AC/07/08/2024/RS1

SIES College of Arts, Science and Commerce
(Empowered Autonomous)
Affiliated to University of Mumbai

Syllabus under NEP effective from June 2024
Programme: B.Sc.
Subject: Biochemistry
Vocational Skill Enhancement Course
and
Skill Enhancement Course

Class: S.Y.B.Sc. Semester: III and IV
Choice Based Credit System (CBCS)

Contents

Preamble

Biochemistry is a branch of biological science that delves into the chemical processes and information pathways governing the survival and propagation of life. It is an interdisciplinary science providing the learner an opportunity to elucidate molecular mechanisms and explore the intricate world of biomolecules and their applications. Under the aegis of New Education Policy-2020, the department offers a three-year BSc program and a four-year BSc Honours program with Biochemistry (major or minor). At the second-year level, along with the core Biochemistry course, the department also offers Vocational skill enhancement course and Skill enhancement course. In this program, we will embark on a comprehensive journey from the structure and function of biomolecules to their interactions and implications in health and disease. Through lectures, laboratory sessions, and interactive discussions, the student will not only gain insights of the biochemical processes and pathways, but also develop skills for employability and aptitude for research.

Objectives:

The goal of this interdisciplinary Biochemistry program is

1. Foundational knowledge: To build the foundation of Biochemistry and physiology in order to enable the student to pursue Biochemistry at a higher level.
2. Application of Biochemistry: To enable the student to recognize the application of biochemistry in areas of nutrition and food, pharmaceuticals, diagnostics, clinical research, bioinformatics, forensics, etc.
3. Laboratory skills: To develop essential laboratory skills for the experimental analysis of biochemical principles.

Program-Specific Outcome

At the end of the second year, the student should be able to:

- Comprehend the concepts in human physiology and understand the role of biomolecules regulating the myriad physiological processes
- Understand the physical and chemical properties of biomacromolecules
- Co-relate the structure of biomolecules with their properties and functions
- Explain the role of biomolecules in maintaining cellular integrity
- Know the significance of the various biochemical pathways that govern life.
- Apply the experimental skills in studying biomolecules and cellular processes
- Recognize the application of biochemistry in diverse fields of food, nutrition, clinical research, drug discovery, diagnostics, forensics, genomics, proteomics and bioinformatics
- Understand the concept of data collection and types of data presentation
- Employ statistical concepts to analyse experimental data.

Evaluation: Student's understanding of biochemistry will be evaluated through a combination of examinations, quizzes, laboratory reports, and class participation. These assessments are designed to gauge learner's comprehension of both theoretical concepts and practical applications.

POs, and PSOs for SYBSc Biochemistry syllabus (NEP-compliant)

The characteristic graduate attributes comprising of Programme Outcomes, Programme Specific Outcomes and Course Outcomes for a science graduate in the subject of Biochemistry are as follows:

Abbreviations used:

PO: Programme Outcome, PSO: Programme Specific Outcome, CO: Course Outcome

Cognitive Levels:- R: Remember, U: Understand, Ap: Apply, An: Analyze, E: Evaluate, C: Create

Serial Number	Details of Programme Outcomes (POs)
PO1 *(Skill level)*	**Academic competence and problem-solving ability** ● Understand fundamental concepts and gain in-depth disciplinary knowledge. ● Apply the knowledge of various courses learned under the program to solve societal issues and problems. ● Recognize and appreciate the scope and applications of the discipline of study. *Cognitive levels*: *R, U, Ap*
PO2 *(Skill level)*	**Critical Thinking and Analytical skills** ● Develop critical thinking and a sense of inquiry or asking relevant scientific questions. ● Demonstrate the ability to analyse, interpret and draw conclusions from qualitative/quantitative data. ● Critically evaluate ideas, theories, and concepts by following scientific and interdisciplinary approach *Cognitive levels: U, An, Ap*
PO3 *(Skill level)*	**Research Aptitude** ● Utilizing the contextual knowledge in an inter-disciplinary framework. ● Integrating research based knowledge and research methods involving problem definition, analysis and interpretation of data, synthesis of the information to provide valid conclusions. ● Exercising analytical skill, research ability, creativity, for employability and collaborating with industries. *Cognitive levels: A, An, E, C*
PO4 *(Skill level)*	**Effective Communication Skills** ● Demonstrate the ability to listen, analyse and reproduce the instructions. ● Express thoughts and ideas effectively through written and oral communication. ● Demonstrate skills to present complex information in a clear, lucid, and concise manner. *Cognitive levels: Ap, C*

PO5 *(Skill level)*	**Proficiency with Information and Communication Technology** ● Use e-resources for effective learning. ● Employ computational tools and internet to retrieve, analyse, present, communicate and disseminate scientific data and information ● Understand the scope and limitations of printed and electronic media in gathering, and disseminating scientific knowledge. *Cognitive levels: Ap, An, E*
PO6 *(Skill level)*	**Personal and behavioral competence** ● Demonstrate conversational competence through effective communication and interaction with peers and seniors ● Exhibit time management while completing tasks in classroom and laboratory ● Exhibit adaptability, team building and leadership qualities as a member of diverse groups ● Demonstrate the ability to work independently and responsibly ● Demonstrate awareness towards issues related to environment, sustainability, and gender equity *Cognitive levels: U, Ap, An, C*

Serial Number	**Details of Programme Specific Outcomes (PSOs)**
PSO1	**Academic Competence and problem-solving ability** ● Imbibe disciplinary knowledge and understand fundamental concepts of biology, chemistry and biochemistry ● Demonstrate coherent understanding of structure and functions of biomolecules ● Explain biochemical processes and underlying mechanisms ● Apply the concepts and mechanisms of metabolic and information pathways to solve problems related to human health and nutrition ● Recognize and appreciate the scope and applications of biochemistry in diverse fields such as pharmaceutical, biopharmaceutical, agriculture, food and nutrition, forensic, genetic engineering and tissue engineering. *Cognitive levels: R, U, Ap, An*
PSO2	**Critical thinking and analytical skills** ● Develop critical thinking and a sense of inquiry for asking relevant questions in the discipline of biochemistry ● Demonstrate the ability to analyse, interpret and draw conclusions from qualitative/quantitative data ● Critically evaluate ideas, theories and concepts by following scientific approach and an open minded and reasoned perspective. *Cognitive levels: U, An, E*

PSO3	**Experiential learning and Laboratory Skills** ● Follow and create standard operating procedures and Good Laboratory Practices ● Understand the principles and working of laboratory equipments ● Develop laboratory skills and qualities required for successful career in teaching, research, industry, etc. ● Apply the analytical and laboratory skills in deeper understanding of life processes and in finding solutions for issues and problems related to biochemistry ● Analyse and evaluate the existing processes, methods and techniques employed in biochemistry and related disciplines *Cognitive levels: R, U, Ap, An, C*
PSO4	**Research Aptitude and Interdisciplinary Approach** ● Demonstrate a sense of inquiry and capability for identifying problems related to health, food and nutrition, agriculture, etc. ● Articulate research problems or questions with an interdisciplinary approach ● Apply the principles of research design ● Employ research methods and tools for analysis and interpretation of data ● Employ computational tools in overcoming challenges related to applications of biochemistry *Cognitive levels: Ap, An, E, C*

Overall Credit Structure for S.Y. B.Sc.

Semester	Core I	Core II	Minor	OE	VSC, SEC (VSEC)	AEC, VEC, IKS	OJT, FP, CEP, CC	Credits / semester	Degree/ cumulative credits
I	4C	4C	4C	2C	VSC-2C	AEC-2C	FP-2C CC-2C	22C	UG Diploma 88C
II	4C	4C	4C	2C	SEC-2C	AEC-2C	FP-2C CC-2C	22C	
Total Credits	8C	8C	8C	4C	4C	4C	8C	44C	

SI: SIES
U: Undergraduate
BC: Biochemistry
CC: Core Course
VS: Vocational Skill Course
SE: Skill Enhancement Cours
OE: Open Elective/Generic open elective
VSC: Vocational Skill Course
SEC: Skill Enhancement Course
AEC: Ability Enhancement Course
VEC: Value Education Course
IKS: Indian Knowledge System
OJT: On-job training
FP: Field Project
CEP: Community engagement and service
CC: Co-curricular courses

Credit Structure of courses offered by Biochemistry department for S.Y. B.Sc. Biochemistry

Name of Program: B.Sc. Biochemistry			**Name of Department:** Biochemistry			
Class	**Semester**	**Course Code**	**Course Title**	**Credits**	**No. of lectures/ per week**	**Marks**
SYBSc Major	III	SIUBCMJ211	Biomacromolecules	03	03	75
		SIUBCMJP211	Biomacromolecules Practical	01	01	25
		SIUBCMJ212	Human Physiology	03	03	75
		SIUBCMJP212	Human Physiology practical	01	01	25
		SIUBCVS211	Introduction to biostatistics	02 (01Th + 01P)	03 (01Th + 02P)	50
SYBSc Minor	III	SIUBCMN211	Biomacromolecules	03	03	75
		SIUBCMNP211	Biomacromolecules Practical	01	01	25
SYBSc Major	IV	SIUBCMJ221	Bioanalytical techniques	03	03	75
		SIUBCMJP221	Bioanalytical techniques Practical	01	01	25
		SIUBCMJ222	Membrane Biology	03	03	75
		SIUBCMJP222	Membrane biology and Microbiology Practical	01	01	25
		SIUBCSE221	Introduction to bioinformatics	02 (01Th + 01P)	03 (01Th + 02P)	50
SYBSc Minor	IV	SIUBCMN221	Membrane Biology	03	03	75
		SIUBCMNP221	Bioanalytical techniques Practical	01	01	25

Summary of syllabus
SEMESTER III

Course Title & Course Codes	Units	Topic Headings	Credits	Hours/Week
Biochemistry as Major				
Biomacromolecules SIUBCMJ211	I	Protein Biochemistry	3	3
	II	Enzymes		
	III	Nucleic acids		
Core Practical SIUBCMJP211		Biomacromolecules Practical	1	2
Human Physiology SIUBCMJ212	I	Digestion and Absorption	3	3
	II	Excretion and Respiration		
	III	Cardiovascular system and Nervous system		
Core Practical SIUBCMJP212		Human Physiology practical	1	2
VSC SIUBCVS211		Introduction to biostatistics	2	2 (tutorial)
Biochemistry as Minor				
Biomacromolecules SIUBCMN211	I	Protein Biochemistry	3	3
	II	Enzymes		
	III	Nucleic acids		
Practical SIUBCMNP211		Biomacromolecules Practical	1	2

Summary of syllabus
SEMESTER IV

Course Title & Course Codes	Units	Topic Headings	Credits	Hours/Week
Biochemistry as Major				
Bioanalytical Techniques SIUBCMJ221	I	Spectroscopy & Centrifugation	3	3
	II	Electrophoresis		
	III	Chromatography		
Core Practical SIUBCMJP221		Bioanalytical techniques Practical	1	2
Membrane biology SIUBCMJ222	I	Composition and function of plasma membrane	3	3
	II	Membrane transport		
	III	Bioenergetics		
Core Practical SIUBCCMJP222		Membrane biology and Microbiology practical	1	2
SEC SIUBCSE221		Introduction to bioinformatics	2	1 +2(Practical)
Biochemistry as Minor				
Membrane biology SIUBCMN221	I	Composition and function of plasma membrane	3	3
	II	Membrane transport		
	III	Bioenergetics		
Practical SIUBCMNP221		Bioanalytical techniques Practical	1	2

Semester III

Syllabus- Vocational Skill Course (VSC)

Course Title: Introduction to Biostatistics; Scientific communication **Course code: SIUBCVS211** **Credits: 02** **Hours/week: 02 L**

Course Outcome:

On completing the Course, the learner should be able to

1. *Discuss types of data and methods of collection of data*
2. *Discuss types of data representation*
3. *Represent a given data appropriately*
4. *Analyse and interpret the given data using measures of central tendency*
5. *Analyse and interpret the given data using measures of dispersion*

Total hours per week: 2	**Contents**	**Credits :2**
Sr No	**Title**	
1	Introduction to biostatistics	
2	Collection of data, types of data and representation	
3	Descriptive statistics	
4	Frequency distribution	
5	Determination of mean, median, and mode	
6	Determination of SD and variance	

References for VSC

1. Ahuja, R. (2001). Research methods. Rawat.
2. Bowers, D. (2008). Doing it right first time—designing a study. Medical Statistics from Scratch, 71-90.
3. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
4. Rosner, B. (2005). Principles and practice of clinical research. Fundamentals of biostatistics.

Semester IV
Syllabus- Skill Enhancement Course (SEC)

Course Title: Introduction to Bioinformatics	**Course code: SIUBCSE221**
Credits: 02	**Hours/week: 02 L**

Course Outcome:

On completing the Course, the learner should be able to

1. *Express the scope, applications and potentials of bioinformatics.*
2. *Collect data/information from the biological and chemical data bases*
3. *Analyse biological data (gene and protein sequence) using basic bioinformatics tools*

Total hours per week: 2	**Contents**	**Credits :2**
Sr No	**Title**	
1	Introduction to bioinformatics	
2	History of bioinformatics, genomics and proteomics	
3	Databases: types- public domain database, chemical database (Pubchem); sequence database, structural database, motif database, genome database, proteome database, annotated sequence database- GenBank, EMBL, PIR, SWISS PROT, PDB, GDB Problems related to above databases.	
4	Sequence analysis tools: BLAST, FASTA, L- ALIGN, CLUSTAL- X & W, RASMOL, Software for protein sequencing- PROPECT, AMMP, COPIA. Problems on sequence analysis	
5	Applications of bioinformatics in sequence analysis, molecular modelling and drug designing, phylogeny/ evolution, ecology & population studies, medical informatics and agriculture	

References for SEC SIUBCSE221

1. Bioinformatics: Sequence and Genome Analysis by Mount DCold Spring Harbor Laboratory Press, New York. 2004 2.
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009 3.
3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education.
4. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith, Pearson Education. 1999 2.
5. Bioinformatics for Dummies by Jean-michel Claverie Cedric Notredame. Publisher: Dummies (Jan 2007) 1999

General Scheme of Examination

Credits	Course Type	Distribution of Credits	Sem end	Internal	Practical	Total
4	Core I with Practical (Major+ Minor)	with Practical 3T+1P	50	25	25	100
4	Core 2 with Practical (Major)	with Practical 3T+1P	50	25	25	100
2	VSC/ SEC	without sem end exam	---	50	---	50
2	Field project		Presentation and Viva voce (30M)	-	Field work 20M	50

Semester end, Internal and Practical as in the above Table, will be separate heads of passing.

1. Details for Internal Assessment:

Weightage for Internal (marks)	Min. marks required for passing	Pattern of Evaluation
25 (Core)	10	10 marks- class test (No retest) + 15 marks- Assignment/ Project/ Viva
50 (with sem end exam) OE	20	20 marks- class test (No retest) + 30 marks- Assignment/ Project/ Practical exam/ Open to Department
50 (without sem end exam) VSC, SEC	20	20 marks- class test (No retest) + 30 marks- Open to Department OR 50 marks from Practical- journal+ viva+ exam etc (continuous evaluation)
20 (IKS/ VEC/ AEC)	8	Open to Conveners of IKS, VEC, AEC
50 Field Project	20	20M Field Project; 30 M Report, presentation and Vive voce

Internal evaluation: Quizzes, Presentations, Surveys, Internship, Tutorials, Role Play

2. Details for Semester End Exam:

- For semester end exam, Two types of Patterns are given.
- Any one pattern can be adapted depending on the number of units in the syllabus.
- Arts and Commerce faculty will follow Type II.
- Students should be informed by the concerned department about the pattern.
- Questions of Objective type (MCQ/ Fill in the blanks/ match the following pairs etc) should not be asked in semester end exam.

Sem End	Min. Re.	Duration	Pattern	
			Type I	Type II
60	24	2 hrs.	• 4 units: 4 questions of 15 marks each on each unit. • 3 units: 3 questions of 15 marks on each unit and one question of mixed type for 15 marks.	4 questions for 10 marks each and 5th question is 4 Short Notes for 5 marks each.
50	20	2 hrs.	• 4 units: 4 questions of 12, 13, 12, 13 marks on 4 units. • 3 units: 3 questions on 3 units of 12 marks each and 4th question of mixed type for 14 marks. • 2 units: 2 questions of 20 marks each on each unit and one question of mixed type for 10 marks.	4 questions for 10 marks each and 5th question is 2 Short notes for 5 marks each.
30	12	1 hr.	• 3 units: 3 questions of 10 marks each on each unit. • 2 units: 2 questions of 15 marks each on each unit / 2 questions of 10 marks each on each unit and one question of mixed type for 10 marks.	2 questions for 10 marks each and 3rd question is 2 Short Notes for 5 marks.