols and organizations (IPCC, Kyoto, Montreal, Earth Summit, UNFCCC) along with national initiatives in addressing climate change	L2

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**3**	**1**	**1**
CO2	**3**	**1**	**1**	**3**	**1**	**1**
CO3	**3**	**1**	**1**	**3**	**1**	**1**
CO4	**3**	**1**	**1**	**3**	**1**	**1**

Unit I **Ecology**	1. Population ecology: Characteristics of population, concept of carrying capacity, population growth and regulations. Population fluctuations, dispersion and metapopulation. Concept of ‘r’ and ‘k’ species. Keystone species 2. Hotspots of biodiversity and biosphere reserve.Strategies for biodiversity conservation 3. Community ecology: Definition, community concept, types and interaction -predation, herbivory, parasitism and allelopathy. Biological invasions 4. Environmental organizations & agencies-CITES, EPA, IUCN & MAB	**15**

Unit II **Climate Change**	1. Introduction to climate change, global warming and its effects. 2. Geospatial technology- Remote Sensing & GIS 3. Role of IPCC in climate change monitoring; Kyoto Protocol, Montreal Protocol, Earth Summit & UN Convention on Climate Change 4. The National Action Plan on Climate Change (NAPCC), Paris Agreement, Role of the Ministry of Environment, Forests & Climate Change	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Ecology and Environment – S. C. Santra	6th	2015
2	Environmental Science – A. K. De	7th	2010
3	Ecology and Environmental Biology – B. D. Singh	4th	2015
4	Ecology and Environment – P. D. Sharma	14th	2021
5	Environmental Studies – R. Rajagopalan	2nd	2016

Course Code 25BUBC6PE2	**Course Title Practicals Based on 25BUBC6TE2**	**Credits 2**	**No. of lectures**

CO1	Enlist biodiversity hotspots, biosphere reserves, lakes, mangroves and prepare herbarium to document ecological diversity	L4
CO2	Plan and perform population analysis using quadrant and transect methods and demonstrate ecological impacts of global warming and carbon footprint	L5
CO3	Investigate endangered and extinct species through IUCN assignments and evaluate ecological importance of species in field visits	L4
CO4	Examine biodegradable plastics, biopesticides, and design eco-friendly products to promote environmental sustainability	L4

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	**1**	**3**	**1**	**3**	**3**	**1**
CO2	**1**	**3**	**1**	**3**	**3**	**1**
CO3	**1**	**3**	**1**	**3**	**3**	**1**
CO4	**1**	**3**	**1**	**3**	**3**	**1**

	1. Study of any five biodiversity hotspots, bio reserves of India. 2. Population analysis by Quadrant method & Line transect method 3. Study of biodegradable plastic products, biopesticides brands 4. Demonstrate effects of global warming using a jar experiment 5. To make eco-friendly products (colors, bags, lanterns, idols) 6. Calculation of Carbon footprint by standard method 7. Preparation of herbarium 8. Visit any national park / biodiversity hotspot and enlist any five species of ecological importance 9. Visit to Flamingo bird sanctuary 10. Assignment on endangered / extinct species of India as per IUCN red list 11. Study of biodiversity of lakes 12. Visit to Mangroves and studying its ecological importance	**60**

Course Code 25BUBC6VSC	Course Title **Advanced Biostatistics**	Credits 2	No. of lectures

CO1	Interpret the meaning of hypotheses, p-values, confidence intervals, and significance levels in the analysis of biological experimental data	L2
CO2	Apply Z-test, t-test, and Chi-square test to perform hypothesis testing in biological data analysis	L3
CO3	Solve problems that require the selection of appropriate statistical tests	L6
CO4	Test statistical software to carry out data analysis tasks	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**1**	**1**	**0**	**0**	**0**
CO2	**3**	**1**	**1**	**0**	**0**	**0**
CO3	**1**	**3**	**1**	**0**	**1**	**0**
CO4	**1**	**3**	**1**	**0**	**1**	**0**

Advanced Biostatistics	1. Tests of significance : Basic of testing of hypothesis – Null and alternate hypothesis, type I and type II errors, level of significance and power of the test , p value 2. Z-test - One-tailed and two tailed tests 3. Tests of significance – t test -paired and unpaired 4. Chi square test: 2x2 table, Yates' correction	**15**
	1. Project report on collection data and analysis using software 2. Problems based on Z test 3. Problems based on t test 4. Problems based on paired t test 5. Problems based on chi square test 6. Analyze data using SPSS	**30**

References

Sr. No.	Title & Author	Edition	Published in
1	Methods in Biostatistics: For Medical Students and Research Workers - BK Mahajan	7th	2010
2	Biostatistics – P. N. Arora & P. K. Malhan	-	2012
3	Research Methodology- C.R.Kothari	2nd	2019
4	Introduction to Biostatistics (A Textbook of Biometry) - Dr. Pranab Kumar Banerjee	4th	2011

Course Code 25BUBC6OJT	Course Title On Job Training in Biochemistry II	Credits 2	No. of lectures

CO1	Apply core biochemistry concepts and laboratory/field techniques during on-the-job training at a recognized professional organization.	L3
CO2	Plan and execute assigned professional tasks responsibly, following standard operating procedures, safety norms, and ethical practices.	L6
CO3	Analyze and interpret observations and data generated during training using appropriate scientific reasoning and basic analytical tools.	L4
CO4	Elaborate on training outcomes effectively through a structured document, visual and oral presentation, and viva demonstrating professional competence.	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**3**	**1**	**3**	**3**
CO2	**1**	**3**	**3**	**1**	**3**	**3**
CO3	**1**	**3**	**3**	**1**	**3**	**3**
CO4	**1**	**3**	**3**	**1**	**3**	**3**

On Job Training in Biochemistry II	The learner is required to undergo on-the-job training at a recognized professional institute or organization related to the field of Biochemistry. During this training, the learner is expected to develop practical, field-based skills and gain experience in professional planning, execution and analysis of activities carried out by the organization. The learner must complete a total of 60 hours of training. As part of the assessment, the learner will be required to document the outcomes and logically interpret observations through a written report, visual and oral presentation and viva.	**60**

OR

Course Code 25BUBC6FPR	Course Title Field Project in Biochemistry IV	Credits 2	No. of lectures

CO1	Apply fundamental principles of biochemistry to address real-life problems in healthcare, environmental sustainability, food and nutrition, agriculture or biotechnology through a field-based project.	L3
CO2	Plan & Perform appropriate experimental or field methodologies in laboratories following safety and ethical guidelines.	L6
CO3	Analyze and interpret experimental or field data logically using scientific reasoning to draw valid conclusions.	L4
CO4	Build a report on project objectives, methods, results, and implications effectively through a structured written document, audio-visual presentation, oral presentation and viva.	L6

Grading will be as 3: High (>60%), 2: Moderate (40%-60%), 1: Low (<40%), 0: No mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**1**	**3**	**3**	**1**	**3**	**3**
CO2	**1**	**3**	**3**	**1**	**3**	**3**
CO3	**1**	**3**	**3**	**1**	**3**	**3**
CO4	**1**	**3**	**3**	**1**	**3**	**3**

Field Project in Biochemistry IV	The learner will be engaged in a field project designed to apply fundamental principles of Biochemistry to real-life challenges in areas such as healthcare, environmental sustainability, food and nutrition, agriculture and biotechnology. This can be taken up in department laboratory or laboratories of any research institute. The assessment will evaluate the learner's ability to logically analyze and interpret results and to clearly present findings through a written report, audio-visual aids, oral presentation and viva.	**60**

T. Y. B. Sc. Biochemistry

	SEMESTER – V	**Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)**			**Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)**			
Course Code	**Major Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
25BUBC5T01	Biochemistry of Metabolism I	-	-	-	-	-	-	-
25BUBC5T02	Cell signaling & Chromatography	-	-	-	-	-	-	-
25BUBC5T03	Fundamentals of Genetics I	-	-	-	-	-	-	-
25BUBC5P01	Practicals based on 25BUBC5T01	√	-	√	√	-	-	√
25BUBC5P02	Practicals based on 25BUBC5T02	√	-	√	√	-	-	-
25BUBC5P03	Practicals based on 25BUBC5T03	√	-	√	√	-	-	-
25BUBC5TE1	Virology, Cancer & Diagnostic Immunology	-	-	-	-	-	-	-
25BUBC5PE1	Practicals based on 25BUBC5TE1	√	-	√	√	-	-	-
25BUBC5TE2	Environmental Pollutants & Toxicology	-	-	-	-	-	-	√
25BUBC5PE2	Practicals based on 25BUBC5TE2	√	-	√	√	-	-	√
25BUBC5VSC	Clinical Biochemistry	√	-	√	√	-	-	-
25BUBC5OJT/ 25BUBC5FPR	On Job Training in Biochemistry I / Field Project in Biochemistry III	√	√	√	√	√	√	√
	Total	**07**	**01**	**07**	**07**	**01**	**01**	**04**

T.Y.B.Sc Biochemistry

	SEMESTER – VI	**Course imparts Employability (EM), Entrepreneurship (EN), Skill Development (SD)**			**Course integrates with Professional Ethics (PE), Gender Equity (GE), Human Value (HV), Environmental Sustainability (ES)**			
Course Code	**Major Course Title**	**EM**	**EN**	**SD**	**PE**	**GE**	**HV**	**ES**
25BUBC6T01	Biochemistry of Metabolism II	-	-	-	-	-	-	-
25BUBC6T02	Advanced Analytical Techniques	-	-	-	-	-	-	-
25BUBC6T03	Fundamentals of Genetics II	-	-	-	-	-	-	-
25BUBC6T04	Immunology	-	-	-	-	-	-	-
25BUBC6P01	Practicals based on 25BUBC6T01	√	-	√	√	-	-	-
25BUBC6P02	Practicals based on 25BUBC6T02	√	-	√	√	-	-	-
25BUBC6P03	Practicals based on 25BUBC6T03 & 25BUBC6T04	√	-	√	√	-	-	√
25BUBC6TE1	Pharmacology	-	-	-	-	-	-	-
25BUBC6PE1	Practicals based on 25BUBC6TE1	√	√	√	√	-	-	-
25BUBC6TE2	Ecology & Climate change	-	-	-	-	-	√	√
25BUBC6PE2	Practicals based on 25BUBC6TE2	√	√	√	√	-	√	√
25BUBC6VSC	Advanced Biostatistics	√	-	√	√	-	-	-
25BUBC6OJT/ 25BUBC6FPR	On Job Training in Biochemistry II / Field Project in Biochemistry IV	√	√	√	√	√	√	√
	Total	**07**	**03**	**07**	**07**	**01**	**03**	**04**

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