HSNC UNIVERSITY, MUMBAI
KISHINCHAND CHELLARAM COLLEGE

FYBSC BIOCHEMISTRY SYLLABUS

As per NEP 2020
Academic Year 2024-25

PART 1

Preamble

Biochemistry is an integral part of understanding life on earth. The scope of biochemistry is as wide as life itself. Wherever there is life, we can observe chemical processes occurring there. Biochemists study chemical processes that occur in various life forms including microorganisms, plants, insects, fishes, birds, mammals and human beings. Based on this, one can easily state that, Biochemistry is the language of biology.

Biochemistry, in simple terms, can be also be defined as a vast branch of science that combines both Biology and Chemistry. It is a study focussing on the life processes of living organisms at both biological and chemical levels. The topic holds a lot of significance in the day-to-day life of every living thing and hence can also be called "the chemistry of everyday life". Biochemistry further deals with the functions and structure of biomolecules such as proteins, carbohydrates, lipids, etc., understanding of the chemical aspects of different biological processes such as digestion, respiration, reproduction, excretion, the behaviour of hormones, contraction, and relaxation of muscles, pharmacology, pharmacokinetics, pharmacodynamics and much more. This course has one paper covering theory and practical per semester. With the introduction of Choice Based Grading System, there will be a continuous evaluation throughout the year in the form of Internal Assessment and summative Assessment.

1.Course Objectives

- **To explain** a strong basis of classification of biomolecules with elucidation related to their function, utilization and relevance of the same to all other living organisms.
- **To ascertain a** holistic coverage of biochemistry through a realistic and practical driven approach of theoretical concepts.
- **To equip** the future graduates of the course with essential skill-sets as per industrial and academia so as to enable students to earn expertise in biochemistry related careers.
- **To ensure** sustainability through Biochemistry by offering endless possibilities in career scope and employment.
- **To empower** young minds to have adequate expertise in reflective thinking, rational scepticism, scientific temperament, and digital literacy so that they are equipped to contribute to contemporary scientific queries and fight immediate social issues apropos to the Indian milieu.

2. Process Adopted for Curriculum Designing

- By preventing ‘rote - learning’ approach, and by encouraging ability driven creative expressions, the curriculum has been designed to follow a student centric, hands-on experience-oriented pedagogical approach which would be outcome-oriented and curiosity-driven.
- Being a multidisciplinary subject, curriculum has been designed to cover a wide range of areas such as origin of life, development of multicellular life, study of water and further biomolecules with linear progression in the levels of difficulty.

- Feedback from various stakeholders, including the students, subject experts, parents, alumni and industry partners, has been actively sought and considered to keep the syllabus updated and modifications have been done in the syllabus with respect to the current needs and requirements of the professionals in industry and academia.

3. Salient features, how it has been more relevant:

- The syllabus aims to illuminate the crosstalk between the organism and its internal chemical processes rather than just being a didactic monologue on mere theoretical concepts.
- Being an applied subject, theoretical concepts of the syllabus have been sufficiently complimented by an assortment of hands-on experimentation which would make the subject more thought-provoking and pertinent to the students.
- Core competencies and discovery-based learning in students has been encouraged by the addition of trending concepts and introduction to the scientific frontiers of the subject.
- The VOC of the subject aims to strengthen the instrumentation and technical know-how of the students in order to make the students more employable.
- Syllabus would provide sufficient competency in the field for the students to undertake further discipline-specific studies, and target domain-related employment opportunities.

4. Learning Outcomes:

- **Students will be able to obtain knowledge and understanding** regarding the various properties of water and the major biomolecules covered in the syllabus
- **Students will be able to analyse and comment** on the concept of pH and Solutions and shall be able to **formulate** various solutions and buffers of as per need
- **Students will be able to interpret** utilization of biomolecules based on their properties and biological functions.
- **Students will be able to estimate** the potential economic and bio-medicinal utilization of various biomolecules **and may explore** entrepreneurial or research avenues in the associated fields.
- **Students will be able to reflect** on the various theories of evolution and **comment** on the flow of events leading to the formation of unicellular and multicellular life.

5. Input from stakeholders:

- Based on the inputs from stakeholders, more relevant and trending topics have been included.
- More hands-on and skill-based practical sessions have been added in the syllabus including the addition of more technique-oriented experiments in VOC.
- The Syllabus prepared under NEP has been made to be more inclined towards the expectations of Industry and Academia.
- More engaging and explorative Entrepreneurial Avenues have been added in the syllabus which also include product conceptualization, product design and product development.

HSNC University, Mumbai
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National Education Policy

First-Year BIOCHEMISTRY
Semester – I
Units – Topics – Teaching Hours

Sr. No	Subject Code	Subject Unit Title		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	**BCH 101B**	I	**Origin of Life and Biomolecules**	15	45 L	3	60
		II	**Water and Cell Transport**	15			
		III	**Biomolecules – Amino Acids and Proteins**	15			
2	**BCH 101D**	I	**practical based on course of theory**	30	15 x 2 = 30P	1	40
			TOTAL			4	100
● Lecture Duration – 60 Minutes ● One Credit =15 Classroom Teaching Hours							

First Year BIOCHEMISTRY
Semester – II
Units – Topics – Teaching Hours

Sr. No	Subject Code	Subject Unit Title		Hours/ Lectures	Total No. of hours/ lectures	Credit	Total Marks
1	**BCH 102B**	I	**Biomolecules - Carbohydrates**	15	45 L	3	60
		II	**Biomolecules - Lipids**	15			
		III	**Biomolecules - Nucleic Acids**	15			
2	**BCH 102D**	I	**Practical based on course 2 of theory**	30	15 x 2 = 30P	1	40
			TOTAL			4	100
● Lecture Duration – 60 Minutes ● One Credit =15 Classroom Teaching Hours							

BCH 101B - BIOCHEMISTRY SEMESTER I

3 Credits – 3 Units – 45 Lectures (15L X 3 Units)

Unit	Details	Lectures
I	**Origin of Life and Biomolecules**	**(15L)**
	A. Theories of Origin of Life a. Creationism b. Biogenesis Theory i. Spontaneous Generation Theory c. Abiogenesis Theory d. Cosmozoic or Interplanetary Theory i. Panspermia e. Eternity of Life Theory	**5L**
	B. Biochemical Evolution a. Oparin and Haldane Theory b. Miller's Experiment c. Coacervates and Molecular Aggregates d. Origin of Simple and Complex Molecules e. Introduction to Biomolecules	**5L**
	C. Formation of a cell a. Cell Theory b. Rise of Autotrophs and Heterotrophs c. Endosymbiont Theory d. Origin of Eukaryotes	**5L**
II	**Water and Cell Transport**	
	A. Water: a. Effect on Biomolecules Structure and properties of water (hydrogen bonding) b. Entropy and dissolution of solute c. Effect of non-polar compounds on the structure of water d. Weak interactions of biomolecules in aqueous solutions	**4L**
	B. Solutions a. Concepts of mole, molar, molar equivalent and normal, =Dalton b. Ionization of water, weak acids and weak bases	**2L** **2L**
	C. pH a. pH scale, H+ and OH- concentrations b. Weak acids and bases and their dissociation constants Ka & Kb	**1L**
	D. **Buffers -** Definition, action	**2L**
	E. **Cell wall -** structure (Plant & Microbial)	**2L**
	F. **Cell membrane –** Unit Membrane model and fluid mosaic model	**2L**
	G. **Transport across cell membranes** a. Diffusion (simple & facilitated) b. Active transport (primary & secondary) c. Endo & Exocytosis	

III	**Biomolecules – Amino Acids and Proteins**	
	A. Amino acids a. Amino acid structure - Forms of all 20 amino acids b. Detailed classification based on polarity c. Physical and chemical properties - Chemical reactions of amino acids with Ninhydrin, Sanger's reagent, Edman's reagent and Dansyl chloride **B. Peptides and Proteins** a. ASBC- APS classification on the basis of shape and function b. Primary structure -Formation and characterization of the peptide bond c. Secondary structure -Alpha helix and beta sheet d. Tertiary and Quaternary structures - One example of each e. Protein denaturation	**6L** **9L**

BCH 102B - BIOCHEMISTRY SEMESTER II

3 Credits – 3 Units – 45 Lectures (15L X 3 Units)

Unit	Details	Lectures
I	**Biomolecules – Carbohydrates**	**(15L)**
	A. **Definition, Classification, and functions of carbohydrates (mono, oligo, polysaccharides)**	**2L**
	B. **Monosaccharides** a. Classification in terms of aldoses and ketoses b. Structures of glucose, fructose, galactose, mannose, and ribose	**2L**
	C. **Properties of Carbohydrates:** a. Physical- isomerism D & L, optical; optical; epimers: anomers	**2L**
	D. **Reaction of Carbohydrates** a. Isomerism b. Oxidation & Reduction c. Mutarotation	**3L**
	E. **Disaccharides** a. Occurrence and structure of maltose, lactose and sucrose b. Formation of glycosidic bonds	**2L**
	F. **Polysaccharides** a. Classification based on function. storage and structure b. Composition: homo & hetero. with examples c. Storage: starch and glycogen - action of amylase on starch d. Structural: cellulose. chitin and Components of peptidoglycan framework	**4L**
II	**Biomolecules – Lipids**	
	A. Lipids a. Definition, classification (Bloor's) b. Fatty' acids and Triacylglvcerol c. Classification, Biological Function and Significance d. Saturated fatty acids - classification of C2 to C20 e. Common and IUPAC names f. Unsaturated fatty acids MUFA, PUFA (2.3.4 double bonds) Omega-3.6.9 fatty acids. g. Triacyl glycerol-simple and mixed-names and structure	**6L**
	B. Chemical Reactions of fats a. Saponification. Iodination. Ozonolysis. Auto-oxidation. b. Action of heat on glycerol and choline. c. Rancidity - Definition & significance d. Saponification number	**3L**
	C. Compound Lipids a. Structure & function of glycerophospholipids (PE.PC.PL) b. Phosphosphingolipids (ceramide, sphingomyelin) c. Glycolipids / Cerebrosidcs (Gluco & Galacto Cerebrosides)	**4L**
	D. Steroids a. Cholesterol structure and biochemical significance.	**2L**
III	**Biomolecules – Nucleic Acids**	
	A. Structure of Nucleic Acids	**5L**

	a. Purine & Pyramidine bases, ribose, deoxyribose b. Nucleosides and nucleotides (ATP, CTP, GTP, TTP, UTP) **B. RNAs** a. Types of RNAs in prokaryotes and eukaryotes **C. DNA** a. Physical evidence of DNA helical structure. b. Chargaff's rules (chemical evidence) c. Watson-Crick model of DNA & its features d. Physical properties of DNA - Effect of heat on physical properties of DNA (Viscosity. buoyant density. UV absorption). e. Types of DNA – Z, A, B, C, D etc. f. Hypocorism, Hyperchroism g. Denaturation of DNA.	**2L** **8L**

BCH 101D - Semester I Practical
Total Credit: 01 = 15L X 2 = 30P = 15 Practical Sessions

Sr.	Content	No. of Sessions
1	Qualitative testing of Biomolecules - Carbohydrates, Proteins and Lipids	3P
2	Micrometry and Measurement of a cell	1P
3	Monochrome and Gram Staining	2P
4	Study of Cell Division – Calculation of Mitotic Index	2P
5	Study of meiosis	1P
6	Amino acid Chromatography using Acid Ninhydrin Reagent	2P
7	Histochemical Localization of Aleurone grains	1P
8	Quantitative Estimation of Proteins using Folin Lowry Method	1P
9	Determination of Salinity Stress in plants using Proline Estimation	2P

BCH 102D - Semester II Practical
Total Credit: 01 = 15L X 2 = 30P = 15 Practical Sessions

Sr.	Content	No. of Sessions
1	DNA Isolation and Estimation using DPA method	2P
2	RNA Isolation and Estimation using Bials' Orcinol Reagent	1P
3	Histochemical Localization of Starch from potato and Rice	1P
4	Histochemical Localization of Lipids from Groundnut	1P
5	Organic Carbon Estimation using FAS	1P
6	Qualitative estimation of Calcium using Titrimetry	1P
7	Extraction and estimation of Essential Oils using Clevenger	2P
8	Preparation of Standard Curve and Estimation of Reducing Sugars by DNSA Method	2P
9	Estimation of Saponification Value of Lipids	2P
10	Acid Base Titration and Calculation of Normality	2P

BCH 103D - VOC – BIOCHEMISTRY
(0.66 Credits/ Semester = As 2 Credits shared in Three Subjects = 6)
5 Practical Sessions
Semester I

Sr.	Content	No. of Sessions
1	Preparation of Solutions: Normality, Molarity and Percent Solutions	2P
2	Calibration of Ph Meter	1P
3	Preparation of Buffers	2P

BCH 104D - Semester II

Sr.	Content	No. of Sessions
2	Study of Colorimeter and Verification of Beer Lamberts law using Colorimeter - Estimation of Lambda Max - Preparation of Linearity using colored solution	5P