Academic Council Meeting No. and Date: 9 / July 02, 2024

Agenda Number: 03 Resolution Number: 41, 42 / 3.7, 3.27

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

Syllabus for

Programme Code: BUBC

Programme: Bachelor of Science

Specific Programme: Biochemistry

[S.Y.B.Sc. (Biochemistry)]

LEVEL 5

Choice Based Grading System

Revised under NEP and Autonomy

From academic year 2024-25

Preamble

Biochemistry is at the core of any field in life sciences. The students opting for the programme of B Sc with Biochemistry as Major, would learn the integral part of biology. This would connect them with all biological sciences. After learning Biochemistry at level 4.5, the learner is expected to have a clear understanding of macromolecules, cell biology, water and basic chemical reactions in the cell. In this program at level 5, we intend to introduce diverse fields to the learners in order to equip them with appropriate analytical skills to solve issues and real life problems.

In the first half of the academic year, students will be introduced to various analytical instruments used in industries, mendelian genetics and physicochemical processes. A new unit of nutrition is introduced to them for opening the doors of a booming field of nutraceuticals in the next half of the academic year. The students would also learn about Enzymes and various environmental factors that influence their efficiency. Under the domain of skill enhancement course (SEC), learners will study microscopy, visit labs having the advanced microscope facility and acquire the skills of staining through experiential learning. They would also learn nanotechnology and develop skills of making nanoparticles in semester IV. Under ability enhancement course (AEC) students would learn physiology and tissue culture where they would be introduced to allied fields like plant tissue culture and animal tissue culture. Ability to use methods of biostatistics and bioinformatics will be developed in the second half of the year under the same course.

The learner would also be engaged in the field project for 60 hours where he/she will be implementing the concepts learnt in theory in practical use and become more job ready. As NEP focuses on the holistic development of the student, the student will opt for any one of the subjects among NSS, NCC, DLLE, Physical Education and Cultural activities under CC in both semesters.

Thus, in this academic year, students will learn subjects of a wide array that will enable them to delve deeper into the field. Their enhanced abilities in implementing concepts of biochemistry into practical use will empower them to take any related job confidently.

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 4.5
Degree Program: B.Sc.
Duration: 1 Year (includes SEM III and SEM IV)
Mode of Conduct: Offline (Offline lectures & Laboratory Practicals), Online courses
Total Credits for the Program: 132
Specific Programme: S. Y. B. Sc. Biochemistry (Major)
Credits: 10

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

Curriculum Structure for the Undergraduate Degree Program S. Y. B. Sc.

Structure of Programme

S. Y. B. Sc. (Biochemistry)

Semester III

Title	Course Code	Course Title	No. of lectures	Credits
Major	24BUBC3T01	Physicochemical Principles & Nutrition Science	30	2
	24BUBC3T02	Mendelian Genetics & Immunology	30	2
	24BUBC3T03	Analytical Biochemistry & Enzymology	30	2
	24BUBC3P01	Practicals based on 24BUBC3T01 & 24BUBC3T02	60	2
	24BUBC3P02	Practicals based on 24BUBC3T02 & 24BUBC3T03	60	2
SEC	24BU3SEC06	Microscopy	15	1
		Practicals	30	1
AEC	24BU3AEC03	Physiology & Tissue Culture	30	2
Field Project	24BUBC3P03	Field Project in Biochemistry I	60	2
	Total			16

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

Curriculum Structure for the Undergraduate Degree Program S. Y. B. Sc.

Structure of Programme

S. Y. B. Sc. (Biochemistry)

Semester IV

Title	Course Code	Course Title	No. of lectures	Credits
Major	24BUBC4T01	Industrial Biochemistry & Nutraceutical Sciences	30	2
	24BUBC4T02	Genetics	30	2
	24BUBC4T03	Applied Biochemistry	30	2
	24BUBC4P01	Practicals based on 24BUBC4T01 & 24BUBC4T02	60	2
	24BUBC4P02	Practicals based on 24BUBC4T02 & 24BUBC4T03	60	2
SEC	24BU4SEC06	Nanotechnology	15	1
		Practicals	30	1
AEC	24BU4AEC03	Biostatistics & Bioinformatics	30	2
Field Project	24BUBC4P03	Field Project in Biochemistry II	60	2
	Total			16

Semester III

Course Code 24BUBC3T01	Course Title Physicochemical Principles & Nutrition Science	Credits 2	No. of lectures

CO1	Explain the principles of diffusion and osmosis along with their physiological relevance, describe renal dialysis processes, differentiate types and properties of colloidal systems, interpret Donnan equilibrium and apply concepts of colloids to biological processes including precipitation and flocculation.	L3
CO2	Define viscosity, surface tension and adsorption, explain the factors influencing them, demonstrate methods used for measuring viscosity and surface tension and relate their applications and importance in biological systems.	L4
CO3	Explain the fundamentals of nutrition science including food functions and nutrient roles, interpret nutrient density, absorption and utilisation with reference to RDA, identify factors affecting dietary needs and outline balanced diet planning for adolescence, pregnancy and geriatric stages while summarising the roles and disorders of key macro and micronutrients.	L2
CO4	Assess the nutritional status using anthropometric, clinical, biophysical and dietary parameters, calculate BMR, explain the effects of malnutrition, interpret protein quality indices and summarise major global nutrition challenges.	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**	**0**	**1**	**0**	**0**	**0**
CO3	**3**	**0**	**1**	**0**	**0**	**0**
CO4	**3**	**2**	**1**	**0**	**2**	**0**

Unit I Physicochemical Principles	1.1 Diffusion & Osmosis: Diffusion & diffusion coefficient and factors affecting diffusion of solute in solution 1.2 Osmosis - Van't Hoff's law of osmotic pressure law & mathematical expression (no derivation), mechanism of osmosis, role of osmosis in physiology. Renal dialysis: Principles and process 1.3 Colloids: True solution, colloidal solution, coarse suspension, Classification of colloids (lyophilic and lyophobic sols), Kinetic (Brownian), optical (Tyndall) & Electrical properties of colloids. Fundamental study of Donnan equilibrium, Applications of colloids in biological systems. Concept of precipitation and flocculation 1.4 Viscosity - definition, Factors affecting viscosity, Measurement of Viscosity, Applications of Viscosity in Biological Systems	**15**

	1.5 Surface tension: Measurement, factors, affecting surface tension E.g., Role of bile in digestion 1.6 Adsorption: Concept, Characteristics & Importance	
Unit II Nutrition Science	2.1 Introduction to Nutrition Science: Definitions, Nutrition Research in India. Food (Function and Composition of food, Classification of food) 2.2 Nutrition: a. Functions of nutrients b. Nutrient Density and Health c. Absorption and Utilisation of Nutrients, Recommended dietary allowances (General principle of Deriving RDA and Use of RDA). d. Factors Affecting RDA. e. Concept and planning of Balanced diet for adolescence, pregnancy and geriatric f. Role of Macro and Micro molecules and their disorders (Ca, Mg, Na, K, Fe & Zn) 2.3 Assessment of Nutritional status: a. Anthropometric, clinical, Biophysical, Dietary assessment b. Calculation of BMR c. Effects of lack of nutrition (Malnutrition) d. Protein deficiency: Protein quality indices: Chemical score of amino acids, Protein Deficiency corrected amino acid score and Net Protein utilization. e. Global problems of Nutrition	**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	Nutrition Science - B Srilakshmi	6th	2018
4	Food Science - B Srilakshmi	6th	2015
5	Fundamentals of Food, Nutrition and Diet Therapy- Rajagopal & Mudambi	6th	2020

Course Code 24BUBC3T02	Course Title Mendelian Genetics & Immunology	Credits 2	No. of lectures

CO1	Explain the principles of Mendelian genetics through monohybrid and dihybrid crosses, analyze the laws of inheritance and differentiate patterns of gene expression such as dominance, codominance, incomplete dominance, and lethality, along with understanding variations like ecophenes and ecotypes.	L3
CO2	Interpret various patterns of gene interaction such as epistasis, multiple allelism, maternal and extranuclear inheritance, solve related genetic problems, and relate chromosomal abnormalities to specific human genetic disorders.	L4
CO3	Describe the immune system, its cells and organs, and mechanisms of humoral and cell-mediated immunity.	L2
CO4	Outline concepts of antigens and antibodies, their structures and functions, and the concept of autoimmunity with examples.	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**	**1**	**0**	**0**
CO2	**3**	**2**	**1**	**0**	**1**	**0**
CO3	**3**	**0**	**1**	**0**	**0**	**0**
CO4	**3**	**0**	**1**	**0**	**0**	**0**

Unit I Mendelian Genetics	1.1 Mendelian genetics: Mendel's experiments-Monohybrid, Dihybrid crosses, 1.2 Laws of inheritance 1.3 Ecophenes, Ecotypes, Dominance, recessivity, codominance, incomplete (semi) dominance, lethal genes 1.4 Gene interaction -Epistasis, types of epistasis, multiple alleles, maternal effects, Extranuclear Inheritance, 1.5 Numerical on above concepts 1.6 Chromosomal abnormalities (Down's Syndrome, Edward, Patau, Klinefelter's Syndrome, Turner's Syndrome, Cri-du-chat syndrome, Philadelphia Chromosome)	**15**
Unit II Basics of Immunology	2.1 Overview of immune system 2.2 Cells of the immune system: Lymphocytes – B cells and T cells, Natural killer cells – Mononuclear phagocytes, Granulocytes, Antigen presenting cells 2.3 Organs of the immune system : a. Primary lymphoid organs: Thymus, Bone marrow	**15**

	b. Secondary lymphoid organs: Lymphatic system, Lymph nodes, Spleen, MALT 2.4 Humoral and cell mediated immunity, factors influencing and mechanisms of each 2.5 Antigens: Antigenicity, immunogenicity, epitope, factors determining immunogenicity, Haptens 2.6 Antibodies : Fine structure of immunoglobulin, Antibody mediated functions, Antibody classes, Ig superfamily 2.7 Autoimmunity: concept & one example	

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	Principles of Genetics - Tamarin	7th	2017
4	Kuby's Immunology- Kindt, Osborne, Goldsby	6th	2006
5	Roitt's Essential Immunology - Delves	11th	2010
6	Janeway's Immunobiology - Murphy & Weaver	9th	2017
7	Cellular and Molecular Immunology - Abbas	7th	2012
8	An introduction to Immunology- C.V. Rao	1st	2003

Course Code 24BUBC3T03	Course Title Analytical Biochemistry & Enzymology	Credits 2	No. of lectures

CO1	Explain the principles of sedimentation and operational parameters of centrifugation (RPM & RCF), differentiate between various types of centrifuges and rotors, and apply preparative centrifugation techniques such as differential and density-gradient methods for separation and analysis of biological samples.	L2
CO2	Explain the principles of colorimetry and spectrophotometry describing the construction and working and solve numerical problems related to their applications.	L4
CO3	Define enzyme-related terms, explain enzyme specificity and mechanisms, analyze factors affecting activity, and apply enzyme kinetics concepts to solve numerical problems.	L2
CO4	Explain multi-substrate enzyme reactions, describe allosteric effects and models and differentiate between types of enzyme inhibition with examples.	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**	**2**	**0**
CO3	**3**	**1**	**1**	**0**	**2**	**0**
CO4	**3**	**0**	**1**	**0**	**0**	**0**

Unit I Analytical Biochemistry	1.1 Centrifugation: Basic Principle of sedimentation, sedimentation rate, concept of RPM & RCF 1.2 Types and applications of centrifuges – Desktop, Clinical, High speed, Ultracentrifuge 1.3 Types of rotors – fixed angle, vertical, swinging bucket 1.4 Types of preparative centrifuges and its applications – a. Differential b. Density gradient (Rate zonal & Isopycnic) 1.5 Colorimetry: Beer-Lambert law, derivation, limitations, application – concepts of Lambda max; determination of molar extinction coefficient, Construction and working of a simple colorimeter 1.6 Spectrophotometer: Construction & Working UV/Vis Spectrophotometer & Its applications 1.7 Numerical Problems based on above concepts	**15**

Unit II **Enzymology**	1.1 Definition – Enzyme, coenzyme, cofactor, apoenzyme, holoenzyme, prosthetic group, active site, Ribozyme. Units of enzyme -Turnover number, Katal, IU 1.2 IUB / EC classification up to one digit, Enzyme specificity & types 1.3 Concept of active site, Allosteric site 1.4 Activation energy, mechanism of enzyme action, Fischer's lock & key and Koshland's induced fit theories 1.5 Factors affecting enzyme activity – substrate concentration, enzyme concentration, pH, temperature, activators 1.6 Enzyme kinetics – Derivation of Michaelis & Menten equation and Lineweaver Burk plot for mono-substrate reactions and numerical problems based on them 1.7 Multi-substrate reactions-Ordered, Random, Ping Pong 1.8 Allosteric effects in enzyme catalyzed reactions a. Koshland-Nemethy-Filmer model, b. Monod-Wymanand-Changeux Model 1.9 Enzyme inhibition – Reversible and Irreversible; competitive, non-competitive and uncompetitive inhibitors (one example of each)	**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	Outlines of Biochemistry - Conn & Stumpf	5th	2009
4	Harper's Illustrated Biochemistry- Robert K. Murray, Darryl K. Granner, Peter A. Mayes, and Victor W. Rodwell	26th	2003
5	Lehninger's Principles of Biochemistry - Nelson & Cox	6th	2012
6	General Enzymology - Kulkarni & Deshpandey	1st	2007
7	Biochemistry - U. Satyanarayan	3rd	2007

Course Code 24BUBC3P01	**Course Title Practicals based on 24BUBC3T01 & 24BUBC3T02**	**Credits 2**	**No. of lectures**

CO1	Perform viscosity measurement using an Ostwald viscometer, prepare colloidal solutions and solve Mendelian genetics problems and case studies.	L5
CO2	Apply chromatographic principles to separate photosynthetic pigments, estimate key plant biomolecules including ascorbic acid, phenols and tannins and interpret their quantitative significance in biological samples.	L4
CO3	Identify human chromosomal patterns through karyotype analysis and examine polymorphonuclear cells using blood smears to interpret cytological features.	L4
CO4	Investigate how temperature, pH and inhibitors influence enzyme activity and determine kinetic parameters such as Km, Vmax, activity and specific activity of amylase to interpret enzymatic behavior experimentally.	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	**2**	**2**	**1**	**1**	**3**	**0**
CO2	**2**	**2**	**1**	**0**	**3**	**0**
CO3	**2**	**2**	**1**	**0**	**3**	**1**
CO4	**2**	**2**	**1**	**1**	**3**	**0**

1	Determination of viscosity by Ostwald's viscometer	**60 Hours**
2	Preparation of colloidal solution of starch in water and egg/albumin in milk	
3	Problems & case studies based on Mendel’s laws	
4	Separation of photosynthetic pigments by TLC (Demo)	
5	Estimation of ascorbic acid	
6	Estimation of phenols by 4-AAP method	
7	Estimation of tannins in fruits and vegetables	
8	A study of Human Karyotypes	
9	Study of PMNs using Blood smear	
10	Studying the effect of different temperatures on enzyme activity	
11	Studying the effect of different pH on enzyme activity	

12	Determination Km & Vmax of Alpha amylase	
13	Checking the effect of inhibitor on amylase activity	
14	Determination of activity & Specific activity of Amylases	

Course Code 24BUBC3P02	Course Title Practicals based on 24BUBC3T02 & 24BUBC3T03	Credits 2	No. of lectures

CO1	Extract plant or microbial enzymes such as β-amylase, urease and invertase and demonstrate their qualitative activity to interpret basic principles of enzymatic function and extraction.	L5
CO2	Estimate iron, carbohydrate using colorimetric methods and measure chloride concentration using the Mohr method	L4
CO3	Measure calcium and lead content by EDTA titration and measure reducing sugars using the DNSA method	L4
CO4	Apply the Biuret method to estimate protein concentration and analyse the practical applications of analytical instruments through lab visit.	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	**2**	**2**	**1**	**1**	**3**	**0**
CO2	**2**	**2**	**1**	**0**	**3**	**0**
CO3	**2**	**2**	**1**	**0**	**3**	**1**
CO4	**2**	**2**	**1**	**1**	**3**	**0**

1	Extraction of beta Amylase from a natural source. Demonstration of the activity Qualitatively	**60 Hours**
2	Extraction of Urease. Demonstration of the activity Qualitatively.	
3	Extraction of Invertase. Demonstration of the activity Qualitatively	
4	Estimation of Iron by colorimetric method	
5	Estimation of carbohydrate by Anthrone method	
6	Determination of Chloride by the Mohr Method	
7	Estimation of calcium by Erichrome black T EDTA method	
8	Estimation of lead by EDTA method	
9	Estimation of reducing sugar by DNSA method	
10	Estimation of proteins by Biuret method	
11	Working & mechanism of UV-Vis Spectrophotometer	
12	Visit to instrumentation facility	

Course Code 24BU3AEC03	Course Title Physiology & Tissue Culture	Credits 2	No. of lectures

CO1	Explain photosynthetic mechanisms and carbon fixation pathways, describe major plant growth regulators and summarise the significance of important secondary plant metabolites.	L2
CO2	Summarize fundamental plant tissue culture concepts and techniques including explants, callus formation, totipotency, culture types and micropropagation.	L2
CO3	Explain the structural and functional organization of the nervous system, mechanisms of nerve impulse and synaptic transmission, roles of major neurotransmitters and the molecular basis of muscle contraction and relaxation.	L2
CO4	Outline the principles and techniques of animal cell culture, differentiate primary cultures and cell lines, explain essential equipment and procedures used in culture systems and outline key applications.	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**	**1**	**0**	**0**
CO2	**3**	**1**	**1**	**1**	**0**	**1**
CO3	**3**	**1**	**1**	**0**	**0**	**0**
CO4	**3**	**1**	**1**	**0**	**0**	**0**

Unit I Plant Physiology & PTC	1.1 Photosynthesis - Light and dark reactions, Z scheme and electron carriers, photophosphorylation [linear and cyclic]; Photorespiration, Photoperiodism Calvin cycle, C4 and CAM. 1.2 Plant growth regulators: Brief Introduction, Structure, biosynthesis and function of - auxins, gibberellins, cytokinins, ethylene and abscisic acid, Brassinosteroids and Jasmonic Acid 1.3 Special features of secondary plant metabolites: terpenes, lignin, tannins, pigments, phytochrome, waxes, alkaloids, Nicotene, functions of alkaloids (in Brief) 1.4 PTC: Introduction, History, Important definitions (Explant, Callus, Dedifferentiation, Redifferentiation, Totipotency), Requirements for In-Vitro cultures 1.5 Culture techniques Basic steps, Types of culture (Explant, Callus, Organ, root, shoot, cell suspension, protoplast culture) 1.6 Micropropagation	**15**

Unit II Animal Physiology & ATC	2.1 Components of Nervous System: Neurons (3 types) and Neuroglia(6 types)–structure and function, Axonal transport 2.2 Nerve impulse transmission: Resting Membrane Potential, Action Potential, propagation of action potential 2.3 Synaptic transmission: Physiological anatomy of a synapse;– Electrical & Chemical synapses, inactivation of Neurotransmitter 2.4 Neurotransmitters: Structure, types and function of acetylcholine, catecholamines, GABA, glutamate, glycine. 2.5 Contractile and regulatory proteins of muscle. Sliding filament model, Contraction and Relaxation of Muscles; mechanisms 2.6 Animal Cell Culture: History, Introduction to Primary cell culture, Cell lines (Finite and continuous), Equipment & materials for Animal cell culture technology, Culture techniques used for primary culture. 2.7 Applications of Animal cell culture: hybridoma (monoclonal antibody), Valuable products	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Plant Physiology and Development- Taiz and Zeiger	6th	2014
2	A textbook of Plant Physiology, Biochemistry and Biotechnology - Verma & Verma	4th	1995
3	Introduction to Plant Physiology- Hopkins & Huner	4th	2008
4	A textbook of Biotechnology - Dr. R.C. Dubey	4th	2007
5	Biotechnology: Expanding Horizons - BD Singh	4th	2014
6	Introduction to Plant Tissue Culture - M.K. Razdan	3rd	2019
7	Textbook of Medical Physiology - Guyten & Hall	11th	2017
8	Principles of Anatomy and Physiology - Tortora	12th	2008
9	Culture of Animal Cells - Ian Freshney	6th	2011
10	Principles & Practice of Animal Tissue Culture- Sudha Gangal	2nd	2010

Course Code 24BU3SEC06	Course Title Microscopy	Credits 2	No. of lectures

CO1	Explain the principles, components and operational features of fundamental microscopy techniques along with concepts of refractive index, magnification, resolution and numerical aperture.	L2
CO2	Differentiate advanced microscopy methods such as SEM, TEM, cryo-electron microscopy and AFM, evaluate their applications and limitations and compare them with light microscopy methods.	L3
CO3	Perform microscopic observations using foldscope and standard microscopes, apply differential staining techniques and interpret cellular structures effectively.	L5
CO4	Identify advanced microscopy facilities through visits / demonstration of SEM or TEM and fluorescent microscopy facilities and relate instrument capabilities to their applications in biological research.	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**	**1**	**0**	**1**
CO3	**3**	**1**	**1**	**0**	**0**	**0**
CO4	**3**	**1**	**1**	**0**	**0**	**0**

Unit I Microscopy	1.1 Basic concepts of Microscopy learnt in First Year: History, Principles of microscopy, Parts of Microscope, Refractive index & Magnification, Resolution & Numerical Aperture, Foldscope, Inverted Microscope, Bright Field, Dark Field. 1.2 Microscopes & Microscopy: Principle, working and applications of each of the following microscopy types: Fluorescence, Phase Contrast, DIC. 1.3 Electron Microscopy in detail: SEM & TEM, Cryoelectron & AFM (in brief) Comparative overview of all microscopy types, Limitations of electron microscopy.	**15**
1	Observing different samples under foldscope	**30**
2	Observing cell organelles using microscope : Endospore staining	
3	Observing cell organelles using microscope : Capsule staining	
4	Observing Spirochetes by staining	
5	Visit to laboratory having facility of SEM / TEM	
6	Visit to laboratory having facility of Fluorescent microscope	

References

Sr. No.	Title & Author	Edition	Published in
1	Molecular Cell Biology - Harvey Lodish	8th	2016
2	Molecular Biology of the Cell - Bruce Alberts	6th	2015
3	Prescott's Microbiology- Willey Sherwood Woolverton	10th	2016
4	Brock Biology of Microorganisms - Madigan	14th	2014
5	Foundations in Microbiology - Talaro	7th	2009

Course Code **24BUBC3P03**	**Course Title** **Field Project in Biochemistry I**	**Credits** **2**	**No. of lectures**

CO1	Apply appropriate field and laboratory techniques to collect, document, and preserve biological or environmental samples ethically and systematically.	L4
CO2	Analyze field-generated data using suitable analytical, statistical, or biochemical tools to interpret real-world biological phenomena.	L3
CO3	Evaluate various factors on biological systems based on field observations and scientific evidence.	L5
CO4	Report field project findings effectively through structured reports, data presentations and oral or poster presentations demonstrating scientific reasoning and teamwork.	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	**2**	**3**	**2**	**2**	**3**	**3**
CO2	**2**	**3**	**2**	**2**	**3**	**3**
CO3	**2**	**3**	**2**	**2**	**3**	**3**
CO4	**2**	**3**	**2**	**2**	**3**	**3**

Projects ● Involving use of analytical instruments like colorimeter, spectrophotometer, centrifuge, etc. ● Application study of various enzymes through immobilization understanding their kinetics ● The Nutrition status of School children with respect their socioeconomic background (Comparative analysis of nutrition pattern in Private & Government School)	**60 Hours**

Semester IV

Course Code 24BUBC4T01	Course Title Industrial Biochemistry & Nutraceutical Sciences	Credits 2	No. of lectures

CO1	Apply fermentation principles and fermenter designs to industrial production of microbial and biochemical products	L3
CO2	Explain techniques of enzyme immobilization, stabilization, and engineering to optimize enzyme performance for industrial and therapeutic use.	L2
CO3	Classify nutraceuticals and functional foods based on their chemical nature, sources, and health-promoting roles	L2
CO4	Evaluate the potential of plant- and marine-derived nutraceuticals in managing disorders and influencing nutritional genomics.	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**	**1**	**0**	**1**
CO2	**3**	**1**	**1**	**0**	**0**	**0**
CO3	**3**	**1**	**1**	**0**	**0**	**0**
CO4	**3**	**2**	**1**	**1**	**0**	**1**

Unit I Industrial Biochemistry	2.1 Basics of fermentation, range of fermentation process 2.2 Typical Fermenter, Types of Fermenters (CSTF, Bubble cap, Airlift, Fluidized Bed reactor, Tower Fermenter) Fermenter choice based on the purpose 2.3 Industrial production of wine, penicillin, Gluconic acid, Vitamin B12, Amylase, Cheese and SCP 2.4 Immobilized Enzyme: Introduction, Methods of immobilization (entrapment, adsorption, covalent binding, microencapsulation, cross linking) Advantages & Applications 2.5 Enzyme Stabilization strategies: Stabilization of soluble enzyme (solvent and substrate stabilization, enzyme stabilization by polymer. Salts and chemical modification) 2.6 Enzyme engineering- principles of enzyme engineering, steps in enzyme engineering, Examples	**15**
Unit II Nutraceutical Sciences	2.1 Introduction to Nutraceuticals: History, Definition, Nutraceuticals vs other Terminologies, Classification of Nutraceuticals based on Chemical nature (isoprenoid derivatives (terpenoids), Food and Nonfood Sources of Nutraceutical.	**15**

	2.2 Functional food: Milk and dairy products as Functional foods, role of Probiotics and Prebiotics. 2.3 Brief idea about some Nutraceutical rich supplements: e.g. Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and Spirulina. 2.4 Nutraceuticals from Seafood- Marine oils, omega -3, Chitin, Chitosan. 2.5 Nutraceutical Foods derived from Fruits and vegetables (Avocados, Banana, Bilberries, Orange, Cranberries, cabbage, beans) and Herbs(Alovera, tea etc.) 2.6 Nutraceuticals in treatment: For cognitive decline, Nutraceutical remedies for common disorders: Arthritis, Cancer (other disorders can be given as an assignment) 2.7 Introduction to nutrigenomics (in brief, with the help of an example)	

References

Sr. No.	Title & Author	Edition	Published in
1	Principles of fermentation technology - P.F. Stanbury, A.Whitaker, S.J. Hall	2nd	2000
2	Fermentation Technology - H.A. Modi	8th	2009
3	Industrial Microbiology - A.H. Patel	2nd	2007
4	Industrial Microbiology - Casida L. E	2nd	2009
5	Biotechnology - U. Satyanarayana	1st	2010
6	Food is Medicine An Introduction to Nutraceuticals - Dr. Perkins Muredz	1st	2013
7	Food Science - B Srilakshmi	6th	2015
8	Foods (facts and Principles) - N Shakuntala Manay	4th	2020
9	Nutraceuticals and Functional Foods in Human Health and Disease Prevention - Debasis Bagchi, Harry G. Preuss, Anand Swaroop	1st	2015
10	Dietetics - B Srilakshmi	7th	2014
11	Nutrition Science - B Srilakshmi	6th	2018

Course Code 24BUBC4T02	**Course Title Genetics**	**Credits 2**	**No. of lectures**

CO1	Explain DNA packaging, chromatin types, and chromosome features with reference to genome structure and function	L2
CO2	Summarize mechanisms of gene transfer in prokaryotes and structural features of specialized chromosomes	L2
CO3	Outline the key features of semi-conservative, conservative, and dispersive replication models along with theta and rolling circle mechanism	L2
CO4	Apply knowledge of DNA replication enzymes and mechanisms to identify key steps and differences in replication across prokaryotic and eukaryotic cells	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**	**1**	**1**	**0**	**0**	**0**
CO3	**3**	**0**	**1**	**0**	**0**	**0**
CO4	**3**	**1**	**1**	**0**	**0**	**0**

Unit I Fundamental Genetics	1.1 Central dogma of molecular biology and its modification. 1.2 Genome organization, Prokaryotic Genome: Nucleoid structure, Eukaryotic chromosomes: Packaging of DNA (upto Solenoid structure), DNA supercoiling, Topoisomerase 1.3 Chromatin structure -Euchromatin, Heterochromatin, structure of condensed chromatin, Centromere, kinetochore, telomere, Comparison of chromosomal structure in prokaryotes and Eukaryotes. 1.4 Banding Pattern in Chromosome 1.5 Recombination in prokaryotes 1.6 Gene Transfer: a. Transformation b. Transduction: General features c. Conjugation: Mechanism F+, F- and Hfr strain 1.7 Lampbrush and Giant chromosome	**15**

Unit II DNA replication	2.1 Watson and crick model replication of DNA (in prokaryotes) - Models of DNA replication : Semi-conservative, Dispersive & Conservative; 2.2 Modes of DNA replication: Theta & rolling circle 2.3 Enzymes, (pol I, II and III) and accessory proteins; Messelson and Stahl experiment 2.4 Mechanism of semi-conservative replication; 2.5 Replication in Eukaryotes: Initiation, elongation and termination.	**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	Principles of Genetics - Tamarin	7th	2017
5	Fundamentals of Biochemistry - Jain & Jain	1st	2016

Course Code 24BUBC4T03	Course Title Applied Biochemistry	Credits 2	No. of lectures

CO1	Apply bioremediation strategies and microbial technologies to address environmental pollutants and xenobiotic degradation	L3
CO2	Classify biopesticides, biofungicides, bioherbicides and biofertilizers based on microbial origin, mode of action and agricultural applications	L2
CO3	Explain the processes of solid waste management and sewage treatment with reference to environmental and health concerns.	L2
CO4	Evaluate the role of biofuels, biogas and zero-waste strategies in addressing energy and environmental challenges.	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**	**3**	**0**	**1**
CO2	**3**	**1**	**1**	**1**	**0**	**0**
CO3	**3**	**2**	**1**	**3**	**2**	**2**
CO4	**3**	**2**	**1**	**3**	**1**	**3**

Unit I Trends in Biotechnology	1.1 Terminology – Bioremediation, Bioaugmentation, Biotransformation, Xenobiotics, Recalcitrant xenobiotics, Biomagnification 1.2 Factors affecting bioremediation, Types of Bioremediation (In-situ, Ex-situ) 1.3 Applications of Bioremediation - hydrocarbons, (Oil spills) Pesticides and herbicides, Dyes & Heavy metals, contaminated soil and waste land, Ground Water; Xenobiotics 1.4 Genetically Engineered Microbes in bioremediation, Concept of Bioleaching & Biosorption (One example each) 1.5 Biopesticides: Introduction; examples each of Bacterial, Viral, Fungal and Protozoal biopesticide 1.6 Bio-fungicide, Bioherbicides - Concept, Examples and Applications 1.7 Biofertilizers: Symbiotic & asymbiotic nitrogen fixer, phosphate solubilizing bacterias, mycorrhiza	**15**

Unit II Waste Management & Bioenergy Production	2.1 Solid waste: Types of waste, treatment, recycling 2.2 Waste water sewage a. Composition of sewage, types of sewage, detection of pathogenic organism of sewage; preliminary treatment, primary treatment b. Secondary treatment; tertiary treatment, disinfectant, Oxidation Ponds and Septic tanks c. Sludge treatment and disposal; wastewater collection vs sewage treatment in developing countries 2.3 Biomass and Bioenergy production a. Biofuel and Biomass: Fossil fuel; Energy rich crops (petroleum plants); Sources of biofuel, its cultivation and extraction process b. Biogas: Production, Composition, Applications. Gobar gas. [MSW and LFG, Renewable natural gas, NG vehicle] 2.4 Other types of wastes: biomedical Waste, electronic waste, agricultural waste, mining waste, radioactive waste, Zero waste Management & Eco-parks	**15**

References

Sr. No.	Title & Author	Edition	Published in
1	Biotechnology - U. Satyanarayana & Chakrapani	1st	2010
2	Environmental Biotechnology: Basic Concepts and Applications - Indu Shekar Thakur	2nd	2011
3	Biotechnology - B.D. Singh	4th	2012
4	A Textbook of Biotechnology- R.C. Dubey	4th	2012
5	Environmental Biotechnology - T. Srinivas	1st	2008

Course Code 24BUBC4P01	Course Title Practicals based on 24BUBC4T01 & 24BUBC4T02	Credits 2	No. of lectures

CO1	Observe and explain the working principles of an industrial fermenter and perform alcoholic fermentation of fruit juice for wine preparation to relate industrial fermentation	L4
CO2	Determine cell viability using the trypan blue exclusion method and perform enzyme immobilization using sodium alginate to understand applications of cell and enzyme-based techniques in biotechnology.	L5
CO3	Estimate organic carbon content of soil, crude fat content, and total nitrogen in food samples using standard analytical methods, and interpret the results to assess soil quality and nutritional value of foods.	L5
CO4	Take part in cultivation of *Drosophila* to study giant chromosomes and extract genomic DNA from bacteria.	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**	**2**	**1**	**1**	**3**	**0**
CO2	**1**	**2**	**1**	**1**	**3**	**0**
CO3	**1**	**2**	**1**	**1**	**3**	**0**
CO4	**1**	**2**	**1**	**1**	**3**	**0**

1	Observing a fermenter at an industry	**60 Hours**
2	Wine Preparation (Alcoholic fermentation of fruit juice)	
3	Determination of cell viability using trypan blue	
4	Immobilization of Enzymes using Sodium Alginate	
5	Estimation of organic content of soil by Diphenylamine method	
6	Estimation of crude fat contents of foods by Soxhlet's method	
7	Estimation of total Nitrogen of foods (Bombay Test House)	
8	Study of Giant chromosome from fruit fly	
9	Extraction of genomic DNA from bacteria	

Course Code 24BUBC4P02	Course Title Practicals based on 24BUBC4T02 & 24BUBC4T03	Credits 2	No. of lectures

CO1	Plan and prepare a biofertilizer for sustainable agriculture and soil fertility by isolating free-living and symbiotic nitrogen-fixing microorganisms	L6
CO2	Evaluate chromium tolerance in microorganisms and isolate phosphate-solubilizing bacteria from soil to understand microbial adaptation and applications in environmental remediation and soil nutrient management.	L5
CO3	Estimate salinity (chloride), fluoride concentration, BOD, and COD of water samples using standard analytical methods to assess water quality and pollution status.	L5
CO4	Estimate acidity and alkalinity of water, calcium carbonate content of soil using standard analytical methods and relate the findings to wastewater treatment practices through a visit to a CETP.	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**	**3**	**3**	**1**
CO2	**1**	**3**	**1**	**2**	**3**	**1**
CO3	**1**	**3**	**1**	**2**	**3**	**1**
CO4	**1**	**3**	**1**	**3**	**3**	**1**

1	Isolation of free living nitrogen fixing organisms	**60 Hours**
2	Isolation of symbiotic nitrogen fixing organisms	
3	Preparation of biofertilizer	
4	Study of chromium tolerance shown by microorganisms	
5	Isolation of Phosphate solubilizers from soil	
6	Determination of salinity of chloride in water by silver nitrate method	
7	Estimation of fluoride in water by Alizarin Red method	
8	Determination of BOD of waste water	
9	Determination of COD of waste water	
10	Determination of Acidity of water	

11	Determination of Alkalinity of water	
12	Estimation of $CaCO_3$ of soil by Bromothymol Blue method	
13	Visit to CETP	

Course Code 24BU4AEC03	Course Title Biostatistics & Bioinformatics	Credits 2	No. of lectures

CO1	Explain the scope and applications of biostatistics, define common statistical terms and interpret different types of data and distributions, including normal and asymmetric distributions, for biological and health-related studies.	L2
CO2	Apply descriptive statistical methods to compute and interpret measures of central tendency and dispersion, solve related numerical problems and use MS-Excel to perform basic statistical operations.	L3
CO3	Outline the types, features and limitations of biological databases describing the scope of Bioinformatics	L2
CO4	Analyze the tools of bioinformatics and assess their role in sequence analysis, modeling, and applied research	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**	**2**	**0**	**0**	**0**
CO2	**3**	**1**	**2**	**0**	**0**	**0**
CO3	**3**	**0**	**2**	**0**	**0**	**0**
CO4	**3**	**1**	**2**	**0**	**0**	**0**

Unit I Basic Biostatistics	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 Distribution: normal distribution and normal Curve, Asymmetric distribution 1.4 Descriptive statistics: Measures of central tendency- Mean, Median and mode, Merits & Demerits of each 1.5 Measures of dispersion- Range, percentiles, Quartile, Deciles, Variance, SD, Mean deviation 1.6 Using MS-Excel for basic statistical operations 1.7 Statistical problems based on the above concepts	**15**
Unit II Basic Bioinformatics	2.1 Definition, Aims and History of Bioinformatics 2.2 Introduction to Genomics and Proteomics 2.3 Databases- Definition & types – (Primary, secondary, specialized, Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database) Limitations of biological databases	**15**

	2.4 Introduction & Application of databases in bioinformatics (Demonstration) Genbank, EMBL, DDBJ, GDB, PDB, PIR, SWISS-PROT, Rasmol, Swiss-PDB, CATH and SCOP 2.5 Sequence analysis Tools - Explain the following terms in brief - BLAST, FASTA, L-ALIGN, CLUSTAL- X & W, RASMOL 2.6 Software for protein sequencing - PROSPECT , AMMP, COPIA (Explanation of the terms in brief) 2.7 Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny evolution, Ecology & population studies, Medical informatics and agriculture	

References

Sr. No.	Title & Author	Edition	Published in
1	Methods in Biostatistics: For Medical Students and Research Workers - BK Mahajan	7th	2010
2	Bioinformatics Concepts, Skill and applications - Rastogi, S.C	2nd	2019
3	Basic Bioinformatics - S. Ignacimuthu	2nd	2012
4	Biotechnology - U. Satyanarayana & Chakrapani	1st	2010
5	Biotechnology - B.D. Singh	4th	2012
6	A Textbook of Biotechnology- R.C. Dubey	4th	2008
7	Research Methodology- C.R.Kothari	2nd	2019
8	Introduction to Biostatistics (A Textbook of Biometry) - Dr. Pranab Kumar Banerjee	4th	2011
9	Biostatistics - Arora P N	-	2012

Course Code 24BU4SEC06	Course Title Nanotechnology	Credits 1	No. of lectures

CO1	Explain the synthesis, structural forms and unique properties of nanomaterials with reference to biomimicry	L2
CO2	Apply nanotechnological tools and biosensor systems to address challenges in medicine, agriculture, environment and diagnostics	L3
CO3	Synthesize silver nanoparticles using plant leaf extract through a green chemistry approach and explain the biochemical basis of nanoparticle formation.	L6
CO4	Evaluate the antimicrobial activity of the synthesized silver nanoparticles	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**	**2**	**0**	**0**
CO2	**3**	**1**	**1**	**1**	**0**	**0**
CO3	**1**	**3**	**0**	**2**	**3**	**1**
CO4	**1**	**3**	**0**	**2**	**3**	**1**

Unit I Nanotechnology	1.1 Introduction to Nanotechnology: Concept of Biomimicry, Nanomaterials, Introduction & forms Nanoparticles, Nanofilms, Nanotubes 1.2 Synthesis & Characterization of Nanomaterials: Top-down & bottom-up approach, 1.3 Methods (Physical, Chemical and Biological) 1.4 Properties of Nanomaterials: Microscopic, Magnetic, Spectroscopic, SPR, Tyndall effect 1.5 Applications of Nanomaterials: in Medicine (Drug Delivery), Agriculture & food, Cleaner and Sustainable Environment, Boosting the business with Nanotech 1.6 Biosensors: Features of Biosensors & its types of biosensor (Electrochemical Biosensor, Optical Biosensor, Resonant Biosensors, Thermal Detection Biosensor, Piezoelectric biosensors), classification based on transducers, applications 1.7 Introduction to Nanobiochip (Organ-on-a-chip, Lab-on-a-chip)	**15**
1	Synthesis of Silver Nanoparticles by Leaf Extract	**30 Hours**
2	Checking the antimicrobial activity of nanoparticles	
3	Biological synthesis of nanoparticles	
4	Characterization of nanoparticles (any one method)	

References

Sr. No.	Title & Author	Edition	Published in
1	Nanostructures and Nanomaterials - Guozhong Cao	2nd	2011
2	Introduction to Nanotechnology - Charles Poole	1st	2003
3	A Laboratory Course in Nanoscience and Nanotechnology- Poinern	1st	2015
4	Nanotechnology: An introduction to Synthesis, Properties and Applications of Nanomaterials- Varghese and Balakrishna	2024th	2024
5	Textbook of Nanoscience and Nanotechnology - Murthy	1st	2012

Course Code 24BUBC4P03	Course Title **Field Project in Biochemistry II**	Credits 2	No. of lectures

CO1	Apply appropriate field and laboratory techniques to plan and implement a project work that will resolve environmental issues ethically and systematically.	L4
CO2	Analyze generated data using suitable analytical, biochemical or statistical tools to interpret.	L3
CO3	Evaluate the effect of various factors on biological systems based on field observations and scientific evidence.	L5
CO4	Report field project findings effectively through structured reports, data presentations and oral or poster presentations demonstrating scientific reasoning and teamwork.	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	**2**	**3**	**2**	**2**	**3**	**3**
CO2	**2**	**3**	**2**	**2**	**3**	**3**
CO3	**2**	**3**	**2**	**2**	**3**	**3**
CO4	**2**	**3**	**2**	**2**	**3**	**3**

Project on ● Data collection & analysis using bioinformatic tools ● Synthesis of nanoparticles by biological methods ● Implementing bioremediation on a small scale ● Formulating a biofertilizer for better plant growth ● Survey based projects involving application of biostatistics	**60 Hours**

S. Y. B. Sc. Biochemistry

	SEMESTER – III	**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**
24BUBC3T01	Physicochemical Principles & Nutrition Science	-	-	-	-	-	√	-
24BUBC3T02	Mendelian Genetics & Immunology	-	-	-	-	-	-	-
24BUBC3T03	Analytical Biochemistry & Enzymology	-	-	-	-	-	-	-
24BUBC3P01	Practicals based on 24BUBC3T01 and 24BUBC3T02	√	-	√	√	-	-	-
24BUBC3P02	Practicals based on 24BUBC3T02 and 24BUBC3T03	-	-	√	√	-	-	-
24BU3SEC06	Microscopy	√	-	√	√	-	-	-
24BU3AEC03	Physiology & Tissue Culture	-	-	-	√	-	-	√
24BUBC3P03	Field Project in Biochemistry I	√	√	√	√	√	√	√
	Total	**03**	**01**	**04**	**05**	**01**	**02**	**02**

S.Y.B.Sc Biochemistry

	SEMESTER – IV	**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**
24BUBC4T01	Industrial Biochemistry & Nutraceutical Sciences	-	√	-	-	-	-	-
24BUBC4T02	Genetics	-	-	-	-	-	-	-
24BUBC4T03	Applied Biochemistry	-	√	√	-	-	√	√
24BUBC4P01	Practicals based on 24BUBC4T01 and 24BUBC4T02	√	-	√	√	-	-	-
24BUBC4P02	Practicals based on 24BUBC4T02 and 24BUBC4T03	√	-	√	√	-	-	-
24BU4SEC06	Nanotechnology	√	√	√	√	-	√	√
24BU4AEC03	Biostatistics & Bioinformatics	√	-	√	√	-	-	-
24BUBC4P03	Field Project in Biochemistry II	√	√	√	√	√	√	√
	Total	**05**	**04**	**06**	**05**	**01**	**03**	**03**

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