Academic Council Meeting No. and Date: 8 / September 04, 2023

Agenda Number: 2 Resolution Number: 34, 35 / 2.7, 2.28

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

Syllabus for

Programme: Bachelor of Science

Specific Programme

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

Level 4.5

Choice Based Grading System

Revised under NEP

From academic year 2023-2024

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Preamble

Biochemistry is a perfect amalgamation of chemical sciences and biological sciences. A biochemist has a knowledge of reactions that drive the core of life processes. As a first step towards the journey of becoming renowned biochemist, students enrolling for this course will be thrilled by the wonders of chemical reactions that various biomolecules carry out. With a little brush-up to the knowledge obtained in earlier levels of education, the student enrolling in this program would find himself learning exciting concepts of cell biology in first semester and Physiology in second semester.

Under the New Education Policy 2020, the syllabus has been modified to include deeper concepts of topics already present in the syllabus. The learner would follow student-centric 'Credit System', which will allow continuous assessment and holistic evaluation of the candidate through internal and external modes. With this thoughtfully designed syllabus, it is expected that the learner would have a very strong conceptual base to be used for upcoming years of graduation and would develop a habit of asking questions encouraging his or her curiosity.

Learner will also be required to gain a knowledge of fundamental chemistry as a part of the minor subject. Theoretical microbiology will be dealt by the students under the Generic elective while the hands-on techniques will be covered under the Vocational education. Students should also be able to speak fluently in the language known as 'window to the world'. Thus, English communication will be covered stressing more onto oral and written English in first semester and scientific writing in second.

With a view of providing holistic education, learner will also be taught Yog, Ayurved, Meditation, Traditional Indian Diet and Stress management as a part of Indian Knowledge System.

BOS Chairman: Ms. Sayali Daptardar

Eligibility:

Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board withMathematics as one of the subjects.

Duration: 1 Year (includes SEM I and SEM II)

Mode of Conduct:
Offline Laboratory Practicals / Offline lectures / Online lectures

Total Credits for the Program: 132

Starting year of implementation: 2023- 24

Name of the Degree Program: B.Sc.

Discipline/Subject: Biochemistry

Eligibility For certificate if exit at level 4.5

Specific Programme: F. Y. B. Sc. Biochemistry (Major)

Credits: 06

Program Specific Outcome:

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

- Analyze the structure of biomolecules and identify their presence or absence by understanding their interactions
- Differentiate between the structures of prokaryotic and eukaryotic cell, identify the parts, elaborate on their role in cellular mechanisms
- Work on microbial cultures for the routine procedures followed in microbiological laboratory
- Develop the skills to write and speak Scientific English and apply it in writing answers
- Apply the resourceful traditional knowledge of the country for self-development.

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

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

F. Y. B. Sc. (Biochemistry)

Structure of Programme

Course Code	Course Title	No. of lectures	Credits
Semester I			
Major			
23BUBC1T1	Biomolecules – I	30	2
23BUBC1T2	Cell Biology	30	2
23BUBC1P1	Practicals based on 23BUBC1T1 and 23BUBC1T2	60	2
23BUVSC7	Laboratory Skills in Microbial Biochemistry	45	2
	Total	**165**	**8**
Minor			
23BUCH1T3	Chemistry Minor 1	30	2
23BUCH1T4	Chemistry Minor 2	30	2
23BUCH1P2	Chemistry Practicals	60	2
	Total	**120**	**6**
Generic Elective (GE)			
23BUBC2T5	Majestic Microbial World	30	2
	Total	**30**	**2**
Open Elective (OE) – Interdisciplinary Sciences			
23BUID1T6	Soft skills and personality development-I	30	2
	Total	**30**	**2**
Ability Enhancement Course (AEC)			
23BUEN1T8	Basic English Learning course	30	2
	Total	**30**	**2**
Indian Knowledge System (IKS)			
23BUIK1T2	Principles of Yoga for Body and Mind Management	30	2
	Total	**30**	**2**

Course Code	Course Title	No. of lectures	Credits
Semester II - Major			
23BUBC2T1	Biomolecules – II	30	2
23BUBC2T2	Biochemistry & Physiology	30	2
23BUBC2P1	Practicals based on 23BUBC2T1 and 23BUBC2T2	60	2
23BU2CC07	CC	60	2
23BU2CC01	NSS - Social Science		
23BU2CC02	NCC - Defense Science		
23BU2CC03	DLLE		
23BU2CC04	Sports - Physical Education		
23BU2CC05	Cultural Activities		
	Total	**180**	**8**
Minor			
23BUCH 2T3	Chemistry Minor 1	30	2
23BUCH2T4	Chemistry Minor 2	30	2
23BUCH2P2	Chemistry Practicals	60	2
	Total	**120**	**6**
Generic Elective (GE)			
23BUBC2T5	Common diseases and their management	30	2
	Total	**30**	**2**
Open Elective (OE) – Interdisciplinary Sciences			
23BUID2T6	Soft skills and personality development-II	30	2
	Total	**30**	**2**
Ability Enhancement Course (AEC)			
23BUEN2T8	Scientific English Writing	30	2
	Total	**30**	**2**
Indian Knowledge System (IKS)			
23BUIK2T2	Ayurveda for Healthy Life Style	30	2
	Total	**30**	**2**

Note: Minor - Chemistry, Generic, statistics/zoology AEC, IKS, Open elective syllabus view

Semester I

Course Code 23BUBC1T1	Course Title **Biomolecules – I**	Credits 2	No. of lectures

Learning Outcomes: Learner will be able to:

- Describe Properties of water and its biological significance
- Solve the problems based on units of concentration
- Compare the different types of carbohydrates
- Analyze the types of lipids based on their structure and functions

Unit I Water	1.1 Biochemistry of Water: Structure and hydrogen bonding, Its effect on Biomolecules 1.2 Hydrophobic & hydrophilic substances, Amphipathic compounds with examples 1.3 Properties (surface tension, latent heat, specific heat, viscosity, dielectric constant, Colligative properties) of water and their biological significance 1.4 Water as a universal solvent, Entropy and dissolution of solute 1.5 Effect of non-polar compounds on the structure of water, Weak interactions of biomolecules in aqueous solutions 1.6 Concentration units: Avogadro's number, mole, mole fraction, molarity, equivalent weight, normality, molality, percentage (Problems to be worked out)	**15**
Unit II Carbohydrates & Lipids	2.1 Carbohydrates: Definition, detailed Classification of carbohydrates (mono, di, oligo, polysaccharides) Occurrence, structures and significance of each 2.2 Physical Properties: Isomerism D & L, optical; epimers, anomers 2.3 Lipids: Definition and functions 2.4 Classification of Lipids (Bloor's): a. Simple (Fats, Oils, Waxes), Derived (Steroids, Sterols, Carotenoids) b. Compound Lipids: Functions of glycerophospholipids Phosphosphingolipids, Glycolipids (Any 3 Examples, structure and significance of each) c. Saturated fatty acids: classification of C2 to C20: even carbon: Common and IUPAC names. d. Unsaturated fatty acids: MUFA, PUFA (Types), Omega-fatty acids. e. Triacyl glycerol - simple and mixed - names and structure	**15**

Course Code 23BUBC1T2	Course Title **Cell Biology**	Credits 2	No. of lectures
Learning Outcomes: Learner will be able to: • Explain the various types of cells along with their organelles and their functions • Compare the characteristics of prokaryotic and eukaryotic cells • Elaborate on the different components of cytoskeleton giving their significances • Relate the function of checkpoints with cell cycle			
Unit I Cell & Cell Organelles	1.1 Overview of Cell Theories 1.2 Comparison between Prokaryotic & Eukaryotic cells 1.3 Cell wall of Plant, Algae, Fungi, Bacteria 1.4 Plasma membrane 1.5 Organelles of Cell a. Nucleus & nucleolus: Structure & functions b. Mitochondria: Organization & functions c. Plastids: Types & functions d. Ribosomes: Structure & functions e. Golgi Apparatus: Structure & functions f. Functions of Lysosomes, Peroxisomes, Mesosomes, Magnetosomes, Glyoxysomes, Proteosomes		**15**
Unit II Cytoskeleton	2.1 Cytoskeleton: Comparative analysis of a. Microtubules (Occurrence, Structure, Chemical Composition, MAPs, MTOCs, Function) b. Microfilaments (Distribution, Chemical composition & Function) c. Intermediate filaments (Introduction in brief, Assembly, Types & Function) 2.2 Centrioles, & Basal bodies (Occurrence & Structure) 2.3 Cilia and Flagella: Distribution, ultrastructure (Axoneme in detail) 2.4 Extracellular Matrix (proteins, polysaccharides and adhesion proteins) 2.5 Cell Junctions (Anchoring, tight, Gap, Occluding, Desmosomes, Plasmodesmata) 2.6 Concept of Apoplastic & Symplastic movement 2.7 Cell Division: Cell Cycle & Check Points 2.8 Concept of Necrosis & Apoptosis		**15**

Course Code 23BUBC1P1	Course Title Practicals based on 23BUBC1T1 and 23BUBC1T2	Credits 2	No. of lectures
1	Working in Laboratory and Safety Measures		**60 Hours**
2	Basic instruments: Microscope, Centrifuge, Analytical balance, pH meter		
3	Calibration of volumetric glassware (Burette, pipette and measuring cylinder)		
4	Preparation of laboratory reagents & solutions - Concept of Molar, Normal and Percent		
5	Standardization of Laboratory Reagents		
6	Qualitative tests for Carbohydrates – Monosaccharides, Disaccharides Polysaccharides		
7	Detection of Unknown Carbohydrate		
8	Determination of Acid value of give oil sample		
9	Determination of SAP value of given oil sample		
10	Qualitative tests for lipids		
11	Effect of isotonic, hypertonic and hypotonic solutions on cells – onion peel		
12	Preparation of temporary mount of onion peel to observe and study epidermal cells		
13	Preparation of microscope slide for Monocot & Dicot leaf section		
14	Observation of stomata & guard cells in leaf under microscope		
15	Isolation of chloroplast from Spinach		
16	Detection of mitochondrial activity		
17	Study of stages of mitosis using onion root tips		
18	Observing stages of mitosis and meiosis using permanent slides		
19	Study the motility in bacteria by flagella using hanging drop method		
20	Observation of movement of paramecium using cilia		

Course Code 23BU1VSC7	Course Title Laboratory techniques in Microbial Biochemistry	Credits 1	No. of lectures
Learning Outcomes: Learners will be able to: • Acquire skills required for basic techniques in microbial work • Explain the different types of microorganisms and their nutritional requirements • Elaborate on the types of culture media used for microbial growth			
Unit I **Basic Techniques in Microbiology**	1.1 Microbial Diversity: Bacteria, Archaea, Fungi, Algae, Protozoa, Viruses) General features 1.2 Observing Bacteria: Dyes and stains: Types, Physicochemical basis Fixatives, Mordants, Decolorizers, Simple and differential staining, Special Staining (Capsule, Cell wall) 1.3 Microbial Growth: Growth curve, optimum conditions, Nutritional requirements: Carbon, Oxygen, Hydrogen, Nitrogen, Phosphorus, Sulfur and growth factors, Nutritional types of microorganisms 1.4 Types of Culture media, Isolation of microorganisms and pure culture techniques 1.5 Preservation of microorganisms		**15**

Course Code 23BU1VSC7	Course Title Laboratory techniques in Microbial Biochemistry	Credits 1	No. of lectures
1	Microbiology Lab: Introduction to Autoclave, Hot air oven, Glassware, Nichrome loop, Methods of preparation of glassware for Sterilization		**30**
2	Observing variety of microorganisms (Diatoms, protozoa) in a drop of lake water under microscope		
3	Wet mount for observing fungi		
4	Monochrome Staining, Negative staining		
5	Differential Staining: Gram Staining		
6	Special Staining: Capsule staining		
7	Isolation & Study of colony Characteristics		
8	Use of Differential & Selective Media: (MacConkey & SMA)		
9	Inoculation techniques (Spreading, Streaking, Swabbing, Stabbing)		
10	Study of Growth under different conditions of pH & Temperature		

Course Code 23BUIK1T2	Course Title Principles of Yoga for Body and Mind Management	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Learn basic concepts in Ayurved related to human body • Understand the importance of Meditation & Stress Management			
Unit I **Know Your Body**	1.1 Three Gunas & Mental Nature 1.2 The Three Doshas 1.3 The Seven Dhatus 1.4 The Five Pranas		**15**
Unit II **Meditation & Stress Management**	2.1 Concept of Stress 2.2 Stimulation - Relaxation for Stress Management 2.3 Dinacharya 2.4 Balancing the female cycle 2.5 Pranayama & Its forms 2.6 Meditation & The Mind 2.7 Resolving inner conflict & limiting beliefs 'The Enquiry', Accomplishing goals		**15**

Semester II

Course Code 23BUBC2T1	Course Title **Biomolecules – II**	Credits 2	No. of lectures

Learning Outcomes: Learner will be able to:

- Describe the functions of nucleic acids in the cell
- Elaborate on the types of DNA & RNA found in the cells
- Compare the different structures of amino acids
- Choose appropriate agent to denature the proteins

Unit I Nucleic Acids	1.1 Nucleic Acids: Structure - Purine & Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP), phosphodiester linkage, Formation of polynucleotide strand with its shorthand Representation 1.2 DNA: Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA & its features, Properties of nucleotides - Effect of heat on physical properties of DNA: Viscosity, buoyant density, UV absorption, Hypochromism, hyperchromism, Denaturation and Renaturation of DNA, Types: A, B & Z 1.3 RNA: various types in prokaryotes and eukaryotes- mRNA & rRNA - general account, tRNA - clover leaf model, 1.4 Uncommon RNAs: snRNA, siRNA, miRNAs, snoRNAs, lncRNA, piRNAs, Ribozymes 1.5 Nucleases (Endo & Exo)	**15**
Unit II Proteins & Amino Acids	2.1 Amino acids: Amino acid structure - D & L forms of all 20 amino acids, Detailed classification based on polarity, nutritional (essential and non-essential amino acid), Chemical structure and chemical nature, reactions with reagents 2.2 Physical properties: Zwitter ions, pI of amino acids as ampholytes, melting point, optical rotation, UV absorption 2.3 Non-Standard amino acids, Functions of amino acids 2.4 Peptides and Proteins: ASBC - APS classification on the basis of molecular shape, composition and function 2.5 Primary structure - Formation and characterization of the peptide bond, Secondary structure - Alpha helix and beta sheet, Tertiary(myoglobin) and Quaternary (hemoglobin) structures 2.6 Properties of proteins 2.7 Protein denaturation (Concept, Conditions, denaturing agents, Enzymes, their mode of action) 2.8 Biological importance of Peptides	**15**

Course Code 23BUBC2T2	Course Title **Biochemistry & Physiology**	Credits 2	No. of lectures
Learning Outcomes: Learner will be able to: • Derive the Hendersen – Hasselbalch equation • Describe the importance of buffers • Elaborate on the body fluids and their significances			
Unit I pH & Buffers	1.1 Definition – pH, pK, pKw, isoelectric pH, buffer, buffering capacity, Electrolytic Dissociation & Electrolytes 1.2 Derivations: Ionic product of water, Hendersen– Hasselbalch equation 1.3 Relation between pI, pKa1 and pKa2 for a neutral, acidic and basic amino acid 1.4 Ionization and titration curves of glycine, lysine and aspartic acid; pKa and pI values of these amino acids 1.5 Buffers - Definition, action, Physiological buffers: Hb - HHb, carbonate bicarbonate, phosphate and protein 1.6 Numerical on above concepts		**15**
Unit II Blood & Body Fluids	2.1 Fluid compartments of the body–ICF and ECF 2.2 Haematopoesis Blood: Composition, characteristics and function 2.3 Role of plasma proteins, Starling hypothesis 2.4 Transport in Blood: Transport of gases CO_2 and O_2, Role of hemoglobin, O_2 dissociation curves 2.5 Bohr effect, Chloride shift 2.6 Bile: Composition, characteristics and function; storage, Importance of testing Bile 2.7 Lymph: Composition, Formation and Circulation 2.8 Urine: Composition–normal and abnormal constituents; formation of urine, Importance of testing urine 2.9 Function, Characteristics and Composition of interstitial fluid, cerebrospinal fluid, synovial fluid, seminal fluid, tears, sweat and feces		**15**

Course Code 23BUBC2P1	Course Title Practicals based on BNBUSBCH2T1 and BNBUSBCH2T2	Credits 2	No. of lectures
1	Isolation of genomic DNA from onion / Banana / Strawberry cells		**60 Hours**
2	Qualitative tests for Nucleic Acids		
3	Qualitative tests for Amino Acids		
4	Qualitative analysis for Protein		
5	Qualitative test to detect unknown protein.		
6	Ammonium sulphate precipitation of Proteins.		
7	Concept of Dialysis in Protein purification		
8	Preparation of buffers for experimental purpose		
9	Acid –Base titration of a Polyprotic acid		
10	Determination of the Achromic point of Salivary Amylase		
11	Extraction of citric acid from lemon juice		
12	Checking pH of various food samples/fruit juices		
13	Density gradient centrifugation of Blood using Ficoll-Hypaque		
14	Determination of RBC & WBC count		
15	Detection of Bilirubin (Iodine test/Gmelin's Nitric acid test/Fouchet's test)		
16	Detection of Bile salt (Pettenkofer's test, Hays sulphur test)		
17	Urine analysis- Normal and Abnormal constituents		
18	Urine Analysis by Dip Stick Method		
19	Estimation of titratable acidity of Urine		
20	Determination of Hemoglobin content by the Sahli's hemoglobinometer		

23BU2CC07	**Course Title** Co-Curricular courses (CC) / Community Engagement and Field projects (CEP)	**30**	**2**
23BU2CC01	NSS-Social science		
23BU2CC02	NCC-Defense science		
23BU2CC03	DLLE		
23BU2CC04	Sports- Physical Education		
23BU2CC05	Culture		
Students will select any one above mentioned course			

Course Code 23BUIK2T2	Course Title Ayurveda for Healthy Life Style	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Learn about Indian Diet & its Impact on Health • Elaborate on the importance of Ayurveda & Ancient Indian Drugs in day – to -day life			
Unit I **Indian Diet & its Impact on Health**	1.1 Ayurvedic detox programs 1.2 Yogic & Ayurvedic Diets 1.3 A balanced diet, the six tastes & Vipaka		**15**
Unit II **Ayurveda & Ancient Indian Drugs**	2.1 Ayurvedic Herbs (Amla, Ginger, Ritha, Maka, Behada, Bell, Tondali, Brahmi, Anar, Corriander seeds, Durva, Erand, Papita, Gulvel, Haldi, Hirada, Hing, Jamun, Hibiscus, nutmeg, Cumin seeds, Banana,Karanja, Karela, Karpur, Khajur, Khaskhas, Kulith, Aloevera, Kesar, Lajalu, Lasun, Laung, Pepper, Methi, Saunf, Mula, Pan, coconut, Kadunimb, Onion, Fig, Sadafuli, Rai, Shatavari, Kadipatta, Shivga, Eliachi, Chandan, Chakraful, teel, Tulasi, Dalchini, Tamalpatra, Almond, Yashtimadhu, Ajwain, Ghee, Honey) 2.2 The Five Main Methods of Herbal Preparation		**15**

Course Code 23BU1CC07	Course Title Community Engagement	Credits 2	No. of lectures
Learning Outcomes: Learners will be able to: • Engage with community empathetically • Inculcate the habit of helping community			
The students would be involved in community services as a part of NSS/ NCC/ DLLE committee OR undertake related project involving community service.			**60**

Credit Framework, Courses Framework and Evaluation Assessment Pattern under NEP

Level	Sem.	Faculty-DSC		Any Faculty		Vocational & Skill Enhancement Courses (VSC), SEC (VSEC)	Ability Enhancement Courses (AEC)/ Value Education Courses/ Indian Knowledge System (IKS)			Field Project/ Apprenticeship/ Community Engagement & Services	Credit	Cumulative Credits
		Subject	Subject	Subject			Subject					
		Major	Minor	GE & OE			AEC	VEC	IKS			
		CREDITS	CREDITS	CREDITS	CREDITS		CREDITS	CREDITS	CREDITS			
				GE	ID							
4.5	I.	06	06	02	02	02	02	-	02	-	22	44
	II.	06	06	02	02	-	02	-	02	02	22	
Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF courses/ internship or continue with Major and Minor												
Transforming F.Y.B.Sc. curriculum into NEP 2020 structure provided by the Government of Maharashtra												
Cum cr.		6*2 = 12	6*2 = 12	4*2 = 08		02	4*2 = 08			02	44	44

Level	Sem.	Faculty - DSC						Any Faculty		Vocational & Skill Enhancement Courses (VSC)	Ability Enhancement Courses (AEC)/Indian Knowledge System (IKS)		Field Project/ Apprenticeship/ Community Engagement & Services		Credit	Cumulative Credits
		Subject			Subject			Subject								
		Major - credits 6 (4T+2P)			Minor- credits 6 (4T+2P)			GE & OE								
		Course - I	Course -II	Course-III	Course- I	Course-II	Course-III	Course-I	Course-II		AEC	VEC	IKS			
Level4.5	I.	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (1T+1P)	02 (2T)	-	02 (2T)	-	22	44
	II.	02 (2T)	02 (2T)	02 (2P)	02 (2T)	02 (2T)	02 (2P)	0 2 (2T)	02 (2T)	-	02 (2T)	-	02 (2T)	0 2	22	

Note: Students will get a choice of **VSC, SEC VSEC for credits- 2**

Credit Framework, Courses Framework and Evaluation Assessment Pattern under NEP

Level	Faculty DSC	Theory					Practical		TOTAL
		Internal	Min. Marks for Passing	External	Min. Marks for Passing	Total	Exam	Min. Marks for Passing	
4.5	**1. Major (Credits 06)**								
	Course I	20	08	30	12	50	50	20	150
	Course II	20	08	30	12	50			
	2. Minor (Credits 06)								
	Course I	20	08	30	12	50	50	20	150
	Course II	20	08	30	12	50			
	3. Generic Elective (GE) / Open Elective (OE) (Credits 04)								
	GE	20	08	30	12	50	-	-	100
	OE	20	08	30	12	50			
	4. Vocational Skill Course (VSE) (Credits 02) SEM I Only								
	VSE	-	-	25	10	25	25	10	50
	5. Ability Enhancement Course (AEC) (Credits 02)								
	AEC	20	08	30	12	50	-	-	50
	6. Indian Knowledge System (IKS) (Credits 02)								
	IKS	20	08	30	12	50	-	-	50
	7. Community Engagement / Field Project (Credits 02) SEM II Only								
	CC	20	08	30	12	50	-	-	50
	SEM I TOTAL								**550**
	SEM II TOTAL								**550**
	FYBSC / Certificate Total Marks								**1100**