

Academic Council Meeting No. and Date : 2 / April 30, 2021

Agenda Number : 4

Resolution Number : 4.8 and 4.24

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



Syllabus for
Programme : Bachelor of Science
Specific Programme : Biochemistry

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

Initiated in Academic year 2001-2002	Revised under Autonomy academic year 2021 - 2022
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Preamble

Biochemistry is the branch of science that explores the chemical processes within and related to living organisms. Biochemistry is central to all areas of the “biological” and “life” science. It aims to provide an understanding of every aspect of the structure and function of living things at cellular level. Being an interdisciplinary subject it is spanning a wide range of areas from microbiology to plant and animal sciences to pathology of diseases and nutrition.

The impact of studies in biochemistry on modern life is enormous. Therefore, the syllabus is structured to touch upon broad base at the beginning. Biomolecules are the basic and important constituents of a living system. Hence, it is mandatory to study structure, occurrence and functions of large biomolecules like carbohydrates, lipids and proteins along with nucleic acids. Life evolved from a small microbe, it is our aim to study living microscopic size organisms which include bacteria, fungi, protozoa and special type of microorganisms called extremophiles. After an in-depth understanding of microorganisms students are introduced to detailed structural organization of basic unit of a living system “The Cell”.

Unique physical and chemical characteristics of water enable it to function in ways essential to human and other life processes due to its structure and composition. Life on Earth began more than 3 billion years ago, evolving from the most basic of microbes into a dazzling array of complexity over time, which makes it necessary to study the origin of life and evolution of a modern species over span of years.

In order to understand the biological processes occurring in the living body, processes as digestion, absorption, respiration and excretion are necessary to be studied.

The course seeks to be diverse and yet will present the essence of biochemistry in a focused manner. This will prepare students for achieving better understanding of the major thrust areas in the disciplines like Chemistry of Biomolecules, Cell biology, Microbiology and Physiology.

Eligibility :

Passed 12th standard (HSC) of Maharashtra State Board / CBSE / ICSE board or equivalent.

Duration : 3 years

Mode of Conduct :

Laboratory practicals / Offline lectures / Online lectures

Program Specific Outcome

1. Develop an adequate background to enable the first year students to study more advanced biochemistry topics.
2. Acquaint the learners with the unique properties of the universal solvent - water, essential for life processes.
3. Understand the life constituting bio molecules: proteins, carbohydrates, lipids, nucleic acids.
4. Familiarize the learners about the origin of life and take them through the process of evolution.
5. Focus on Cell as the basic unit of life which is the center for all biochemical processes.
6. Familiarize the learners to the world of microorganisms which exist as independent cellular units.
7. Develop an interest in the learner in nutrition for sustaining life, and physiology and functioning of life systems.
8. Appreciate the importance of the broad spectrum of biochemistry

F.Y.B.Sc. (Biochemistry)

Structure of Programme

Semester I			
CourseCode	Course Title	No. of lectures	Credits
BNBUSBC1T1	Biochemistry - Paper I	45	2
BNBUSBC1T2	Biochemistry - Paper II	45	2
BNBUSBC1P1	Biochemistry Practical	30	2
Total		120	6

Semester II			
CourseCode	Course Title	No. of lectures	Credits
BNBUSBC2T1	Biochemistry - Paper I	45	2
BNBUSBC2T2	Biochemistry - Paper II	45	2
BNBUSBC2P1	Biochemistry Practical	30	2
Total		120	6

Semester I

Course Code BNBUSBC1T1	Course Title Biochemistry Paper - I	Credits 2	No. of lectures
<p>Course Outcomes: After successful completion of this course student will be able to</p> <ul style="list-style-type: none"> • Understand the contributions of various scientists in the field of Biochemistry. • Able to comprehend the structure, function and properties of amino acids. • Introduced to the structure, properties and roles of carbohydrates- Monosaccharides, disaccharides and Polysaccharides. • Able to identify and quantitative various biomolecules in the laboratory. 			
Unit I :	<p>History of Science : General history of science, Aim and Scope of Biochemistry, Contributions of Scientists in the Field of Biochemistry, Har Gobind Khurana, G N Ramachandran , Homi Jehangir Bhabha, Kamla Sohnie, R Rajalaxmi.</p>	15	
Unit II :	<p>Amino acids and proteins : Amino acids : Amino acid structure - D & L forms of all 20 amino acids. Detailed classification based on polarity, essential and non essential amino acid Physical properties: zwitter ions, pI of amino acids amino acids as ampholytes, melting point, optical rotation, UV absorption chemical properties: Chemical reactions of amino acids with Ninhydrin, Sanger's reagent, Edman's reagent and Dansyl chloride, Non Standard amino acids, Functions of amino acids. Peptides and Proteins : ASBC - APS classification on the basis of shape and function Primary structure - Formation and characterization of the peptide bond Secondary structure - Alpha helix and beta sheet Tertiary(myoglobin) and Quaternary (hemoglobin) structures - an introduction Protein denaturation</p>		15
Unit III :	<p>Carbohydrates : Definition, Classification and functions of carbohydrates (mono, oligo polysaccharides) Monosaccharides : Classification in terms of aldoses and ketoses Occurrence, structures and significance of glucose, fructose, galactose, mannose, and ribose Properties: a) Physical - isomerism D & L, optical; epimers : anomers Chemical reactions - Oxidation to produce aldonic. aldaric and uronic acids (with respect to glucose); b) reducing action in boiling alkali, enediol formation (with respect to glucose and fructose) c) Osazone formation (with respect to glucose and fructose). d) Orcinol (with respect to ribose) Disaccharides : Occurrence and structure of maltose , lactose and sucrose Formation of glycosidic bonds Polysaccharides: Classification based on function, storage and structure Composition: homo & hetero. with examples Storage : starch and glycogen - action of amylase on starch Structural: cellulose, chitin.</p>	15	

Course Code BNBUSBC1T2	Course Title Biochemistry Paper – II	Credits 2	No. of lectures
<p>Learning Outcomes: After successful completion of this course student will be able to</p> <ul style="list-style-type: none"> • Gain knowledge about cell theory and basic cell structure, structure and function of various cell organelles in a eukaryotic cell. • Get acquainted with the composition of cytoskeleton and extracellular matrix • Acquire insight into cell division and cell death mechanisms. • Understanding of world of Microbes and conditions required for growth of microbes. • Able to identify microorganisms by using various staining techniques. 			
Unit I :	<p>The cell and cell organelles : Structural organization of cells : Cell Theory, Prokaryotic, Eukaryotic (plant & animal) - a comparative overview Cell wall structure (plant), cell membrane (fluid mosaic model) Cell organelles: Mitochondrion: Organization & function of the mitochondria, mitochondrial genome Chloroplast: Structure and function of the chloroplast. the chloroplast genome, other plastids Ribosome: Structure & Function of Ribosome ER: SER and RER structure and function. Golgi apparatus: Structural Overview Peroxisome & Lysosome: Peroxisome function & assembly (in brief) and Lysosome structure and function Nucleus: Structure & function of the nucleus, nuclear envelope, nuclear pores, nuclear matrix and Nucleolus</p>	15	
Unit II :	<p>Cytoskeleton, ECM and Cell Cycle : Cytoskeleton Structure, assembly and function of Microtubules: Axonemal and cytoplasmic microtubules (cilia, flagella, centrioles, basal bodies) Microfilaments: Actin and Myosin Intermediate Filaments: different classes. Extracellular Matrix and Cell Junctions ECM components – proteins, polysaccharides and adhesion proteins; basic concept of anchoring junctions, tight junctions and communication junctions (gap junctions and plasmodesmata) Cell Cycle, Cell Cycle Checkpoints, Cell Death, Cell Division (mitosis and meiosis) Brief overview of apoptosis and necrosis</p>	15	
Unit III :	<p>Microbiology : Historical background (contributions of Leeuwenhoek. Pasteur ,etc) General characteristics (size, shape and structure) of Bacteria, classification of bacteria based on morphology (shape and flagella) Bacterial cell wall: Structure and function, components of peptidoglycan frame work (structures of NAG and NAMA not necessary) An introduction to Extremophiles: thermophiles, psychrophiles, halophiles, magnetotactic, radiation resistant - examples with their application , Staining methods - principles of staining & types of stains, Microbial Growth - Growth Curve, Mathematical expression, Synchronous growth, Generation time , Culture media (N, C, Special requirements), Natural and Synthetic media. Sterilization and Disinfection techniques- Physical Agent of sterilization - Hot Air Oven, Autoclave, Radiations (UV, Gamma) , Chemical agents of sterilization - Alcohol, Halogens, Formaldehyde</p>	15	

Course Code BNBUSBC1P1	Course Title	Credits 2	No. of lectures
Section I			30
Practical 1	Safety Measures in Laboratory.		
Practical 2	Preparation laboratory reagents- Concept of Molar, Normal and Percent solutions.		
Practical 3	Qualitative tests for Carbohydrates – Monosaccharides (glucose and fructose), Disaccharides (lactose, maltose and sucrose) Polysaccharides (starch and dextrin)		
Practical 4	Detection of unknown carbohydrate.		
Practical 5	Qualitative test for amino acids		
Practical 6	Qualitative analysis for Proteins (albumin, peptone, gelatin and casein - any four proteins)		
Practical 7	Qualitative test to detect unknown protein.		
Practical 8	Assignment/ Case Study based on Unit 1.		
Practical 9	Demonstration of Analytical Balance.		
Section II			
Practical 1	Effect of isotonic, hypertonic and hypotonic solutions on cells – onion peel.		
Practical 2	Adsorption of oxalic acid on activated charcoal.		
Practical 3	Oxidation Reduction test- MBRT		
Practical 4	Gram staining.		
Practical 5	Online demonstration of Staining techniques- Capsule, Endospore, Negative staining.		
Practical 6	To study of cell organelles by using electron micrographs.		
Practical 7	Study of stages of mitosis using onion root tips.		
Practical 8	Permanent slides of mitosis and meiosis		
Practical 9	Microscopy – study of a compound microscope.		

Semester II

Course Code BNBUSBC2T1	Course Title Biochemistry Paper - I	Credits 2	No. of lectures
<p>Learning Outcomes : After successful completion of this course student will be able to –</p> <ul style="list-style-type: none"> • Acquainted with chemical and molecular foundations of life and appreciate the role of water in biological systems. • Able to comprehend the structure, function and classification of Lipids. • Introduced to the structure, properties and roles of nucleic acids. • Aware of the importance of vitamins and Minerals in biological systems. 			
Unit I :	<p>Lipids : Definition, classification (Bloor's) and functions of Lipids, Fatty' acids and Triacylglycerol</p> <p>Classification & Chemistry : Saturated fatty acids - classification of C2 to C20: even carbon: Common and IUPAC names. Unsaturated fatty acids MUFA, PUFA (2.3.4 double bonds), Omega - 3.6.9 fatty acids. Triacyl glycerol - simple and mixed - names and structure</p> <p>Chemical Reactions of fats : Saponification, Iodination, Ozonolysis, Auto-oxidation, Action of heat on glycerol and choline, Rancidity Definition & significance - Acid number, Saponification number, Iodine number, Reichert - Meissel number</p> <p>Compound Lipids : Functions of glycerophospholipids (PE.PC.PL) Phosphosphingolipids (ceramide, sphingomyelin), Glycolipids / Cerebrosides (gluco & galactocerebrosides), Steroids Cholesterol structure and biochemical significance.</p>	15	
Unit II :	<p>Nucleic Acids: Structure - Purine & Pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) Formation of polynucleotide strand with its shorthand Representation RNAs (various types in prokaryotes and eukaryotes) mRNA & rRNA - general account, tRNA - clover leaf model, Ribozymes</p> <p>DNA: Physical evidence of DNA helical structure. Chargaff's rules (chemical evidence), Watson-Crick model of DNA & its features Physical properties of DNA - Effect of heat on physical properties of DNA (Viscosity, buoyant density, UV absorption), Hypochromism, hyperchromism, denaturation of DNA. Reactions of nucleic acids (with DPA and Orcinol)</p>	15	
Unit III :	<p>Biochemistry of Water, Vitamins and Minerals :</p> <p>Water: Its effect on Biomolecules, hydrogen bonding and structure, properties (surface tension, latent heat, specific heat, viscosity, dielectric</p>	15	

Course Code BNBUSBC2P2	Course Title Biochemistry Paper - II	Credits 2	No. of lectures
<p>Learning Outcomes : After successful completion of this course student will be able to –</p> <ul style="list-style-type: none"> • Broadly study digestion for absorption of nutrients through the digestive system. • Appreciate and understand the biochemical, molecular and cellular events that coordinate working of the organ systems that regulate life processes. • Understand the disorders and diseases related to organ systems. • Perform and analyze various physiological tests that examine the function of various systems of the human body. • Familiarize the learners about the origin of life and take them through the process of evolution. 			
Unit I :	<p>Physiology of digestion, absorption and Respiration: Parts and Functions of Organs associated with GIT, Glands associated with GIT Secretions and Juices of GIT (Saliva, Gastric juice, Intestinal juice,pancreatic and Bile juice) Digestion and Absorption of carbohydrates, Lipids , Proteins. Disorders - Peptic ulcer, Lactose Intolerance Respiratory system, Breathing - inspiration and expiration, Composition of air and partial pressure of gases Physical exchange of gases • Transport of oxygen • Transport of carbon dioxide Respiratory disorders – cyanosis, respiratory acidosis and alkalosis</p>	15	
Unit II :	<p>Physiology of Excretion and Circulation. Excretion : Structure of the nephron: Bowman’s capsule & glomerulus - Structure & function, (ultrafiltration, pressures involved, GFR, regulation of GFR); Renal tubule - structure & function (proximal and distal convoluted tubules and Henle's loop) Urine formation: Reabsorption / Secretion of glucose, Na⁺, K⁺. HCO₃⁻ Cl⁻ and H⁺ : renal threshold, Excretory disorder: Nephritis Cardiovascular system : Anatomy and physiology of Blood Vessels and Cardiac Muscle. Cardiac Cycle. Regulation of heart rate, Blood Pressure. ECG and measurement of blood pressure. Circulatory Disorders- congestive heart disease, myocardial infarction, cardiacarrhythmias</p>	15	
Unit III :	<p>Origin of Life & Formation of cells: Big bang theory, Theories on the origin of life: Abiogenesis, Heterotroph hypothesis, RNA world, protein world, Miller's experiment, Formation of the first cell, endosymbiont theory Evolution - Darwinian theory, Modern synthetic theory of evolution and its factors: Gene mutations(recombination), heredity, natural selection and isolation Biological evidences: Fossil record, chemical and anatomical similarities of related life forms, geographic distribution of related species, genetic changes in living organisms over generations and Mechanism of evolution, Gene flow and genetic drift, Hardy-Weinberg principle</p>	15	

Course Code BNBUSBC1P1	Course Title	Credits 2	No. of lectures
Section I			30
Practical 1	Standardization of Laboratory Reagents- Primary standards - 0.1N oxalic acid, Secondary standards - 0.1N NaOH, 0.1N HCl		
Practical 2	Qualitative tests for lipids		
Practical 3	Determination of SAP value of given oil sample		
Practical 4	Determination of Acid value of give oil sample		
Practical 5	Qualitative tests for Nucleic Acids.		
Practical 6	Estimation of Iron.		
Practical 7	Estimation of Vitamin C.		
Practical 8	Qualitative Analysis of Minerals -Sodium, Potassium, Phosphorus,Iron, Chloride, Nitrate		
Practical 9	Demonstration of Ostwalds Viscometer.		
Section II			
Practical 1	Analysis of the action of salivary α - amylase action on starch.		
Practical 2	Concept of Dialysis: Ammonium sulphate precipitation.		
Practical 3	Estimation of total acidity of gastric juice.		
Practical 4	Estimation of titrable acidity of Urine.		
Practical 5	Urine analysis- Normal and Abnormal constituents.		
Practical 6	Identification of organs / parts of digestive system		
Practical 7	Identification of organs / parts of respiratory system		
Practical 8	Identification of organs / parts of excretory system		
Practical 9	Assignment based on Unit 1.		

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Evaluation Scheme

Internals

Class Test	Attendance & Leadership qualities	Total
30	10	40
Certification of Swayam / NPTEL in concern course		

Internal Examination : Based on Unit 1 / Unit 2 / Unit 3

Duration : 1 Hour

Total Marks : 30

	Answer the following	
Q.1		
Q.2		
Q.3		
Q.4		
Q.5		

Theory Examination : Suggested Format of Question paper

Duration : 2 Hours

Total Marks : 60

- All questions are compulsory

Q. 1	Answer any two of the following	16
	a Based on Unit I	
	b Based on Unit I	
	c Based on Unit I	
	d Based on Unit I	
Q. 2	Answer any two of the following	16
	a Based on Unit II	
	b Based on Unit II	
	c Based on Unit II	
	d Based on Unit II	
Q. 3	Answer any two of the following	16
	a Based on Unit III	
	b Based on Unit III	
	c Based on Unit III	
	d Based on Unit III	
Q. 4	Answer any two of the following	12
	a Based on Unit I	
	b Based on Unit II	
	c Based on Unit III	
	d Based on Unit IV	

** (4 questions of 8 marks each / 8 questions of 4 marks can be asked with 50% options)

Marks Distribution and Passing Criterion for Each Semester

Semester I							
Theory					Practical		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSBC1T1	40	16	60	24	BNBUSBC1P1	50	20
BNBUSBC1T2	40	16	60	24			

Semester II							
Theory					Practical		
Course Code	Internal	Min marks for passing	Theory Examination	Min marks for passing	Course Code	Practical Examination	Min marks for passing
BNBUSBC2T1	40	16	60	24	BNBUSBC2P1	50	20
BNBUSBC2T2	40	16	60	24			

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