St. Xavier's College (Autonomous), Mumbai

Programme: B.Sc. Microbiology – Biochemistry

Department of Microbiology:
Programme Specific Outcomes (PSOs) and Course Outcomes (CO) for Microbiology

Department of Life Science and Biochemistry:
Programme Specific Outcomes (PSOs) and Course Outcomes (CO) for Biochemistry

St. Xavier's College (Autonomous), Mumbai
Department of Microbiology

Programme: B.Sc. Microbiology

Programme Specific Outcomes (PSOs) for B.Sc. Microbiology

Sr. No.	On completing B.Sc. Microbiology, the student will be able to:
PSO 1	Demonstrate thorough knowledge of the principles and concepts of basic and applied microbiology.
PSO 2	Demonstrate how the study of microorganisms can provide insights into the working of higher organisms.
PSO 3	Demonstrate the presence of microorganisms using simple microscopy techniques, and cultivate, isolate, identify, enumerate and preserve them.
PSO 4	Employ safe laboratory practices and follow the rules of biosafety.
PSO 5	Appreciate inquiry-based learning, understand elements of research methodology, review published literature, design and execute experiments.
PSO 6	Understand microbial life processes, and devise strategies using microorganisms to obtain industrially valuable products.
PSO 7	Evaluate data, perform relevant qualitative and/or quantitative analyses and draw appropriate inferences.
PSO 8	Communicate experimental/research work orally and in written form.
PSO 9	Apply the knowledge of her/his core competency to develop solutions to social problems.
PSO 10	Practice science in an ethical and responsible manner.

Course Outcomes (COs): B.Sc. Microbiology

Semester I

Course Title: Microbial Cell Structure and Function
Course Code: SMIC0101

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Recognize, name members of the microbial world and state their position on the Universal Phylogenetic tree. Describe milestones in the field of Microbiology.	1	R
CO 2	Identify and illustrate various prokaryotic and eukaryotic cells and their structures. Compare and contrast the three cell types Bacteria, Archaea and Eucarya.	1, 2	R, U
CO 3	Relate structure with function of various cell components and demonstrate their functions using experimentation.	1, 2, 3	U, Ap
CO 4	Define basic terms and understand principles of microscopy, recognize, illustrate and label various structural components of a microscope and relate structure with function.	1	R, U
CO 5	Compare different types of microscopes, draw, label their ray diagrams and choose appropriate microscopy for observing a particular specimen.	1, 3	U, Ap
CO 6	Explain principles that apply to different staining methods and select an appropriate method to demonstrate components of a specimen.	3	U, Ap
CO 7	Solve problems on microscopy.	7	Ap

Course Title: Elements of Microbial Nutrition, Growth and Control
Course Code: SMIC0102

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	State nutritional requirements of microorganisms, give examples of nutritional types of microbes and give examples of microbes that fall in each type.	1, 3, 6	R, An
CO 2	Design and/or choose a suitable culture medium needed for cultivation and study of microorganisms.	1, 3	Ap
CO 3	Define pure culture and select appropriate strategy for obtaining the same.	1, 3	R, An
CO 4	Compare various strategies for preservation of microbes.	1, 3	U
CO 5	Describe bacterial growth curve, explain and illustrate different methods of microbial growth measurement.	1, 3, 7	U, Ap
CO 6	Explain and discern physical and chemical methods in microbial control and be able to distinguish between terms such as disinfection, sterilization and sanitation.	1	U, R, An
CO 7	Choose a suitable method for control of microorganisms and justify its use.	1	Ap, E

Course Title: Microbiology Practicals – I
Course Code: SMIC01PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Acquire skills of aseptic transfer, handle microbial cultures while following rules of biosafety, stain bacteria and the cell components and observe them under a light microscope.	3, 4, 10
CO 2	Prepare microbial media, cultivate microbes to obtain pure cultures, and enumerate viable and total number of organisms.	3, 4, 7, 10
CO 3	Use chemical and physical methods to control microbial cells, evaluate their efficiency, interpret the results and employ methods to demonstrate activity of an antimicrobial agent.	3, 4, 7, 10

Semester II

Course Title: Microbial Diversity, Taxonomy and Significance
Course Code: SMIC0201

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Recall and explain different theories that are associated with the origin of prokaryotic and eukaryotic cells.	1	R, U
CO 2	Discuss the basic concepts of microbial taxonomy and classification systems and list techniques used	1	R. U
CO 3	Describe the diversity and unusual characteristics amongst representative groups of bacteria, archaea and viruses	1, 2	U
CO 4	Describe the eukaryotic cell cycle, the different phases of eukaryotic cell division and compare and contrast mitosis and meiosis.	1, 2	U, An
CO 5	Recognize the diversity between eukaryotic cell types, describe, draw and differentiate the morphology, reproduction, classification and state the significance of fungal, algal and protozoal protists.	1, 2	R, U, Ap, An
CO 6	Describe principles of microbial ecology, illustrate, compare and contrast the biogeochemical cycles and state the significance of each cycle and the overall interconnection between them.	1	U, Ap, An
CO 7	Describe, draw and compare the structures of the soil and aquatic habitats and extreme environments, recall the types of microbial populations and their interactions with examples and with an emphasis on the human microbiome.	1, 2	R, U, Ap
CO 8	Explain the basic concepts of applied Microbiology and biotechnology, list microbial products of commercial value in the field of food, industrial, pharmaceutical, agricultural and environmental Microbiology.	1, 6, 7	U, R

Course Title: Basics of Metabolism and Genetics
Course Code: SMIC0202

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Identify and draw the structures of biomolecules, describe the role of biomolecules in the biological system, relate the importance of chemical bonds in formation of stable macromolecular structures and discuss the unique properties of water.	1	U, R
CO 2	Define terms in enzymology, classify enzymes, and discuss the effect of various factors on enzyme activity.	1, 6	U, R
CO 3	Define catabolism and anabolism, state the role of ATP and reducing power in metabolism, describe the processes for ATP generation and differentiate between fermentation and respiration.	1	U, R, An
CO 4	Describe, draw and differentiate between the structures of DNA and RNA, compare different forms of DNA.	1	R, Ap, An
CO 5	Define and describe the basic terminology in genetics and describe, analyze and interpret the results for various experiments in genetics.	1, 7	U, R, An
CO 6	Explain chromatin structure, differentiate between euchromatin and heterochromatin, illustrate and explain organization of DNA in prokaryotic and eukaryotic chromosome, state the significance of histones, nucleosomes, kinetochores, centromere and telomeres.	1	U, R, Ap
CO 7	Illustrate the process of DNA replication and describe the enzymes involved in the process.	1	R, Ap
CO 8	Explain the central dogma of molecular biology, predict the polypeptide sequence of a given DNA fragment. Define bioinformatics, genomics, proteomics and metabolomics.	1, 7	U, R, C

Course Title: Microbiology Practicals – II
Course Code: SMIC02PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Comprehend the significance of and demonstrate microbial diversity by isolating microorganisms from natural environments, use microscopic and culture methods to observe fungi, *Actinobacteria*, *Cyanobacteria* and protozoa, and set up an ecosystem to study the microbes *in-situ*.	1, 3, 4, 10
CO 2	Microscopically demonstrate the microorganisms found in fermented food products such as curd and idli; prepare some of the fermented products (wine, bread) in the laboratory to observe the associated physical and chemical changes.	3, 4, 6, 10
CO 3	Use appropriate methods to detect proteins, microbial enzymes, carbohydrates, lipids and nucleic acids in given samples; isolate genomic DNA and demonstrate its presence on agarose gel electrophoresis.	1, 2, 3, 4, 6, 7, 10

Semester III

Course Title: Cell Biology, Microbial Virulence and Innate Immunity
Course Code: SMIC0301

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	List the main components of a cell and summarize the structure and function of the components.	1	R, U
CO 2	Examine and outline how cell ultrastructure is related to cell function.	1, 2	R, U
CO 3	Comprehend the role of virulence factors of pathogens in establishing disease and thus differentiate between levels of pathogenicity.	1	U
CO 4	Outline mechanisms of infectious disease transmission and then evaluate recommended control measures.	1, 7	Ap, E
CO 5	List and classify the components and characteristics of the two lines of defense that comprise the innate immune system.	1	U
CO 6	Link elements of the innate and adaptive immune systems and explain how innate responses help to generate an effective specific adaptive immune response.	1, 7	U, Ap, E

Course Title: Introduction to Microbial Metabolism and Biostatistics
Course Code: SMIC0302

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Graphically represent a dataset, describe it with respect to its central tendency and dispersion measures and apply appropriate hypothesis testing using Q, t and f test.	7, 8	Ap, E
CO 2	Solve numerical problems in biology based on thermodynamics and Nernst equation and demonstrate the role of ATP, NAD, FAD in metabolism.	1, 6, 7	Ap
CO 3	Comprehend various concepts involved in enzymology.	6	R
CO 4	Identify types and apply enzyme kinetics to examples of enzyme inhibition and multi-substrate reactions.	6, 7	R, Ap
CO 5	Define basic concepts in enzymology and classify enzymes based on the reactions catalyzed, location of action.	1, 6	U, Ap
CO 6	Classify types of metabolism used by microorganisms based on electron, energy and carbon source utilized and evaluate the type of metabolism for the suitability of organism's niche and energy requirement.	1, 6	U, An, E
CO 7	Compare anabolism to catabolism and demonstrate the role of anaplerotic reactions.	1, 6	U, Ap

Course Title: Basics of Genetics and Introduction to Bioinformatics
Course Code: SMIC0303

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Discuss DNA replication in prokaryotes and eukaryotes.	1, 2	U
CO 2	List the differences between prokaryotic and eukaryotic DNA replication.	1, 2	R, An
CO 3	Describe the mechanisms of transcription and translation in prokaryotes.	1, 2	U
CO 4	Compare prokaryotic and eukaryotic transcription and translation.	1, 2	R, An
CO 5	Critically think, apply and analyze problems based on transcription, translation and Mendelian genetics.	1, 7	An, Ap
CO 6	Apply bioinformatics online software for solving problems.	1, 7	An, Ap

Course Title: Microbiology Practicals – III
Course Code: SMIC03PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Prove the significance of biosafety in the microbiology laboratory; study fomites as a source of infection; apply basic and advanced techniques for the preservation of microbial cultures; test potability of water.	1, 3, 4,7, 8, 10
CO 2	Demonstrate basic expertise in molecular biology and solve problems using bioinformatics tools.	1, 4, 7, 8, 10
CO 3	Estimate the concentration of biomolecules; carry out basic biostatistical analysis of experimental results.	1, 6, 7, 10

Semester IV

Course Title: Virology and Immunology
Course Code: SMIC0401

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Recall various terms, basic properties, functions and diagrams associated with antigens and antibodies.	1	U, R
CO 2	Recall techniques of determination of antibody structure and distinguish between different antibodies.	1, 7	U, R, An
CO 3	Understand concepts of virus structure, replication and taxonomy and sketch the ultrastructure and replication cycles of different viruses.	1	U, Ap
CO 4	Compare methods of virus cultivation, visualization, purification and enumeration.	1, 7	U, An
CO 5	Select appropriate methods of cultivation, visualization, purification and enumeration for an unknown virus.	1, 7	Ap, E

Course Title: Environmental Microbiology
Course Code: SMIC0402

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Discuss the conventions used in microbial taxonomy and demonstrate the use of the Bergey's manual.	1, 2	U, An
CO 2	Evaluate various classical and molecular techniques used in microbial taxonomy.	1	E
CO 3	Examine the beneficial and harmful roles of microbes in air, water and soil as well as factors affecting their presence in these environments.	1, 6	U, An
CO 4	Summarize tests used for drinking water and sewage and evaluate their usefulness.	6, 9	U, E
CO 5	Compare different methods used in treatment of drinking water and waste water and classify them as primary, secondary or tertiary methods.	6, 9	U, Ap, An
CO 6	Discuss and compare different methods used in studying microbial ecology.	1, 6	U, An
CO 7	Apply the knowledge of microbial processes to environmental management.	1, 6, 9	U, Ap

Course Title: Food Microbiology and Bioprocess Technology
Course Code: SMIC0403

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe the role of a microbiologist in food industry.	1, 6	U, R
CO 2	Describe food spoilage and explain the factors affecting association of microorganisms with food.	1, 6	U, R
CO 3	List, categorize, describe and explain different methods used for preservation of food and state their advantages and disadvantages.	1, 6	U, R, An
CO 4	Discuss food fermentation processes, list the microbes involved and state their role in the fermentation process.	1, 6	U, R
CO 5	List causative agents of food and milk borne diseases, categorize them and explain different methods used for detection, quantification or study of food borne pathogens.	1, 6	R, An, E
CO 6	Describe, explain and apply the concepts involved in ensuring food safety.	1, 9	U, R, Ap
CO 7	Discuss the basic concepts in microbial biotechnology and explain the components of upstream bioprocess technology, scale-up of inoculum, and preservation of industrially important cultures.	1, 6	U, R
CO 8	Choose a suitable bioreactor design for a production process, suggest components of fermentation medium and design an experiment to isolate production strain.	1, 6	U, Ap, E, C

Course Title: Microbiology Practicals – IV
Course Code: SMIC04PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Perform plaque assay to enumerate bacteriophages; apply microbiological methods for food analysis; screen antibiotic producers.	1, 3, 4, 6, 7, 8, 10
CO 2	Isolate and identify bacteria from environmental samples as part of a basic research project.	1, 3, 4, 5, 6, 7, 8, 9, 10
CO 3	Carry out basic proteomic techniques.	1, 4, 6, 7, 10

Semester V

Course Title: Industrial Biotechnology and Genetics
Course Code: SMIC0501

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Identify and explain the basic concepts and principles involved in downstream processing in fermentation technology.	1, 6	R, U
CO 2	Recall and illustrate the steps involved in fermentation product recovery and create additional or alternative steps if required.	1,6	R, Ap, C
CO 3	Describe the principles and methods underlying detection of the recovered products and apply these principles to the detection of unknown products.	1, 6, 7	R, U, Ap
CO 4	Apply learnt concepts to understand the design of different categories of fermentation processes, illustrate and compare various microbial biotechnological processes.	1, 6	U, Ap, An
CO 5	Comprehend significance and applications of biosensor technology and nanotechnology.	1	U
CO 6	Explain concepts of Intellectual property rights and Good manufacturing practices	1	U, R
CO 7	Comprehend the concepts of forward mutations, reverse mutations and the consequences of these mutations.	1, 7	U, An, Ap
CO 8	Link various DNA repair mechanisms with mutation frequency.	1, 7	U, E
CO 9	Discuss the concept of gene expression and its regulation in prokaryotes, eukaryotes, and bacteriophages.	1, 7	U, E, Ap
CO 10	Acquire thinking ability, apply and analyze problems based on concepts taught in genetics.	1, 7	An, Ap

Course Title: Medical Microbiology and Immunology – I
Course Code: SMIC0502

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe the process of clinical specimen collection, handling and transport, and demonstrate at least three methods of pathogen identification from clinical specimen.	1, 3	U
CO 2	Describe the anatomy of human respiratory system and explain the modes of transmission, pathogenesis, diagnosis, prophylaxis, and treatment of some significant pathogens that establish infection of upper and lower respiratory tract respectively.	1	U
CO 3	Compare the mode of action of the five principal groups of antibacterial agents, elucidate the mechanisms of microbial drug resistance and describe methods of testing.	1	An
CO 4	Explain the basic process of drug design and the significance of pharmacogenomics in drug discovery.	1, 2	U, Ap
CO 5	Outline the organization of the immune system and demonstrate an understanding of key concepts in immunology.	1	R, U
CO 6	Examine the major events in development of T cells and B cells and understand the significance of generation of T cell and B cell receptor diversity.	1, 7	U, E
CO 7	Schematically represent and categorize the structures of MHC class I and II molecules; categorize molecules and receptors on the T cells that recognize them; understand inheritance of MHC genes.	1	U
CO 8	Compare and contrast the major pathways of complement activation and schematically represent them.	1	U, An
CO 9	Describe the activation of naïve CD4 T cells into different T-cell lineages; understand the difference between costimulatory and inhibitory signals, the role of cytokines and regulators in the activation process, the steps that lead to differentiation of T precursors into CTLs, and compare and contrast the mechanisms by which cytotoxic T cells and natural killer cells recognize and kill target cells.	1, 7	U
CO 10	Describe the activation of naïve B cells; Elucidate the differences between T-independent and T-dependent B-cell responses.	1, 7	U, Ap

Course Title: Microbiology Practicals – V
Course Code: SMIC05PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Isolate mutants using suitable mutagenic agents; perform penicillin and vitamin bioassays; separate biological molecules using chromatographic techniques.	1, 2, 4, 7, 8, 10
CO 2	Isolate and identify bacteria causing respiratory tract infections; determine antibiotic susceptibility; implement principles of quality assurance in clinical microbiology.	1, 2, 3, 4, 7, 8, 10
CO 3	Design and complete a basic research project (group project); evaluate the rationale and methods; perform experiments, analyse results and draw conclusions using scientific principles; write a manuscript based on the project.	1, 4, 5, 6, 7, 8, 9, 10

Semester VI

Course Title: Genetics, Molecular Biology and Bioinformatics
Course Code: SMIC0601

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Explain the basic concept of genetic exchange in bacteria by transformation, transduction and conjugation.	1, 7	U
CO 2	Solve genetic problems (gene order and distance) related to transformation, transduction and conjugation.	7	An, Ap
CO 3	Comprehend the outcomes of recombination and transposition.	1, 7	U, An
CO 4	Compare the types of transposition.	1, 7	U, An
CO 5	Summarize the structure and function of plasmid and explain the copy number maintenance mechanisms.	1, 7	U, An
CO 6	Describe the functioning of restriction enzymes, vectors, basic techniques such as PCR and the types and screening systems used in recombinant DNA technology.	1, 7	U, R
CO 7	Associate and apply the basic steps involved in gene cloning and explore the applications of gene cloning	1, 7, 9	U, E, Ap
CO 8	Develop analytical problem-solving and critical thinking ability to apply bioinformatic tools.	1, 7	An, Ap, C

Course Title: Medical Microbiology and Immunology – II
Course Code: SMIC0602

Sr. No.	On completing the course, the student will be able to:	PSOs addressed	Cognitive levels
CO 1	Describe the anatomy of the human gastrointestinal tract, genitourinary tract, skin and central nervous system; list defense mechanisms associated and significant microbial pathogens causing infection in these systems.	1, 9	U, R
CO 2	Discuss the modes of transmission, pathogenesis, diagnosis, prophylaxis, and treatment of diseases of the gastrointestinal tract, genitourinary tract, skin and central nervous system.	1, 3, 9	U, R, Ap
CO 3	Realize the significance of nosocomial infections, the pathogens involved, transmission and methods of control.	1, 3, 9	U, R, Ap
CO 4	Describe how vaccines work in providing individual and community protection and compare and contrast different types of vaccines.	1, 7, 10	U
CO 5	Design a theoretical vaccine using rational immunological reasoning.	1, 6, 7, 9, 10	Ap, E
CO 6	Summarize the inheritance and expression of human blood groups and apply the principles to evaluate tests performed in a transfusion laboratory.	1, 7, 10	U, Ap, E
CO 7	Comprehend the nature of antigen antibody reactions and apply them in various immunological assays.	1, 7	U, Ap
CO 8	Distinguish between the four different types of hypersensitivities, and understand the underlying immunological mechanisms.	1,7	U, Ap
CO 9	Distinguish between the events and immune players involved in central versus peripheral tolerance pathways and relate it to autoimmune disorders; categorize autoimmune diseases by their effector cell/molecule types as well as their targets.	1,7	U, Ap
CO 10	Apply understanding of primary and secondary immune responses to create a sequence for the immune events that occur during allograft rejection and explain how specific therapeutic interventions can alter steps in this process.	1, 7	U, E

Course Title: Microbiology Practicals – VI
Course Code: SMIC06PR

Sr. No.	On completing the course, the student will be able to:	PSOs addressed
CO 1	Perform basic molecular biology experiments – plasmid isolation, transformation, restriction digestion; use online and offline bioinformatic tools and software.	4, 6, 7, 8, 10
CO 2	Isolate and identify bacteria causing infections of the urinary tract, gastrointestinal tract, central nervous system and skin; determine antibiotic susceptibility.	3, 4, 7, 8, 9, 10
CO 3	Prepare TAB vaccine and evaluate the preparation using sterility checks; select and conduct appropriate immunological tests – agglutination, and precipitation.	4, 6, 7, 8, 10

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, Kw, 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