

**Course Outcomes – Program Outcomes (COPO) Mapping
For BSc Life Science (LOCF)**

Life Science has three components:

- I. BSc LIFE SCIENCE BOTANY COMPONENT**
- II. BSc LIFE SCIENCE ZOOLOGY COMPONENT**
- III. BSc LIFE SCIENCE CHEMISTRY COMPONENT**

Learning Outcome-based Curriculum Framework (LOCF)

The LOCF approach is envisioned to provide a focused, outcome-based syllabus at the undergraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner.

ABBREVIATIONS / NOMENCLATURE

Sno.	Nomenclature	Description	Aggregate Courses
1.	PO	Program Outcome	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8
2.	CO	Course Outcome	CO1, CO2, CO3, CO4, CO5, CO6, CO7, CO8
3.	CC	Core Courses	CC1, CC2, CC3, CC4
4.	DSE	Discipline Specific Electives	DSE1, DSE2

I. BSc LIFE SCIENCE BOTANY COMPONENT

PROGRAM OUTCOMES (PO): BSc LIFE SCIENCE BOTANY COMPONENT

Program Outcomes (PO): B.Sc Life Science (Botany)	Statements
PO1	Students of the B.Sc. Life Sciences programme will learn to use scientific logic as they explore a wide range of contemporary subjects spanning various basic and applied aspects life sciences
PO2	Students will appreciate the biological diversity of plant and animals and compounds in them to be able to describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations. They will become aware of the important role of plant and animals in ecosystem functioning
PO3	Students will gain knowledge of various biotechnological applications of plants and animals and will learn of industrially important natural products produced by them.
PO4	Students will become familiar with scientific methodology, hypothesis generation and testing, design and execution of experiments. Students will develop the ability to think critically and to read and analyze scientific literature.
PO5	Students will acquire and demonstrate proficiency in good laboratory practices in biological sciences and be able to explain the theoretical basis and practical skills of the tools/technologies commonly used to study this field.
PO6	Students will develop proficiency in the quantitative skills necessary to analyze biological problems (e.g., arithmetic, algebra, and statistical methods as applied to biology)
PO7	Students will develop strong oral and written communication skills through the effective Presentation of experimental results as well as through seminars.
PO8	Graduates of the B.Sc. programme in Life Sciences will make the students understand and evaluate the impact of new research discoveries in the life sciences, and will be able to stimulate to think on wide range of careers, including biological and medical research in higher education institutions as well as careers in public and global health, scientific writing, environmental organizations, and food, pharmaceuticals and biotechnology industries.

	CO6		✓						✓
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SEMESTER II:			
CC2: Plant Anatomy and Embryology			
Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
42164301	CC2: Plant and Embryology	CO1	Knowledge regarding anatomy equipped the students to identify different types of tissues and make them able to correlate their physiology in a better away.
		CO2	This will also help them to understand how different plant tissue evolve and modify their structure and functions with respect to their environment.
		CO3	Knowledge regarding embryology make them understand how reproduction play significant role in defining population structure, natural diversity and sustainability of ecosystem in a better way

COPO MAPPING

Papers	SEMESTER II : COPO MAPPING								
	Program Outcome : PO								
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CC2	CO1	✓	✓						
	CO2	✓	✓						✓
	CO3	✓	✓						✓

SEMESTER III:			
CC3: Plant Ecology and Taxonomy			
Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
42161201	CC3: Plant Ecology and Taxonomy	CO1	After successful completion of the course the student shall have adequate knowledge about the introduction to environment and taxonomy.
		CO2	Basic principles of environment and taxonomy

Papers	SEMESTER III: COPO MAPPING								
	Program Outcome : PO								
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CC3	CO1	✓	✓						
	CO2	✓	✓	✓	✓				✓

SEMESTER IV:			
CC4: Plant Physiology and Metabolism			
Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
42164401	CC4: Plant Physiology and Metabolism	CO1	The students are able to correlate morphology, anatomy, cell structure and biochemistry with plant functioning.

		CO2	The link between theory and practical syllabus is established, and the employability of youth would be enhanced. The youth can also begin small-scale enterprises.
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Papers	SEMESTER IV: COPO MAPPING								
	Program Outcome : PO								
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CC4	CO1		✓						✓
	CO2		✓		✓				✓

SEMESTER V:			
DSE1: Cell and Molecular biology			
Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
42167902	DSE1: Cell and Molecular Biology	CO1	This course will be able to demonstrate foundational knowledge in understanding of: The relationship between the properties of macromolecules, their cellular activities and biological responses
		CO2	Understanding of Cell metabolism, chemical composition, physiochemical and functional organization of organelle Contemporary approaches in modern cell and molecular biology.
		CO3	Understanding of nucleic acid, organization of DNA in prokaryotes and Eukaryotes, DNA replication mechanism, genetic code and transcription process.
		CO4	Processing and modification of RNA and translation process, function and regulation of expression and Application in biotechnology

Papers	SEMESTER V: COPO MAPPING								
	Program Outcome : PO								
DSE1	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
	CO1		✓						✓
	CO2		✓			✓			✓
	CO3		✓						✓
	CO4		✓			✓			✓

SEMESTER VI:			
DSE2: Economic Botany and Biotechnology			
Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
42167901	DSE2: Economic Botany and Biotechnology	CO1	Understanding of morphology and processing and economic value of plant sources of cereals, legumes, spices, oil, rubber, timber and medicines
		CO2	Economic value of plant sources of cereals, legumes, spices, oil, rubber, timber and medicines

Papers	SEMESTER VI: COPO MAPPING								
	Program Outcome : PO								
DSE2	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
	CO1					✓			✓
	CO2		✓	✓					✓

II. BSc LIFE SCIENCE ZOOLOGY COMPONENT

PROGRAM OUTCOMES (PO): BSc LIFE SCIENCE ZOOLOGY COMPONENT

Program Outcomes (PO): B.Sc Life Sciences (Zoology)	Statements
PO1	Students enrolled in B.Sc. (Program) Life Sciences will study and acquire complete knowledge of disciplinary and allied biological sciences. At the end of graduation, they would have expertise which will provide them competitive advantage in pursuing higher studies from India and abroad or seek jobs in academia, research or industries.
PO2	Students should be able to identify, classify and differentiate in types of chordates and nonchordates based on their morphological, anatomical and systemic organization. This will create a curiosity and awareness among them to explore the animal diversity and take up wildlife photography or wildlife exploration as a career option. The procedural knowledge about identifying and classifying animals will help students professional advantages in teaching, research and taxonomist jobs in various Government organizations, such as Zoological Survey of India or National Sanctuaries.
PO3	Acquired practical skills in biochemistry and biotechnology can be used in pursuing career as a scientist in pharmaceutical industry in India or abroad.
PO4	Students will be gaining basic experimental skills in genetics, biotechnology, qualitative and quantitative microscopy, and also enzymology that will give them an edge to pursue higher studies.
PO5	The skill enhancement courses will hone skills in rearing fish, bees and silk moth for generating self-employment.
PO6	Students can acquire expertise to join clinical and research laboratories for diagnostic assays, haematology, histopathology, staining procedures etc.
PO7	They will be able to examine and assess some basic physiological functions and interpret physiological charts.

CC1	CO1		✓					
	CO2	✓						
	CO3		✓					
	CO4							
	CO5							
	CO6							

Semester -II			
CC2: Comparative Anatomy and Development Biology of Vertebrates			
Code	Name of the Paper	Course Outcome: CO	Statement
UPC-42231202	CC2: Comparative Anatomy and Development Biology of Vertebrates	CO1	Know about the levels of organization among different groups of vertebrates.
		CO2	Understand that different organs and organ systems integrate with each other to impart proper regulation of a particular function.
		CO3	Understand how the various organs evolved during the course of evolution through succession.
		CO4	Know the evolution of different concepts in developmental biology.
		CO5	Be able to understand the process of gamete formation from stem cell population to mature ova and sperm.
		CO6	Be able to comprehend the sequence of steps leading to the formation of gametes and development of embryo..
		CO7	Learn the mechanisms underpinning cellular diversity and specificity in animals.
		CO8	Study the methods and tools related to developmental biology which help to understand different processes of embryogenesis.

Papers	SEMESTER II: COPO MAPPING							
	Program Outcome: PO							
CC2	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	CO1	✓						
	CO2	✓				✓		
	CO3	✓						
	CO4		✓			✓		
	CO5					✓	✓	
	CO6					✓	✓	
	CO7					✓	✓	✓
	CO8					✓	✓	✓

Semester -III			
CC3: Physiology and Biochemistry			
Code	Name of the Paper	Course Outcome: CO	Statement
UPC: 422343301	CC3: Physiology and Biochemistry	CO1	Have an increased knowledge of human physiology and be able to appreciate its functions.
		CO2	Understand the functions of major physiological systems in body.
		CO3	Recognise and identify principal tissue structures.
		CO4	Have understanding of the metabolic pathways of carbohydrates, proteins and fats; and appreciate how the cells harness energy.
		CO5	Understand the importance of enzymes, mechanism of working and kinetics.
		CO6	Relate how biochemical systems interact to yield integrated physiological responses.
		CO7	Understand the principles and approach to experimental design.
		CO8	Perform, analyse and interpret basic experiments and observations in physiology and biochemistry.

Papers	SEMESTER III: COPO MAPPING								
	Program Outcome: PO								
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	
CC3	CO1			✓					
	CO2			✓					
	CO3				✓			✓	
	CO4						✓		
	CO5			✓		✓		✓	
	CO6					✓		✓	
	CO7					✓		✓	✓
	CO8					✓		✓	

Semester -IV			
CC4: Genetics and Evolutionary Biology			
Code	Name of the Paper	Course Outcome: CO	Statement
UPC:42234406	CC4: Genetics and Evolutionary Biology	CO1	Help students understand the basic principles of pedigree analysis and will be able to construct and analyse pedigree related problems for inherited traits.
		CO2	Students would gain knowledge on chromosomal and genetic mutation.
		CO3	Students would be able to describe the chromosomal sex-determination mechanisms and dosage compensation.
		CO4	Students would be able to understand the major events in history of life and major theories of evolution..
		CO5	Students would be able to appreciate the contribution of fossil studies in evolution and the phylogeny of horse.

		C06	Students would be able to calculate the gene and allele frequency using Hardy-Weinberg law and analyse population genetics problems.
		C07	Students would understand the fundamental concepts of natural selection, speciation, mass extinction and macro-evolution.

Papers	SEMESTER IV: COPO MAPPING							
	Program Outcome: PO							
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CC4	CO1				✓			
	CO2	✓						
	CO3				✓			
	CO4				✓			
	CO5				✓			
	CO6				✓			
	CO7				✓			

Semester V			
DSE-1: Animal Biotechnology			
UPC:42237903	DSE-1 Animal Biotechnology	CO1	Use or demonstrate the basic techniques of biotechnology; like DNA isolation, PCR, transformation, restriction, digestion etc.
		CO2	Devise a strategy to manipulate genetic structure of an organism for the improvement in any trait or its well-being based on the techniques.
		CO3	Understand the ethical and social issues raised regarding GMOs..

		CO4	Apply the knowledge for designing a proposal for research project.
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Papers	SEMESTER V: COPO MAPPING for DSE 1							
	Program Outcome: PO							
DSE 1	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
	CO1				✓			
	CO2	✓			✓			
	CO3				✓			
	CO4	✓			✓			

Semester VI DSE-2: Immunology			
Code	Name of the Paper	Course Outcome: CO	Statement
UPC:42237904	DSE 2: Immunology	CO1	Study hematopoiesis to know the concepts of stem cells and their differentiation into progenitor stem cells and adult lineages.
		CO2	Learn the concepts of innate and acquired immunity.
		CO3	Understand adaptive immune responses and sequential phases-antigen recognition by lymphocytes, their proliferation, differentiation into effector and memory cells and elimination of pathogens.
		CO4	Learn about major histocompatibility complex and their role in transplantation immunity and Autoimmunity combat with the host immune system.
		CO5	Gain knowledge about the Complement system and how they interact and activate a catalytic cascade to remove immunogens.

		C06	Study the role of various cytokines involved in cell to cell communication in the removal of pathogens.
		C07	Understand the advent of hypersensitivities due to inappropriate innate and adaptive immune responses.
		C08	Know the basic immunological aspects to comprehend the newer strategies in vaccine design, and efforts to treat autoimmunity, hypersensitivity and immunodeficiency.

Papers	SEMESTER VI : COPO MAPPING for DSE 2							
	Program Outcome: PO							
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
DSE 2	CO1						✓	
	CO2	✓					✓	
	CO3	✓						
	CO4	✓						
	CO5							
	CO6		✓					
	CO7		✓					
	CO8		✓					

III. B. Sc. LIFE SCIENCE CHEMISTRY COMPONENT

Program Outcomes (PO): B.Sc (Prog) Life Science

LOCF

S.No.	Program Outcomes (PO): B.Sc Life Sciences (Chemistry)	Statements
1.	PO1	Knowledge: Students acquire theoretical knowledge and understanding of the fundamental concepts, principles and processes in main branches of chemistry, namely, organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry and biochemistry. In depth understanding is the outcome of transactional effectiveness and treatment of specialized course contents. Width results from the choice of electives that students are offered.
2.	PO2	Laboratory Skills: A much valued learning outcome of this programme is the laboratory skills that students develop during the course. Quantitative techniques gained through hands on methods opens choice of joining the industrial laboratory work force early on. The programme also provides ample training in handling basic chemical laboratory instruments and their use in analytical and biochemical determinations. Undergraduates on completion of this programme can cross branches to join analytical, pharmaceutical, material testing and biochemical labs besides standard chemical laboratories.
3.	PO3	Communication: Communication is a highly desirable attribute to possess. Opportunities to enhance students' ability to write methodical, logical and precise reports are inherent to the structure of the programme. Techniques that effectively communicate scientific chemical content to large audiences are acquired through oral and poster presentations and regular laboratory report writing.
4	PO4	Capacity Enhancement: Modern day scientific environment requires students to possess ability to think independently as well as be able to work productively in groups. This requires some degree of balancing. This life science programme course is designed to take care of this important aspect of student development through effective teaching learning process.
5	PO5	Portable Skills: Besides communication skills, the programme develops a range of portable or transferable skills in students that they can carry with them to their

		new work environment after completion of this life science programme course. These are problem solving, numeracy and mathematical skills- error analysis, units and conversions, information retrieval skills, IT skills and organizational skills. These are valued across work environments
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COURSE OUTCOMES (CO): B. Sc. LIFE SCIENCE CHEMISTRY COMPONENT

SEMESTER 1:			
CC1: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons			
Code	Name of the Paper	Course Outcome : CO	Statement
42171103	CC1: Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons	CO1	The course enables the students to solve the conceptual questions using the knowledge gained by studying the quantum mechanical model of the atom, quantum numbers, electronic configuration, radial and angular distribution curves, shapes of s, p and d orbitals, and periodicity in atomic radii, ionic radii, ionization enthalpy and electron affinity of elements.
		CO2	The students can draw the plausible structures and geometries of molecules using radius ratio rules, VSEPR theory and MO diagrams (homo- & hetero-nuclear diatomic molecules).
		CO3	The students can understand the concept of lattice energy using Born-Landé and Kapustinskii equation.
		CO4	Students can rationalize the conductivity of metals, semiconductors and insulators based on the Band theory.
		CO5	Students can understand the importance and application of chemical bonds, inter-molecular and intramolecular weak chemical forces

			and their effect on melting points, boiling points, solubility and energetics of dissolution.
		CO6	Students can understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.
		CO7	Students can be able to formulate the mechanism of organic reactions by recalling and correlating the fundamental properties of the reactants involved.
		CO8	Students can learn and identify many organic reaction mechanisms including free radical substitution, electrophilic addition and electrophilic aromatic substitution.

COPO MAPPING

Papers	SEMESTER I: COPO MAPPING					
	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
CC1	CO1	✓			✓	
	CO2	✓		✓		
	CO3	✓	✓		✓	
	CO4	✓	✓		✓	
	CO5	✓		✓	✓	
	CO6	✓			✓	✓
	CO7			✓	✓	✓
	CO8			✓		✓

SEMESTER II:

CC2: Chemical Energetics, Equilibria and Functional Group Organic Chemistry-I

Code	Name of the Paper	Course Outcome: CO	Statement
		CO1	Students can understand the laws of thermodynamics, thermochemistry and equilibrium.

42171205	CC2:Chemical Energetics, Equilibria and Functional Group Organic Chemistry-I	CO2	Students can understand concept of pH and its effect on the various physical and chemical properties of the compounds.
		CO3	Students can use the concepts learnt to predict feasibility of chemical reactions and to study the behaviour of reactions in equilibrium.
		CO4	Students can understand the fundamentals of functional group chemistry through the study of methods of preparation, properties and chemical reactions with underlying mechanism.
		CO5	Students can use concepts learnt to understand stereochemistry of a reaction and predict the reaction outcome
		CO6	Students can design newer synthetic routes for various organic compounds.

COPO MAPPING

SEMESTER II : COPO MAPPING						
Papers	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
CC2	CO1	✓			✓	
	CO2	✓	✓		✓	
	CO3	✓	✓		✓	
	CO4	✓	✓		✓	
	CO5	✓	✓			
	CO6		✓	✓	✓	

SEMESTER III:			
CC3: Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry-II			
Code	Name of the Paper	Course Outcome: CO	Statement
42174304	CC3: Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional	CO1	Students will be able to explain the concepts of different types of binary solutions- miscible, partially miscible and immiscible along with their applications.
		CO2	Students will be able to explain the thermodynamic aspects of equilibrium

	Group Organic Chemistry-II		between phases and draw phase diagrams of simple one component and two component systems.
		CO3	Students will be able to explain the factors that affect conductance, migration of ions and application of conductance measurement.
		CO4	Students will be able to understand different types of galvanic cells, their Nernst equations, measurement of emf, calculations of thermodynamic properties and other parameters from the emf measurements.
		CO5	Students will be able to understand and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses.
		CO6	Students will be able to design newer synthetic routes for various organic compounds

COPO MAPPING

SEMESTER III : COPO MAPPING						
Papers	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
CC3	CO1	✓	✓		✓	
	CO2	✓	✓	✓	✓	
	CO3	✓	✓		✓	
	CO4	✓	✓		✓	
	CO5		✓	✓		
	CO6		✓	✓	✓	✓

SEMESTER IV:

CC4: Chemistry of s- and p-Block Elements, States of Matter and Chemical Kinetics
Chemistry of s- and p-Block Elements, States of Matter and Chemical Kinetics

Code	Name of the Paper	Course Outcome: CO	Statement
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42174404	CC4: Chemistry of s- and p-Block Elements, States of Matter and Chemical Kinetics	CO1	Students can understand the chemistry and applications of s- and p-block elements.
		CO2	Students can derive ideal gas law from kinetic theory of gases and explain why the real gases deviate from ideal behaviour.
		CO3	Students can explain Maxwell-Boltzmann distribution, critical constants and viscosity of gases
		CO4	Students can explain the properties of liquids especially surface tension and viscosity.
		CO5	Students can explain symmetry elements, crystal structure specially NaCl, KCl and CsCl
		CO6	Students can define rate of reactions and the factors that affect the rates of reaction.
		CO7	Students can understand the concept of rate laws e.g., order, molecularity, half-life and their determination
		CO8	Students can learn about various theories of reaction rates and how these account for experimental observations

COPO MAPPING

Papers	SEMESTER IV : COPO MAPPING					
	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
CC4	CO1	✓		✓		
	CO2	✓		✓		
	CO3	✓	✓			
	CO4	✓	✓		✓	
	CO5	✓		✓		
	CO6	✓	✓	✓		
	CO7	✓	✓	✓		
	CO8	✓	✓	✓	✓	

**SEMESTER V:
DSE 1: Chemistry of d-Block Elements, Quantum Chemistry and Spectroscopy**

Code	Name of the Paper	Course Outcome: CO	Statement
42177925	DSE 1: Chemistry of d-Block Elements, Quantum Chemistry and Spectroscopy	CO1	Students will be able to understand chemistry of d and f block elements, Latimer diagrams, properties of coordination compounds and VBT and CFT for bonding in coordination compounds
		CO2	Students will be able to understand basic principles of quantum mechanics: operators, eigen values, averages, probability distributions.
		CO3	Students will be able to understand and use basic concepts of microwave, IR and UV-VIS spectroscopy for interpretation of spectra.
		CO4	Students will be able to explain Lambert-Beer's law, quantum efficiency and photochemical processes.

COPO MAPPING

Papers	SEMESTER V : COPO MAPPING					
	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
DSE 1	CO1	✓		✓		
	CO2	✓			✓	
	CO3	✓	✓	✓	✓	
	CO4	✓	✓		✓	

SEMESTER VI:			
DSE 2: Molecules of life			
Unique Paper Code	Name of the Paper	Course Outcome: CO	Statement
42177913	DSE 2: Molecules of life	CO1	Students can learn and demonstrate how the structure of biomolecules determines their chemical properties, reactivity and biological uses.
		CO2	Students can gain an insight into mechanism of enzyme action and inhibition.
		CO3	Students can understand the basic principles of drug-receptor interaction and SAR.
		CO4	Students can understand biological processes like replication, transcription and translation.
		CO5	Students can demonstrate an understanding of metabolic pathways, their inter-relationship, regulation and energy production from biochemical processes.

Papers	SEMESTER VI: COPO MAPPING					
	Program Outcome : PO					
	Course Outcome: CO	PO1	PO2	PO3	PO4	PO5
DSE 2	CO1	✓		✓		
	CO2	✓	✓		✓	
	CO3	✓	✓		✓	
	CO4	✓	✓		✓	
	CO5	✓		✓	✓	