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**St. Xavier's College (Autonomous), Mumbai**

**Programme: B.Sc. Life Science – Biochemistry**

**Department of Life Science and Biochemistry:**

*Programme Specific Outcomes (PSOs) and Course Outcomes (CO) for Life Science*

*Programme Specific Outcomes (PSOs) and Course Outcomes (CO) for Biochemistry*



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**St. Xavier's College (Autonomous), Mumbai**  
**Department of Life Science and Biochemistry**

**Programme: B.Sc. Life Science**

*Programme Specific Outcomes (PSOs) for B.Sc. Life Science*

Sr. No.	On completing B.Sc. Life Science, the student will be able to:
PSO 1	Comprehend and evaluate basic biological concepts and integrate perspectives from diverse fields of modern biology.
PSO 2	Pursue higher education and research in various branches of biology such as genetics, evolution, cell biology, microbiology, physiology, biochemistry, immunology, developmental biology, neurobiology, ecology, biotechnology and bio-informatics.
PSO 3	Understand niches within human health and environmental domains wherein life science applications have the potential to bring about substantial and sustainable change.
PSO 4	Demonstrate proficiency in scientific fields such as biostatistics, bioinformatics and analytical techniques necessary for effective biological research; comprehend biotechnological processes used in industry and to foresee need-based entrepreneurship avenues in all fields of biology.
PSO 5	Comprehend and use information from varied scientific resources; evaluate and interpret graphical data; formulate testable hypotheses, design experiments and observational strategies in a laboratory setting; exhibit problem-solving skills and present scientific data in oral and written form.
PSO 6	Work in collaboration in a team, develop interpersonal communication skills and be empowered to pursue a career in any field of choice.



## Course Outcomes (COs): B.Sc. Life Science

### Semester I

**Course Title: Fundamentals of Biochemistry and Analytical Techniques**

**Course Code: SLSC0101**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the concept of pH and buffers and solve simple problems based on them.	1, 2, 5	R, Ap
CO 2	Recognize bio-molecules (carbohydrates, lipids, amino acids nucleotides) and classify them based on different criteria.	1, 2	U, An
CO 3	Write the structures and basic reactions of simple sugars, amino acids, lipids and nucleotides and apply it to chemical processes and interactions that prevail in living systems.	1, 2	R, U, Ap
CO 4	Understand the bonds that play a vital role in determining the structure of macromolecules and know the role of the macromolecules in vivo.	1, 2	U, An
CO 5	Explain simple techniques used in studying microorganisms, separating and estimating bio-molecules and to solve problems related to the techniques.	1, 4, 5	U, Ap



**Course Title: Genetics and Evolution**  
**Course Code: SLSC0102**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand and explain the theories of origin of life, from creation myths to biochemical theories; comprehend the basics of evolution, from pre-Darwin ideas to macroevolution.	1, 2	U, R
CO 2	Understand the link between origin of life and gene as a unit of heredity; understand the structures of prokaryotic and eukaryotic genomes; explain the evidence of DNA as genetic material; understand the concept of cytoplasmic inheritance.	1, 2	U, R
CO 3	Understand Mendel's laws of inheritance; utilize Punnett square and forked line methods for calculating offspring ratio and solve problems associated with monohybrid, dihybrid and trihybrid crosses and prove Mendel's laws using Chi-square test.	1, 2	U, R, An, Ap
CO 4	Understand and explain the extensions of Mendel's laws and show deviations from the three laws of inheritance.	1, 2	U, R, An, Ap
CO 5	Understand pedigree and karyotype analysis; construct and analyse pedigrees and determine patterns of inheritance and probabilities of disease occurrence.	1, 2	U, An, Ap, C

**Course Title: Life Science Practicals – I**  
**Course Code: SLSC01PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Know good laboratory practices, and comprehend the workings of common laboratory instruments.	1
CO 2	Display basic skills pertaining to preparation of solutions and buffers, perform simple biochemical assays, analyse findings for drawing inferences.	1, 5



## Semester II

**Course Title: Cell Biology**

**Course Code: SLSC0201**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Comprehend and describe the structure and composition of the plasma membrane of eukaryotic cells and the cell wall of plant cells.	1, 2	R, U
CO 2	Understand the modes of transport across the plasma membrane, correlate them with the properties of the plasma membrane and analyse the differences in transport mechanisms for particular solutes.	1, 2	R, U, An
CO 3	Illustrate and discuss the role of intercellular junctions in cell adhesion, inter-cellular transport and communication.	1, 2	R, U
CO 4	Explain the structure and function of various organelles, evaluate their role in cellular processes with special emphasis on protein synthesis and trafficking, and correlate errors in their function with disease conditions.	1, 2, 3	U, An, Ap
CO 5	Discuss the structural organisation of cytoskeletal elements and analyse their role in intracellular transport, cell adhesion, cell division and cell migration/movement.	1, 2, 5	R, U, An
CO 6	Comprehend the eukaryotic cell cycle; differentiate between mitosis and meiosis; and analyse the significance of each process for an organism.	1, 2, 3	R, U, An
CO 7	Describe the structural and functional features of nuclear components; assess the significance of chromatin packaging and discuss the specialized chromosome structures.	1, 2	R, U, An



**Course Title: Fundamentals of Microbiology**  
**Course Code: SLSC0202**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe historical experiments used to prove biogenesis; recall contributions of various scientists in developing the field of microbiology, and discuss the significance of microorganisms in various sectors.	1, 2, 3, 4	U, R
CO 2	Differentiate between prokaryotes and eukaryotes; discuss strategies used to classify microorganisms; classify a representative bacterium; explain features of the three-domain classification and explain the significance of 16S rRNA sequence comparison in classification.	1, 2, 6	U, R, Ap
CO 3	Enlist different bacterial morphologies and arrangement; illustrate and label the microbial (bacterial and archaeobacterial) ultra-structure and recall associated functions; explain Gram staining and differentiate between characteristics of Gram-negative and Gram-positive cells.	1, 2, 3	U, R, Ap, An
CO 4	Discuss the characteristics of different classes of viruses, fungi, algae and protozoa with a representative example in each.	1, 2	U, R, Ap, An
CO 5	Explain the nutrient requirement of bacteria; describe different kinds of culture media, discuss the effect of environmental factors that affect growth; represent bacterial growth graphically and with mathematical equation; calculate generation time; explain techniques to obtain pure culture, enumerate and preserve bacterial cultures.	1, 2, 5	U, R, Ap, An
CO 6	Explain methods of microbial control; provide examples of physical, mechanical and chemical methods with their mechanisms and explain methods to evaluate antimicrobials.	1, 2	U, R, Ap, An

**Course Title: Life Science Practicals – II**  
**Course Code: SLSC02PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Demonstrate good laboratory practices, and follow standard operating procedures pertaining to basic laboratory instruments and equipment.	1, 5
CO 2	Safely handle microbial cultures, perform aseptic techniques and staining of microorganisms, and demonstrate microscopy skills.	1, 2, 5



### Semester III

**Course Title: Comparative Physiology – I**

**Course Code: SLSC0301**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Compare and analyse the diversity in the mechanisms involved in digestive, excretory, respiratory and circulatory systems among different phyla.	1	R, An
CO 2	Recognize the structures and finer anatomy of organs involved in digestive, excretory, respiratory and circulatory systems of humans.	2	R, U
CO 3	Understand and analyse the cellular and biochemical mechanisms involved in each of the physiological processes mentioned above.	2, 4	U, An
CO 4	Comprehend the physiological/structural abnormalities involved in digestive, respiratory and cardiovascular diseases.	1, 5	An
CO 5	Explain the techniques involved in assessing physiological parameters, such as measuring blood pressure and blood count.	6	Ap



**Course Title: Enzymes and Metabolic Pathways**  
**Course Code: SLSC0302**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Appreciate the role and importance of water as a solvent and apply the concept of pH and buffers in preparation of desired buffers; solve numerical questions on the above concepts.	1, 5, 6	R, U, Ap
CO 2	Compare different types of biological catalysts; classify different types of enzymes and summarize the various terms associated with enzymes.	1, 2, 4, 5	R, U
CO 3	Derive mathematical expression for enzyme kinetics; represent the equation in graphical forms; analyse factors that govern enzyme kinetics, experimentally identify these factors and outline the process of protein purification.	1, 3, 6	R, U, Ap
CO 4	Understand and recall various biochemical pathways associated with carbohydrates, lipids, nitrogenous bases and amino acids.	1, 3, 6	R, U, Ap
CO 5	Recall and compare mechanisms of ATP synthesis in plants and animals and discuss the interaction of metabolic pathways.	2, 3	R, U, E





**Course Title: Microbes and Human Health**  
**Course Code: SLSC0303**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Recall various terms associated with microbial ecology; explain microbial habitats, the steps of biofilm formation; explain the concept of and provide examples for positive and negative microbial interactions and quorum sensing.	1, 2, 3	U, R, Ap
CO 2	Understand the biogeochemical cycling of elements, and the role of microorganisms in their biotransformation.	1, 2, 3	U, R, Ap, An
CO 3	Explain the human body as a host for microorganisms; recall sites on the human body colonized by the normal flora; discuss the significance of normal flora and explain the difference between pathogens and normal flora; describe the innate physical and chemical defenses in the human body that protect it from infection.	1, 2, 3, 5	U, R, Ap
CO 4	Explain the concept of virulence and associated factors; describe the transmission, pathogenesis, clinical features, diagnosis and treatment of infectious diseases such as typhoid/ malaria/ influenza/ candidiasis and explain or illustrate steps in diagnostic techniques such as ELISA/ RIA.	1, 2, 3, 5, 6	U, R, Ap, An
CO 5	Explain modes of transmission and vectors involved in infectious diseases with help of examples; identify steps to stop spread of communicable disease transmission; discuss emerging and re-emerging infectious diseases.	1, 2, 3, 5	U, R, Ap, An
CO 6	Comprehend public health concepts and critically evaluate the success of public health policies in India.	1, 2, 3, 5, 6	U, R, Ap, An, E

**Course Title: Life Science Practicals – III**  
**Course Code: SLSC03PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Perform and demonstrate experiments involving animal dissection and histology, biochemical purification and assays, and microbiological techniques.	1, 2
CO 2	Effectively use instruments such as microscopes, colorimeters, etc. and interpret data.	2, 5



### Semester IV

**Course Title: Comparative Physiology – II**

**Course Code: SLSC0401**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand and evaluate the diversity in the mechanisms involved in endocrine, nervous and reproductive systems among different animal phyla; apprehend the basics of hormones and reproduction in plants.	1	R, An
CO 2	Recognize detailed anatomical aspects involved in the three systems mentioned above in humans; understand and analyse the cellular and biochemical mechanisms involved in each.	2	R, U
CO 3	Comprehend and evaluate the physiological/structural abnormalities involved in diseases pertaining to malfunctioning of endocrine, nervous and reproductive systems.	3, 5	An, Ap
CO 4	Analyse and apply the understanding of the above in daily-life situations such as contraception and assisted reproductive techniques.	6	Ap, C



**Course Title: Molecular Biology**  
**Course Code: SLSC0402**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Discuss the concept of a gene in the context of its discovery to current day definition, historical experiments conducted and techniques used.	1, 2, 3	U, R
CO 2	Gain a fundamental understanding of the molecular mechanisms underlying the 3 major biological information processing pathways – DNA replication, transcription and translation – with a focus on prokaryotic system and in solving related analytical problems.	1, 2, 5	U, R, An
CO 3	Understand the principles of gene regulation in prokaryotes, and apply the same to solving problems on the subject.	1, 5	U, R, An
CO 4	Develop an understanding of the molecular basis of mutations, the mechanisms of action of mutagenic agents and how these lead to human genetic disorders.	1, 3, 5	U, R, Ap
CO 5	Compare and contrast the key features of the above concepts between prokaryotic and eukaryotic organisms, correlating them to human health and disease.	1, 3, 5	Ap, An



**Course Title: Biostatistics and Population Genetics**  
**Course Code: SLSC0403**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand and remember the basic terminology associated with biostatistics; recognize the types of data to apply for measures of central tendency and dispersion; recognize the difference between normal and skewed distribution, and its use in parametric and non-parametric statistical tests; learn the use of normal distribution as a measure of location.	1, 5	U, R, Ap
CO 2	Understand and calculate Z-score, probability and the importance of distribution and probability in hypothesis testing; understand the importance of sampling techniques in hypothesis testing.	1, 4, 5	U, R, Ap
CO 3	Apply basic correlation and regression for describing data; choose appropriate statistical tests for accurate analysis; understand the basics of experimental design.	1, 4, 5	U, R, Ap, An, C
CO 4	Understand and remember the concepts of population genetics and calculate allelic and genotypic frequencies.	1, 5	U, R
CO 5	Understand and derive the Hardy Weinberg equation and explain the factors affecting the HWE.	1, 5	U, R, Ap, An

**Course Title: Life Science Practicals – IV**  
**Course Code: SLSC04PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Possess improved dissection and microbial handling skills; learn data analysis through biostatistics tools, both manually and using softwares.	1, 2, 4
CO 2	Design experiments, analyse data and write interpretative reports as part of the project-based learning.	4, 5



**Course Title: Nutrition and Reproductive Health (Cross-faculty Course)**  
**Course Code: ASPC04017**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Gain a fundamental understanding of concepts of nutrition - nutritive value and energy content of food, balanced diet, nutritional and eating disorders, food regulation and food regulatory bodies, body composition and energy expenditure.	1, 2, 3	U, R
CO 2	Analyse and assess nutrition panels, and design a diet plan by extrapolating nutritional information to personal health and disease based on current scientific research.	5, 6	Ap, An, E
CO 3	Gain a basic understanding of the anatomy and physiology of the male and female reproductive systems with an emphasis on the hormones involved in gametogenesis and pregnancy, deviations from normal functioning, and the effects of environmental pollutants on anomalies at birth and reproductive dysfunctions in adults.	1, 2, 3	U, R
CO 4	Apply the above knowledge to understand the concept of abortion and usage of various contraceptives; evaluate case studies to assess infertility problems and to provide an appropriate solution based on hormone treatment, use of assisted reproductive techniques and other concepts studied.	5, 6	Ap, An, E
CO 5	Interlink concepts of nutrition and reproductive health so as to make informed choices in day-to-day life based on correct scientific understanding and research.	3, 5	Ap, An, E



### Semester V

**Course Title: Genetics**

**Course Code: SLSC0501**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the principle of genetic transfer and explain the experimental evidences for mapping of genes in bacteriophages, prokaryotes and some eukaryotes; solve problems on gene mapping based on the above concepts.	1, 5	U, Ap, An
CO 2	Enumerate the various causes and methods of DNA damage; understand the various mechanisms that are involved in the repair of the DNA damage.	1	U, R, Ap
CO 3	Understand and explain the types and mechanisms of genetic recombination.	2	U, R, Ap,
CO 4	Get an insight into the fundamental concepts, components and techniques of gene cloning.	2	U, R, Ap, An
CO 5	Explain the advanced analytical techniques like PCR, DNA sequencing and examine the potential applications of genetic engineering to various fields.	2	U, Ap



**Course Title: Developmental Biology**  
**Course Code: SLSC0502**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Comprehend and explain the significance of model organisms in developmental biology.	1, 2, 5	U, An
CO 2	Comprehensively analyse the principles and mechanisms that underlie early developmental events in multi-cellular animals using avian system as an example.	1, 2, 5	R, U, Ap, An
CO 3	Discuss the role of genes and proteins involved in totipotency, cell fate determination and differentiation; analyse the significance of intercellular communication, cell cycle and apoptosis in developmental processes; and identify emerging concepts in stem cell biology.	2, 3, 5	U, An, Ap
CO 4	Explain the molecular interplay of genes and gene products involved in development of drosophila and arabidopsis.	2, 5	R, U, An
CO 5	Explain instances of post-embryonic development; understand how errors in development lead to congenital defects; ascertain the ways in which internal mechanisms and environment regulate sexual phenotypes; and comprehend the relationship between evolutionary dynamics ("Evo") and the fundamental basis of developmental mechanisms ("Devo").	2, 3, 5	U, R, Ap, An, E
CO 6	Identify researchable areas pertaining to the betterment of human life such as stem cell biology, cancer biology, ageing and teratology.	3, 5, 6	U, Ap, An



**Course Title: Industrial Biotechnology and Nanotechnology**  
**Course Code: SLSC0503**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Be acquainted with the fundamental concepts of bioprocess technology, its component parts (upstream and downstream) and applications in the development of industrial products.	2, 4	U, R, Ap
CO 2	Examine the steps involved in the production of commercial products based on animal tissue culture and plant tissue culture.	4	U, R
CO 3	Understand the concepts of entrepreneurship; and acquire skills needed to analyse potential business opportunities in the field of biotechnology.	4	U, Ap
CO 4	Comprehend the journey of a pharmacoactive compound from bench to bedside.	4	R, Ap
CO 5	Understand the concepts of bionanotechnology and its potential applications to various fields.	2	U, Ap





**Course Title: Ecology and Biodiversity**  
**Course Code: SLSC0504**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Demonstrate an understanding of the basic principles of ecology including population ecology, community ecology, and ecosystem functions; understand and interpret ecological relationships between organisms and their biotic and abiotic environments.	1, 2, 3, 5	U, R, Ap, An
CO 2	Understand the relationship between behaviour and ecology; recognize and analyse the various factors that determine behavioural choices.	1, 2, 3, 5	U, R, Ap, An, E
CO 3	Discuss biodiversity with reference to its measurement, status, importance, evolution and loss; understand basics of cladistics and analyse, evaluate and construct cladograms.	1, 2, 3, 5	U, R, Ap, An, E, C
CO 4	Integrate and describe basic information related to human utilization of resources and how human activities impact the environment, with a special thrust on biodiversity and toxicology.	1, 2, 3, 5	U, R, Ap, An
CO 5	Evaluate current environmental issues and problems including the solutions and management practices that have been used or offered to address these issues and problems.	4, 5, 6	U, R, Ap, An, E

**Course Title: Life Science Practicals – V (for B.Sc. Life Science)**  
**Course Code: SLSC05PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Perform simple molecular biology techniques such as extraction of genomic DNA, PCR, DNA electrophoresis, quantitative estimation of DNA; use microbiology techniques efficiently.	2, 5, 6
CO 2	Handle model systems for biological study and research; use classical techniques to carry out experiments and research projects; communicate well scientific information and ideas orally and in writing.	2, 5, 6
CO 3	Demonstrate techniques involved in the analysis of commercial products - chromatography-based separation and analysis of products; enzyme extraction, purification and analysis; assay of antimicrobials; take up careers in bioprocessing industries; evaluate environmental impact of pollutants via water testing; promote original ideas, integrate knowledge, apply logical principles to analyse results and draw conclusions, write and present scientific reports.	2, 3, 4, 5, 6



**Course Title: Life Science Practicals – V (for B.Sc. Life Science and Biochemistry)**  
**Course Code: SLSC05PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Perform simple molecular biology techniques such as extraction of genomic DNA, PCR, DNA electrophoresis, quantitative estimation of DNA; use microbiology techniques efficiently.	2, 5, 6
CO 2	Handle model systems for biological study and research; use classical techniques to carry out experiments and research projects; communicate well scientific information and ideas orally and in writing.	2, 5, 6

**Course Title: Environment and Environmental Pollution**  
**Course Code: SLSC05AC**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Gain an understanding of the physico-chemical composition of the hydrosphere, atmosphere and lithosphere, and study how certain life-sustaining parameters are variable in these spheres.	2, 3, 5	U, R, An
CO 2	Analyse the impacts of human commercial activity such as mining, petroleum exploration, damming and farming on the environment, when carried out without proper environmental impact assessments; understand and analyse how these situations can be resolved using specific case studies.	2, 3, 5	U, R, Ap, An
CO 3	Gain understanding of the sources and types of water, air, noise and thermal pollutants, including agents that cause chemical toxicity; study their categorization on the basis of physical, chemical and biological parameters and assess their impact on the environment.	1, 3, 5	U, R, Ap, An
CO 4	Apply the background information to analyse and evaluate various case studies on different environmental pollutants and their impact on the environment (biotic and abiotic).	1, 3, 5	U, R, Ap, An, E



**Course Title: Applied Component Practical**  
**Course Code: SLSC05ACPR**

<b>Sr. No.</b>	<b>On completing the course, the student will be able to:</b>	<b>PSOs addressed</b>
CO 1	Assess various parameters determining the quality of water from different sources.	1, 3
CO 2	Analyse water samples from different sources to estimate the extent of pollution.	3, 5



## Semester VI

**Course Title: Immunology**

**Course Code: SLSC0601**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Identify the cellular and molecular basis of immune responsiveness; and understand the roles of the immune system in both maintaining health and contributing to disease.	1, 2	U, R, Ap
CO 2	Comprehend, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity and their coordination in fighting invading pathogens.	1, 2	U, R, Ap, An
CO 3	Elucidate the genetic basis for immunological diversity, describe immunological responses, their triggers and regulation.	2, 5	R, U, Ap
CO 4	Outline key events and cellular players in antigen presentation and immunological events as seen in transplantation and allergic reactions.	2, 5	U, R, An
CO 5	Explain the mechanisms involved in immune system alterations and comprehend the function of vaccines and immunotherapy.	2, 5, 6	U, An, Ap



**Course Title: Neurobiology**  
**Course Code: SLSC0602**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe the organization, anatomy and functions of the central and peripheral components of human nervous system.	1, 2	R, U
CO 2	Comprehend detailed cellular, molecular and electrical mechanistic aspects of nerve impulse transmission; and analyse the role of glial cells in neural function.	1, 2, 5	R, U, Ap
CO 3	Understand and analyse the synthesis, turnover and function of different neurotransmitters, in normal and clinical conditions.	1, 2, 3	R, U, An
CO 4	Acquire knowledge about different sensory systems and analyse how humans respond to a single or multiple environmental cues as sensory inputs.	2, 3, 5	U, An
CO 5	Understand how complex molecular interplay causes cell fate specification and apply it to the development of the mammalian vertebrate system.	2, 3, 5, 6	U, Ap, C
CO 6	Apply the understanding of basic neurobiology to comprehend higher order brain functions such as behavior, learning-and-memory and emotions.	2, 3, 5, 6	Ap, An, C

**Course Title: Recombinant DNA Technology and Bioinformatics**  
**Course Code: SLSC0603**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the fundamental concepts in recombinant DNA technology – enzymes, techniques and steps involved in gene cloning.	1, 2	U, Ap, An
CO 2	Explain the advanced techniques in transgenic technology: knock in, knock out, knock down and CRISPR technologies.	2	U, Ap
CO 3	Get an insight into an overall approach to prokaryotic and eukaryotic transgenesis based on assimilation of the above concepts.	2	U, Ap
CO 4	Appreciate and learn the applications of recombinant DNA technology to various fields; and be aware of the ethics involved in gene cloning.	4	U, Ap
CO 5	Have an introductory understanding of bioinformatics and the various databases available to analyse nucleotide and protein sequence and structure data.	2, 4	Ap, An



**Course Title: Sustainable Development and Carbon Management**  
**Course Code: SLSC0604**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Understand the valuation of biodiversity and the importance of its conservation via in-situ and ex-situ conservation; appreciate the role of legislation and policies in ecotourism and conservation.	2, 3, 4, 5, 6	U, R, Ap, An, E
CO 2	Understand Earth's natural greenhouse effect and current evidences for global warming; explain and quantify the impacts of climate change on human well-being and the natural world, and evaluate means by which these impacts can be reduced; assess the 'best predictions' of current climate models.	1, 2, 3, 5, 6	U, R, Ap, An, E
CO 3	Evaluate the successes and failures of past and current national and international efforts to address climate change, and evaluate prospects for future management of climate change; evaluate the issue of climate change from the Indian perspective.	2, 3, 5	U, R, Ap, An, E
CO 4	Understand the concept of sustainable development; analyse and apply its principles for development of sustainable practices in agriculture, urban development, product manufacturing as well as greening supply chains; evaluate current sustainable practices and apply indigenous knowledge to further ease the use of sustainable practices.	2, 3, 4, 5	U, R, Ap, An, E
CO 5	Understand carbon accounting and management measures; identify the drivers and benefits of implementing carbon management measures.	2, 3, 5, 6	U, R, Ap, An, E



**Course Title: Life Science Practicals – VI (for B.Sc. Life Science)**

**Course Code: SLSC06PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Use basic immunological techniques such as blood typing, agglutination and precipitation reactions, separation of lymphocytes, and serum electrophoresis.	2, 5, 6
CO 2	Dissect and work with model organisms; assess specific cognitive capacities of individuals using standard cognitive testing.	2, 5, 6
CO 3	Perform and demonstrate techniques and skills involved in recombinant DNA technology and in silico analysis; analyse the issues of sustainable development and carbon management via water testing for pollutants, calculation of C footprints, life cycle analysis and designing of green products.	2, 3, 4, 5, 6

**Course Title: Life Science Practicals – VI (for B.Sc. Life Science and Biochemistry)**

**Course Code: SLSC06PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Use basic immunological techniques such as blood typing, agglutination and precipitation reactions, separation of lymphocytes, and serum electrophoresis.	2, 5, 6
CO 2	Dissect and work with model organisms; assess specific cognitive capacities of individuals using standard cognitive testing.	2, 5, 6



**Course Title: Environment Sustainability and Legislation**  
**Course Code: SLSC06AC**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Analyse, discuss and recall the basic methods of waste water treatment focusing on waste-water recycling strategies.	2, 3, 5, 6	U, R, An
CO 2	Evaluate and discuss case studies about solid waste minimization strategies in order to identify and explain greener methods of disposal.	2, 3, 5, 6	U, Ap
CO 3	Discuss, recall, illustrate and analyse the applications of effective remediation processes to reduce ecologically harmful chemicals/ molecules at contaminated sites.	2, 3, 5, 6	U, R, Ap, An
CO 4	Describe, review, discuss case studies and deliberate upon green technology, quality mechanisms, corporate social responsibility and disaster management; link these to sustainable development and sustainable businesses.	2, 3, 5, 6	U, R, An, C
CO 5	Comprehend, discuss, review the principle and compare advantages and disadvantages of various renewable sources of energy; collate and analyse information about their contributions to the Indian power scenario.	2, 3, 5, 6	U, R, An, Ap
CO 6	Recall provisions of and analyse environmental laws and regulations in India using relevant case studies, and discuss carbon management strategies.	2, 3, 5, 6	U, R, An

**Course Title: Applied Component Practical**  
**Course Code: SLSC06ACPR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Determine various parameters in sewage effluents and soil samples from different sources.	1, 3, 4
CO 2	Integrate the understanding of soil and water pollution and apply this learning to design a sustainable project pertaining to current environmental issues.	3, 4, 5





**St. Xavier's College (Autonomous), Mumbai**  
**Department of Life Science and Biochemistry**

**Programme: For B.Sc. Botany-Biochemistry / B.Sc. Life Science and Biochemistry /  
B.Sc. Microbiology-Biochemistry / B.Sc. Zoology-Biochemistry**

***Programme Specific Outcomes (PSOs) for T.Y.B.Sc. Biochemistry***

Sr. No.	On completing T.Y.B.Sc. Biochemistry, the student will be able to:
PSO 1	Associate the structure of molecules with their chemical interactions/kinetics and role in the organism and to recognise the operation of fundamental scientific principles in the functioning of the human body.
PSO 2	Comprehend the significance of bio-molecules/nutrients, their metabolic fate, energetics and interconversion, and the integration of biochemical pathways within organisms; and apply this knowledge for a better understanding of nutrition, health and allied fields of biology.
PSO 3	Understand the principle and working of various analytical instruments and methods, and their appropriate selection for biochemical investigations.
PSO 4	Be equipped to perform the calculations required for preparation of reagents, to perform/design simple biochemical experiments, to apply her/his knowledge to solve theoretical and practical problems based on concepts, and to do troubleshooting in the laboratory.
PSO 5	Be able to use search engines and bioinformatics tools for literature surveys, reference citations, and analysis of biological sequence and structural data.
PSO 6	Be capable of working in a heterogeneous group towards a common goal through research projects, and be empowered to present ideas logically and with confidence, in a scientific paper and an oral presentation.

**Biochemistry is offered only in the third year of the UG programme.**



## Course Outcomes (COs): T.Y.B.Sc. Biochemistry

### Semester V

**Course Title: Molecules of Biological Significance**

**Course Code: SBCH0501**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Recall structures of biomolecules like carbohydrates, lipids, proteins, vitamins, nucleic acids, and secondary plant metabolites.	1, 5	R, U
CO 2	Compare biomolecules based on their chemistry and functions.	1, 5	R, U
CO 3	Summarize and evaluate the significance of biomolecules and minerals in health and deficiency conditions.	1, 5	U
CO 4	Explain the structure and function of biocatalysts and evaluate the role of regulators of biochemical pathways.	1, 5	U, E
CO 5	Comprehend the basics of enzyme kinetics and inhibition; solve problems based on the above concepts.	1, 4, 5	R, U



**Course Title: Nutrition and Metabolism**  
**Course Code: SBCH0502**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe and discuss fundamental concepts of nutrition, nutritional and eating disorders, food regulation, body composition and energy expenditure.	2, 4, 5	R, U
CO 2	Analyze and assess nutrition panels, design a nutritional plan by extrapolating nutritional information to personal health and disease.	2, 5	Ap, An, E
CO 3	Identify the location of, and describe the pathways that lead to the oxidation (aerobically/anaerobically), synthesis and storage of glucose and fatty acids in the human body.	1, 2, 5	R, U
CO 4	Explain the role of electron transport chain and ATP synthase in using the energy of electrons (extracted from simple sugars and fatty acids) to make ATP in the mitochondria.	2, 4, 5	U, An
CO 5	Describe the role of chloroplast in harnessing energy and analyze the steps involved in the fixation of atmospheric carbon dioxide by a plant.	2, 4, 5	U, An
CO 6	Determine the link between nutrition, metabolism and energy.	2	U, An, E

**Course Title: Biochemistry Practicals – I**  
**Course Code: SBCH05PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Acquire the fundamental skill of understanding the concepts of concentration and dilution, and apply these in accurately and efficiently preparing and storing laboratory reagents for use.	3, 4
CO 2	Identify and critically analyze the principle and working of various analytical instruments such as pH meter, colorimeter, spectrophotometer, centrifuge; choose appropriate techniques for biochemical investigations associated with qualitative and quantitative analysis of carbohydrates, proteins, lipids, various inorganic ions and micronutrients, confidently applying this learning to real-life quality assurance situations.	3, 4



## Semester VI

**Course Title: Biophysical and Bio-analytical Chemistry**

**Course Code: SBCH0601**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Derive equations involving terms such as pH, $K_w$ , pI etc., understand the working of a pH meter and interpret the contribution of physiological buffers to homeostasis in humans.	3, 4	U, An
CO 2	Understand the various principles and processes involved in extracting and purifying proteins.	3, 4, 5	U, Ap
CO 3	Correlate and apply basic gas laws and concepts of viscosity and dipoles in living systems.	1	Ap, An, E
CO 4	Comprehend and apply the principles of common analytical techniques like centrifugation, chromatography, electrophoresis and spectrophotometry to the separation and analyses of biomolecules.	3, 4, 5	R, U
CO 5	Apply the knowledge of instrumentation to solve simple problems.	3, 4, 5	Ap



**Course Title: Metabolism, Clinical Biochemistry and Pharmacology**  
**Course Code: SBCH0602**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe the steps in the synthesis of a peptide and the role of ubiquitin and proteosomes in its degradation.	2, 4, 5	R, U
CO 2	Provide an overview of: the fates of amino acids, metabolism of purines and pyrimidines, excretion of protein nitrogen as urea and also appreciate the integration of carbohydrate, lipid and amino acid metabolism in the human body.	2, 5	R, U, An
CO 3	Comprehend the importance of signal molecules, with emphasis on hormones and their role in the regulation of metabolism and to understand the etiology of some disorders associated with carbohydrate, protein and lipid metabolism.	2, 5	R, U
CO 4	Relate inborn errors of metabolism to the associated enzymatic and biochemical profiles, to interpret the same in the context of human health and disease, and identify suitable enzymatic and diagnostic techniques.	2, 5	U, An, E
CO 5	Select the right bioinformatics tools to analyse biological molecules and the sequence and structural information they contain.	2, 4, 5	Ap, An
CO 6	Discuss in-depth the concepts of Pharmacodynamics, Pharmacokinetics and Pharmacogenomics, and be able to distinguish between the various allied fields of pharmacology.	2, 5	R, U

**Course Title: Biochemistry Practicals – II**  
**Course Code: SBCH06PR**

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Understand and integrate the principles of protein purification, enzymology, chromatographic and electrophoretic separations, and their appropriate selection for biochemical investigations.	3, 4
CO 2	Plan, design and execute simple biochemistry-based group research projects, defend the verified results before a panel of teachers in an oral presentation, and submit them as scientific research papers.	3, 4