SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

Learning Outcomes based Curriculum Framework

(LOCF)

For

T.Y. B.Sc. Biochemistry (3 Units)

Undergraduate Programme

From

Academic year

2023-2024

Vision & Mission

Mission:

Equip the student with knowledge and skills of their chosen vocation,

Inculcate values.

Provide them opportunities for all, round growth and prepare them for life.

Vision:

- To equip the students with advanced knowledge and skills in their chosen vocation.
- To provide value-based education and opportunities to students.
- To help them to face challenges in life.
- To nurture a scientific attitude, temperament and culture among the students.
- To continually review, develop and renew the approach to build India of the Founder dream.

Goals and Objectives:

- To build a strong Academia-Industry bridge.
- To provide flexibility in the courses offered and proactively adapt to the changing needs of students and the society.
- To establish a centre for multidisciplinary activities.
- To mould individuals who would nurture the cultural heritage of our country and contribute to the betterment of the society.

Board of studies in Biochemistry

Undergraduate and Post graduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Dr. Samidha M. Pawaskar	Chairperson	Head, Department of Biochemistry, K.J.Somaiya college of Sci. & Comm., Chairperson, BOS in Biochemistry, University of Mumbai
Subject Expert nominated by Vice-Chancellor			
1	Dr. Prashant Ratnaparkhi	Associate Professor & Head, Dept. of Life Sciences & Biochemistry	St. Xavier's college, Mumbai
Subject experts from outside the parent University			
1	Dr. Naveen Padmadas	Assistant Professor	School of Biotechnology & Bioinformatics, D. Y. Patil University, Nerul, Navi Mumbai
2	Dr. Uma Shinde	Emeritus Professor & Head, Dept. of Biochemistry, HBT Medical College	Cooper Hospital, Juhu, Mumbai MUHS University
Subject experts from outside the college			
1.	Dr. Deepali Kothekar	Associate Professor & Head, Dept. of Biochemistry	SIES College, Mumbai
2.	Dr. Nupur Mehrothra	Assistant Professor, Dept. of Biochemistry	Mithibai College, Mumbai
Representative from Industry/corporate sector/allied area			
1	Mr. Narasimha Bhat	Founder and Director	Quality Fusion India, Mumbai
2	Mr. Girish Desai	Proprietor	Parel Diagnostic Laboratory, Parel, Mumbai

Meritorious Alumnus			
1	Ms. Pragati Dandekar	Head, Admin	Homi Bhaba Centre for Science Education, Mumbai
2	Mr. Nilesh Vishe	Food safety officer	FDA, Maharashtra
Faculty of the specialisation			
1	Dr. Heena Shah	Assistant Professor	K.J.Somaiya college of Sci. & Comm.
2	Dr. Ketan Ranade	Assistant Professor	K.J.Somaiya college of Sci. & Comm.
3	Mrs. Saeema Khan	Assistant Professor	K.J.Somaiya college of Sci. & Comm.
Students Representative			
1.	Mr. Siddharth Nakhwa	M.Sc. II Student	K.J.Somaiya college of Sci. & Comm.
2.	Ms. Shruti Kenjale	M.Sc. II Student	K.J.Somaiya college of Sci. & Comm.

Foreword

Autonomy reflects efforts for excellence in academic performances, capability of self-governance and enhancement in the quality of education. In the year 2012, the UGC and University of Mumbai conferred the Autonomous Status to K. J. Somaiya College of Science and Commerce. Post this recognition and having several accolades to our credit, we made significant changes to our existing syllabi to reflect the changing business, industrial and social needs. A holistic education that provides opportunities to gain and share knowledge, experiment and develop beyond curriculum, is offered at our College.

Autonomous college carries a prestigious image for the students and the teachers and we have made a collaborative attempt to maintain a high level of quality in the standard of education that we impart.

Structured feedback obtained from the students, alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi. The Board of Studies constituted for each department meets to carry out in depth discussions about different aspects of the curriculum taking into cognizance the recent trends in the discipline.

The IQAC team has facilitated the conduct of a number of workshops and seminars to equip the faculty with the necessary skill set to frame the syllabi and competencies to deliver the same. Training was also provided to employ innovative evaluation methods pertaining to higher cognitive levels of revised Bloom's taxonomy. This ensured the attainment of the learning outcomes enlisted in the syllabus. Audits are conducted to critically review the practices undertaken in teaching, learning and evaluation. Innovative learning methodologies such as project-based learning, experiential learning and flip- class learning practiced by a committed fleet of faculty, supported by several hands have been our unique outstanding propositions. All efforts have been made to nurture the academic ambitions as well as the skills in co-curricular activities of the most important stakeholder i. e. student.

With sincere gratitude, I acknowledge the constant support and guidance extended by Shri Samir Somaiya, President- Somaiya Vidyavihar, and all the esteemed members of the Governing board and Academic council of the College. I also would like to acknowledge the Heads of the Departments and all the faculty members for their meticulous approach, commitment and significant contribution towards this endeavour for academic excellence.

Dr. Pradnya Prabhu
Principal

Acknowledgement

This T.Y.B.Sc. syllabus is a result of the valuable contributions and sharing of the expertise by the eminent members of the board of studies in Biochemistry and also due to untiring efforts by all the staff members of my department.

I would like to thank all the respected members of our BOS for the same.

I would also like to thank our, Principal Dr. Pradnya Prabhu for giving valuable directives for framing this curriculum.

Dr. Samidha Mohan Pawaskar
Chairperson
Board of Studies in Biochemistry

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Preamble

Biochemistry is the branch of the life sciences devoted to understanding the mechanisms by which living organisms carry out their many functions in complete, molecular detail. It is inherently interdisciplinary in nature and fundamental to every other branch of the life and biomedical sciences. It is chemistry of life. It explores the chemical processes within and related to living organisms. Biochemistry focuses on processes happening at the cellular and molecular level. Biochemistry is the study of the mechanisms and composition of living things and their assembly and interactions important in sustaining life. With this knowledge, biochemists attempt to investigate and solve biological problems pertaining to the understanding of physiological processes and the diseases associated with their malfunctioning. Prevention and diagnosis is also an important component of this subject. Bachelor's degree in Biochemistry helps students to create knowledge pool and skilled manpower to take on the challenges that modern biological sciences poses in understanding the emerging dynamics of life processes.

1 Introduction

Learning Outcomes-based Curriculum Framework (LOCF) under the Choice Based Credit System (CBCS) for Bachelor's Degree in Biochemistry is prepared according to UGC guidelines and Ordinance for Undergraduate Programmes. The students who complete the undergraduate programme in Biochemistry should be able to demonstrate academic, personal and behavioural as well as entrepreneurial and social competencies. It is expected that a student completing a particular course must have a level of understanding of the Biochemistry subject and its sub-areas in consonance with the learning outcomes mentioned

2 Learning Outcome based Curriculum Framework

The LOCF approach is planned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to organize the entire teaching-learning experiences in a more student-centric manner. The LOCF approach has been adopted to strengthen students' experiences as they engage themselves in the programme of their choice. This framework will prepare and strengthen the students for both, academia and employability.

This framework also provides examples of effective learning, teaching and assessment practices.

2.1 Nature and extent of B.Sc. Biochemistry

The subject Biochemistry is introduced in the third year of the undergraduate programme in combination with chemistry or Biochemistry. The students opting for Biochemistry will be getting a degree with two major subjects. Entire academic year is divided into two semesters. The teaching and learning in the B.Sc. Biochemistry programme will involve theory classes (lectures) and practical. The curriculum will be taught through formal lectures with the aid of power-point presentations/audio and video tools/ and other teaching aids can be used as and when required. Students will be able to learn professional skills through experiential learning. ICT-based teaching-learning tools will be incorporated through which even the difficult concepts could be made more interesting and relevant

2.2 Aim of Bachelor degree Programme

The overall aims of bachelor's degree program in Biochemistry are to:

1. Provide students complete knowledge and understanding of major concepts, principles and experimental findings in Biochemistry, thus making the students competent to work in the industry
2. Encourage students for critical thinking and improve their problem solving skills in different areas of Biochemistry.
3. Inculcate the importance of team work by encouraging students to work effectively in diverse teams in both classroom, laboratory as well as in field based situations.
4. To develop skill based knowledge that would enable them to undertake further studies in Biochemistry and related fields
5. Develop a range of general skills that are appropriate to pursue teaching, research and entrepreneurship.

3 Graduate Attributes in Biochemistry

Attributes expected from the graduates of B.Sc. Biochemistry Programme are:

GA 1: Professional discipline based knowledge

GA 2: Analytical thinking

GA 3: Social Responsibility

GA 4: Positive attitude, Critical thinking.

GA 5: Clear and accurate written and verbal communication.

GA 6: Team work and creativity.

GA 7: Intensive experiential learning activities.

GA 8: practice and commitment

4 Qualification descriptors

Upon successful completion of the programme, students receive B.Sc. degree with two major subjects i.e. (Biochemistry-Chemistry or Biochemistry-Microbiology. Graduates of this department are expected to exhibit the extensive knowledge of various concepts of Biochemistry and their applications thus contribute in research, development, teaching, government and public sectors. This programme will establish a foundation for student to further pursue higher studies in Biochemistry. The list below provides an overview of possible employment areas provided by an undergraduate training in Biochemistry.

The list below provides a synoptic overview of possible career paths provided by an undergraduate training in Biochemistry:

1. Research and Academics
2. Clinical diagnostic industry
3. Quality control and Quality assurance
4. Food industry
5. Pharmaceutical industry
6. Cosmetic industry
7. Forensic science
8. Agrochemical industry

Job Roles for B.Sc. Biochemistry graduate:

After graduation one can seek a professional career as:

1. Food safety executive
2. Project fellow
3. Laboratory technician in Diagnostic industry
4. Laboratory chemist
5. R&D assistant
6. Quality control executive
7. Production executive
8. Executive in food industry
9. Assistant in Forensic department
10. Executive in food auditing industry

Higher Education options for B.Sc. Biochemistry graduate (Double major):

1. M.Sc. in Biochemistry, Microbiology/Chemistry, Biotechnology, Nutraceutical, Nutrition and Dietetics etc.
2. Integrated M.Sc.-Ph.D. in Biochemistry
3. PG Diploma in advance instrumental analysis/drug design/Intellectual Property rights/ Bioinformatics/Clinical research, etc.
4. Post-graduation Diploma / MBA in Health care management

The learners who complete three years of full-time study of an undergraduate programme of study will be awarded a Bachelor's degree in Biochemistry with Microbiology/Chemistry.

5 Programme Learning outcomes

After the successful completion of modules in different courses of B.Sc. Biochemistry, the learner will be able to:

PLO I: Strengthen the base in fundamental aspects of Biochemistry viz. Bio-organic and Biophysical Chemistry, Metabolism, Nutrition and Advanced Biochemical concepts viz., Genetics and Genetic engineering, Immunology, etc.

PLO II: sharpen practical skills in performing experiments involving latest protocols.

PLO III: gain competence for gainful employment in industry, research-oriented career and qualifying examinations.

PLO IV: To develop scientific temper and interest by exposure through Internet, computers, various databases, industrial visits and study/educational tours.

PLO V: To develop independent approach to design and implement a scientific study in the field

PLO VI: apply this knowledge to the greater benefit of the society at large; through public engagement via presentations and outreach activities.

5.1 Course Mapping

Semester	PLO	I	II	III	IV	V	VI
	Course						
V	DSC I	√	√	√	√	√	√
	DSC II	√	√	√	√	√	√
	DSE I	√	√	√	√	√	√
	DSE II	√	√	√	√	√	√
	DSE III	√	√	√	√	√	
VI	DSC I	√	√	√	√	√	
	DSC II	√	√	√	√	√	√
	DSE I	√	√	√	√	√	√
	DSE II	√	√	√	√	√	√

DSC = Discipline specific core course

DSE = Discipline specific elective

6 Structure of B.Sc. Biochemistry programme

The curriculum frame work is designed around the choice-based credit system (CBCS). The programme consists of three years and six semesters (two semesters per year). To acquire a degree in B.Sc. Biochemistry a learner must study

1. **Discipline specific Core Courses (DSC):**

a) A course which is required to be opted by a candidate as a core course.
b) There are four Core courses (DSC), two each, in semesters V and VI
c) Each Core Course is compulsory.
d) Each DSC is comprised of 2 credits for theory ie. 30 hour; 3 lectures of each 50 min per week and 1 credit for practical of two hour per week in every semester.
e) The purpose of fixing core papers is to ensure that the institution follows a minimum common curriculum so as to adhere to common minimum standard with other universities/institutions.
f) The course designed under this category aims to cover the basics that a student is expected to imbibe in that particular discipline.

2. **Discipline Specific Elective Courses (DSE):**

a) Elective courses offered under the main discipline subject of study.
b) There are five discipline specific elective courses (DSE), three in semester V and two in Semester VI. The student is supposed to choose two out of three in semester V.
c) Each DSE theory course is of 2 credits i.e. 30 hour; 3 lectures of each 50 min per week and 1 credit for practical of two hour per week in every semester.
d) Research Project is offered as an option for the student to choose in lieu of a regular DSE course in Semester VI

6.1 Content

Sr. No	Semester	Course number	Course Code	Course title
Core Course (DSC) and Discipline specific Elective(DSE)				
1	V	DSC I	23US5BCHCC1CAP	Cell and Proteins (Chemistry and Metabolism)
2		DSC II	23US5BCHCC2BOC	Bio-organic Chemistry
3		DSE I	23US5BCHDS1NAD	Nutrition and Dietetics
4		DSE II	23US5BCHDS2ABC	Applied Biochemistry
5		DSE III	23US5BCHDS3BAC	Bioanalytical Chemistry
1	VI	DSC I	23US6BCHCC1MNR	Metabolism, Nucleic Acid and Recombinant DNA Technology
2		DSC II	23US6BCHCC2GIE	Genetics, Immunology and Endocrinology
3		DSE I	23US6BCHDSE1REP	Research Project
4				

6.2 Credit distribution for B.Sc. Biochemistry

Semester	Course number	Course title	Credits		
			Theory	Practical	Total
V	DSC I	Cell and Proteins (Chemistry and Metabolism)	2	1	3
	DSC II	Bio-organic Chemistry	2	1	3
	*DSE I	Nutrition and Dietetics	2	1	3
	*DSE II	Applied Biochemistry	2	1	3
	*DSE III	Bioanalytical Chemistry	2	1	3
VI	DSC III	Metabolism, Nucleic Acid and Recombinant DNA Technology	2	1	3
	DSC– IV	Genetics, Immunology and	2	1	3

		Endocrinology			
	DSE- III	Research Project		3	3
	DSE- IV			3	3

Note: - Students will be undertaking:

1. Two core courses (DSC) in each semester
2. *Any two of the three Discipline specific Electives (DSE) in Semester V.
3. Students can earn extra credits in Biochemistry by completing above mentioned certificate courses, MOOC courses available on NPTEL, SWAYAM, etc. in Semester-V &/or Semester -VI

Abbreviations:

DSC: Discipline specific course (Core course)

DSE: Discipline specific Elective

6.3 Course level Learning Objective

Course-level learning outcomes will be finally aligned to programme learning outcomes. Course-level learning outcomes are specific to a course of study within a given programme of study. The achievement by students of course-level learning outcomes leads to the attainment of the programme learning outcomes. The undergraduate Biochemistry programme is designed to train students with significant developments in Biochemistry. The objective of structured syllabus in Biochemistry is to introduce and make students understand the fundamental concepts of Biochemistry. It will also enable students to develop analytical skills and critical thinking. The structured syllabus also focuses on experiential learning through various assignments and projects, discussions, debates, presentations etc.

7 Detailed T.Y.B.Sc. Biochemistry Syllabus

With effect from the Academic year 2023–2024

Syllabus - T. Y. B.Sc. Biochemistry

Course No.	Course Title	Course Code	Credits	Hr.	Periods	Module	Lectures per module	Examination		
								Internal Marks	External Marks	Total Marks
SEMESTER V										
THEORY										
I	Cell and Proteins (Chemistry and Metabolism) (DSC 1)	23US5BCHCC1CAP	2	30	36	3	12	40	60	100
II	Bio-organic Chemistry (DSC 2)	23US5BCHCC2BOC	2	30	36	3	12	40	60	100
III	Nutrition and Dietetics (DSE 1) (choice 1)	23US5BCHDS1NAD	2	30	36	3	12	40	60	100

IV	Applied Biochemistry (DSE 2) (choice 2)	23US5BCHDS2ABC	2	30	36	3	12	40	60	100
V	Bioanalytical Chemistry (DSE 3) (choice 3)	23US5BCHDS3BAC	2	30	36	3	12	40	60	100
PRACTICAL (Based on 2 DSCs and DSEs)										
		23US5BCHP	4	150	180					200
SEMESTER VI										
THEORY										
I	Metabolism, Nucleic Acid and Recombinant DNA Technology (DSC 3)	23US6BCHCC1MNR	2	30	36	3	12	40	60	100
II	Genetics, Immunology and Endocrinology (DSC IV)	23US6BCHCC2GIE	2	30	36	3	12	40	60	100
III	Research Project	23US6BCHD	6							300

	(DSE IV and V)	SE1REP								
PRACTICAL (Based on 2 DSCs)										
		23US6BCHP	2	75	92					100

SEMESTER - V

Discipline Specific Course – I Cell and Proteins (Chemistry and Metabolism)			
Course Code	**Module**	**Topics**	**Credits**
23US5BCHCC1 CAP	I	Cell Biology	Theory: 2 Practicals:1
	II	Amino acids and Proteins	
	III	Ionic equilibria, pH, Buffers; Amino acid and protein metabolism	

Discipline Specific Course – II Bio-organic chemistry			
Course Code	**Module**	**Topics**	**Credits**
23US5BCHCC2 BOC	I	Carbohydrates	Theory: 2 Practicals:1
	II	Lipids	
	III	Enzymes	

Discipline specific Electives (DSE) – I Nutrition and Dietetics			
Course Code	**Module**	**Topics**	**Credits**
23US5BCHDS1 NAD	I	Macronutrients and Food calorimetry,	Theory: 2 Practicals:1
	II	Micronutrients and Balanced / Seasonal diet	
	III	Digestion and absorption and other nutritional concepts	

Discipline specific Electives (DSE) – II Applied Biochemistry			
Course Code	**Module**	**Topics**	**Credits**
23US5BCHDS2 ABC	I	Industrial Biotechnology and Industrial Biochemistry	Theory: 2 Practicals:1
	II	Bioinformatics	
	III	Biostatistics	

Discipline specific Electives (DSE) – III Bioanalytical Chemistry			
Course Code	**Module**	**Topics**	**Credits**
23US5BCHDSE3	I	Centrifugation and Spectroscopy	Theory: 2 Practicals:1
	II	Chromatography,	
	III	Electrophoresis and Radioactivity	

SEMESTER VI

Discipline Specific Course – III Metabolism, Nucleic Acid and Recombinant DNA Technology			
Course Code	**Module**	**Topics**	**Credits**
23US6BCHCC1 MNR	I	Nucleic Acids and Recombinant DNA Technology	Theory: 2 Practicals:1
	II	Carbohydrate metabolism and photosynthesis	
	III	Lipid metabolism and Bioenergetics	

Discipline Specific Course – IV Genetics, Immunology and Endocrinology			
Course Code	**Module**	**Topics**	**Credits**
23US6BCHCC2 GIE	I	Genetics	Theory: 2 Practicals:1
	II	Immunology and Developmental Biology	
	III	Endocrinology	

Discipline specific Electives (DSE) –I			
Course Code	**Module**	**Topic**	**Credits**
23US6BCHDSE1 REP	-	Research Project	6

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER V

Core Course- I (DSC-1)

COURSE TITLE: Cell and Proteins (Chemistry and Metabolism)

COURSE CODE: 23US5BCHCC1CAP [CREDITS - 02]

Discipline Specific Course (DSC) – I **Cell and Proteins (Chemistry and Metabolism)** **Course Code: 23US5BCHCC1CAP**			
Course Learning Objective and Outcome			
Learning Objective: 1) To acquaint students with types of cells, cellular processes and cellular transport. 2) To acquaint the students with knowledge of amino acids, proteins and metabolism of proteins 3) To develop knowledge about pH, ions and buffer action. **Learning Outcomes:** 1) A learner will be able to differentiate between the types of cells and will be able to explain the concepts of active and passive transport 2) The learner will be able to identify and classify the amino acids 3) The learner will be able to describe the biochemical pathways of protein metabolism 4) A learner will be able to explain about concepts associated with pH, pH meter, mechanism of action of various physiological buffers and titration curves of amino acids			
Module	**Topics**	**Credits**	**Lectures**
I	**Cell Biology** ● **Cell as a basic Module of life:** Organization and structure of prokaryotic and eukaryotic cells, Animal and plant cell. ● **Parts of the Cell:** Plasma Membrane - Structure, functions of membrane proteins, membrane fluidity, membrane permeability, gradient and transport across the membrane. Cell wall and its function. ● **Cell organelles:** Cytoplasm/cytosol, Nucleus (Chromosomes, chromatin, histones), Centromere, endoplasmic reticulum, Mitochondria, Golgi apparatus, lysosomes, peroxisomes, proteasomes, cilia and flagella. Plant cells - Chloroplast, xylem, phloem and epidermal cells. ● **Cellular transport:** Principles and Mechanism of Simple and Facilitated Diffusion and Active Transport	2	12

	(primary and secondary). ● **Cell division:** The cell cycle - Interphase and M phase, Mitosis and Meiosis.		
II	**Amino acids and Proteins** **Amino acids:** ● Classification of amino acids based on the polarity of R-groups (structure of 20 amino acids). ● Chemical reactions of amino acids with following reagents –Ninhydrin, Sanger's, Edman's, Dansyl chloride. ● Cleavage of polypeptide - Trypsin, Chymotrypsin, Pepsin, Aminopeptidase, Carboxypeptidase, (S-S bond, -Mercaptoethanol). **Proteins:** ● ASBC-APS classification on the basis of shape and function. ● Formation and characteristics of peptide bond. ● Primary structure, Secondary structure-alpha helix and beta sheet, Tertiary structure - myoglobin, Quaternary structure - haemoglobin. ● Forces stabilizing protein structure. ● Protein denaturation.		12
III	**Ionic equilibria, pH and Buffers:** ● Definition - pH, pK, Kw, Isoelectric pH, buffer, buffering capacity. ● Derivation of Henderson-Hasselbalch equation. ● Ionic product of water and relation between isoelectric pH, pKa1 and pKa2 (for neutral amino acid). ● pH meter, glass electrode. ● Titration and ionization of Gly, Lys and Asp and relation between IEpH, pHm and pKa values of these amino acids, Sorensen's reaction and formol titration of amino acids (Ala). ● Physiological Buffers (Hb – Carbonate buffer, phosphate buffer and protein buffer). ● Numericals based on the above concepts		12

	● Analytical methods used for identification, separation and estimation of proteins & Amino acids **Amino acid and protein metabolism:** ● Catabolism - reactions of amino acids –Transamination (GOT/GPT and mechanism of transamination) and Deamination. ● Decarboxylation (His, Trp, Glu). ● Urea Cycle - Cellular location, sequence of reactions, labeling of N-atom, formation and transport of ammonia.		

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER V

Core Course- II (DSC-2)

COURSE TITLE: Bio-organic Chemistry

COURSE CODE: 23US5BCHCC2BOC [CREDITS - 02]

Discipline Specific Course (DSC) – II
Bio-organic Chemistry
Course Code: 23US5BCHCC2BOC

Course Learning Objective and Outcome

Learning Objective:

1) This course is intended to provide students with a basic understanding of the chemical nature and properties of biomolecules.

Learning Outcomes:

1) The learner will be able to describe the classification, reactions and biochemical importance of biomolecules like carbohydrates, lipids and enzymes including the mechanism of action of enzymes.
2) A learner will be able to explain the enzyme kinetics

Module	Topics	Credits	Lectures
I	**Carbohydrates** **Carbohydrates:** ● Definition and classification of carbohydrates (mono, oligo and poly) ● **Monosaccharides:** Classification of monosaccharides in terms of – A) aldoses and ketoses. B) Number of carbon atoms. ● **Reactions of monosaccharides**: 1) Oxidation to produce aldonic, aldaric and Uronic acid (only	2	12

	w.r.t glucose), 2) Osazone (only w.r.t glucose and fructose), 3) Reducing action of sugar in boiling alkaline medium (enediol formation) -only w.r.t glucose and fructose, 4) Orcinol (for ribose). ● **Disaccharides:** Occurrence and structure of maltose, lactose, sucrose. ● **Polysaccharides**: Classification based on function (storage and structural), composition (homo and hetero) giving examples. Storage polysaccharides (Starch and Glycogen), action of amylases on starch. ● **Structural polysaccharides**: Cellulose, Chitin, Hyaluronic acid, Chondroitin sulphates and Heparin (Structure and biochemical importance). ● **Analytical methods** used for identification, separation and estimation of carbohydrates		
II	**Lipids:** ● Definition and Bloor's Classification of lipids. ● **Fatty acids and TAG:** Saturated fatty acids – definition, classification of C2 and C20 (only even C chain fatty acids) Unsaturated fatty acids – MUFA, PUFA (2, 3, 4 double bonds), Omega - 3, Omega - 6 and Omega - 9 fatty acids. ● **Triacylglycerol:** Simple and mixed. ● **Chemical reactions:** Saponification, Iodination, Ozonolysis, Auto-oxidation, Phospholipases, action of heat on glycerol and choline, Rancidity of fats. ● **Definition and significance:** Acid Number, Saponification Number, Iodine Number and Reichert-Meissel Number. ● **Compound lipids:** Structure and function of Glycerophospholipids (Cephalin, Lecithin and Phosphotidyl inositol) Phosphosphingolipids (Ceramide, Sphingomyeline), Glycolipids or Cerebrocides (Galacto and Glucocerebrocides). **Steroids and Lipoproteins:** ● **Steroids**: Cholesterol structure and biochemical significance ● **Lipoproteins:** Types (Chylomicron, VLDL, LDL, HDL) and biochemical significance - Schematic depiction of inter-relationship. ● **Analytical methods** used for identification, separation and		12

	estimation of lipids.		
III	**Enzymes:** ● **Definition**: enzyme, apoenzyme, holoenzyme, prosthetic group, active site, enzyme specificity, turnover number, specific activity, Katal, IU, coenzyme, cofactor, allosteric enzymes and Isoenzymes (Only definition). ● IUB/EC Classification (up to one digit). ● **Factors affecting enzyme reaction**: Substrate concentration, enzyme concentration, pH and temperature. ● **Enzyme kinetics:** Derivation of Michaelis - Menten equation and Lineweaver - Burk plot for mono-substrate reaction and numerical problems based on them. ● **Enzyme inhibition**: Competitive, Non-competitive and uncompetitive. ● Diagnostic importance of Enzymes (ALT/SGPT, AST/SGOT, ALP, LDH, CK, GGT).		12

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER V

Discipline specific Electives- I (DSE-1)

COURSE TITLE: Nutrition and Dietetics

COURSE CODE: 23US5BCHDS1NAD [CREDITS - 02]

Discipline specific Electives (DSE) – I **Nutrition and Dietetics** **Course Code: 23US5BCHDS1NAD**
Course Learning Objective and Outcome
Learning Objective: 1) To develop knowledge of the nutritional significance of macro and micronutrients and to acquaint students with the disorders of macro and micronutrients 2) To introduce various aspects and techniques of nutrition 3) To introduce students with basics of Dietetics and its applications. **Learning Outcome:** 1) The learner will be able to explain the concept of balanced diet in different age groups 2) The learner will be able to describe the digestion and absorption of cabohydrates, lipids and proteins 3) The learner will be able to explain about various concepts in nutrition like food calorimetry and calorific values of proximate principles, biochemical importance of various nutrients like vitamins, minerals in humans and their deficiency diseases,

antinutritive factors, Antioxidants.

4) The learner will be able to develop critical and creative thinking about applications of dietetics in various life stages and lifestyle related disorders.

Module	Topics	Credits	Lectures
I	**Macronutrients and Food calorimetry:** **Macronutrients:** ● **Nutritional significance, sources, RDA and Disorders of proximate principles:** carbohydrates (digestible / non-digestible), protein, lipids. **Food Calorimetry:** ● **Definition**: Calorie and Joule. ● **Food calorimetry:** calorific value by Bomb calorimeter, calorific values of proximate principles, concept of BMI, BV and PER and RQ and Non protein RQ. ● **BMR:** definition, factors affecting BMR, significance of BMR in clinical diagnosis. ● **SDA:** General concept and significance, energy requirement of individuals for various activities - sedentary, moderate and heavy. ● Numerical problems based on above concepts.	2	12
II	**Micronutrients and Balanced / Seasonal diet:** **Micronutrients:** ● **Nutritional significance, sources, RDA and Disorders of Minerals:** Calcium, Phosphorus, Magnesium, Iron, Sodium, Potassium, Iodine, Copper, Selenium, Manganese, Zinc, Cobalt, Chromium and Fluorine. ● **Nutritional significance, sources, RDA and Disorders of Vitamins:** Water soluble vitamins and Fat Soluble Vitamins **Balanced / Seasonal diet:** ● **Balanced diet** for healthy adult, Balanced diet for different age groups (Children, old age, Pregnancy and Lactation) ● **Seasonal variation in diet** (Summer, Winter and Rainy season)		12

III	**Digestion, absorption and Other Nutritional Concepts:** **Digestion, absorption:** ● Structure and function of different components of digestive system. ● Digestion and absorption of carbohydrates, lipids and Proteins, Glycaemic index, blood glucose buffer system, hormonal control of blood glucose level (in brief) **Other Nutritional Concepts:** ● **Anti-Nutritional Factors** in Food: Their Occurrence, Health- Hazards and Effect of Cooking on reduction in Anti-nutrient levels. ● **Anti-oxidants :** Nutritional significance, sources and Disorders of Non-enzymatic Anti-oxidants ● **Concept of Nutraceutical**, Functional Food, Traditional Foods, Designer Foods and Pharma/ Therapeutic Foods ● **Nutrition for Sports** – Basic concepts		12

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER V

Discipline specific Electives- II (DSE-2)

COURSE TITLE: Applied Biochemistry

COURSE CODE: 23US5BCHDS2ABC [CREDITS - 02]

Discipline specific Electives (DSE)- II: Applied Biochemistry Course Code: 23US5BCHDS2ABC			
Course Learning Objective and Outcome			
Learning Objective: 1) To introduce students with basics of industrial biochemistry and biotechnology 2) To introduce students with basic bioinformatics and biostatistics **Learning Outcome:** 1) The learner will be able to describe the basic fermentation process. 2) The learner will be able to differentiate between different types of fermenters and describe the applications of these types 3) The learner will be able to understand and explain applications and concepts of bioinformatics like types of sequencing, types of databases etc. 4) The learner will be able to explain the basic statistical concepts and their applications			
Module	**Topics**	**Credits**	**Lectures**
I	**Industrial Biotechnology and Industrial Biochemistry** **Industrial Biotechnology:** ● **Fermentation processes:** ● Process of fermentation, Brief history, ● Fermentation process; i) for alcohol production ii) lactic acid production, Advantages of fermentation. ● Types of fermenters, Basic components of a typical fermenter ● **Plant tissue culture:** definition of totipotency, callus regeneration, protoplast fusion and application of plant tissue culture in brief. **Industrial Biochemistry** ● **Industrially important Proteins -** Applications of casein, whey proteins and Egg proteins. ● **Industrially important Carbohydrates -** Applications of Pectin, Cellulose Production Cane sugar.	2	12

	• **Industrially important Lipids** - Industrial applications of essential oils (Eucalyptus and Wintergreen) • Production of Biodiesel (Biofuel) from Jatropha.		
II	• **Bioinformatics:** • Definition, Aims and History of Bioinformatics • Applications of Bioinformatics in – Sequence analysis, Molecular modeling and drug designing, Phylogeny/evolution, Ecology & population studies, Medical informatics and agriculture. • Genomics and Proteomics – Explanation in brief. • Databases- Definition & types – Public domain database, Sequence database, Structural database, Motif database, Genome database, Proteome database, Annotated sequence database. Full form & function in brief of – Gen Bank, EMBL, PIR, SWISS PROT, PDB, GDB. • Sequence analysis Tools - Explain the following terms in brief - BLAST, FASTA, L-ALIGN, CLUSTAL- X & W, RASMOL, Software for protein sequencing - PROPECT, AMMP, COPIA (Explanation of the terms in brief). • Micro-array analysis-concept and applications.		12
III	**Biostatistics** • **Data:** collection and presentation. • Frequency distribution, normal distribution • **Measures of central tendency**: Mean (Arithmetic), Median and Mode. • **Measures of variation:** Range, Variance and Standard deviation. • Numerical problems based on above concepts to the biological data • **Probability:** definition Probability distribution: normal distribution and normal curve, Asymmetric distribution Statistical problems based on the above concepts		12

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER V

Discipline specific Electives- III (DSE-3)

COURSE TITLE: Bioanalytical Chemistry

COURSE CODE: 23US6BCHDS3BAC [CREDITS - 02]

Discipline specific Electives (DSE) –III Bioanalytical Chemistry Course Code - 23US6BCHDS3BAC			
Course Learning Objective and Outcome			
Learning Objective: 1) This course intends to develop knowledge of various bioanalytical techniques used in separation, purification and estimation of molecules. **Learning Outcome:** 1) The learner will be able define and explain terms, principle, instrumentation, operation and applications of Centrifugation, Electrophoresis, Chromatography, Spectroscopy. 2) The learner will be able explain the basics of radioactivity and applications of various industrially important biomolecules.			
Module	**Topics**	**Credits**	**Lectures**
I	**Centrifugation and Spectroscopy** **Centrifugation:** ● Definition of RCF and RPM, derivation of equation relating RCF and RPM, Nomogram. ● Types of centrifuges - Clinical, High Speed, Ultra – preparative and Analytical. ● Components and working of - Analytical Ultracentrifuge – (with diagram). ● Applications of centrifugation – Use of preparative centrifuge in the separation of cell organelles by differential centrifugation, proteins by rate zonal centrifugation and nucleic acids by isodensity centrifugation. ● Use of Analytical Ultracentrifugation in the determination of molecular weights (sedimentation velocity method), conformational studies and purity of a sample. ● Numerical problems based on above concepts. **Spectroscopy:**	CC: 2	12

	● Definition, derivation and limitations of Beer-Lambert Law. Concepts of Lambda max, Definition and determination of molar extinction coefficient. ● Construction and working of simple colorimeter (single beam) and a spectrophotometer. ● Application of Beer Lambert Law in estimation of proteins (Biuret method), Sugars (DNSA method). ● Numerical problems based on above concepts.		
II	**Chromatography:** ● Principle, requirements and working of-Partition chromatography (Paper), Adsorption chromatography (TLC and Column), Ion exchange chromatography (Column) and Gel filtration. ● Introduction to GLC, HPLC and Affinity chromatography - Principles only ● Applications of partition, adsorption, ion exchange and gel filtration chromatography techniques		12
III	**Electrophoresis and Radioactivity** **Electrophoresis:** ● Principles of electrophoresis, Factors affecting the rate of migration of sample in electric field supporting media - paper, cellulose acetate, agar, agarose and polyacrylamide. Discontinuous electrophoresis – Native, PAGE. ● Application of electrophoresis - Separation of proteins and nucleic acids. (One staining method each). Molecular weight determination using PAGE. Isoelectric focusing. Numerical problems based on above concepts. **Radioactivity:** ● Definition – Radioactivity, radioisotope with 2 examples (^{14}C, ^{15}N), decay constant, Half-life period, Applications of radioisotopes in biological studies w.r.t ^{14}C, ^{15}N) – Metabolic pathway (glycolysis, TCA, Urea), Molecular biology studies (w.r.t ^{32}P, Clinical studies (^{131}I in hypo/hyperthyroidism detection).		12

Practicals based on 23US5BCHCC1CAP and 23US5BCHCC2BOC	
Topics	**Credits**
Separation of Biomolecules by Circular Paper Chromatography of: 1. Amino acids 2. Sugars	2
Colorimetry: 1. Verification of Beer and Lamberts Law using $CoCl_2$ 2. Proteins by Biuret method 3. Proteins by Folin-Lowry method 4. Maltose by DNSA method	
Qualitative Analysis: 1.Carbohydrates - Glucose, Fructose, Maltose, Lactose, Sucrose, Starch, Dextrin. 2. Proteins - Albumin, Casein, Gelatine, Peptone.	

Practicals of Discipline specific Elective 23US5BCHDS1NAD	
Topics	**Credits**
1. Calcium by EDTA method 2. Iron by Wongs method 3. Phosphorus by Fiske-Subbarow method 4. Magnesium by Titan Yellow method 5. Preparation of Diet chart / menu planning 6. Recipe / Product development - foods rich in calcium / Iron Proteins / Fibres/ Vitamins / Minerals / High medium and low energy content/ antioxidants. 7. Visits to Industries/Research institutes	1

Practicals of Discipline specific Elective 23US5BCHDS2ABC	
Topics	**Credits**
• Biostatistics – Numericals based on Mean (Arithmetic), Median, Mode, Range, Variance, Standard deviation and Probability distribution • Bioinformatics - Searches on Medline, PubMed, BioMed Central, NCBI, OMIM	1

Practicals of Discipline specific Elective 23US5BCHDS3BAC	
Topics	**Credits**
1. Ascending paper chromatography (Amino acids / Sugars) 2. TLC of oils and plant pigments 3. Preparation of buffers and use of pH meter 4. Column chromatography - separation of chlorophylls, Starch & Glucose. 5. Agar/Agarose/PAGE gel electrophoresis of serum proteins	1

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER VI

Core Course-III (DSC-3)

COURSE TITLE: Metabolism, Nucleic Acid and Recombinant DNA Technology

COURSE CODE: 23US6BCHCC1MNR [CREDITS - 02]

Discipline Specific Course – III
Metabolism, Nucleic Acid and Recombinant DNA Technology
Course Code - 23US6BCHCC1MNR

Course Learning Objective and Outcome

Learning Objectives:

1) To develop knowledge about structure, functions and reactions of nucleic acids
2) To introduce the basics of Recombinant DNA Technology
3) To acquaint the students with knowledge of metabolism of carbohydrates and lipids

Learning Outcomes:

1) The learner will be able explain different types ,structures, properties of nucleic acids
2) The learner will be able to explain the synthesis and reactions of nucleic acids
3) The learner will be able to describe the biochemical pathways of carbohydrate and lipid metabolism.
4) The learner will be able to explain the basics of energy relationships and energy transformations in living systems and will be able to explain the synthesis of ATP

Module	Topics	Credits	Lectures
I	**Nucleic Acids and Recombinant DNA Technology** **Nucleic Acids:** ● Structure of purine and pyrimidine bases, ribose, deoxyribose, nucleosides and nucleotides. c AMP and formation of polynucleotide strand with its shorthand representation. ● RNAs- (various type in pro and eukaryotes) rRNA, t- RNA (Clover –leaf model), m-RNA (general account) and action of alkali on RNA. ● DNA-X-ray diffraction pattern (Physical evidence), ● Chargaff's rules (Chemical evidence), Watson –Crick model of DNA and its characteristic features. ● Physical properties of DNA - Ionisation, Viscosity, Buoyant density, UV absorption and Hypochromism, Hyperchromism, Denaturation of DNA, Tm. **Recombinant DNA Technology:**	2	12

	• Basis of DNA cloning, cloning vectors, isolation of gene from cellular chromosomes, gene library, DNA probes. • DNA amplification by PCR (Cycle - with diagram, role of TAQ polymerase). • Applications of recombinant DNA technology in medicine (Insulin) and agriculture (BT cotton).		
II	**Carbohydrate metabolism and Photosynthesis** **Carbohydrate metabolism:** • Definition of Glycolysis, glycogenesis, glycogenolysis. • Catabolism - Cellular location, sequence of reactions, labeling of C-atoms and energetics of glycolysis (aerobic and anaerobic) and Krebs cycle. • Anabolism - HMP Shunt (Synthesis of pentose phosphates) - Cellular location, sequence of reactions, oxidative and non-oxidative phases of pathway and multifunctional nature. Schematic account (ONLY) of gluconeogenesis, Glyoxylate pathway. (No structures) • Anaplerotic reactions - Definition, Role of Pyruvate carboxylase, PEP carboxykinase, Mallic enzyme. **Photosynthesis:** • Light and Dark reactions, Z-scheme and electron carriers, photophosphorylation (linear and cyclic), Calvin cycle (schematic representation only).		12
III	**Lipid metabolism and Bioenergetics** **Lipid metabolism:** • Catabolism - Knoop's experiment, Beta – Oxidation of even – Carbon saturated fatty acids and its energetics from C4 to C20. • Anabolism - Fatty acid biosynthesis (only Palmitic acid) and role of fatty acyl synthetase complex. • Ketone bodies formation, utilization, and physiological significance in Diabetes mellitus, starvation, alcoholism and pregnancy. **Bioenergetics:** • Definition of Free energy, respiratory electron transport chain - basic chemistry, electron carriers, sequence - redox potentials, location of these electron carriers on mitochondrial membrane, Inhibitors of ETC - Antimycin A, Amytal, Rotenone, CN, Azide, CO.		12

	• Definition of Oxidative Phosphorylation, Structure of ATPase (FoF1 ATPase), Chemiosmotic hypothesis, Proton motive force.		

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER VI

Core Course-IV (DSC-4)

COURSE TITLE: Genetics, Immunology and Endocrinology

COURSE CODE: 23US6BCHCC2GIE [CREDITS - 02]

Discipline Specific Course – IV
Genetics, Immunology and Endocrinology
Course Code: 23US6BCHCC2GIE

Learning Objective:

1) This course is intended to provide students with the understanding of physical properties, structural and functional aspects of genetic material, Genetics and r-DNA technology.
2) The course aims to introduce the students about the basics of Immunology, developmental Biology and Endocrinology.

Learning Outcome:

1) The learner will be able to understand the processes like replication, transcription and translation.
2) The learner will be able to explain the types of immunology and will be able to describe the organs and cells of immune system
3) The learner will be able to explain basic concepts of Reproduction, fertlity and developmental Biology.
4) The learner will be able to describe the classification, mechanism of action of classes, roles of various hormones and maintenance of homeostasis in the body.

Module	Topics	Credits	Lectures
I	**Genetics:** ● **Replication of DNA**: mechanism of replication, modes of DNA replication, semi-conservative replication, discontinuous DNA synthesis, termination of replication. ● **Transcription of DNA**: in prokaryotes, prokaryotic RNA polymerases, synthesis of RNA species and their processing, concept of split genes, Reverse transcription. ● **Translation (protein biosynthesis) in prokaryotes**: activation of amino acids, chain initiation, chain elongation, chain termination, post translational modifications of proteins.	2	12

II	**Immunology and Developmental Biology** **Immunology** ● Definition of immunity, types of immunity, definition of antigen, hapten and antibody. ● Cells and organs of immune system. ● Immunoglobulins basic structure, classes and sub-classes; their structure and functions. ● Antigen– antibody reactions; Precipitation, agglutination. **Developmental Biology:** ● Organs of the male and female reproductive system ● Spermatogenesis and oogenesis. ● Reproduction - Sex hormones (LH, FSH, androgens, gonadotropins), Reproductive cycle, ● Physiology of pregnancy and parturition. ● Methods of contraception. ● Clinical disorders associated with reproduction (male and female infertility, PCOD)		12
III	**Endocrinology** **Mechanism of hormone action** ● Definition of Hormone, hormone receptor, classification of hormones on the basis of chemistry, Hierarchical organisation. ● **Mechanism of hormones action of**: Steroid and protein/Peptide ● Mechanism of action, secretion, physiological role and deficiency disorders of following hormones: ● Posterior pituitary – Vasopressin / Oxytocin ● Aldosterone and glucocorticoid ● Thyroid hormones ● Insulin and Glucagon ● Epinephrine(Epinephrine cascade) ● Growth hormone		12

T.Y. B. Sc. (BIOCHEMISTRY) SEMESTER VI

Discipline specific Elective- IV & V (DSE- 4 & 5)

COURSE TITLE: Research Project

COURSE CODE: 23US6BCHDSE1REP [CREDITS - 06]

Learning Objective:

1) This course intends to enable students identify and discuss the issues and concepts relevant to the research process.
2) To enhance the critical thinking ability of the students

Learning Outcome:

1) The learner will be able to understand and demonstrate the practical skills
2) The learner will be able report research findings in written and verbal forms
3) The learner will be able to understand and explain the concepts of research methodology

Discipline specific Electives (DSE) –I
Research Project
Course Code: 23US6BCHDSE1REP

	Topics	Credits	
	Research Project: **GUIDELINE TO CARRY OUT PROJECTWORK** 1. The main purpose of introduction Project Work at T.Y.B.Sc. Semester VI is to make the students familiar with Research Methodology i.e. reference work, experimental work, statistical analysis of experimental data, interpretation of results obtained, writing of project work and compilation of bibliography in proper order. This will not only help train the inquisitive minds of the students, but also inspire them to take up research- oriented higher studies and career. 2. Each student shall complete a research project during his/ her academic year of T.Y.B.Sc. Semester VI. However, the initial reference work can be started in T.Y.B.Sc. Semester V. 3. **Nature of Research Project:-** The following will be considered as the Research Project. a. Experimental based involving laboratory analytical work, or b. Survey based Field work with statistical analysis of data collected, or c. Any reputed research Institute training /Industrial R and D training/work experience where the candidate has undergone actual hands on training in	2	

	production/ Instrumental analytical techniques/ FDP/ Clinical/ Pharmaceutical Biochemistry etc. d. Start-ups in the field of Nutrition, dietetics, food science and other areas related to biochemistry can also be considered as Projects. 4. **Schedule for Submission of project Work:-** a. The final copy of the project work (2 Copies) will have to submitted to the HOD by the date assigned by the Head of the Department 5. The project containing minimum about 50-100 pages. Should be divided into the following parts:- a. Certification of completion of Project Work from the HOD. b. Acknowledgement. c. Introduction d. Review of Related Literature e. Aims and Objectives f. Signification of research problems selected g. Plan of work h. Material and Methods i. Results j. Discussion **k.** Bibliography		

Practicals based on 23US6BCHCC1MNR and 23US6BCHCC2GIE	
Topics	**Credits**
Preparation: 1.Casein from milk 2. Starch from potato.	2
Enzymes & Nucleic Acid: 1. Determination of optimum pH of Amylase 2. Determination of optimum temperature of Amylase 3. Determination of Km of Amylase 4. RNA by Orcinol	
Volumetry: 1. Lactose by Cole's method 2. Vitamin C by Iodometric method 3. Glucose by Benedict's method	

8. Teaching learning process

The teaching process involves direct interactive lectures, discussions, as well as technology-supported presentations. We make students to avoid hesitancy and interactive byWe believe that education is interactive and all sessions between students and teachers are based upon reciprocity and respect.

Learners should be encouraged to engage in a process of learning by adopting a highly focused and yet flexible approach to education as opposed to routine learning. Learners should be encouraged to focus on key areas of the course and spend time on learning the course fundamentals and their application. In teaching and learning pedagogy, there should be a shift from domain or conclusions based approach to the experiential or process/es based approach.

1) The lectures (of fifty minutes duration) delivered to one whole class constitutes the core of the teaching- learning process. The students are provided with bibliographic references and encouraged to go through at least some readings so that they could be more interactive and ask more relevant questions in the class. This also helps obtain knowledge beyond the boundaries of the syllabi.

2) Lectures are conducted using good proportion of ICT enabled tools. In order to achieve its objective of focused process based learning and holistic development, variety of knowledge delivery methods can be used

3) Remedial coaching, bridge courses are adopted to enhance the scope of learning for the learners. Remedial sessions are conducted to offer assistance on certain advanced topics.

9. Assessment Methods

Evaluation Pattern: Theory

- Assessments are divided into two parts: Continuous Internal Assessment (CIA) & Semester End Examination.
- The Semester End Examination shall be conducted by the College at the end of each semester.
- Semester End Examination (external) (60 M)- Duration:
  2.5 hours Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	I	5 M x 6 Q = 30 M	5 M x 4 Q = 20 M
2	II	5 M x 6 Q = 30 M	5 M x 4 Q = 20 M
3	III	5 M x 6 Q = 30 M	5 M x 4 Q = 20 M

Each question will have six sub questions a, b, c, d, e, f and out of which any four should be answered.

- For Internal Evaluation (40 M)

i. Mid Semester Examination 25 M

ii. ONE class test/ online examination to be conducted in the given semester/ case study / Assignment/ Making &/or Review of Documentary/ IV report/ Book review/ Nutritional Awareness program/ lectures or lecture series organised/ workshop/ Participation in Nutritional awareness program/ other departmentally organized event Publishing review/ research paper/ Participation &/or organization committee member in a intercollegiate competitions in Biochemistry and related subjects.

(Any combination/s from the above mentioned options) (15 M)

Evaluation pattern: Practical

- Semester-end evaluation: 200 Marks practical examination based on DSC and DSE Course at the end of semester.

SEMESTER V

Course	Experiments	Marks
	Experiments on DSC I and II	100
	Experiments on 2 DSE's	100
	Total	200

Note:

1. Candidate without duly certified Journal/s **shall not** be allowed to appear for the Practical Examination.

2. Duration for the Practical examination for the practicals of DSC-I and DSC-II in Semester V

   a. One day of two sessions of total 6 hours.
   b. Morning session: 09.00 am to 01.30 pm
      Afternoon session: 02.00 pm to 04.00 pm.

SEMESTER VI

Course	Experiments	Marks
	Experiments on DSC III and IV	100
	TOTAL	100

Course	Experiments	Marks
	Research Project (DSE III and IV)	300
	TOTAL	300

Note:

1. Candidate without duly certified Journal/s **shall not** be allowed to appear for the Practical Examination.

2. Duration for the Practical examination for Sem VI the practicals of DSC-III and DSC-IV in Semester VI
   a. One day of two sessions of total 6 hours.
   b. Morning session: 09.00 am to 01.30 pm
      Afternoon session: 02.00 pm to 04.00 pm.

10. Program and Course Code Format

The course is coded according to following criteria:

1. First two numbers in each course code indicates year of implementation of syllabus (23- year of implementation is 2023-24)
2. Third letter 'U' designates undergraduate
3. Fourth letter 'S' designate Science discipline and the digit followed is for semester number (S5 – 5th Semester)
4. Letter 'BCH' is for Biochemistry discipline (BCH- Biochemistry)

   This forms the programme code 23USCH. For the further course codes programme code is amended as follows
5. To designate the semester, add the digit (1-6) after S in the programme code. (Eg: 23US5CH- for semester 5)

   For the further course codes, addition to the program code should be done as per the following instructions.
6. To represent core courses (DSC) followed by course number digit (1/2/3/4) and three lettered code representing the title of the course.
7. For Discipline specific elective course (DSE) of Semester V and VI, (DSE) followed by digits (1/2/3/4) followed by a three lettered code representing the title of the course are used.
8. 'P' followed by digit indicates practical course number. (practical course number will be added for semesters only where there are more than one course.