Program Structure

Program: B.Sc. Life Science

Program Code: SBR0415

Batch: 2020-2023

Department of Life Sciences

School of Basic Science & Research

Vision, Mission and Core Values of the University

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation and nurturing entrepreneurship.

Mission of the University

1. **Transformative educational experience**
2. **Enrichment by educational initiatives that encourage global outlook**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship**
4. **Seeking beyond boundaries**

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

Vision and Mission of the School

Vision of the School

Achieving excellence in the realm of basic and applied sciences to address the global challenges of evolving society

Mission of the School

1. **To equip the students with knowledge and skills in basic and applied sciences**
2. **Capacity building through advanced training and academic flexibility.**
3. **To establish centre of excellence for ecologically and socially innovative research.**
4. **To strengthen interinstitutional and industrial collaboration for skill development and global employability.**

Core Values

1. **Passion**
2. **Perseverance**
3. **Scientific nature**
4. **Yearning for truth**

Vision and Mission of Department of Life Sciences

Vision of Life Sciences Department

To acquire and impart knowledge of biology and bio-techniques so as to build capacity for addressing current global challenges

Mission of Life Sciences Department

1. **To train and transform students into thinking researchers/ professionals who are able to integrate theoretical knowledge and analytical skills in diverse areas of Biotechnology.**
2. **To make students and faculties updated with advance techniques and to introduce the students to dynamic environment of bioscience**
3. **To conduct cutting-edge interdisciplinary research.**
4. **To introduce various skill development courses thereby enhancing the**

Program Educational Objectives (PEO)

PEO1: To create a foundation of various zoology concepts and phenomena in the minds of students through theoretical and practical knowledge.
PEO2: To keep students upgraded with new discoveries in biological world and inculcate continuous learning and self-improvement so that students are motivated for higher studies and research.
PEO3: To make the students to tackle detailed problem-solving and analytical tasks associated with pure and applied zoological questions, in areas that include evolution, ecology and conservation.
PEO4: To make students industry- or academia-ready by developing independent thinking, good communication and scientific skills and to acquaint them with professional ethics so that they can work well in an industrial or academic environment.
PEO5: To make students understand interdisciplinary nature of research in zoology by assigning them different research projects/ case studies/ presentations.

Map PEOs with Mission Statements:

PEO Statements	School Mission 1	School Mission 2	School Mission 3	School Mission 4
PEO1	3	2	-	-
PEO2	3	2	2	-
PEO3	3	3	2	1
PEO4	2	3	2	2
PEO5	3	2	2	2

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

Map PEOs with Department Mission Statements:

PEO Statements	Departmental Mission 1	Departmental Mission 2	Departmental Mission 3	Departmental Mission 4
PEO1	3	1	1	1
PEO2	3	3	2	2
PEO3	2	2	2	2
PEO4	3	-	2	3
PEO5	3	2	3	2

Program Outcomes (PO's)

PO1: Knowledge: Students will develop a sound understanding the biological systems and processes.

PO2: Skill Set Development: The student will be skilled in various biological techniques that will enhance the employability of the students.

PO3: Oral Communication and Scientific Writing: The students will be able to demonstrate good oral communication. Students will also be knowledgeable about writing technical (project report and reviews) content.

PO4: Environment and Sustainable Development: Student will be able to realize the effect of human malpractices on environment and the need and importance of sustainable development.

PO5: Ethics, Independent Thinking and Team Work: The students will develop professional ethics and also gain knowledge about various ethical issues associated with biotechnology.

Students will learn to think and analyze a problem independently while at the same time realizing the importance of team work in carrying out successful research/ projects/ presentations.

Mapping of Program Outcome Vs Program Educational Objectives

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	2	2	2	2
PO2	3	2	2	3	2
PO3	1	1	-	3	2
PO4	1	2	3	-	2
PO5	1	2	-	3	2

1. Slight (Low) 2. Moderate (Medium) 3. Substantial (High)

1. TITLE: Bachelor of Science in Life Sciences

2. DURATION OF THECOURSE: 3 YEARS

3. YEAR OF IMPLIMENTATION

This syllabus will be implemented from July 2020 onwards.

4. PREAMBLE

Total Credits- 147 (19+20+24+26+28+30)

Total Number of Semesters – 6 (Two semesters per year)

Total Number of Papers (including practical) – 31

Total Number of Practical courses – 13

Community connect

Dissertation

Department of Life Science, S.B.S.R., Sharda University

Scheme for CBCS in B.Sc. Life Sciences, effective from 2020-21

Semester	CORE COURSE (17)	Ability Enhancement Compulsory Course (AECC) (2)	Ability Enhancement Elective Course (AEEC) (Skill Based) (2)	Elective: Discipline Specific DSE (5)	Elective: Generic (GE) (6)
I	Cell Biology	AECC-1	AEEC-1		GE-1
					GE-2
II	Microbiology	AECC-2			GE-3
	Genetics				GE-4
III	Non Chordates			DSE-1	GE-5
	Animal Physiology and Histology-I				GE-6
IV	Genetic Engineering		AEEC-2	DSE-2	
	Diversity of Chordates				
	Developmental Biology of Animals				
	Metabolic Pathways				
V	Animal Physiology & Histology II			DSE-3	
	Ecology				
	Comparative Anatomy of Vertebrates				
	Bioinformatics				
VI	Animal Biotechnology			DSE-4	
	Genomics				
	Parasitology			DSE-5	
	Evolutionary Biology				

Core Papers (C):

1. Cell Biology
2. Microbiology
3. Genetics
4. Non Chordates
5. Animal Physiology and Histology I
6. Genetic Engineering
7. Diversity of Chordates
8. Developmental Biology of Animals
9. Metabolic Pathways
10. Animal Physiology and Histology-II
11. Ecology
12. Comparative Anatomy of Vertebrates
13. Bioinformatics
14. Animal Biotechnology
15. Genomics

16. Parasitology
17. Evolutionary Biology

Discipline Specific Elective Papers (DSE):

TERM-III

1. Animal Behaviour and Chronobiology/ Insect Vector and Diseases

TERM-IV

1. Immunology/ Applied microbiology

TERM-V

1. Fish and fisheries/ Applied Zoology

TERM-VI

1. Endocrinology/ Biology of Insecta
2. Project / Dissertation

Other Discipline – GE-I to GE-VI

1. Essentials of Chemistry for Biosciences
2. Biomolecules / Diversity of Animals
3. Physics V
4. Bioanalytical techniques/ Environmental Biotechnology
5. Molecular biology/ Advanced Biochemistry
6. Food Biotechnology / Food Microbiology

SEMESTER	COURSE OPTED	COURSE NAME	Credits
I	Ability Enhancement Compulsory Course-I	Environmental Science	3
	Core course-I	Cell Biology	4
	Core course-I Practical	Cell Biology Lab	1
	Generic Elective-I	Essentials of Chemistry for Biosciences	4
	Generic Elective-I Practical	Chemistry Lab for Biosciences	1
	Generic Elective-II	Biomolecules/ Diversity of Animals	4
	Ability Enhancement Elective Course-I	University elective	2
II	Core course-II	Microbiology	4
	Core course-II Practical	Microbiology Lab	1
	Core course-III	Genetics	4
	Generic Elective-III	Physics V	4
	Generic Elective-I Practical	Physics Lab	1
	Generic Elective-IV	Bioanalytical Techniques / Environmental Biotechnology	4
	Ability Enhancement Compulsory Course-II	Communicative English	2
III	Core course-IV	Non chordates	4
	Core course-IV Practical	Non Chordates Lab	2
	Core course-V	Animal Physiology and Histology-I	4
	Core course-V Practical	Histology of Animals	2
	Generic Elective-V	Molecular Biology/ Advanced Biochemistry	4
	Generic Elective-VI	Food Biotechnology / Food Microbiology	4
	Discipline Specific Elective-I	Animal Behavior and Chronobiology/ Insect Vector and Disease	4
IV	Core course-VI	Genetic Engineering	4
	Core course-VI Practical	Genetic Engineering Lab	2
	Core course-VII	Diversity of Chordates	4
	Core course-VII Practical	Biology of Chordates Lab	2
	Core course-VIII	Developmental Biology of Animals	4
	Core course-IX	Metabolic Pathways	4
	Discipline Specific Elective-II	Immunology/ Applied microbiology	4
	Ability Enhancement Elective Course-II	University Elective	2
V	Core course-X	Animal Physiology & Histology-II	4
	Core course-X Practical	Animal Physiology Lab	2
	Core course-XI	Ecology	4
	Core course-XII	Comparative Anatomy of Vertebrates	4
	Core course-XII Practical	Comparative Anatomy of Vertebrates Lab	2
	Core course-XIII	Bioinformatics	4
	Core course-XIII-Practical	Bioinformatics Lab	2
	Discipline Specific Elective-III	Fish and Fisheries/ Applied Life Sciences	4
	Community Connect		2
VI	Core course-XIV	Animal Biotechnology	4
	Core course-XIV- Practical	Animal Biotechnology Lab	2
	Core course-XV	Genomics	4
	Core course XVI	Parasitology	4
	Core course-XVI- Practical	Parasitology Lab	2
	Core Course- XVII	Evolutionary Biology	4
	Discipline Specific Elective-IV	Endocrinology/Biology of Insecta	4
	Discipline Specific Elective-V	Project / Dissertation	6

LEVEL I
Term I

S. No.	SUBJECT CODE	TITLE OF COURSE	HOURS				CREDITS
THEORY							
			L	**T**	**P**	**TOTAL**	
1.	BSL101	Essentials of Chemistry for Biosciences (GE)	4	0	0	4	4
2.	BSB102	Cell Biology (C)	4	0	0	4	4
3.	EVS106	Environmental Studies (AECC)	3	0	0	3	3
4.		University elective (AEEC)	2	0	0	2	2
5.	BSB103/ BSZ120	Biomolecules/ Diversity of Animals (GE)	4	0	0	4	4
PRACTICALS							
6.	BSL151	Chemistry Lab for Biosciences (GE)	0	0	2	2	1
7.	BSP102	Cell Biology Lab (C)	0	0	2	2	1
TOTAL			**17**	**0**	**4**	**21**	**19**

Term II

S. No.	SUBJECT CODE	TITLE OF COURSE	HOURS				CREDITS
THEORY							
			L	**T**	**P**	**TOTAL**	
1.	PHY115	Physics-V (GE)	4	0	0	4	4
2.	ARP101	Communicative English (AECC)	2	0	0	2	2
3.	BSB105	Microbiology (C)	4	0	0	4	4
4.	BSB108	Genetics (C)	4	0	0	4	4
5.	BBT112/ BSB107	Bioanalytical techniques / Environmental Biotechnology(GE)	4	0	0	4	4
PRACTICALS							
6.	BSP105	Microbiology Lab	0	0	2	2	1
7.	PHY151	Physics Lab (GE)	0	0	2	2	1
TOTAL			**18**	**0**	**4**	**22**	**20**

L – Lecture; T – Tutorial; P – Practical

LEVEL II
Term III

S. No.	SUBJECT CODE	TITLE OF COURSE	HOURS				CREDITS
THEORY							
			L	**T**	**P**	**TOTAL**	
1.	BSZ201	Non Chordates (C)	4	0	0	4	4
2.	BSZ202	Animal Physiology and Histology-I (C)	4	0	0	4	4
3.	BSB201/ BBT208	Molecular Biology/ Advanced biochemistry (GE)	4	0	0	4	4
4.	BFS204/ BFS202	Food Microbiology/ Food Biotechnology (GE)	4	0	0	4	4
5.	BSZ203/ BSZ205	Insect Vector & Diseases /Animal Behaviour and Chronobiology (DSE)	4	0	0	4	4
PRACTICALS							
6.	BSZ251	Non Chordates Lab (CP)	0	0	3	3	2
7.	BSZ253	Histology of animals (CP)	0	0	3	3	2
TOTAL			**20**	**0**	**6**	**26**	**24**

Term IV

S. No.	SUBJECT CODE	TITLE OF COURSE	HOURS				CREDITS
THEORY							
			L	**T**	**P**	**TOTAL**	
1.	BSB205	Genetic Engineering (C)	4	0	0	4	4
2.	BSZ204	Diversity of Chordates (C)	4	0	0	4	4
3.	BSB211	Developmental Biology of Animals (C)	4	0	0	4	4
4.	BSB202	Metabolic Pathways (C)	4	0	0	4	4
5.	BSB207/	Immunology/ Applied Microbiology (DSE)	4	0	0	4	4
6.	OPE	University Elective	2	0	0	2	2
PRACTICALS							
7.	BSP205	Genetic engineering Lab (CP)	0	0	3	3	2
8.	BSZ254	Biology of Chordates Lab (CP)	0	0	3	3	2
TOTAL							**26**

L – Lecture; T – Tutorial; P – Practical

LEVEL III
Term V

S. No.	SUBJECT CODE	TITLE OF COURSE	HOURS				CREDITS
THEORY							
			L	**T**	**P**	**TOTAL**	
1.	BSZ301	Animal Physiology & Histology II (C)	4	0	0	4	4
2.	BSZ302	Ecology (C)	4	0	0	4	4
3.	BSZ303	Comparative Anatomy of Vertebrates (C)	4	0	0	4	4
4.	BSB303	Bioinformatics (C)	4	0	0	4	4
5.	BSZ304/ BSZ309	Fish and Fisheries/ Applied Zoology (DSE)	4	0	0	4	4
PRACTICALS							
6.	BSZ358	Comparative Anatomy of Vertebrates Lab	0	0	3	3	2
7.	BSZ352	Animal Physiology Lab (C)	0	0	3	3	2
8	BSP302	Bioinformatics Lab(C)	0	0	3	3	2
9	CCU401	Community Connect	0	0	2	2	2
TOTAL							**28**

Term VI

S. No.	SUBJECT CODE	TITLE OF COURSE	HOURS				CREDITS
THEORY							
			L	**T**	**P**	**TOTAL**	
1.	BSB301	Animal Biotechnology (C)	4	0	0	4	4
2.	BSB306	Genomics(C)	4	0	0	4	4
3.	BSZ305	Parasitology (C)	4	0	0	4	4
4.	BSZ306	Evolutionary Biology (C)	4	0	0	4	4
5.	BSZ307/ BSZ308	Endocrinology/ Biology of Insecta (DSE)	4	0	0	4	4
PRACTICALS							
6.	BSZ 354	Parasitology Lab(C)	0	0	3	3	2
7.	BSZ 355	Animal Biotechnology Lab(C)	0	0	3	3	2
8.	BBT351	Project / Dissertation (DSE)	0	0	6	6	6
TOTAL							**30**

L – Lecture; T – Tutorial; P – Practical

BSL101: Essentials of Chemistry for Biosciences

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch: 2020-2023**	
Program: BSc		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester:1**	
1	Course Code	**BSL101**	
2	Course Title	**Essentials of Chemistry for Biosciences**	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-1	
	Course Status	Compulsory	
5	Course Objective	• To provide the basics of ionic equilibrium, thermochemistry and chemical kinetics so as to apply on various biological systems. • To provide thorough knowledge in organic basics and stereochemistry of the organic molecules and to make its use in biomolecules	
6	Course Outcomes	CO1: Use the ion product of water to calculate hydrogen ion and hydroxide ion concentrations in aqueous solution. Identify the components of a buffer and their function; Realize the different types of salts solution and their pH CO2: To recognize the order of reactions, How catalysis increase the rate of reaction and its types. CO3: Important effects, electrophiles and nucleophiles as applied to organic chemistry and reaction intermediates, Different types of organic reactions Important effects, electrophiles and nucleophiles as applied to organic chemistry and reaction intermediates and different types of organic reactions Knowledge of the basic mechanisms of substitution and elimination (Sn^1, Sn^2, E^1, E^2) CO4: To draw the three dimensional structures of typical organic molecules, differentiating between isomers and identical molecules, Naming Structures including stereoisomers and geometric isomers CO5: To understand the synthesis and reactions of carbohydrate molecules CO6: To ensure the basic knowledge of physical and organic chemistry related to life science.	
7	Course Description	This course enrich the students with concepts of physical chemistry and organic chemistry. Acid-base, buffers, salt hydrolysis, solubility product, reactive intermediates in organic chemistry, stereochemistry and simple carbohydrates are the topics covered in this paper.	
8	Outline syllabus		CO Mapping
	Unit 1	Ionic Equillibrium	

	A	Strong and weak acids and bases, Ionization constants of weak acids and base, pH and pOH, Ionic product of water, Factors affecting degree of ionization: Common ion effect	CO1, CO6
	B	Buffers and their types, applications of buffers in analytical chemistry and biochemical processes in the human body, pH of buffers – Henderson equation for acidic and basic buffers	CO1, CO6
	C	Solubility products, applications of solubility product principle, Salt hydrolysis and pH of salt solutions, Related numerical problems	CO1, CO6
	Unit 2	Chemical Kinetics and Catalysis	
		Order and molecularity of a reaction, Rates of reactions and its expressions, Reactions of zero, first and second order, pseudo first order, Half-lives, Determination of order of reactions by half-life method, Experimental methods of the determination of rate laws, kinetics of complex reactions (integrated rate expressions up to first order only)	**CO2, CO6**
		Activation energy, Reaction rate and temperature (Arrhenius equation), Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates	**CO2, CO6**
		Catalysis: Definition, Types of catalysis with example, Characteristics of catalysis, Elementary enzyme catalyzed reactions – Meaning and examples	**CO2, CO6**
	Unit 3	**Principle of Organic Chemistry**	
		Electronic displacements: inductive effect, mesomeric effect, resonance effect (resonance energy and its significance), Hyperconjugation (concepts and consequences), resonance effect (resonance energy and its significance)	**CO3, CO6**
		Reactive intermediates: Generation, Structure, General reactions of carbocations, Reactive intermediates: Generation, Structure, General reactions of free radicals	**CO3, CO6**
		Reactive intermediates: Generation, Structure, General reactions of carbenes (singlet and triplet), Electrophiles and nucleophiles, organic reactions - E_1 and E_2, mechanism of electrophilic reactions	**CO3, CO6**
	Unit 4	Stereochemistry	
		Classification of stereoisomers, Optical isomers: enantiomers and distereomers, D and L configuration	CO4, CO6
		Absolute configuration (R and S), Projection formulae, Stereochemistry of compounds containing one and two asymmetric C-atoms, Stereochemistry of biphenyls and spiro compounds	CO4, CO6
		Conformations: Conformations around a C – C bond in acyclic compounds, Structures of cyclohexanes, Cyclohexane (non-substituted) and its conformations	CO4, CO6
	Unit 5	**Carbohydrates**	
		Classification, and General Properties**,** General Properties - Glucose (open chain and cyclic structure)**,Fructose,** Determination of configuration of monosaccharides	CO5, CO6
		absolute configuration of Glucose and Fructose**,** Mutarotation, ascending and descending in monosaccharides	CO5, CO6
		Structure of disacharrides (sucrose, cellobiose, maltose, lactose) excluding their structure elucidation, Structure of	CO5, CO6

		polysacharrides (starch and cellulose) excluding their structure elucidation			
	Mode of examination	CA/MTE/ETE			
	Weightage Distribution	20	30	50	
		20%	30%	50%	
	Text book/s*	1. Principles of Physical Chemistry by Puri, Sharma and Pathania,42nd Edition. 2. Essentials of Physical Chemistry by B.S. Bahl and G. D. Tuli. 3. A Textbook of Organic Chemistry, Arun Bahl B. S. Bah S.Chand & Co. 4. Concise inorganic chemistry by J. D. Lee. 5. Stereochemistry Conformation and Mechanism by P S Kalsi, 8th Edition. 6. Organic Chemistry by Morrison & Boyd.			
	Other References	1. College chemistry by Linus Pauling. 2. Organic Chemistry by I.L. Finar Volume II.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSB102: Cell Biology

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 01**	
1	Course Code	**BSB102**	
2	Course Title	**Cell Biology**	
3	Credits	4	
4	Contact Hrs. (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. Understanding the concept of structure and function of biological cells and its living and non-living components 2. Learn and discuss the techniques of protein synthesis, protein sorting and transportation from organ to organ 3. Discuss the metabolic activities of a cell and the production of metabolic energies in form of ATP 4. Recognize the cell nucleus and its function 5. Analyze and discuss the cell movement and structural framework of the cell	
6	Course Outcomes	CO1: Identify different types of cell organs and review the complexity of cell organelles CO2: Analyze the importance of protein synthesis in biological cell and its transportation from cell to cell CO3: Demonstrate the metabolic activities of a cell and the production of metabolic energies in form of ATP CO4: Identify and analyze the cell nucleus, cell ribosome and cell movement and its function CO5: Analyze and discuss the cell movement and structural framework of the cell CO6: Complete understanding to function of cell.	
7	Course Description	This course will to help us to understand how biological cells do have different minute organelles which coordinate with each other and perform all the functions and metabolic activities of the cell. Study this course will help them to explore the structure and function of cells. Student will learn about cell diversity that arises during its growth and how cells co-operate and communicate with each other in normal tissues. This course will help them to prepare for a wide range of careers both inside and outside the lab	
8	Outline syllabus		CO Mapping
	Unit 1	**Cell and Cell Theory**	
	A	Cell as a basic unit of life, Cell theory, Cell size and shape	CO1
	B	Prokaryotic and Eukaryotic cells	CO1

	C	Different types of cells			CO1
	Unit 2	**Ultra-structure of Cell**			
	A	Plasma membrane, Ribosomes			CO1
	B	Protein sorting and transportation; Endoplasmic Reticulum, Golgi Apparatus, Lysosomes;			CO2
	C	Bioenergetics and metabolism, Mitochondria, Chloroplast, peroxisomes			CO3
	Unit 3	**Nucleus and Chromosomes**			
	A	Ultra-structure of nucleus, nuclear membrane			CO1, CO4
	B	Chromosome structure, Centromeres, Telomeres			CO4
	C	Euchromatin and heterochromatin, Polytene and lampbrush chromosomes			CO4
	Unit 4	**Cell Cycle**			
	A	Growth cycle and cell division			CO1
	B	Mitosis, Meiosis			CO4
	C	Significance of cell division			CO3
	Unit 5	**Cytoskeleton and Cell-to-cell interaction**			
	A	Concept about cytoskeleton, microtubules, microfilaments, intermediary filaments			CO1
	B	Structure of cilia and flagella and their movement;			CO3
	C	Cell to cell interaction			CO4
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Cooper G.M., and Hausman R.E., *The Cell: A Molecular Approach, 5th Edition.* Sinauer Associates (2009)			
	Other References	Karp G., *Cell and Molecular Biology: Concepts and Experiments, 6th Edition*. Wiley (2009).			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

EVS106: Environmental Studies

L T P: 3-0-0 **Credit: 3**

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: I**	
1	Course Code	**EVS106**	
2	Course Title	Environmental Studies	
3	Credits	03	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	1. Enable students to learn the concepts, principles and importance of environmental science 2. Provide students an insight of various causes of natural resource depletion and its conservation 3. Provide detailed knowledge of causes, effects and control of different types of environmental pollution and its effect on climate change, global warming and ozone layer depletion. 4. Provide knowledge of different methods of water conservation 5. Provide and enrich the students about social issues such as R&R, population and sustainability.	
6	Course Outcomes	CO1.Understand the principles and scope of environmental science CO2. Study about various pollution causes, effects and control and solid waste management. CO3. Effect of global warming and ozone layer depletion CO4. Knowledge about various types of natural resources and its conservation CO5. Understand about sustainable development, resettlement and rehabilitation, impact of population explosion on environment the methods of water conservation CO6. Overall understanding of various environmental components, its protection and management.	
7	Course Description	Environmental Science emphasises on various factors as 1. Importance and scope of environmental science 2. Natural resource conservation 3. Pollution causes, effects and control methods 4. Social issues associated with environment	
8	Outline syllabus		CO Mapping
	Unit 1	**General Introduction**	
	A	Definition, principles and scope of environmental science	CO1/CO6
	B	Land resources, Forest Resources	CO1/CO6
	C	Water Resources ,Energy Resources	CO1/CO6
	Unit 2	**Environmental Pollution (Cause, effects and control measures) and solid waste management**	
	A	Air pollution ,Water Pollution	CO2/CO6

	B	Soil and Noise pollution			CO2/CO6
	C	Solid wastes and its management			CO2/CO6
	Unit 3	**Climate Change and its impact**			
	A	Concept of Global Warming and greenhouse effect			CO3/CO6
	B	Ozone layer Depletion and its consequences			CO3/CO6
	C	Climate change and its effect on ecosystem, Kyoto protocol and IPCC concerns on changing climate			CO3/CO6
	Unit 4	**Natural resource conservation**			
	A	Hot spots, threats to biodiversity, endemic species			CO4/CO6
	B	Conservation of biodiversity, ex-situ, in-situ conservation, biodiversity services.			CO4/CO6
	C	Need of Water Conservation, Rain Water Harvesting Watershed management			CO4/CO6
	Unit 5	**Social Issues and the Environment**			
	A	Concept of sustainable development			CO4/CO6
	B	Resettlement and rehabilitation of people; its problems and concerns, Case studies			CO4/CO6
	C	Population explosion and its consequences			CO4/CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**1.** Joseph, Benny, "Environmental Studies", Tata Mcgraw-Hill.			
	Other References				

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	2	2
CO2	2	3	2	2	2
CO3	2	2	3	2	2
CO4	2	2	2	3	2
CO5	2	2	2	2	3
CO6	3	3	3	3	3

BSB103: Biomolecules
L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 01**	
1	Course Code	**BSB103**	
2	Course Title	**Biomolecules**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To study the structure and function of macromolecules present in biological systems 2. Understanding the general properties of lipids, amino acids and carbohydrates 3. To learn the hierarchical level of proteins 4. To study the structure as well as properties of DNA and RNA	
6	Course Outcomes	After studying this course, students will be able to CO1: Summarize structural chemistry and general properties of lipids CO2: Distinguish the structure, classification and significance of carbohydrates CO3: Analyze the structure and properties of amino acids and proteins CO4: Evaluate the structure of nucleosides and nucleotides and stability of DNA backbone CO5: Illustrate the structure as well as properties of DNA and RNA CO6 : Summarize the structure, properties and significance of biological macromolecules	
7	Course Description	This course comprises of the structure, function, properties and significance of various macromolecules found in biological systems. Several different macromolecules viz. lipids, carbohydrates, amino acids, proteins, and nucleic acids will be studied in details.	
8	Outline syllabus		CO Mapping
	Unit 1	**Lipids**	
	A	Structure and chemistry of fatty acids	CO1, CO6
	B	Saturated and unsaturated fatty acids	CO1, CO6
	C	General properties and structures of phospholipids, sphingolipids and cholesterol	CO1, CO6
	Unit 2	**Carbohydrates**	
	A	Carbohydrate classification, Monosaccharides; D- and L-designation, Open chain and cyclic structures	CO2, CO6
	B	Structure and biological importance of disaccharides	CO2, CO6
	C	Structural polysaccharides and storage polysaccharides	CO2, CO6
	Unit 3	**Proteins**	

	A	Amino Acids			CO3, CO6
	B	Classification, Structure and Properties; Proteins: Primary, Secondary,			CO3, CO6
	C	Tertiary and Quaternary Structure; Biological functions of proteins			CO3, CO6
	Unit 4	**Nucleic Acids**			
	A	Nature of nucleic acids, Structure of purines and pyrimidines			CO4, CO6
	B	Nucleosides and Nucleotides			CO4, CO6
	C	Stability and formation of phosphodiester linkages			CO4, CO6
	Unit 5	**Structure of DNA**			
	A	Watson-Crick model, Types of DNA - A, B and Z DNA,			CO5, CO6
	B	Complementary pairing between A/T/G and C, Structure of DNA and RNA			CO5, CO6
	C	5' and 3' end of DNA, DNA denaturation, monocistronic and polycistronic mRNA.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Nelson D.L., and Cox M.M., *Lehninger Principles of Biochemistry, 6th Edition.* W. H. Freeman (2012).			
	Other References	Berg J.M., Tymoczko J.L., and Stryer L., *Biochemistry, 7th Edition.* W. H. Freeman (2010). Voet D., and Voet J.G., *Biochemistry, 4th Edition.* Wiley (2010).			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**1**	**1**	**1**	**1**	**3**

BSZ120: Diversity of Animals
L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 01**	
1	Course Code	BSZ120	
2	Course Title	Diversity of Animals	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objectives	To get a brief idea about the whole animal world in terms of their general characteristics	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: To learn about the general characteristics of protists, poriferans and cnidarians CO2: To understand the general features of Platyhelminthes, aschelminthes and annelids CO3: To understand the diversity of arthropods, molluscs, and echinoderms CO4: To learn about the salient features of protochordates, pisces and amphibians CO5: To get a brief idea about reptiles, aves and mammals CO6:To understand the salient features of whole animal world	
7	Course Description	The 'Diversity of Animals' course outlines the general characteristics of different animal phylum and also provides the basic knowledge of different animal species affecting human beings. The course covers whole non-chordates and chordates with brief discussion about important species.	
8	Outline syllabus		CO Mapping
	Unit 1	**Diversity of Protista, Porifera and Radiata**	
	A	Basic introduction to non-chordates and chordates	CO1, CO6
	B	General Characteristics of Protista, Porifera and Cnidarians	CO1
	C	Life cycle of *Plasmodium* and *Leishmania* in brief	CO1
	Unit 2	**Diversity of Platyhelminths, Aschelminthes and Annelids**	
	A	General features of Platyhelminthes and Life cycle of *Taeniasolium*	CO2
	B	General Characteristics of Aschelminthes, Life cycle of *Ascaris*	CO2
	C	General characteristics of Annelids, General features of Earthworm and Vermicomposting	CO2, CO6
	Unit 3	**Diversity of Arthropods, Mollusca and Echinodermata**	

	A	General characteristics of Arthropods			CO3 , CO6
	B	Metamorphosis in insects; General features of Mollusca			CO3, CO6
	C	General characteristics of Echinodermata			CO3, CO6
	Unit 4	**Diversity of Protochordates, Pisces and Amphibia**			
	A	Salient features of protochordates; General features of *Branchiostoma*			CO4, CO6
	B	General characteristics of Pisces; Overview of Migration in Fishes			CO4, CO6
	C	General features of Amphibia, Adaptations for living on land in Amphibia			CO4, CO6
	Unit 5	**Diversity of Reptiles, Aves and Mammals**			
	A	General features of reptiles, terrestrial adaptations in reptiles			CO5, CO6
	B	General characteristics of Aves, flight adaptations in birds			CO5, CO6
	C	Mammalia-general features and dentition in mammals			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Cleveland P. Hickman, Jr., Larry S. Roberts, Allan Larson (2003). Animal Diversity. 3rd Edition. McGraw−Hill			
	Other References	1. Ruppert, F & Barnes. (2006). Invertebrate Zoology. A Functional Evolutionary Approach. 7th Edition. Thomas Books/ Cole. 2. Campbell & Reece. (2005). Biology. Singapore Pvt. Ltd.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**1**	**1**	**1**	**1**	**3**

BSP102: Cell Biology Lab

L T P: 0-0-2 Credit: 1

School: SBSR		**Batch: 2020-2023**			
Program: B.Sc.		**Current Academic Year: 2020-21**			
Branch: Life Sciences		**Semester: 1**			
1	Course Code	BSP102			
2	Course Title	Cell Biology Lab			
3	Credits	1			
4	Contact Hours (L-T-P)	0-0-2			
	Course Status	Compulsory			
5	Course Objective	● To understand how cell is to maintain life			
6	Course Outcomes	After finishing the course the students will be able to CO1: To Understand the basic components of prokaryotic and eukaryotic cell. CO2: To understand the structure and purpose of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membrane and organelles. CO3: To learn the transpiration by stomata. CO4: To understand movement across the cell membrane. CO5: To learn different phases of growth cycle and cell division. CO6: To Understand the basic concept of Biology			
7	Course Description	Introduces the basics of cell biology. The structure and function of the cell.			
8	Outline syllabus				CO Mapping
	Unit 1	**Practical based on Cell observation**			CO1, CO6
	Unit 2	**Practical related to cell and cell organelle**			CO2, CO6
	Unit 3	**Practical based to Transportation**			CO3, CO6
	Unit 4	**Practical based upon Nucleus and Chromosomes**			CO4, CO6
	Unit 5	**Practical related to Cytoskeleton and Cell to cell interaction**			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	-			
	Other References				

List of Practical's:

Week 1	**Unit 1**	**Practical based on Cell and Cell Theory**	
Week 1-2	a	Lab expt.1	To Prepare a Stained Temporary Mount of Onion Peel.
Week 3		Lab expt.2	To Prepare a stained Temporary Mount of Human Cheek Cells
	Unit 2	**Practical related to study different types of cell**	
Week 4	b	Lab expt.4	To observe Bacterial cell
		Lab expt.5	To prepare a thin blood smear and visualize and identify the different blood cell types in human blood.
	Unit 3	**Practical based upon Bacterial cell and cell division**	
Week 5	a	Lab expt.5	To study mitosis in onion root tip.
Week 6	b	Lab expt.6	To study miosis
Week 7	Mid term		
	Unit 4	**Practical based upon study movement**	
Week 8	a	Lab exp 7	Preparation of temporary of leaf epidermis to visualize stomata and study the structure of stomatal apparatus.
Week 9-10	b	Lab exp 8	Demonstration of Osmosis
	Unit 5	**Practical related**	
Week 11-14	a, b and c	Lab expt 9	To isolate and observe filamentous soil fungi using dilution and plating techniques.

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**1**
CO6	**3**	**3**	**3**	**3**	**3**

BSL-151: Chemistry Lab for Biosciences

L-T-P 0-0-2 Credits 1

1	Course number	**BSL-151**		
2	Course Title	**Chemistry Lab for Biosciences**		
3	Credits	1		
4	Contact Hours (L-T-P)	0-0-2		
5	Course Objective	1. To learn methods for preparation of solution of different concentration, their standardization 2. To learn quantitative estimation of different chemical species by various volumetric methods. 3. To prepare the buffer solutions of desired pH and study of change in pH. 4. To understand the practical concepts of reaction kinetics 5. To understand the procedure for testing of functional groups in organic compounds.		
6	Course Outcomes	1. Able to prepare solutions of different strength, standardize them and buffer solutions of different strength. 2. Able to understand neutralization titration by indicator method/pH metrically. 3. Perform complex metric/Redox/Precipitation titration. 4. Understand the order of reaction- First order/second order. 5. Able to detect functional groups present in organic compound. 6. Able to gain the basic knowledge of qualitative and quantitative analysis of chemicals		
7	Outline syllabus:			
7.01	BSL 151.01(a)	Task 1	To prepare N/10 normality solution of sodium carbonate and use it to standardize the given hydrochloric acid solution.	Outcome no.
7.02	BSL 151.01(b)	Task 2	To prepare the N/5 oxalic acid and use it to standardize given NaOH solution.	1,6
7.03	BSL 151.01(c)	Task 3	To prepare N/30 normality solution of potassium dichromate and use it to standardize the given hypo solution.	1,6
7.04	BSL 151.02(a)	Task 4	To prepare an acidic buffer with CH_3COOH and CH_3COONa and observe the change in pH on addition of acid and base.	1,6

7.05	BSL151.02(b)	Task 5	To prepare a basic buffer with NH_4OH and NH_4Cl and observe the change in pH on addition of acid and base.	1,6
7.06	BSL 151.03	Task 6	To determine the strength of NaOH and Na_2CO_3 in a given alkali mixture.	2,6
7.07	BSL 151.04 (a,b)	Task 7	To determine the strength of given HCl solution by titrating with standard NaOH solution: a. Indicator method; b. pH metrically.	2,6
7.08	BSL 151.05	Task 8	To determine the hardness of water by EDTA method.	3,6
7.09	BSL 151.06	Task 9	To determine the chloride content in water by Mohr's Method.	3,6
7.10	BSL 151.07	Task 10	To determine the Fe^{2+}content in the given sample by titrating with standard $K_2Cr_2O_7$ solution using potassium ferricyanide as external indicator.	3,6
7.11	BSL 151.08	Task 11	To determine the rate constant and order of the reaction of hydrolysis of an ester catalyzed by an acid.	4,6
7.12	BSL 151.09	Task 12	To determine the rate constant of hydrolysis of ethyl acetate with NaOH and show that the reaction is of second order.	4,6
7.13	BSL 151.10	Task 13	Detection of functional groups in organic compound(C, H,O containing).	5,6

8	Course Evaluation	
8.1	Course work: 100% marks	
8.11	Attendance	None
8.12	Homework	None
8.13	Quizzes	None
8.14	Labs	Evaluation of work done on each lab turn in the lab notebook and feedback from oral quiz about the work done that day. Zero, if the student is absent. 0.75N best marks out of N such evaluations: 100 marks
8.15	Presentations	None
8.16	Any other	None
8.2	MTE	None

8.3	End-term examination: None	
9	References	
9.1	Text book	O.P. Pandey, D.N. bajpai, S.Giri, " Practical Chemistry", S. Chand & Co.
9.2	Other References	Vogel's "Textbook of quantitative Analysis", Pearson.

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**1**	**3**	**2**	**1**	**3**
CO2	**2**	**1**	**3**	**2**	**2**
CO3	**2**	**1**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**3**	**1**
CO5	**1**	**1**	**2**	**2**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

PHY115: Physics 5

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 2**	
1	Course Code	PHY115	
2	Course Title	Physics 5	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Compulsory	
5	Course Objective	1. To make students aware of basic laws governing the fluids and associated physical parameters. 2. To teach students fundamental laws of thermodynamics and how heat flows. 3. To encourage students to apply the knowledge of fluids and thermodynamics in the study of biological systems	
6	Course Outcomes	CO1: Students will learn about the basic parameters related with fluids and fluid properties. CO2: Students will learn basic laws governing the fluid statics and floating of bodies. CO3: Students will learn basic concepts of heat and temperature. CO4: Students will gain knowledge about the basics of thermodynamics, thermodynamic cycle and zeroth law of thermodynamics and first law of thermodynamics. CO5: Students will learn the concept of heat transfer, its different modes of transfer, Black body radiation Planck's law, Stefan Boltzmann law. CO6: Students will learn about the thermodynamics and will be able to use the knowledge to understand various biological and chemical processes better under the light of heat exchange.	
7	Course Description	This is a basic course on fluids and thermodynamics designed for the biotechnology students so that they can appreciate the fluid behavior and thermal mechanism of various processes which they study.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Physical properties of fluids, Concept of fluid and flow. Types of fluids- Ideal and real fluids	CO1, CO6
	B	Continuum concept, Density, Specific weight, Specific volume, Specific gravity, Compressibility	CO1, CO6
	C	Elasticity, Surface tension and its applications, Capillarity, Vapour pressure, Viscosity	CO1, CO6
	Unit 2		

	A	Pascal's law, hydrostatic equation, hydrostatic forces on plane surface			CO2, CO6
	B	Pressure-density-height relationship, Manometers			CO2, CO6
	C	Buoyancy, Stability of immersed and floating bodies			CO2, CO6
	Unit 3				
	A	Macroscopic and Microscopic Approaches, Thermodynamics system and surroundings, Thermodynamic Property– Intensive and Extensive			CO3, CO6
	B	Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasi-static.			CO3, CO6
	C	Zeroth law of thermodynamic and its utility, Concept of thermal equilibrium. Temperature and its measurement and scales.			CO3, CO6
	Unit 4				
	A	Thermodynamic processes, calculation of work in various processes			CO4, CO6
	B	first law for a closed system undergoing a cycle and undergoing a change of state			CO4, CO6
	C	Internal energy as a system property, specific heat, Limitations of First Law.			CO4, CO6
	Unit 5				
	A	Definition of Heat Transfer, Reversible and irreversible processes, Modes of heat flow, Combined heat transfer system and law of energy conservation.			CO5, CO6
	B	Heat Conduction (Steady State): Introduction, 1-D heat conduction through a plane wall, long hollow cylinder, hollow sphere, Critical Insulation.			CO5, CO6
	C	Heat Transfer by Radiation: Thermal radiation, The Stephen-Boltzmann law, The black body radiation, Laws of black body radiation, Plank's law (qualitative). Combined heat transfer by conduction, convection and radiation.			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*				
	Other References	1. Engineering Fluid Mechanics By K. L. Kumar, S. Chand & Co. **2.** Fluid Mechanics By V. L. Streeter, Wylie, MGH 3. Engg. Thermodynamics- Hawkins, G.A. John Wiley & Sons. 4. Engg. Thermodynamics- Nag, P.K. Tata McGraw Hill. 5. Heat Transfer-Principles & Applications -Binay K. Dutta, PHI, New Delhi 6. Thermal Radiation Heat Transfer -Siegel, R. and J.R. Howell, Mc. Graw Hill			

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	2	2
CO2	3	1	2	2	2
CO3	3	1	2	2	2
CO4	3	1	2	2	2
CO5	3	1	2	2	2
CO6	3	1	2	2	2

BSB105: Microbiology

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 02 (Even)**	
1	Course Code	BSB105	
2	Course Title	Microbiology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objectives	1. This course has been designed to make students understand the basic characteristics of microbes 2. To know about basis principle and to understand the methods of sterilization 3. Students understand the basic structure of Bacteria	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: To study the history of microbiology and its basic concepts. Structure and nutrition of bacteria CO2: Growth, multiplication, factors affecting growth of bacteria and techniques related to its isolation CO3: Principles of physical and chemical methods used in the control of microorganisms CO4: Prevention and control of microbial diseases CO5: Structure and life cycle of bacteriophage and virus CO6: Application of microorganisms in different industries that can benefit human	
7	Course Description	Microbiology course outlines the general characteristics of different microorganisms and also provides the basic knowledge of significance of different microbes affecting the human beings.	
8	Outline syllabus		**CO Mapping**
	Unit 1	**Introduction to Microbiology**	
	A	History of Microbiology & contribution of microbiologists	CO1, CO6
	B	Spontaneous generation; Koch Postulates	CO1
	C	Whittaker's 5 kingdom concept; Pasteurization.	CO1
	Unit 2	Morphology and Nutrition of Bacteria	
	A	Morphology and fine structure of Bacteria; outer surface of bacteria; Cell wall of Gram +ve and Gram –ve bacteria	CO2
	B	Nutritional classification of Bacteria	CO2,
	C	Brief overview on Archaea; Cyanobacteria, PPLO	CO2, CO6
	Unit 3	**Growth and Sporulation in Bacteria**	
	A	Modes of cell division (Binary fission; budding and Septum formation); Normal growth of bacteria; Growth curve	CO3, CO6

	B	Pure culture, Method of isolating pure culture (Streak method, Pour-plate and spread plate technique); Synchronous and asynchronous			CO3, CO6
	C	Growth inhibitory substances (temperature, acidity, alkalinity, water availability, oxygen)			CO3, CO6
	Unit 4	**Control of Microbial Growth**			
	A	Microbes and Human welfare (medical and chemical industry)			CO4, CO6
	B	Microbes in food industry			CO4, CO6
	C	Physical and chemical methods of control of microorganisms			CO4, CO6
	Unit 5	**Virus and Its Control**			
	A	Ultra-structure of Virus			CO5, CO6
	B	Life Cycle and its control			CO5, CO6
	C	Life cycle of Bacteriophage			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	***Microbiology - Pelezar,*** M.J. Reid, R.D. and E.C.S. Chan, Tata McGraw Hill, New Delhi.1977 (4th Edition)			
	Other References	1. ***Prescott***, ***Harley*** and ***Kelvin*** – ***Microbiology***, 2nd ed. TMH Publication 2. General Microbiology: Roger & Strainer et.al. PHL Publication			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**1**	**3**	**2**	**1**	**3**
CO2	**2**	**1**	**3**	**2**	**2**
CO3	**2**	**1**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**3**	**1**
CO5	**1**	**1**	**2**	**2**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSB108: Genetics

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 02**	
1	Course Code	BSB108	
2	Course Title	Genetics	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. This course has been designed to make students understand the basic principles of classical Mendelian Genetics 2. To know about modern basis of heredity and to understand the transmission of characters via non-nuclear genes and effect of mutations on transmission of characters 3. Students understand the fine structure of gene and classical experiments that lead to the development of gene fine structure and its function	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1:describe various Mendelian laws as well as exception to these laws CO2:explain the structure of DNA, chromosomes and aberrations in chromosomes CO3: analyze extranuclear inheritance and examples to understand cytoplasmic inheritance CO4: describe mutation, its consequences and types CO5:demonstrate the fine structure of gene and experiments that lead to the understanding of gene structure and function CO6: describe basic principles of genetics and gene mutations and mechanisms of inheritance and heredity	
7	Course Description	The 'Genetics' course outlines the basic principles of Classical Genetics. This course also sheds light upon modern genetics and is designed to make student learn the structure of chromosomes; nucleosomal organization of genetic material etc to understand the basis of heredity. The course also further encompasses the concept of mutation; extra nuclear inheritance of characters and effect of these phenomena on transmission of characters.	
8	Outline syllabus		CO Mapping
	Unit 1	**Mendelism**	

	A	Brief overview of Mendel's work; Mendel's experimental design, monohybrid and di-hybrid crosses; Mendel's Law of segregation & Law of independent assortment	CO1, CO6
	B	Verification of segregates by back and test crosses; Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, co-dominance, semi-dominance, multiple allele, pseudo-allele, essential and lethal genes.	
	C	Non allelic interactions: epistasis (dominant & recessive), duplicate genes.	
	Unit 2	**Physical Basis of Inheritance**	
	A	Chromosome theory of inheritance; Eukaryotic Chromosome: Macromolecular Organization; packaging of DNA molecule into chromosomes	CO2, CO6
	B	Chromosome banding pattern, Heterochromatin and Euchromatin and its significance, karyotype; Chromosome types, primary and secondary constrictions; Centromere and Telomeres; Satellite -bodies	
	C	Variation in chromosome number Aneuploidy and Euploidy; Variations in chromosomes structure - deletion, duplication, inversion and translocation.	
	Unit 3	**Linkage and Crossing Over**	
	A	Concept of linkage and crossing over; Coupling and repulsion hypothesis; Linkage in maize and Drosophila; Linkage groups; Theories of linkage; Cis-Trans arrangement	CO3, CO6
	B	Crossing over and Genetic recombination	
	C	Extrachromosomal Inheritance: Maternal Inheritance: shell coiling in Limnaea; Inheritance of Mitochondrial DNA and Mitochondrial diseases in Human; Inheritance of Chloroplast DNA and Cytoplasmic Male Sterility (CMS) in crop plants	
	Unit 4	**Mutation**	
	A	Discovery of DNA as the genetic material	CO4, CO6
	B	Definition and types of mutations, Molecular basis of mutations	
	C	Ames test for mutagenic agents, screening procedures for isolation of mutants	
	Unit 5	**Fine Structure of Gene**	
	A	Benzer and T4 rII locus, Complementation test;	CO5, CO6
	B	Cistron, recon and muton	

	C	Beadle and Tatum's one gene one enzyme concept; One gene one polypeptide concept			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	1. Hartl D.L. and Jones E.W, **"Genetics: analysis of genes and genomes".** Edition 5. Jones and Bartlett Publishers, 2000. 2. Gardner E.J., Simmons M.J., Snustad M.J., **"Principles of genetics".** Edition 8. John Wiley & Sons (Asia) Pte. Ltd., 2007.			
	Other References	1. Griffiths J.F., Wessler, S.R., Levonotin, R.C., Gelbart, W.M., Suzuki, D.T., Miller J.H., **"An Introduction to Genetic Analysis".** Edition 8.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**1**	**3**	**2**	**1**	**3**
CO2	**2**	**1**	**3**	**2**	**2**
CO3	**2**	**1**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**3**	**1**
CO5	**1**	**1**	**2**	**2**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSB107: Environmental Biotechnology

L T P: 4-0-0 Credit: 4

School : SBSR		**Batch : 2020-23**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 2nd**	
1	Course Code	BSB107	
2	Course Title	**Environmental Biotechnology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Status	Compulsory	
6	Course Objective	1. Concept of biological control of air pollution 2. Physical, chemical and biological treatment of waste water. 3. Microbial degradation of xenobiotics 4. Biofertilizers, Microbes in oil recovery and bioleaching	
7	Course Outcomes	After studying this course, students will be able to CO1: Determine scope and market Biological control of air pollution CO2: Summarize the Aerobic processes: activated sludge, oxidation ponds and trickling filter towers CO3: Describe the pulp mill effluent, tannary effluent CO4: Determine the Bioremediation of fuel oils and lubricants in soil and water. CO5: Analyze the Use of R-DNA technology to enhance the efficacy microbial insecticides CO6: Compare the Biodeterioration of stored plant food materials.	
8	Course Description	The course comprises of general concept of environmental biotechnology to combat air pollution, waste water treatment, treatment of industrial effluents and bioremediation.	
9	Outline syllabus		CO Mapping
	Unit 1	**Environmental Biotechnology:**	**CO1**
	A	An overview, concept, scope and market Biological control of air pollution	
	B	Testing of water for physiochemical parameters including BOD & COD,	
	C	Solid waste: Sources and management (composting and verrmicomposting)	
	Unit 2	**Waste water:**	**CO2**
	A	origin, composition and treatment.	
	B	Physical, chemical and biological treatment of waste water.	
	C	Aerobic processes: activated sludge, oxidation ponds and trickling filter towers. Anaerobic processes: anaerobic digesters.	
	Unit 3	**Treatment of industrial effluents:**	**CO3**
	A	distillery effluent, paper mill effluents	
	B	pulp mill effluent, tannary effluent,	

	C	textile dye effluent.			
	Unit 4	**Bioremediation:**			**CO4**
	A	Bioremediation of fuel oils and lubricants in soil and water.			
	B	Degradation of sulphur compounds present in coal and petroleum.			
	C	Microbial degradation of xenobiotics, genetic engineering of biodegradation pathways.			
	Unit 5	**Microbial Insecticides:**			**CO5**
	A	Use of R-DNA technology to enhance the efficacy microbial insecticides,			
	B	Biofertilizers, Microbes in oil recovery and bioleaching,			
	C	Biodeterioration of stored plant food materials, leather, wool, metals, textiles, stone & related building.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1.Environmental Chemistry. A.K. De, Wiley Eastern Ltd., New Delhi. 2.Introduction to Biodeterioration. D. Allsopp and K.J. Seal, ELBS/Edward Arnold.			
	Other References	1. Advanced Environmental Biotechnology by S.K. Agarwal. APH Publishing, New Delhi,(2005). 2. Bioremediation Protocols. David S. (1997), Humana Press, New Jersey. 3. Environmental Science and Technology. Stankey E.M. (1997), Lewis Publishers, NewYork. 4. Microbial Biotechnology: Fundamentals of Applied Microbiology (2 nd edition). Glazer and Nikaido Cambridge University Press, (2007). 5. Biodegradation and Bioremediation: Soil Biology. Singh A. and Ward O.P. (2004), Springer			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**1**	**3**	**2**	**1**	**3**
CO2	**2**	**1**	**3**	**2**	**2**
CO3	**2**	**1**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**3**	**1**
CO5	**1**	**1**	**2**	**2**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BBT112: Bioanalytical techniques

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch: 2020 - 2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 02**	
1	Course Code	**BBT112**	
2	Course Title	**Bioanalytical techniques**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Status	Compulsory	
6	Course Objective	To get a brief idea about different bioanalytical techniques commonly use in the biotech laboratories	
7	Course Outcomes	After successfully completion of this course, students will be able to: CO1: To understand how to prepare the solutions and buffers CO2: To know the procedure of cell lysis and different extraction methods CO3: To comprehend the principle and technical overview on mass spectrometry CO4: To know the basic principle of spectroscopy and discuss different types of spectroscopies CO5: To discuss different types of chromatography techniques, different DNA-protein, protein-protein interactions methods, and x-ray crystallography CO6: To understand various bioanalytical techniques and know the basic principles.	
8	Course Description	This course will help us to understand the preparation of different solutions and buffers, types of cell lysis and extraction methods. Also, students will learn the working principles and applications of various bioanalytical techniques which will help them to enhance their basic and advanced knowledge on biotech research.	
9	Outline syllabus		CO Mapping
	Unit 1	**Preparations of Solutions and Buffers**	
	A	Preparation of solutions, polar, nonpolar, molar and normal solutions, ppm solutions	CO1
	B	Mass Fraction, Solution by Serial Dilutions, Percentage Solutions	CO1
	C	Preparation of Standard Solution of Acids and Bases, Buffer System, various types of buffers	CO1
	Unit 2	**Cell lysis and Extraction methods**	
	A	Principle and working: Cell lysis (Mechanical, Chemical, enzymatic)	CO2
	B	Methods of extraction: Solid-liquid, liquid-liquid macerations	CO2
	C	Conventional and non-conventional type of extraction methods	CO2
	Unit 3	**Mass spectrometry**	
	A	Mass spectrometric techniques: Ionisation	CO3
	B	Mass analysers, Detectors	CO3
	C	Structural information by tandem mass spectrometry, Analysing protein complexes	CO3
	Unit 4	**Spectroscopy**	

	A	Principles and working: Spectroscopy, UV-VIS spectrophotometer			CO4
	B	Fundamentals of Infrared and Raman spectroscopy			CO4
	C	Atomic spectroscopy, Circular dichroism spectroscopy, NMR Spectroscopy			CO4
	Unit 5	**Advance techniques in biochemistry and molecular biology**			
	A	Chromatography: HPLC, FPLC, GC			CO5
	B	DNA-Protein, Protein-protein interactions – Northern, western, southern blotting			CO5
	C	ELISA, X-ray crystallography			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30 %	20 %	50 %	
	Textbook/s*	Principles of Biochemistry, Latest Edition, A.L. Lehninger, D.L. Nelson, M.M. Cox., Worth Publishing			
	Other References	1. Biochemistry by Mathews, Van Holde. 2. Textbook of Biochemistry by Metzler 3. Biological Instrumentation and Methodology by Dr. PK Bajpai 4. The Tools of Biochemistry by Cooper 5. Practical biochemistry by Wilson and Walker			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSP105: Microbiology Lab

L T P: 0-0-2 **Credit: 1**

School: SBSR		**Batch: 2020-23**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 02**	
1	Course Code	**BSP105**	
2	Course Title	**Microbiology Laboratory**	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Compulsory	
5	Course Objective	To explain relationships and apply appropriate terminology relating to the structure, metabolism, and ecology of prokaryotic microorganisms, eukaryotic microorganisms, and viruses. To explain the principles of physical and chemical methods used in the control of microorganisms and apply this understanding to the prevention and control of infectious diseases. To develop the appropriate laboratory skills and techniques related to the isolation, staining, identification, assessment of metabolism, and control of microorganisms. To develop an information base for making personal health decisions in regard to infectious diseases	
6	Course Outcomes	CO1: Analyze the identifying characters and classify the bacteria in terms of nutritional development, oxygen requirement and other characters. CO2: Isolate and culture bacteria in laboratory under both aerobic and anaerobic conditions. CO3: Comprehend the kinetics of bacterial growth in terms of growth phases, generation time, yields and determine factors affecting growth and methods of growth determination. CO4: Determine the impact of microbes on human health and examine physical and chemical methods used in the control of microorganisms and apply this understanding to the prevention and control of infectious diseases. CO5: Identify the host and determine the life cycle of pathogenic bacteria, bacteriophage and virus. CO6: Develop the ability to work both independently and with others in the laboratory and draw appropriate conclusions from laboratory results.	
7	Course Description	To explain the principles of physical and chemical methods used in the control of microorganisms and apply this understanding to the prevention and control of infectious disease.	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical based on Introduction to Microbiology**	CO1, CO6

		Sub-topic A			
	Unit 2	**Practical based on Morphology and Nutrition of Microbes**			CO2, CO6
		Sub-topic A			
	Unit 3	**Practical related to Bacteria Growth and Sporulation in Bacteria**			CO1, CO3, CO6
		Sub-topic A,B			
	Unit 4	**Control of Microbial Growth**			CO4, CO5, CO6
		Sub-topic A			
	Unit 5	**Virus and Its Control**			CO1, CO6
		Sub-topic A, B, C			
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Textbook/s*	Practical manual of Biotechnology by Ritu Mahajan, Jitendar Sharma, RK Mahajan, Vayu Publishers			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**3**	**1**	**2**	**1**
CO2	**3**	**3**	**1**	**2**	**2**
CO3	**1**	**1**	**3**	**2**	**1**
CO4	**2**	**2**	**1**	**3**	**2**
CO5	**2**	**2**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

PHY151: Physics Lab 2

L-T-P 0-0-2 Credits 1

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 2**	
1	Course Code	PHY151	
2	Course Title	Physics Lab 2	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
	Course Status	Compulsory	
5	Course Objective	To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.	
6	Course Outcomes	On successful completion of the course the students will have: CO1: Knowledge and study of basic physics experiments based on Semiconductors, energy band gap, planck constant etc. CO2: Use the concept of electricity and magnetism to find out variation of magnetic field through a current carrying coil and hall effect CO3: Understand and learn how to determine specific resistance CO4: Understand and perform laser-based experiments. CO5: Knowledge and study of various optical experiments. CO6: Apply the mathematical concepts/equations to obtain quantitative results and ability to conduct, analyze and interpret experiments	
7	Outline Syllabus		CO Mapping
	Unit 1		
	A B C	1. To determine Energy band gap of a semiconductor using Four Probe method. 2. To determine the variation of magnetic field along the axis of a current carrying coil and estimate the radius of the coil. 3. To study Hall effect and determine the Hall coefficient, carrier density and the mobility of a semiconductor material	CO1 CO2,CO6
	Unit 2		
	A B C	4. To draw hysteresis curve (B-H curve) of a specimen in the form of a transformer on a C.R.O. And to determine its hysteresis loss 5. To determine the Planck's constant by measuring radiation in a fixed spectral range. 6. To determine the specific resistance of the material of a given wire using Carey Foster's bridge.	CO2,CO6

	Unit3		
	A B C	7. To determine the diameter of thin wire by diffraction using laser. 8. To determine the wavelength of laser light by diffraction at a single slit. 9. To determine slit width of single and double slit by using Laser.	CO3,CO6 CO4,CO6
	Unit 4		
	A B C	10. To determine the wavelength of prominent lines of mercury by plane diffraction grating. 11. To determine the wavelength of monochromatic light by Newton's Ring method.	CO4,CO6
	Unit 5		
	A B C	12. To determine the focal length of the combination of two lenses separated by a distance with the help of a nodal slide and to verify the formula. 13. To verify Stefan's Law.	CO5,CO6 CO5,CO6
	Mode of Examination	Practical/Viva	
	Weightage Distribution	CA: 60% / MTE: 0% / ETE: 40%	
	Text books	1. B.Sc. Practical Physics- Harnam Singh, S. Chand Publishing. 2. B.Sc. Practical Physics- C L Arora, S. Chand Publishing.	
	Other References	1. Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co. 2. B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New	

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	1	1
CO2	2	2	2	1	1
CO3	2	2	2	1	1
CO4	2	2	2	1	1
CO5	2	2	2	1	1
CO6	2	2	2	1	1

BSZ201: Non-chordates

L-T-P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B. Sc.(H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 03**	
1	Course Code	**BSZ201**	
2	Course Title	**Non-chordates**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To be familiar with the different non-chordate phyla and distinguish between lower and higher organism. 2. To predict and construct relationship between the complex evolution process for rearranging study contrasts in the life processes of different phyla.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: Recognize common and distinctive features of lower invertebrate phyla, including poriferans, protists and protozoans. CO2: Sketch distinctive features of taxonomic classes within Cniderians and cteophorans. CO3: Assess distinctive measurable features of different group of helminthes and pathogenicity caused by them. CO4: Summarize characteristics of Annelids and Arthropodans with their economic importance. CO5: Grade the evolution of mollusks and echinoderms as higher invertebrates and predict their role in Life Sciences. CO6: Combine the characteristic of different phyla to formulate and prepare phylogenetic relationship amongst invertebrates.	
7	Course Description	At the end of the course, the students will be familiar with the non-chordate world that surrounds us. They will be able to appreciate the process of evolution and see how it progressed from simple, unicellular cells to complex, multicellular organisms.	
8	Outline syllabus		CO Mapping
	Unit 1	**Protista, Metazoa and Porifera**	**CO1, CO6**
	A	General characteristics and Classification of Protista; General account of locomotion in Protista	CO1
	B	Study of Euglena; Life cycle of Paramecium, Segmentation of Metazoa	CO1
	C	General characteristics and classification of sponges; Canal system in porifera	CO1, CO6
	Unit 2	**Unit 2: Cnidaria and Ctenophora**	**CO2, CO6**
	A	General characteristics and Classification up to classes in Cnideria	CO2

	B	Structure and life cycle of *Obelia*; polymorphism in Obelia			CO2
	C	Evolutionary significance of Ctenophora			CO2, CO6
	Unit 3	**Unit 3: Platyhelminthes and Nemathelminthes**			**CO3, CO6**
	A	General characteristics and Classification of platyhelminthes			CO3
	B	General characteristics and Classification of Nemathelminthes			CO3
	C	Life cycle of *Taenia solium*, *Ascaris Lumbricoides* and *Wuchereria bancrofti*			CO3, CO6
	Unit 4	**Annelida and Arthropoda**			**CO4**
	A	General characteristics and Classification up to classes in Annelida;			CO4
	B	General characteristics and Classification up to classes in Arthropoda			CO4
	C	Excretion in Annelida; Vision and Respiration in Arthropoda			CO4, CO6
	Unit 5	**Mollusca and Echinodermata**			**CO5, CO6**
	A	General characteristics and Classification up to classes of mollusks; Respiration in Mollusca			CO5
	B	General characteristics and Classification up to classes of echinoderms			CO5
	C	General characteristics and Classification up to classes of echinoderms; Water vascular systems in Asteroidea			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Kotpal, R. L. *Modern Text Book of Zoology: Invertebrates*. Rastogi Publications, 2012.			
	Other References	1. Purves, William K., Gordon H. Orians, David Sadava, and H. Craig Heller. *Life: The Science of Biology: Volume III: Plants and Animals*. Vol. 3. Macmillan, 2003. 2. Campbell, N., and J. Reece. "Biology 7th edition, AP." (2005).			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	2	1
CO2	3	3	1	2	2
CO3	1	1	3	2	1
CO4	2	2	1	3	2
CO5	2	2	1	1	3
CO6	3	3	3	3	3

BSZ202: Animal Physiology & Histology I

L-T-P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 3**	
1	Course Code	**BSZ202**	
2	Course Title	**Animal Physiology and Histology I**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To make the students know about the basics of animal body organization. 2. In-depth knowledge of different types of body systems and their organization. 3. To acquire knowledge about how body actually works via coordination of different body systems.	
6	Course Outcomes	CO1: To learn about basic structural organization; and the various types of body tissues and their structures. CO2: To understand the types and growth mechanism of bones and cartilages. CO3: To learn the fundamentals behind the body response involving nervous system. CO4: To learn about the types and working mechanism of muscular system. CO5: To learn about the histology and functions of human endocrine systems. CO6: To understand the importance of various body systems and their interactions to perform various tasks.	
7	Course Description	The subject provides a deeper basics of physiology and histology with main emphasis over nervous system, muscular system, and endocrine systems. In histology part an in depth knowledge about all the different types of body tissues present at various body locations has been included in the course contents.	
8	Outline syllabus		CO Mapping
	Unit 1	**Study of Tissues**	
	A	Basic structural organization, Types and classification of epithelial tissue	CO1, CO6
	B	Types and classification connective tissue	CO1, CO6
	C	Types and classification of muscular and nervous tissue	CO1, CO6
	Unit 2	**Study of Bone and Cartilage**	
	A	Structure and types of bone	CO2, CO6
	B	Ossification, bone growth and resorption	CO2, CO6

	C	Structure and types of cartilages			CO2, CO6
	Unit 3	**Nervous System**			
	A	General organization of nervous system			CO3, CO6
	B	Basic structure of nervous system and its working			CO3, CO6
	C	Propagation of nerve impulse			CO3, CO6
	Unit 4	**Muscle**			
	A	Histology of muscle			CO4, CO6
	B	Mechanism of muscle contraction			CO4, CO6
	C	Muscular dystrophy			CO4, CO6
	Unit 5	**Endocrinology**			
	A	Histology and hormone functions of pineal and pituitary glands			CO5, CO6
	B	Histology and hormone functions of thyroid and parathyroid glands			CO5, CO6
	C	Histology and hormone functions of pancreas and adrenal glands			CO5, CO6
	Mode of examination	**Theory**			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company. 2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology, XI Edition. John Wiley & Sons			
	Other References	Victor, P. Eroschenko. (2008). diFore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**1**	**1**	**1**	**1**

BSB201: Molecular Biology
L T P: 4-0-0 Credit: 4

School : SBSR		**Batch : 2020-2023**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 3rd**	
1	Course Code	**BSB 201**	
2	Course Title	**Molecular Biology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
6	Course Objective	1. DNA replication and its machinery 2. Transcription and post- transcription processes 3. Prokaryotic and Eukaryotic translation and its mechanism 4. DNA repair and its mechanism	
7	Course Outcomes	After studying this course, students will be able to CO1: Determine Prokaryotic and Eukaryotic DNA replication CO2: Evaluate Prokaryotic and eukaryotic transcription CO3: Interpret the regulation of translation, post translational modifications of proteins CO4: Analyse the Homologous recombinations CO5: Determine Operon Concept. CO6 : Analyze and study DNA repair mechanisms	
8	Course Description	This course contains various molecular biology concepts ranging from replication, transcription and translation in both prokaryotes and eukaryotes. After studying course, students will be able to learn molecular machinery inside the organisms.	
9	Outline syllabus		CO Mapping
	Unit 1	**DNA replication**	**CO1**
	A	Prokaryotic and Eukaryotic DNA replication	
	B	Mechanism of DNA replication	
	C	Enzymes, factors and other accessory proteins involved in DNA replication.	
	Unit 2	**Transcription**	**CO2**
	A	Prokaryotic and eukaryotic transcription- basis of initiation, elongation and termination	
	B	post transcriptional modifications- polyadenylation	
	C	capping and RNA splicing	
	Unit 3	**Translation**	**CO3**
	A	Prokaryotic and eukaryotic translation	
	B	mechanisms of initiation, elongation and termination	
	C	regulation of translation, post translational modifications of proteins	
	Unit 4	**Operon Concept**	**CO4**
	A	Operon Concept	
	B	the lac operon	
	C	tryptophan operon	
	Unit 5	**DNA Repair and Recombination**	**CO5**
	A	Homologous recombinations	

	B	Holiday junction			
	C	DNA repair mechanisms			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Molecular Cloning: a Laboratory Manual, J. Sambrook, E. F. Fritsch and I. Maniatis, Cold Spring Harbour Laboratory Press, New York,2000.			
	Other References	Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & sons Ltd., Yourk,1988. Molecular Biology Lab Fax. T.A. Brown (Ed.), bios Scientific Publishers Ltds., Oxford, 1991. Molecular biology of the Gene (4th Edition),J .D. Watson, N. H. Hopkins, J. W. Roberts,J.A. Steitz and A.M.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**1**	**1**
CO3	**3**	**2**	**3**	**2**	**1**
CO4	**3**	**2**	**1**	**3**	**2**
CO5	**2**	**2**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BBT208: Advanced Biochemistry

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B. Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 3**	
1	Course Code		
2	Course Title	Advanced Biochemistry	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. This course provides a comprehensive introduction to fundamentals of biochemistry. 2. The course is designed to give students an up-to-date understanding of various biomolecules and their roles. 3. This course focuses on proteins and nucleic acids along with their various conformations. 4. The course also highlights the biological membranes and how the cell response to the signals.	
6	Course Outcomes	After the successful completion of this course students shall be able to: CO1: Understand the basic concepts of bioenergetics and its role in the functioning of a cell. CO2: Know about the proteins and various types of it. CO3: Explain about various nucleic acid molecules and DNA structure types that exists in nature. CO4: Understand the cell membranes and mode of transportation across them CO5: Understand how cell functions when it receives a signal and how the cell cycle is regulated. CO6: Apply his knowledge in understanding the cellular structure and cellular function	
7	Course Description	The 'Advanced Biochemistry' course covers different aspects of biochemistry starting from bioenergetics to cell signaling. This course provides detailed information about different biomolecules and their role in the cell. Lastly, with the help of some important cellular receptors, it helps in understanding how a cell functions.	
8	Outline syllabus		CO Mapping
	Unit 1	**Molecular Tools Of Genetic Engineering**	
	A	Principles of Bioenergetics**,** Bioenergetics and Thermodynamics	CO1, CO6
	B	Biological Oxidation-Reduction Reactions, Free Energy Calculations, The Cell's Energy Currency- Phosphoryl Group Transfers and ATP	
	C	Free-Energy-Driven Transport across Membranes	
	Unit 2	**Protein structure**	
	A	Primary Secondary and Tertiary structure, Quaternary structures	
	B	Fibrous and globular proteins, Protein-assisted folding and chaperones in protein folding, protein targeting	

	C	the physiological chemistry Of oxygen binding by myoglobin and hemoglobin, The regulatory compound, 2,3 — bisphosphoglycerate (BPG)			CO2, CO6
	Unit 3	**Nucleic acids**			
	A	Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,			CO3, CO6
	B	Biologically important nucleotides, Double helical model of DNA structure			
	C	forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA			
	Unit 4	**Biological Membranes and Transport**			
	A	The Composition and Architecture of Membranes			CO4, CO6
	B	Solute Transport across Membranes; transport of small molecules, active and passive transport			
	C	transport of macromolecules- Endocytosis, Phagocytosis, Pinocytosis.			
	Unit 5	**Biosignaling**			
	A	Molecular Mechanisms of Signal Transduction, Gated Ion Channels, Receptor Enzymes, G Protein-Coupled Receptors and Second Messengers			CO5, CO6
	B	Signaling in Microorganisms and Plants,			
	C	Regulation of Transcription by Steroid Hormones, Regulation of the Cell Cycle by Protein Kinases			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	**1.** Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.			
	Other References	1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman 2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants.American Society of Plant Biologists.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	2	3	2	3	3
CO3	2	3	3	3	2
CO4	2	3	3	3	3
CO5	2	3	3	3	3
CO6	3	3	3	2	3

BFS204: Food Microbiology

L-T-P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 3**	
1	Course Code	BFS 204	
2	Course Title	Food Microbiology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To prepare students with a basic understanding of microbes and their natural habitat 2. To make the students identify microbes involved in biological processes such as fermentation and spoilage. 3. To impart knowledge in students about food pathogens and their diagnosis 4. To help the students identify methods of destruction of microbes	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: Identify microbes associated with food, their classification and factors affecting their growth CO2: Describe fermented foods and their microflora. CO3: Compare food spoilage in different classes of food CO4: Examine and detect food-borne pathogens CO5: Recognize microbial destruction methods CO6: Develop an overall idea of food-borne microbes involved in beneficial and harmful activities and methods of influencing their growth and survival.	
7	Course Description	The course gives an insight into industrially and clinically important microbes, their growth, diagnosis and destruction. It provides a foundation for careers in microbiology, food microbiology, or research in all branches of food sciences.	
8	Outline syllabus		CO Mapping
	Unit 1	**Food and Microorganisms**	CO1, CO6
	A	History of Food Microbiology	
	B	Microorganisms important for food- moulds, yeast and bacteria- general characteristics and importance, classification	
	C	Intrinsic and Extrinsic factors affecting growth of microorganisms	
	Unit 2	**Fermented and microbial foods**	CO2, CO6
	A	Fermented Milk and milk products, Concept of Probiotics and health benefits	
	B	Fermented fruits and vegetables, Fermented fish, Fermented meats	

	C	Fermented beverages- Beer, Vinegar and Wine, single cell proteins			
	Unit 3	**Food Spoilage**			CO3, CO6
	A	Cereal and its products, Vegetables, fruits, and its products			
	B	Milk and its products			
	C	Meat and meat products, poultry, fish and sea foods and Drinking water			
	Unit 4	**Diagnosis**			CO4, CO6
	A	Food borne illness (bacterial, fungal, viral),			
	B	Detection of food-borne organisms, Bioassays for detecting microbes			
	C	Concept of Metabolically injured organisms their examination,			
	Unit 5	**Destruction of microorganisms**			CO5, CO6
	A	Principles underlying the destruction of microorganisms			
	B	Destruction of microorganisms by physical and chemical methods Heating process, Irradiation, Low temperature storage			
	C	Chemical preservatives, High-pressure processing, Control of water activity.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Jay, J.M. (2008) Modern Food Microbiology (Sixth Edition). Aspen Publishers, Inc. Gaithersburg, Maryland.			
	Other References	1. Frazier, W. C. and Westhoff, D. C. (2007) Food Microbiology. Tata McGraw Hill, Publishing Company Ltd. New Delhi. 2. Adams, M. R. and Moss, M. O. (2005) Food Microbiology (Second edition).Royal Society of Chemistry Publication, Cambridge.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**1**	**1**	**1**	**1**

BFS202: Food Biotechnology

L-T-P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 3**	
1	Course Code	BFS202	
2	Course Title	Food Biotechnology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objectives	1. To develop fundamental knowledge of food biotechnology. 2. To acquire knowledge for applications of biotechnology in food industry.	
6	Course Outcomes	After successfully completion of this course students will be able to: **CO1.** Understand the basic principles, application, safety, regulations and food authentication methods of food biotechnology. **CO2.** Understand fundamentals of downstream processing and biosensors in food industry. **CO3.** Understand natural control of micro-organism and production with control of Aflatoxin. **CO4.** Understand all about GMOs and Protein Engineering applications in food industry. **CO5.** Understand the biotechnology and industrial production of different . food product **CO6.** Develop an overall idea of food-borne microbes involved in beneficial and harmful activities and methods of influencing their growth and survival.	
7	Course Description	Biotechnology is tool for various quality measurements in food products like PCR, Immunological methods and DNA based methods. Biotechnology offers various purification operations for food products. Fermented food products manufacturing are based on biotechnology.	
8	Outline syllabus		CO Mapping
	Unit 1	**Food Biotechnology**	**CO1**
	A	Introduction to Food Biotechnology, basic principles of Gene technology and its application in food industry	CO1
	B	Food safety and biotechnology- Impact of Biotechnology on foods, New challenges	CO1
	C	Immunological methods, DNA based methods in food authentication, Real time PCR based methods	CO1
	Unit 2	**Downstream processing**	**CO2**
	A	Principle and types of downstream processing of food products, General types and stages in downstream processing	CO2

	B	Bacterial starter culture, Methods of inoculation, media preparation, Slurry processing and product isolation			CO2
	C	Biosensors types and applications in food processing			CO2
	Unit 3	**Toxins and Bacteriocins**			**CO3**
	A	Natural control of micro-organisms – Bacteriocins of Lactic acid bacteria			CO3
	B	Applications of bacteriocins in food systems			CO3
	C	Aflatoxins – production, control and reduction using molecular strategies			CO3
	Unit 4	**GMO**			**CO4**
	A	Transgenic plants and animals : Current status of transgenic Plants and animals, methods, concept, risks regulation and application, Ethical issues			CO4
	B	Protein engineering in Food technology –objectives, methods, Limitations			CO4
	C	Protein engineering: applications(e.g. Lactobacillus, β-galactosidase, nisin and Glucose isomerase).			CO4
	Unit 5	Industrial Application			**CO5**
	A	Biotechnology and industrial production of enzymes, beer, wine			CO5
	B	Amino acids, organic acids, vitamins			CO5
	C	baker's yeast, brewer's yeast and single cell protein.			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1.Gupta.P.K, "Botechnology and genomics", Rastogi publications, 2010.			
	Other References	1. Lovric J., "Introducing Proteomics: From concepts to sample separation, mass spectrometry and data analysis", Wiley-Blackwell, 2011. 2. Nelson D.L. and Cox M.M., "Lehninger Principles of Biochemistry", W. H. Freeman, 2004.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	1	1	1	1

BSZ203: Insect Vector and Diseases

L-T-P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 03**	
1	Course Code	**BSZ203**	
2	Course Title	**Insect Vector and Diseases**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To enable the students to understand about the general features of class Insecta and its different orders. 2. In-depth knowledge about various insects acting as disease carrier and their mode of transmission.	
6	Course Outcomes	CO1: To learn about the general and morphological features of Insects. CO2: To understand the key factors behind responsible for vector capacity of different kinds of insects. CO3: To learn about the common diseases spread by the members of order Diptera. CO4: To learn about the common diseases spread by the members of order Siphonaptera and Siphunculata. CO5: To learn about the common diseases spread by the members of order Hemiptera. CO6: To understand how the insect world influencing our life and how we can control diseases spread by them.	
7	Course Description	The subject provides a deeper knowledge about insect world and how these insects are acting as a carrier of human and animal diseases. The course also include the different ways to control all these diseases.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Insects**	
	A	General features and morphology of insects	CO1, CO6
	B	Head – eyes, types of antennae	CO1, CO6
	C	Mouth parts with respect to feeding habits	CO1, CO6
	Unit 2	**Basic Characteristics of Vectors & Insect as Vectors**	
	A	Basic introduction of Carrier and Vectors	CO2, CO6
	B	Vectorial capacity and factors defining parasite-vector specificity	CO2, CO6
	C	Key features of orders with insect as vectors	CO2, CO6
	Unit 3	**Dipteran as Disease Vectors**	CO3
	A	Brief description of Dipterans as important insect vectors	CO3, CO6
	B	Study of mosquito borne diseases - Malaria and Leishmaniasis	CO3, CO6
	C	Study of house fly as important mechanical vector	CO3, CO6

	Unit 4	**Siphonaptera and Siphunculata as Disease Vectors**			
	A	Study of Fleas as important insect vectors and diseases caused by it.			CO4, CO6
	B	Human louse as important insect vectors			CO4, CO6
	C	Study of Louse-borne diseases			CO4, CO6
	Unit 5	**Hemiptera as Disease Vectors**			
	A	Bugs as insect vectors			CO5, CO6
	B	Bed bugs as mechanical vectors			CO5, CO6
	C	Control and prevention measures			CO5, CO6
	Mode of examination	**Theory**/Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Imms, A.D. (1977). A General Text Book of Entomology. Chapman and Hall, UK. 2. Chapman, R.F. (1988). The insects: Structure and Function. IV Edition, Cambridge University Press, UK.			
	Other References	1. Mathews, G. Integrated Vector Management: Controlling Vectors of Malaria and Other Insect Vector Borne Diseases. Wiley-Blackwell			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSZ205: Animal Behavior and Chronobiology

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-23**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 03**	
1	Course Code	**BSZ205**	
2	Course Title	**Animal Behavior and Chronobiology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to make the students understand the various types of patterns of animal behaviour, their interactions with other animals, and their sexual selection for mating.	
6	Course Outcomes	**CO1** Comprehend the basic significance of Animal Behaviour **CO2** Differentiate in different Patterns of Behaviour **CO3** Comprehend the knowledge of Social, Sexual and Parental Behaviour **CO4** Understand about different Chronobiology and biological clocks **CO5** Understand different application of Biological Rhythm **CO6** Familiar with the different sexual selection	
7	Course Description	This course mainly comprises the various types of patterns of animal behaviour. Students will be able to understand the their interactions with other animals, and their sexual selection for mating.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction and significance of Animal Behaviour**	**CO1, CO6**
	A	Ecoethology, History of Ethology; Brief profiles of Karl Von Frish, , Konrad Lorenz and Niko Tinbergen, Proximate and ultimate mechanism of behaviour	
	B	Significance of study of animal behaviour;	
	C	Animal behaviour study in relation to environment and human society; Anthropomorphism	
	Unit 2	**Patterns of Behaviour**	**CO2, CO6**
	A	Introduction to Motivation; evolution of behaviour;	
	B	Fixed action pattern (FAP); Constancy or stereotypes; Characteristics of instincts;	
	C	Differences between instinctive and learned behaviour; Learning behaviour – Imprinting, Habituation, classical conditioning, Discrimination learning, Assosiative learning; Aggressive behaviour patterns	
	Unit 3	**Social, Sexual and Parental Behaviour**	**CO3, CO6**

	A	Concept of society, Cost of benefits of group living; Altruism; Co-operation, Selfishness; Eusociality;			
	B	Sexual selection; Mating systems- monogamy, polygyny and polyandry; Characteristics of courtship;			
	C	Evolution of courtship- Intrasexual selection and intersexual selection; Types of parental care; parent offspring conflict			
	Unit 4	**Chronobiology and biological clocks**			**CO4, CO6**
	A	Introduction to chronobiology; History of research on human; Various terminology used in chronobiology; Biological clocks;			
	B	Clocks and human physiology; Working of clock gene;			
	C	Sleep Disorders-Insomnia, Restless legs syndrome, delayed sleep phase syndrome, parasominas; chronotherapy.			
	Unit 5	**Biological Rhythm**			**CO5, CO6**
	A	Types of biological rhythms: Epicycles, Tidal rhythms, Lunar rhythms, circadian rhythms; Circannual rhythms;			
	B	Effects of temperature and light intensity upon circadian rhythms; Ecological adaptation;			
	C	Diurnality; Hibernation; Migration.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	1. Chronobiology Biological Timekeeping: Jay. C. Dunlap, Jennifer. J. Loros, Patricia J. DeCoursey (ed). 2004, Sinauer Associates, Inc. Publishers, Sunderland, MA, USA			
	Other References	1. Animal Behaviour. Mohan P Arora (1995) second edition, Himalaya Publishing house, New Delhi. 2. Animal Behaviour: A textbook for University students (2017) Fifth Edition Rastogi publication, Meerut.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	3	2	3	-	3
CO3	-	3	3	3	3
CO4	3	-	2	3	2
CO5	3	2	-	2	3
CO6	3	3	2	3	3

BSZ251: Non-Chordates Lab

L-T-P 0-0-3 Credits 2

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 3**	
1	Course Code	BSZ251	
2	Course Title	Non-Chordates Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	1. To appreciate the range and diversity of organisms within Non - Chordata. 2. To learn the distinguishing characteristics of various phylum. 3. To become skilled in the use of a dichotomous key to identify animal specimens. 4. To design your own dichotomous key.	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Know the characteristic features of Porifera and Coelenterata. CO2: Understand the characteristic features of Platyhelminthes and Aschelminthes. CO3: Learn about the characteristics of Annelida. CO4: Get complete understanding about species Arthropoda. CO5: To understand the salient features of Mollusca and Echinodermata. CO6: To get a complete knowledge about various species that comes under invertebrates.	
7	Course Description	The aim of this course is to provide better understanding about different species invertebrates. The student get acquainted with various characteristic features of non-chordates along with zoogeographical distribution across the world.	
8	Outline syllabus		CO Mapping
	Unit 1	**General survey of invertebrates through charts/specimens, slides and e-resources**	
	a, b	**Porifera** – Specimen studies: Sycon, Spongilla; Permanent Slides: T.S. and L.S. of Sycon	CO1, CO6
	c	**Coelentrata -** Specimen studies: Hydra, Rhizostoma, Obelia; Permanent Slides: T.S. and L.S. of Hydra	
	Unit 2		
	a, b	**Platyhelminthes –** Specimen studies: Fasciola, Taenia solium; Permanent Slides: Redia and cercaria larva of Fasciola hepatica.	CO2, CO6
	c	**Aschelminthes –** Specimen studies: Ascaris, Wuchereria bancrofti	
	Unit 3		

	a, b, c	**Annelida –** Specimen studies: Hirudinaria, Earthworm, Nereis; Permanent Slides: T.S. of Earthworm through 12^{th} and 18^{th} segment; T.S. of Hirudinaria through crop with and without diverticula			CO3, CO6
	Unit 4				
	a, b, c	**Arthropoda -** Specimen studies: Cancer, Melanopus, Millipede, Mouth parts of Cockroach			CO4, CO6
	Unit 5				
	a, b	**Mollusca –** Pila globosa, Octopus			CO5, CO6
	c	**Echinodermata –** Asrerias, Permanent Slides: Bipinnaria larva, Brachiolaria larva			
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	1. Verma, Prem Singh. *A Manual of Practical Life Sciences: Invertebrates*. S. Chand Publishing, 2000.			
	Other References	1. Practical Invertebrate Zoology; a Laboratory Manual for the Study of the Major Groups of Invertebrates, Excluding Protochordates by Rodney Phillips, And Cox, Francis Edmund Dales **2.** Practical Zoology Invertebrate by Dr. S.S. Lal			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**3**	**2**	**3**	**3**
CO2	**3**	**2**	**3**	**-**	**3**
CO3	**-**	**3**	**3**	**3**	**3**
CO4	**3**	**-**	**2**	**3**	**2**
CO5	**3**	**2**	**-**	**2**	**3**
CO6	**3**	**3**	**2**	**3**	**3**

BSZ253: HISTOLOGY OF ANIMAL LAB

L-T-P 0-0-3 Credit: 2

School : SBSR		**Batch : 2020-2023**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 3**	
1	Course Code	**BSZ253**	
2	Course Title	**Histology of Animals Lab**	
3	Credits	2	
4	Contact H (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objectives	To understand basis of animal histology From this course students will be able to learn on the importance of animal histology and their histological importance in research.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1 Understand the histology of animal kingdom CO2 Comprehend the importance of staining of tissues CO3 Comprehend the understanding of tools such as microscope used in animal histology CO4 Compare the differences between histological importance of different animal species CO5 To understand the overall importance of animal kingdom in terms of having significantly different biology	
7	Course Description	Course is composed of histological morphology of animals. This includes the general features, disease caused, their importance in the area of animal hitology.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction**	CO1, CO2
	A	Regulations in the lab	
	B	Brief of Equipment used	
	C	General animal histology lab set up	
	Unit 2	**Staining techniques**	
	A	Understanding staining techniques	CO2, CO3
	B	Tissue staining	
	C	Tissue preservation	
	Unit 3	**Tissue Slide**	CO1, CO3
	A	Preparation of Tissue Slides	
	B	Preservation of slides	
	C	Slide management	
	Unit 4	**Microscopy**	CO2, CO4
	A	Bright Field Microscopy	
	B	Dark Field Microscopy	
	C	Florescence Microscopy	
	Unit 5	**Histological importance**	C01, C05
	A	Type of histology	

	B	Type of staining needed	
	C	Method of identification	
	Mode of examination	Viva	
	Weightage Distribution	CA	ETE
		60%	40%
	Textbook/s*	1. Textbook on Basic Principles of Histology- CF Bowen	
	Other References	**Sue E Knoblaugh: Pathology Principles and Practices for Analysis of Animal Models** .	

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**1**	**1**	**1**	**1**

BSB211: Developmental Biology of Animals

L T P: 4-0-0 Credit: 4

School : SBSR		**Batch : 2020-2023**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 4**	
1	Course Code	**BSB211**	
2	Course Title	**Developmental Biology of Animals**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Status	Compulsory	
6	Course Objective	1. Introduction to Ultrastructure of sperm and ovum 2. Types of menstrual cycles in mammals 3. Molecular events of fertilization 4. Steps in development of eye	
7	Course Outcomes	After studying this course, students will be able to CO1: Determine Process of Spermatogenesis in humans and its hormonal control CO2: Summarize the Egg types and egg membranes in animals CO3: Describe the Cleavage types and role of yolk in cleavage CO4: Determine the Production of Antibiotics CO5: Analyze the Extra-embryonic membranes in humans CO6: Compare the Placenta: types; structure and function of placenta in humans	
8	Course Description	The course comprises of features of developmental biology processes like gametogenesis, fertilization, embryonic development and their events. It includes concept of potency; introduction to types of stem cells and embryonic stem cells.	
9	Outline syllabus		CO Mapping
	Unit 1	**Gametogenesis**	
	A	Process of Spermatogenesis in humans and its hormonal control; Process of oogenesis in humans and its hormonal control	**CO1**
	B	Ultrastructure of sperm and ovum- changes in sperm body during maturation	
	C	changes in ovum structure during maturation; layers of ovum and their function	
	Unit 2	**Female Reproductive Biology**	
	A	Types of menstrual cycles in mammals- Estrous cycle	**CO2**
	B	menstrual cycle in human females- role of hormones in menstruation	
	C	Egg types and egg membranes in animals	
	Unit 3	**Fertilization**	**CO3**
	A	Physical events of fertilization- changes in sperm before ejaculation, female genital tract environment, features of female reproductive tract that help in sperm motility	
	B	Molecular events of fertilization- changes in sperm before fertilization (capacitation),	

	C	site of fertilization, mechanisms to prevent polyspermy, sperm-egg fusion; Cleavage types and role of yolk in cleavage			**CO4**
	Unit 4	**Embryonic Development**			
	A	Formation of blastula (humans); Morphogenetic movements and process of gastrulation (humans)- formation of epiblast and hypoblast, formation of primitive streak			
	B	Extra-embryonic membranes in humans			
	C	Organogenesis: brain and eye (humans)- organizer and its role; notochord formation; formation of brain vesicles; steps in development of eye			
	Unit 5	**Embryonic Development- associated events**			**CO5**
	A	Placenta: types; structure and function of placenta in humans			
	B	Introduction to *in vitro* fertilization			
	C	Concept of Potency; introduction to types of stem cells and embryonic stem cells			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Developmental Biology. 6th Edition. Gilbert SF			
	Other References	Comparative Reproductive Biology. Ed: Schatten H, Constantinescu GM. Blaackwell Publishing. 2007			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**1**	**1**	**1**	**1**

BSZ204: Diversity of Chordates

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 04**	
1	Course Code	**BSZ204**	
2	Course Title	**Diversity of Chordates**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To understand about chordates and their general characteristics. 2. To understand the level of organization in different chordate species. 3. To understand the origin and evolutionary relationship in different class of chordates.	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Helps in understanding salient features of hemichordates and protochordates. CO2: To understand the origin of chordates and characteristic features of cyclostomes. CO3: To learn about origin of tetrapoda and general characteristics of amphibians and reptiles up to order. CO4: To learn about aves and mammals with special emphasis on important features. CO5: To understand about the different geographical realms and theories regarding animal distribution. CO6: To get a complete knowledge about chordates and brief idea about the evolution of animal species along with their distribution.	
7	Course Description	The 'Diversity of Chordates' course provides deeper knowledge about general characteristics of chordates along with origin of different classes. The important and special characteristics of each class has been discussed in more detail. The course also provides brief knowledge about distribution of animals.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to chordate and Protochordata**	
	A	General characteristics and Classification of chordates	CO1, CO6
	B	General characteristics of Hemichordata, and Urochordata	
	C	Larval forms in protochordates, Retrogressive metamorphosis in Urochordata	
	Unit 2	**Origin of chordates, Agnatha and Pisces**	
	A	Dipleurula concept and Echinoderm theory of origin of chordates	CO2, CO6
	B	Advanced features of vertebrates over protochordata	

	C	General characteristics of cyclostomes, Osmoregulation and parental care in fishes			
	Unit 3	**Amphibians and Reptilia**			
	A	Origin of *Tetrapoda*;			CO3, CO6
	B	General characteristics and classification up to classes in amphibians, Parental care in Amphibians			
	C	General characteristics and classification up to order in reptilia; Poison apparatus and Biting mechanism in snakes			
	Unit 4	**Aves and mammals**			
	A	General characteristics and classification up to order in Aves; *Archaeopteryx*-- a connecting link			CO4, CO6
	B	Flight adaptations and migration in birds			
	C	General characters and classification up to order in mammalia; Locomotory appendages in mammalia			
	Unit 5	**Zoogeography**			
	A	Zoogeographical realms, Theories pertaining to distribution of animals			CO5, CO6
	B	Plate tectonic and Continental drift theory			
	C	Distribution of vertebrates in different realms			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	3. Cleveland P. Hickman, Jr., Larry S. Roberts, Allan Larson (2003). Animal Diversity. 3rd Edition. McGraw–Hill			
	Other References	1. Kotpal, R. L. Modern Textbook of Zoology: Vertebrates. Rastogi Publications, 2012. 2. Purves et al: Life-the Science of Biology, (7thed. 2004, Sinauer) 3. Parker &Haswell: Textbook of Zoology, Vol. II (2005, Macmillan)			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSB202: Metabolic Pathways

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 04**	
1	Course Code	**BSB202**	
2	Course Title	**Metabolic Pathways**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1.Carbohydrate Metabolism 2. Lipid metabolism 3. Amino Acid Metabolism 4. Electron Transport Chain 5. Nucleotide Metabolism	
6	Course Outcomes	After studying this course, students will be able to CO1: Evaluate metabolism of carbohydrates by different pathways CO2: Interpret the metabolism of different types of lipids CO3: Determine and differentiate between gluconeogenic and ketogenic amino acids CO4: Analyze and learn the electron transport chain CO5: Differentiate between de novo and salvage pathways for biosynthesis of purines and pyrimidines CO6: Understand metabolic pathways inside living cells such as metabolism of carbohydrates, lipids, nucleic acids and also carbon dioxide fixation.	
7	Course Description	This course contains various metabolic pathways inside living cells such as metabolism of carbohydrates, lipids, nucleic acids and also carbon dioxide fixation. After studying course, students will be able to learn various metabolic processes going inside the body of living cells.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Glycolysis	CO1
	B	Glycogenolysis, Kreb's cycle and net energy yield	CO1
	C	Pentose Phosphate pathway and its clinical significance	CO1
	Unit 2		
	A	Beta oxidation of fatty acids and energy yield	CO2
	B	Cholesterol synthesis	CO2
	C	Synthesis of fatty acids	CO2
	Unit 3		
	A	Introduction to gluconeogenic and ketogenic amino acids	CO3
	B	Degradation of amino acids	CO3
	C	Synthesis of amino acids, Urea Cycle	CO3
	Unit 4		

	A	ATP synthase and proton transfer during electron transfer			CO4
	B	Coupling of electron transport to oxidative phosphorylation			CO4
	C	Inhibitors of electron transport			CO4
	Unit 5				
	A	Biosynthesis of purines			CO5
	B	Biosynthesis of pyrimidines			CO5
	C	Structure of DNA and RNA			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Nelson D.L., Cox M. M., "Principles of Biochemistry" W. H. Freeman, 2012.			
	Other References	Stryer L., "Biochemistry", W. H. Freeman, 2010. Jain JL., "Principles of Biochemistry", S. Chand Publications.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**2**	**1**	**2**	**1**
CO2	**3**	**3**	**2**	**1**	**1**
CO3	**3**	**3**	**1**	**1**	**2**
CO4	**3**	**3**	**2**	**1**	**1**
CO5	**3**	**3**	**2**	**1**	**1**
CO6	**3**	**3**	**3**	**3**	**3**

BSB205: Genetic Engineering

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 4**	
1	Course Code	**BSB205**	
2	Course Title	**Genetic Engineering**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. This course provides a comprehensive introduction to fundamentals and applications of genetic engineering 2. The course is designed to give students an up-to-date understanding of a wide array of techniques that are used in genetic manipulation 3. This course also focuses on various DNA sequencing and DNA amplification techniques 4. The course also highlights the modern methods of gene and protein probing	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Identify various molecular tools for genetic engineering; host cells and right kind of enzymes to perform DNA digestion, ligation etc. CO2: Classify different kinds of cloning vectors and their uses. CO3: Analyze the use of Polymerase chain reaction in molecular cloning along and describe various DNA sequencing techniques. CO4: Explain different ways of cloning blunt ended DNA fragments and transfection as well as transformation methods. CO5: Recognize different types of gene libraries and apply different techniques of probing gene libraries. CO6: This course provides a comprehensive introduction to fundamentals and applications of genetic engineering	
7	Course Description	The 'Genetic Engineering' course outlines the definition, procedure and study of molecular tools in genetic engineering for undergraduate students. This course encompasses the detailed procedure of genetic engineering so that students can become familiar with the Recombinant DNA Technology and its applications.	
8	Outline syllabus		CO Mapping
	Unit 1	**Molecular Tools of Genetic Engineering**	
	A	Restriction enzymes Type I, II and III	CO1
	B	DNA polymerase and RNA polymerase' reverse transcriptase	

	C	Modifying enzymes terminal deoxynucleotidyl transferase, polynucleotide kinase, Phosphatases and DNA ligase			
	Unit 2	**Cloning Vectors**			
	A	Introduction to cloning vectors;			CO2
	B	Phage vectors; cosmid vectors; phagemid vectors;			
	C	Plasmid vectors BAC vectors and YAC vectors			
	Unit 3	**Nucleic Acid Isolation and Amplification**			
	A	Isolation of nucleic acid; PCR and its application			CO3
	B	cDNA synthesis; RT-PCR			
	C	Nucleic acid sequencing			
	Unit 4	**Cloning Techniques**			
	A	Steps to cloning; Cloning after restriction digestion			CO4
	B	blunt and cohesive end ligation; creation of restriction sites by PCR			
	C	cloning using linkers and adapters; cloning after homopolymer tailing; Strategies for cloning PCR products – TA cloning			
	Unit 5	**Techniques of Genetic engineering**			
	A	Library construction			CO5
	B	DNA hybridization, colony hybridization and in-situ hybridization			
	C	Screening methods; Blotting techniques (Southern, Northern and Western blotting)			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	**Genomes 3.** Brown TA. Garland Science Publishing @ 2007. ISBN 08153-41385.			
	Other References	1. **Molecular Biotechnology. Principles and Applications.** 3rd Edition. Glick BR and Pasternak JJ. ASM Press @2003. ISBN 1-55581-224-4. 2. **Gene cloning and DNA Analysis- An Introduction.** 6th Edition. Wiley-Blackwell. Brown TA @2010.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

BSB207: Immunology

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 04**	
1	Course Code	**BSB207**	
2	Course Title	**Immunology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. Understand the concepts of immune system, immunity, immune responses, cells and organs of immune system 2. Describe about antigens, antibodies and their types & properties, qualitative and quantitative analysis of antigens or antibodies for diagnostic purposes, role of molecules like MHC and cytokines in generation of immune response 3. Explore immunology as a basic toll for medical applications	
6	Course Outcomes	CO1: Understand immune system, immunity and immune response. CO2: Describe cells and organs of immune system. CO3: Illustrate about antigens, antibodies and their types & properties. CO4: Demonstrate the qualitative and quantitative analysis of antigens or antibodies for diagnostic purposes. CO5: Identify the role of molecules like MHC and cytokines in generation of immune response. CO6: Explore immunology as a basic tool for medical applications.	
7	Course Description	This course will cover the major topics in Immunology, including immune system, lines of defense, immunity, immune response, cells and organs of immune system, "antigens, antibodies and their types & properties", qualitative and quantitative analysis of antigens or antibodies for diagnostic purposes, "role of molecules like MHC and cytokines in generation of immune response".	
8	Outline syllabus		CO Mapping
	Unit 1	**Immune responses**	CO1, CO6
	A	Innate and acquired immunity, humoral and cell mediated immune response	
	B	Lines of defense and various barriers	
	C	Clonal nature of immune response, Primary and secondary immune response	
	Unit 2	**Cells and organs of Immune system**	CO2, CO6

	A	Primary and secondary lymphoid organs, their structure and function			
	B	Cells of immune system; hematopoiesis and differentiation			
	C	Structure and role of B and T lymphocytes, NK cells, macrophages, Dendritic cells, mast cells, eosinophil's, basophils and neutrophils			
	Unit 3	**Antigen and Antibody**			CO3, CO6
	A	Antigen and Immunogen, antigenicity vs immunogenicity, properties of antigens			
	B	Antibody molecule, types and structure			
	C	Role in immune response, monoclonal antibody and hybridoma technology			
	Unit 4	**Antigen Antibody Interaction**			CO4, CO6
	A	Antigen antibody interaction: Immunodiffusion (double and radial)			
	B	RIA & ELISA			
	C	Immunoelectrophoresis			
	Unit 5	**MHC and Cytokines**			CO5, CO6
	A	MHC molecule and its types, structure and their function			
	B	Cytokines and their role in immune response			
	C	Overview of hypersensitivity and autoimmunity			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Kuby Immunology,7th Edition-R.A. Goldsby, Thomas			
	Other References	1. Immunology-A short course,4th Edition-Eli Benjamini, Richard Coico, Geoffrey Sunshine, (Wiley-Liss). 2. Fundamentals of Immunology, William paul 3. Immunology, By Roitt and others.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSP205: Genetic Engineering Lab

L T P: 0-0-3 Credit: 2

School : SBSR		**Batch : 2020-23**			
Program: B.Sc.		**Current Academic Year: 2020-21**			
Branch: Life Sciences		**Semester: 04**			
1	Course Code	**BSP205**			
2	Course Title	**Genetic Engineering Lab**			
3	Credits	2			
4	Contact Hours (L-T-P)	0-0-3			
	Course Status	**Compulsory**/Elective			
5	Course Objective	To give students a introduction and hands on basic experiments of genetic engineering technique			
6	Course Outcomes	CO1: Perform experiments on DNA isolation from biological resource and understanding different methods for DNA isolation CO2: Perform experiments on RNA isolation. CO3: Validation of isolated DNA and RNA content. CO4: Amplification of particular gene of interest by PCR method. CO5: Validation of amplified gene by electrophoresis method. CO6: Performing basic experiments of Genetic engineering technique.			
7	Course Description	This course is designed to make students a thorough understanding of Database usage, tools and software for each bioinformatics applications			
8	Outline syllabus				CO Mapping
	Unit 1	**DNA isolation**			CO1, CO6
	Unit 2	**RNA isolation**			CO2, CO6
	Unit 3	**Validation of isolated DNA and RNA**			CO3, CO6
	Unit 4	**Amplification of specific gene of interest by PCR method**			CO4, CO6
	Unit 5	**Validation of amplified gene by electrophoresis method**			CO5, CO6
	Mode of exam	Jury/Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	Brown T.A, "Gene Cloning and DNA Analysis:An Introduction", John Wiley & Sons, 2010.			
	Other References	1. Old R.W and Primrose S.B., "Principles of Gene Manipulation", Blackwell Scientific Publication, 2002. 2. Dale W., von Schantz M. and Plant N., "From Genes to Genomes: Concepts and Applications of DNA Technology", John Wiley, 2011.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

BSZ254: Biology of Chordates Lab

L T P: 0-0-3 **Credit: 2**

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 04**	
1	Course Code	**BSZ254**	
2	Course Title	**Biology of Chordates Lab**	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	1. To appreciate the range and diversity of organisms within Phylum Chordata. 2. To learn the distinguishing characteristics of each major vertebrate class. 3. To become skilled in the use of a dichotomous key to identify animal specimens. 4. To design your own dichotomous key.	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Know the characteristic features of hemichordates. CO2: Understand the characteristic features of cyclostomes and pisces. CO3: Learn about the characteristics of amphibians and reptiles. CO4: Get complete understanding about aves and mammalian species. CO5: Understand about the distribution of species across different zoogeographical realms. CO6: To get a complete knowledge about various species that comes under phylum chordata.	
7	Course Description	The aim of this course is to provide better understanding about different species of hemichordates and chordates. The student get acquainted with various characteristic features of chordates along with zoogeographical distribution across the world.	
8	Outline syllabus		CO Mapping
	Unit 1	**General survey of chordates through charts/models and e-resources**:	
	a, b, c	**Hemichordata**: Balanoglossus; Protochordata - Herdmania, Doliolum, and Branchiostoma, T.S. Branchiostoma through different regions	CO1, CO6
	Unit 2		
	a, b	**Cyclostomata** – Myxine, Petromyzon and Ammocoetes larva	CO2, CO6
	c	**Chondrichthyes -** Zygaena, Pristis, Narcine, Trygon and Rhinobatus **Actinopterygii** – Polypterus, Labeo rohita, Hippocampus, Syngnathus, Exocoetus, Lophius, Solea and Anguilla	

		Dipneusti (Dipnoi) – Any of the lungfishes			
	Unit 3				
	a, b	**Amphibia** – Necturus, Proteus, Amphiuma, Salamandra, Ambystoma, Hyla, Rhacophorus, Ichthyophis and Axolotl larva			CO3, CO6
	c	**Reptilia**- Tortoise, Turtle, Hemidactylus, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python, Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis and Alligator Key for identification of poisonous and non-poisonous snakes			
	Unit 4				
	a, b	**Aves**: Anas, Ardea, Milvus, Pavo, Tyto, Alcedo, Eudynamis, Casuarius and Struthio; types of beaks and claws			CO4, CO6
	c	**Mammalia** – Echidna, Ornithorhynchus, Macropus, Erinaceus, Sorex, Loris, Macaca, Manis, Hystrix, Funambulus, Felis, Capra, Canis, Herpestes, Pteropus and Leo			
	Unit 5				
	a, b, c	Power point presentation on study of animals from any two zoogeographical realms.			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Textbook/s*	Verma, Prem Singh. *A Manual of Practical Zoology: Chordates*. S. Chand Publishing, 2000.			
	Other References	1. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. 2. Pough H. Vertebrate life, VIII Edition, Pearson International. 3. Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSZ301: Animal Physiology & Histology II

L-T-P 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 05**	
1	Course Code	**BSZ301**	
2	Course Title	**Animal Physiology & Histology II**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To understand the various physiological aspects of animal body. 2. To understand the histology of different systems of the body. 3. To understand the functioning of different body systems.	
6	Course Outcomes	After studying this course, students will be able to CO1 : Get complete knowledge of the digestive system CO2 : Understand the functioning of the respiratory system CO3 : Know about the excretory system and its role CO4 : Understand the importance of the blood CO5 : Get complete knowledge about the functioning of heart CO6: Understand the various aspects of different biological systems of the animal body	
7	Course Description	This course contains various components of animal physiology and histology. The course highlights the different biological systems like digestive, respiratory, excretory and circulatory. It helps in understanding the functioning of these systems and their importance. The course also highlights the histology of these systems.	
8	Outline syllabus		CO Mapping
	Unit 1		
	A	Histology and functions of gastrointestinal tract and its associated glands	CO1, CO6
	B	Mechanical and chemical digestion of food; Role of gastrointestinal hormones	CO1, CO6
	C	Control and action of GI Tract secretions; Absorption of carbohydrates, lipids, and protein	CO1, CO6
	Unit 2		
	A	Histology of trachea and lung; Pulmonary ventilation; Respiratory volumes and capacities	CO2, CO6
	B	Transport of oxygen in the blood (oxygen-hemoglobin and myoglobin dissociation curve and its influencing factors), Carbon monoxide poisoning	CO2, CO6
	C	Carbon dioxide transport in the blood; Regulation of acid-base balance; Control of respiration	CO2, CO6
	Unit 3		
	A	Histology of kidney	CO3, CO6

	B	Renal blood supply; Mechanism and regulation of urine formation			CO3, CO6
	C	Regulation of acid-base balance; Renal failure and dialysis			CO3, CO6
	Unit 4				
	A	Composition; Structure and functions of haemoglobin			CO4, CO6
	B	Haemopoiesis; Haemostasis			CO4, CO6
	C	Coagulation of blood; Disorders of blood			CO4, CO6
	Unit 5				
	A	An outline structure of heart; Origin and conduction of cardiac impulse; Cardiac cycle			CO5, CO6
	B	Cardiac output and its regulation-Frank-Starling Law of the heart			CO5, CO6
	C	Autonomic control and chemical regulation of heart rate, Blood pressure and its regulation; Electrocardiogram			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.			
	Other References	1. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology, XI Edition. John Wiley & Sons. 2. Victor, P. Eroschenko. (2008). diFore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSZ302: ECOLOGY

L-T-P 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**	
Program: B.Sc		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 5**	
1	Course Code	BSZ302	
2	Course Title	Ecology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To enable students bridge the gap between theoretical concepts and practical aspects in ecology 2. To have In-depth knowledge and extended approach for applying natural concepts of ecology with appropriate laws for creation of employment in the field of ecological management.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: To study about the history and taxonomic importance of ecological systems. CO2: Design strategies to understand characteristics for population dynamics and other attributes. CO3: To separate different communitybased upon structure, origin or other basis with focus on succession. CO4: To diversify different ecosystems and elucidate the underlying ,echanism governing the different atmospheric cycle. CO5: To formulate and apply the priorities of environment in India and apply them to ecological zones in India. CO6: Create and execute strategies for integrating different aspects of ecology for applied understanding.	
7	Course Description	This introduction to ecology covers population, community and ecosystem level ecology of plants and animals. It focuses on the interactions of organisms with each other and with their abiotic environment. In ecology nearly everything depends on other things, i.e., the presence or absence of other organisms or whether it was a wet or dry year, etc. This makes it very difficult to consider facts in isolation, and this class will focus on understanding the interconnections among different concepts and facts. Although the class focuses on basic ecology, we will often consider the relationships between basic ecological science and current environmental problems.	
8	Outline syllabus		CO Mapping
	Unit 1	**INTRODUCTION TO ECOLOGY**	**CO1, CO6**
	A	Introduction to ecology; Scope of ecology, Relation of ecology to other sciences, History of ecology	CO1
	B	Basic concepts of ecology, Approaches to Ecology: Based upon -taxonomic affinities, habitat, level of organization	CO1

	C	Laws of limiting factors, Study of climatic factors-light, temperature, rainfall and wind.	CO1, CO6
	Unit 2	**POPULATION ECOLOGY**	**CO2, CO6**
	A	Basic concepts of ecology, Attributes (characteristics) of population-based on size, density, dispersion, age structure, natality, mortality and life tables	CO2
	B	Population dynamics: Exponential and logistic growth (equation and patterns), Theory of population growth	CO2
	C	population ecology and evolution, r and k selection, modification of logistic theory; regulation of Population density	CO2, CO6
	Unit 3	**COMMUNITY ECOLOGY**	**CO3, CO6**
	A	Community characteristics, Composition, structure, origin and development of a community	CO3
	B	Characters used in community structure- analytical and synthetic characters; Classification of communities	CO3
	C	Basic type of Succession; Climax concept in succession; Ecotone and edge effect	CO3, CO6
	Unit 4	**ECOSYSTEM**	**CO4**
	A	Types of ecosystems, Concepts of food chain and food web,Structure of ecosystem, Functional aspects of ecosystem	CO4
	B	productivity of ecosystem, Energy flow through the ecosystem, Y shaped energy flow model	CO4
	C	Nutrient cycles inecosystem, Atmospheric cycles in ecosystem- Carbon, nitrogen and sulphur cycles	CO4, CO6
	Unit 5	**Environmental priorities in India & applied ecology**	**CO5, CO6**
	A	Population stabilization, Integrated land use planning; Healthy cropland and grassland, conservation of biological diversity	CO5
	B	Water resource management, Water quality management in India, Ecological sub-regions of India	CO5
	C	Endangered fauna in India, Indian board for wild life (IBWL), project tiger, Concept of Biosphere sphere	CO5, CO6
	Mode of examination	Theory	
	Weightage Distribution	CA / MTE / ETE	
		30% / 20% / 50%	
	Text book/s*	**1.** Colinvaux, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.	
	Other References	**2.** Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole **3.** Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.	

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

BSB303: Bioinformatics

L T P: 4-0-0 Credit: 4

School: SBSR		**Batch : 2020-2023**
Program: B.Sc. (H)		**Current Academic Year: 2020-21**
Branch: Life Sciences		**Semester: 05**
1	Course Code	**BSB303**
2	Course Title	**Bioinformatics**
3	Credits	4
4	Contact Hrs. (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	**1.** To acquire a fundamental knowledge of bioinformatics by studying an overview of bioinformatics, fields and their scope in India as well as abroad. **2.** To have introduction about database design and Biological database. **3.** To attain knowledge about data storage model, retrieval of information and integration. **4.** To learn the procedure of sequence alignment and phylogenetic analysis by using different online and offline tool along with their algorithms. **5.** To understand about gene organization, genome sequencing, gene prediction methods and motif search methods. **6.** To have a clear-cut idea about bioinformatics scope, concepts and major databases/tools/softwares with their algorithms used for various applications.
6	Course Outcomes	**CO1:** Understand about overview of bioinformatics scope and their disciplines. Generation of large-scale data in the field of molecular biology. **CO2:** Review of database source, database management system, Biological databases and their classification. Sequences databases and specialized databases. **CO3:** To attain knowledge about data storage model/format, retrieval of information and integration. **CO4:** Understanding about different sequence formats. Perform sequence alignment and phylogenetic prediction with different tools/softwares with algorithm. **CO5:** To apply different techniques for gene prediction, motif search and genome sequencing analysis. **CO6:** Basic knowledge of various bioinformatics concepts, scope, database usage, tools and software used for each application along with their algorithms.
7	Course Description	To acquire a fundamental knowledge of basic computational biology by studying, designing and analyzing *in-silico* experiments. To learn the

		procedure of sequence alignment and its application in molecular phylogenetics. To understand different techniques used for gene prediction and creation of biological databases.			
8	Outline syllabus				**CO Mapping**
	Unit 1	**Introduction to Bioinformatics**			**CO1**
	A	Introduction to bioinformatics; Scope and importance			CO1
	B	Large scale generation of molecular biology data; Different fields in bioinformatics			CO1
	C	Omics; Bioinformatics scenario in India & the rest of the world			CO1
	Unit 2	**Databases**			**CO2**
	A	Introduction to data types and Sources; Classification and Presentation of Data; Quality of data; Private and Public data sources			CO2
	B	General Introduction of Biological Databases: Nucleic acid databases, Protein databases			CO2
	C	Specialized Genome databases, Structure databases			CO2
	Unit 3	**Data Storage and Integration**			**CO3**
	A	Flat files, relational, object-oriented databases and controlled vocabularies			CO3
	B	File Format (GenBank, DDBJ, FASTA, PDB, SwissProt); Introduction to Metadata			CO3
	C	File Storage; Boolean Search and Fuzzy Search, Data integration			CO3
	Unit 4	**Sequence Alignments and Analysis**			**CO4**
	A	Biological sequences and Alignment Methods			CO4
	B	Global and Local alignment, Pairwise alignment and Multiple sequence alignment			CO4
	C	Phylogenetic tree analysis			CO4
	Unit 5	**Gene, Genome and Analysis**			**CO5**
	A	Structure of Prokaryotic and Eukaryotic gene			CO5
	B	DNA and genome sequencing Motif and consensus; Gene Expression			CO5
	C	Gene finding composition-based finding, sequence motif-based finding			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Xiong Jin "Essential Bioinformatics", Cambridge University Press.2006.			
	Other References	1. Attwood TK., "Introduction to Bioinformatics", Pearson Education, 2006. 2. J. S, Ignacimuthu.S, "Basic Bioinformatics", Narosa, 2013. 3. Roy Darbeshwar., "Bioinformatics", .Narosa,2009.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

BSZ304: Fish and Fisheries

L-T-P 4-0-0 Credit: 4

School : SBSR		**Batch : 2020-2023**	
Program: B.Sc.(H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 5**	
1	Course Code	**BSZ304**	
2	Course Title	**Fish and Fisheries**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
6	Course Objective	1. Introduction of pisces 2. Morphology and physiology of pisces 3. Fishing crafts and Gears 4. Fishery technology & fish in research	
7	Course Outcomes	After studying this course, students will be able to CO1: Determine classification based on feeding habit, habitat and manner of reproduction CO2: Evaluate osmoregulation in Elasmobranchs CO3: Interpret the Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal CO4: Analyse the Extensive, semi-intensive and intensive culture of fish CO5: Determine Sensory evaluation of fresh fish and fish products CO6 : Analyze and study Zebrafish as model for research	
8	Course Description	This course contains various concepts of fishes and fisheries ranging from structure and classification, reproduction, physiology, electric organs and their migration patterns. After studying course, students will be able to learn different types of fisheries and different crafts and gears related to it.	
9	Outline syllabus		CO Mapping
	Unit 1	**Introduction of pisces**	**CO1**
	A	Introduction to fishes, General description of fish;	
	B	Account of systematic classification of fishes (upto order);	
	C	Classification based on feeding habit, habitat and manner of reproduction.	
	Unit 2	**Morphology and physiology of pisces**	**CO2**
	A	Morphology and Physiology: Types of fins and their modifications; Locomotion in fishes; Types of Scales, Gills and gas exchange	
	B	Swim Bladder: Types and role in Respiration, Osmoregulation in Elasmobranchs; Reproductive strategies	
	C	Electric organs; Bioluminiscience; Mechanoreceptors; Parental care and Migration in fishes.	
	Unit 3	**Fisheries**	**CO3**
	A	Types of fisheries- Inland Fisheries and Marine Fisheries;	
	B	Environmental factors influencing the seasonal variations in fish catches in the Arabian Sea and the Bay of Bengal	
	C	Fishing crafts and Gears; Depletion of fisheries resources; Fisheries law and regulations	
	Unit 4	**Aquaculture**	**CO4**

	A	Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture			
	B	Composite fish culture; Brood stock management; Induced breeding of fish; Management Role of water quality in aquaculture			
	C	Preservation and processing of harvested fish, Fishery by-products			
	Unit 5	**Fishery technology & fish in research**			**CO5**
	A	Chemical composition of fish-lipids and protein, Post mortem changes in fish –glycolysis, nucleotide degradation, bacterial spoilage, autolysis, rigor mortis			
	B	autolytic enzymes. Sensory evaluation of fresh fish and fish products			
	C	Iced storage- different types of ice and their production flow ice and gel ice; Transgenic fish, Zebrafish as model for research			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	D. H. Evans and J. D. Claiborne, The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor.The Senses of Fish: Adaptations for the Reception of Natural Stimuli, Springer, Netherlands			
	Other References	1.Khanna, S. S., and H. R. Singh. A text book of fish biology and fisheries. Narendra Publishing House, 2011. 2.Bone, Quentin, and Richard Moore. Biology of fishes. Taylor & Francis, 2008.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**1**	**1**
CO3	**3**	**3**	**2**	**1**	**1**
CO4	**2**	**2**	**2**	**1**	**1**
CO5	**2**	**2**	**2**	**2**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSZ309: Applied Zoology

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-2023**	
Program: BSc		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 05**	
1	Course Code	**BSZ309**	
2	Course Title	**Applied Zoology**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Core	
5	Course Objectives	1. To enable the students to understand the different types of diseases from the insect world. 2. In-depth knowledge about various practices followed by the farmers as a source of income other than agriculture.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: To learn about the various types of interactions in among different species and life history & pathogenicity of few species. CO2: To know about the diseases spread by parasitic worms and their control. CO3: To learn about the economic importance of insects. CO4: To learn about the apiculture, lac culture and sericulture methodologies and their importance. CO5: To learn about the poultry farming and fish culture methodologies. CO6: To understand the effect of insect world in our life and to know about certain animals used by farmers as an extra income source other than agriculture.	
7	Course Description		
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Host-parasite Relationship and epidemiology of diseases**	
	A	Host, Definitive host, Intermediate host, Parasitism, Symbiosis, Commensalism, Reservoir, Transmission	CO1, CO6
	B	Prevention and control of diseases: Tuberculosis, typhoid	CO1, CO6
	C	Life history and pathogenicity of *E.histolytica, P. vivax* and *T. gambiense*	CO1, CO6
	Unit 2	**Zooparasitic Helminthes and their control**	
	A	Parasites infecting man as well as domestic animals, Trematoda, Cestoda, nematodes	CO2, CO6
	B	Parasites infecting only domestic animals	CO2, CO6
	C	Control of Zoo-parasitic helminthes	CO2, CO6
	Unit 3	**Economic Importance of insects**	
	A	Harmful insects; Insects as carrier of disease of human beings, livestock and plant disease	CO3 , CO6

	B	Biology, Control and damage caused by *Helicoverpa armigera*, *Pyrilla perpusilla* and *Papilio demoleus*			CO3, CO6
	C	Life cycle, damage caused and prevention & control of insects affecting human health- Cockroach, House flies, Mosquitoes and sand flies; Beneficial insects			CO3, CO6
	Unit 4	**Apiculture, Lac culture and Sericulture**			
	A	Honey bee and their social organization and apiculture & it's importance			CO4, CO6
	B	Life cycle of Lac, Lac culture and its importance, Enemies of lac cultivation and economic importance			CO4, CO6
	C	Life cycle of silk moth, sericulture and its diseases, Status of sericulture industry in India			CO4, CO6
	Unit 5	**Poultry Farming and Fish Technology**			
	A	Principles of poultry breeding and rearing of Chickens; Disease of poultry			CO5, CO6
	B	Fish culture; types of hatching pits; Nursery and rearing ponds			CO5, CO6
	C	Methods of fishing; preservation of fish; Fish culture and water pollution and Polyculture			CO5, CO6
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Dunham R.A. (2004). *Aquaculture and Fisheries Biotechnology Genetic Approache*s. CABI publications, U.K. 2. Pedigo, L.P. (2002). *Entomology and Pest Management*, Prentice Hall			
	Other References	1. G. S. Shukla and V. B. Upadhyay (2017) Economic Zoology: A textbook for University students, Fifth Edition, Rastogi publication, Meerut.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**3**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSZ303 Comparative Anatomy of Vertebrates

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-23**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 05**	
1	Course Code	**BSZ303**	
2	Course Title	**Comparative Anatomy of Vertebrates**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to make the students understand the various types of interactions amongst various life forms, the anatomy as well as the economic importance of various vertebrates	
6	Course Outcomes	**CO1** Understand about the various types of interactions in among different species and life history & pathogenicity of few species. **CO2** Know about the diseases spread by parasitic worms and their control **CO3** Understand about the economic importance of insects. **CO4** Understand about the apiculture, lac culture and sericulture methodologies and their importance. **CO5** Understand about the poultry farming and fish culture methodologies. **CO6** Understand the effect of insect world in our life and to know about certain animals used by farmers as an extra income source other than agriculture.	
7	Course Description	This course mainly comprises the various types of interactions amongst various life forms, the anatomy as well as the economic importance of various vertebrates. Students will be able to understand the various methodologies that are used for apiculture, lac culture, sericulture, poultry farming, fish culture etc.	
8	Outline syllabus		CO Mapping
	Unit 1	**Integumentary System & Skeletal System**	**CO1, CO6**
	A	Structure, functions and derivatives of integument	
	B	Overview of axial and appendicular skeleton	
	C	Jaw suspensorium, Visceral arches	
	Unit 2	**Digestive System & Respiratory System**	**CO2, CO6**
	A	Alimentary canal and associated glands	
	B	Dentition	

	C	Skin, gills, lungs and air sacs, Accessory respiratory organs			
	Unit 3	**Circulatory System & Urinogenital System**			**CO3, CO6**
	A	General plan of circulation, evolution of heart and aortic arches			
	B	Succession of kidney			
	C	Evolution of urinogenital ducts, Types of mammalian uteri			
	Unit 4	**Nervous System & Sense Organs**			**CO4, CO6**
	A	Comparative account of brain Autonomic nervous system			
	B	Spinal cord, Cranial nerves in mammals			
	C	Classification of receptors, Brief account of visual and auditory receptors in man			
	Unit 5	**Embryology**			**CO5, CO6**
	A	Fertilization, Cleavage			
	B	Gastrulation and Neurulation			
	C	Extraembryonic membranes in reptiles, birds and mammals.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Rastogi publication; comparative anatomy and developmental biology, 2 edition			
	Other References	RK Saxena, comparative anatomy of vertebrates, 2 edition			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSP302: Bioinformatics Lab

L-T-P 0-0-3 Credits 2

School: SBSR		**Batch : 2020-2023**
Program: B.Sc.(H)		**Current Academic Year: 2020-21**
Branch: Life Sciences		**Semester: 05**
1	Course Code	**BSB303**
2	Course Title	**Bioinformatics**
3	Credits	4
4	Contact Hrs. (L-T-P)	4-0-0
	Course Status	Compulsory
5	Course Objective	• To acquire a fundamental knowledge of bioinformatics by studying an overview of bioinformatics, fields and their scope in India as well as abroad. • To have introduction about database design and Biological database. • To attain knowledge about data storage model, retrieval of information and integration. • To learn the procedure of sequence alignment and phylogenetic analysis by using different online and offline tool along with their algorithms. • To understand about gene organization, genome sequencing, gene prediction methods and motif search methods. • To have a clear-cut idea about bioinformatics scope, concepts and major databases/tools/softwares with their algorithms used for various applications.
6	Course Outcomes	**CO1:** Understand about overview of bioinformatics scope and their disciplines. Generation of large-scale data in the field of molecular biology. **CO2:** Review of database source, database management system, Biological databases and their classification. Sequences databases and specialized databases. **CO3:** To attain knowledge about data storage model/format, retrieval of information and integration. **CO4:** Understanding about different sequence formats. Perform sequence alignment and phylogenetic prediction with different tools/softwares with algorithm. **CO5:** To apply different techniques for gene prediction, motif search and genome sequencing analysis. **CO6:** Basic knowledge of various bioinformatics concepts, scope, database usage, tools and software used for each application along with their algorithms.
7	Course Description	To acquire a fundamental knowledge of basic computational biology by studying, designing and analyzing *in-silico* experiments. To learn the procedure of sequence alignment and its application in molecular phylogenetics. To understand different techniques used for gene prediction and creation of biological databases.

8	Outline syllabus				**CO Mapping**
	Unit 1	**Introduction to Bioinformatics**			**CO1**
	A	Introduction to bioinformatics; Scope and importance			CO1
	B	Large scale generation of molecular biology data; Different fields in bioinformatics			CO1
	C	Omics; Bioinformatics scenario in India & the rest of the world			CO1
	Unit 2	**Databases**			**CO2**
	A	Introduction to data types and Sources; Classification and Presentation of Data; Quality of data; Private and Public data sources			CO2
	B	General Introduction of Biological Databases: Nucleic acid databases, Protein databases			CO2
	C	Specialized Genome databases, Structure databases			CO2
	Unit 3	**Data Storage and Integration**			**CO3**
	A	Flat files, relational, object-oriented databases and controlled vocabularies			CO3
	B	File Format (GenBank, DDBJ, FASTA, PDB, SwissProt); Introduction to Metadata			CO3
	C	File Storage; Boolean Search and Fuzzy Search, Data integration			CO3
	Unit 4	**Sequence Alignments and Analysis**			**CO4**
	A	Biological sequences and Alignment Methods			CO4
	B	Global and Local alignment, Pairwise alignment and Multiple sequence alignment			CO4
	C	Phylogenetic tree analysis			CO4
	Unit 5	**Gene, Genome and Analysis**			**CO5**
	A	Structure of Prokaryotic and Eukaryotic gene			CO5
	B	DNA and genome sequencing Motif and consensus; Gene Expression			CO5
	C	Gene finding composition-based finding, sequence motif-based finding			CO5
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	Xiong Jin “Essential Bioinformatics”, Cambridge University Press.2006.			
	Other References	• Attwood TK., “Introduction to Bioinformatics”, Pearson Education, 2006. • J. S, Ignacimuthu.S, “Basic Bioinformatics”, Narosa, 2013. • Roy Darbeshwar., “Bioinformatics”, .Narosa,2009.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

BSZ358: Comparative Anatomy of Vertebrates Lab

L-T-P 0-0-3 Credits 2

School : SBSR		**Batch: 2020-2023**	
Program: B.Sc. H		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 5**	
1	Course Code	BSZ358	
2	Course Title	Comparative Anatomy of Vertebrates Lab	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	1. To appreciate the range and diversity of organisms within the vertebrates. 2. To learn the anatomical characteristic features of all vertebrate classes. 3. To understand the differences in the body systems of the vertebrate species. 4. To comprehend the evolution via comparing vertebrate classes anatomically and physiologically.	
6	Course Outcomes	After the successful completion of this course students shall be able to: CO1: Know about the integumentary and skeletal system of vertebrates in general. CO2: Understand the digestive and respiratory systems of vertebrates. CO3: Learn about the characteristics features of circulatory and urinogenital systems found in vertebrate species. CO4: Get complete understanding about sense organs. CO5: Understand about the course of embryological development. CO6: To get a complete knowledge about various anatomical, physiological and developmental characteristics of vertebtrates.	
7	Course Description	The aim of this course is to provide better understanding about different species of vertebrates. The student get acquainted with various characteristic features of vertebrates in context to anatomy and development.	
8	Outline syllabus		CO Mapping
	Unit 1	**Integumentary System & Skeletal System**	
	a, b	To study placoid, cycloid and ctenoid scales through permanent slides/photographs	CO1, CO6
	c	To study disarticulated skeleton of any two : Frog, *Varanus,* Fowl, Rabbit	
	Unit 2	**Digestive System & Respiratory System**	
	a, b, c	To study the structure of mammalian lung from video recording	CO2, CO6
	Unit 3	**Circulatory System & Urinogenital System**	
	a	To study arterial system of rat	
	b, c	To study urinogenital organs of rat	

					CO3, CO6
	Unit 4	**Nervous System & Sense Organs**			
	a, b	To study the structure of mammalian eye from video recording			CO4, CO6
	c	To study the structure of mammalian ear from video recording			
	Unit 5	**Embryology**			
	a, b	To study chick embryo development at any three time period of its development: 24, 36, 72 and 96 hours			CO5, CO6
	c	Project work assigned on selected topics			
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	1. Verma, Prem Singh. *A Manual of Practical Zoology: Chordates*. S. Chand Publishing, 2000.			
	Other References	• Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press. • Pough H. Vertebrate life, VIII Edition, Pearson International. • Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub. Co.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

BSZ352: Animal Physiology Lab

L-T-P 0-0-3 Credits 2

School : SBSR		**Batch :**	
Program: B.Sc.		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 5th**	
1	Course Code	**BSZ352**	
2	Course Title	**Animal Physiology Lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
5	Course Status	Compulsory	
6	Course Objective	1) The primary objective of this course design is to achieve a general understanding of animal physiology including digestion, respiration, circulation etc. 2) Physiological topics will be examined from a comparative and integrative perspective rather than just studying mammalian physiological systems.	
7	Course Outcomes	After successfully completion of this course students will be able to: CO1: understand basic principles of animal physiology CO2: promote good laboratory skills and learn aspects of physiological experimentation CO3: understand synthesis of several areas within physiology (respiration, circulation, digestion, energy metabolism, etc.) as they apply to an animal's ability to maintain homeostasis. CO4: A comprehensive knowledge of functional physiological pathways common to all animals. CO5: A knowledge of physiological topics from a comparative and integrative perspective CO6: Skills in using experimental techniques and physiological equipment to collect data, proper record-keeping and data analysis and effective presentation of results	
8	Course Description	The aim of this course is to acquaint the students about the versatile tools and techniques employed in animal physiology. The course will also provide students with a hands-on understanding of how animal physiology can be used to discover various processes used by animals to attain homeostasis.	
9	Outline syllabus		CO Mapping
	Unit 1	**Practical based on Digestive System**	
	A	Examination of sections of mammalian oesophagus, stomach, duodenum	**CO1**
	B	To study the effect of varying pH on salivary amylase	
	C	To determine the effects of varying temperatures on the activity of salivary amylase	
	Unit 2	**Practical based on Respiration**	**CO2**
	A	To study the rate of respiration by aquatic animals	
	B	To determine the concentration of free CO2 in variety of given samples	
	C	Determination of dissolved O2 of given samples by Wrinklers method	
	Unit 3	**Practical based on Circulation**	**CO3**
	A	Isolation of monocytes	
	B	To study hematological parameter in blood	

	C	To study the effect of osmolarity of solution on RBC			
	Unit 4				
	A	**Practical based on Excretion**			**CO4**
	B	To test the urine for urea,proteins,			
	C	To test the urine for ketones and sugar			
	Unit 5				**CO5**
	A	Finding the coagulation time, blood groups, RBC count, TLC, DLC			
	B	To identify & Study the different of Endocrine glands			
	C				
	Mode of examination	Theory / practical			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. / W.B. Saunders Company.			
	Other References	1. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons, Inc. 2. Victor P. Eroschenko . (2008). diFiore's Atlas of Histology with Functional Correlations. XII Edition. Lippincott W. & Wilkins. 4. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**1**	**3**	**1**	**1**	**1**
CO3	**1**	**1**	**3**	**1**	**1**
CO4	**1**	**1**	**1**	**3**	**1**
CO5	**1**	**1**	**1**	**1**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSB301: Animal Biotechnology

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc.(H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 6**	
1	Course Code	BSB301	
2	Course Title	Animal Biotechnology	
3	Credits	3	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. This course provides a comprehensive introduction to fundamentals and applications of animal biotechnology. 2. The course is designed to give students an up-to-date understanding of a wide array of techniques that are used in animal cell culture, tissue culture and organ culture. 3. This course also focuses on stem cell culture and their applications. 4. The course also highlights the potential of transgenic animals to improve human welfare.	
6	Course Outcomes	After the successful completion of this course students will be able to: CO1: Understand the methods of obtaining cells from the tissue for cell culture. CO2: Classify the different types of media used in animal cell culture based on cell types and the cell line types. CO3: Know about the animal cell cloning and the methods of transfecting cells in the culture. CO4: Explain the stem cell technology and its applications. CO5: Understand the basics of tissue and organ culture as well as the applications of transgenic animal in different sectors. CO6: To get a complete knowledge about various techniques and methodology used in animal biotechnology.	
7	Course Description	The aim of this course is to provide better understanding about the animal cell culture and its types. The student get acquainted with the various types of media used in animal cell culture and about the types of cell lines. It briefs about the applications of cell culture and transgenic animals.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Animal Cell Culture**	
	A	Structure and organization of animal cell; sources of cell	CO1, CO6
	B	Techniques of obtaining cells by disaggregation of tissues, Enzymatic disaggregation	
	C	EDTA treatment; Types of cell culture, Equipments required for animal cell culture	
	Unit 2	**Development of Cell Lines**	

	A	Medium preparations and its various types Natural, artificial serum protein free media Advantages and disadvantages			CO2, CO6
	B	sub culturing techniques, viable cell counts with haemocytometer, development of cell lines, types of cell lines, their characteristics			
	C	Suspension culture advantages & disadvantages, totipotency in animal cell culture.			
	Unit 3	**Animal Cell Cloning**			
	A	Cloning, types of cell cloning methods of cloning			CO3, CO6
	B	Transfection; methods, retro-virus mediated gene transfer			
	C	Embryonic stem cell-mediated gene transfer, artificial twining, risk of cloning cloned animals.			
	Unit 4	**Stem Cell Culture and Technology**			
	A	Stem cell technology; haematopoiesis			CO4, CO6
	B	Methods to study repopulation assay, in vitro cloning assay, long term culture			
	C	Embryonic stem cell culture, Application of stem cell culture.			
	Unit 5	**Application of Animal Cell Culture Technology**			
	A	Transgenic cells and animals & their application;			CO5, CO6
	B	Organ culture, Histotypic & organotypic culture, rearing animal models and advantages			
	C	Potential of transgenic animals to improve human welfare in Agriculture, medicine and industry, ethical and value issues in animal biotechnology			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Text book/s*	1. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005.			
	Other References	1. Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006. 2. Shenoy M., "Animal Biotechnology", Laxmi Pub, 2007.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	3
CO2	1	2	3	2	3
CO3	2	2	3	3	3
CO4	2	2	3	3	3
CO5	2	2	2	3	3
CO6	2	2	3	3	3

BSB306: Genomics

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc. (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 06**	
1	Course Code	**BSB306**	
2	Course Title	**GENOMICS**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	1. To comprehend the basic principles of genomics, so that they realize its importance and use its knowledge for human benefit. 2. To acquire knowledge of techniques and strategies involved in understanding a genome.	
6	Course Outcomes	After successfully completion of this course students will be able to: CO1: Comprehend the basic concept of Genome and its importance. Choose the right of sequencing method. CO2: Differentiate between different sequencing methods and the degree of enhancement in techniques with application of bioinformatics. CO3: Relate the differences between different Genome structure. CO4: Apply the techniques of locating unidentified genes in a sequence and their organization. CO5: Discuss different application of Genomics in different field of study CO6: Be familiar with the different techniques used in genome analysis.	
7	Course Description	Genomics is an interdisciplinary field of science focusing on the structure, function, evolution, mapping, and editing of genomes. Genomics also involves the sequencing and analysis of genomes through uses of high throughput DNA sequencing and bioinformatics to assemble and analyze the function and structure of entire genomes. Advances in genomics have triggered a revolution in discovery-based research and systems biology to facilitate understanding of even the most complex biological systems such as the brain.	
8	Outline syllabus		CO Mapping
	Unit 1	**DNA Sequencing**	**CO1, CO6**
	A	Introduction to concept of Genome; DNA and RNA as genome	
	B	Information flow in Biology; DNA Sequencing technologies, Maxam-Gilbert	
	C	Sanger method of Sequencing, manual and automated	
	Unit 2	**Whole Genome Sequencing**	**CO2, CO6**
	A	Concept and application of Whole genome sequencing, Shot Gun Sequencing methods	

	B	Clone contig Sequencing methods; Pyrosequencing			
	C	Genome sequence data and genome databases; Application of Bioinformatics in genomics			
	Unit 3	**Genome Anatomy**			**CO3, CO6**
	A	Difference between gene and genome; Prokaryotic and eukaryotic genome structure			
	B	Intergenic spaces, gene families, monopartite genome, multipartite genome, split genes, overlapping genes; C value Paradox			
	C	Viral genome, Yeast and *Drosophila* genome structure			
	Unit 4	**Functional genomics**			**CO4, CO6**
	A	Gene prediction methods, function prediction, Annotation			
	B	Functional genomics, its tools and methodologies, organellar genomes, endosymbiosis			
	C	Comparative genomics its tools and methodologies, phylogeny			
	Unit 5	**Application of Genomics**			**CO5, CO6**
	A	Application of comparative genomics, Pharmaco-genomics			
	B	Application of genomics in crop improvement			
	C	Application of genomics in industry; personalized medicine			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	1. Brown TA. Genomes 3. 3rd edition. Oxford: Wiley-Lis; (2002) 2. Pevsner J., "Bioinformatics and Functional Genomics", John Wiley and Sons, 2008.			
	Other References	1. Lewin B., Jocelyn E.K., Elliot S., "Lewin Genes XI", Jones and Bartlette; (2014) 2. Bioinformatics: Tools and Applications, David Edwards, Jason Stajich, David Hansen, Springer Science & Business Media, (2009)			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	1	1
CO2	3	3	2	1	2
CO3	3	2	3	1	1
CO4	2	3	3	1	2
CO5	3	3	1	2	3
CO6	3	3	3	1	2

BSZ305: PARASITOLOGY

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2018-21**	
Program: B.Sc. (H)		**Current Academic Year: 2018-19**	
Branch: Life Sciences		**Semester: 06**	
1	Course Code	**BSZ305**	
2	Course Title	**PARASITOLOGY**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to make the students understand the various types of parasites, life cycles, their pathogenicity, cure and their interactions with other organisms	
6	Course Outcomes	**CO1** Comprehend the basic concept of parasites and its importance and relationship between host and parasites **CO2** Differentiate in different morphology and life cycles, epidemiology and diagnosis methods. **CO3** Comprehend the knowledge in parasitic Platyhelminthes of its morphology and life cycles and treatment diagnosis. **CO4** Understand about different parasitic Nematodes **CO5** Understand different application of parasitic arthropods and vertebrates **CO6** Familiar with the different diagnosis treatment.	
7	Course Description	This course mainly comprises the various types of interactions amongst life forms of various parasites, life cycle. Students will be able to understand the pathogenicity and the cure from these parasites.	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction to Parasitology**	**CO1, CO6**
	A	Brief introduction of Parasitism, Parasite	
	B	Parasitoid and Vectors (mechanical and biological vector)	
	C	Host parasite relationship	
	Unit 2	**Parasitic Protists**	**CO2, CO6**
	A	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Entamoeba histolytica, Giardia intestinalis*	
	B	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and	

		Treatment of *Trypanosoma gambiense*, *Leishmaniadonovani*			
	C	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Plasmodium vivax*			
	Unit 3	**Parasitic Platyhelminthes**			**CO3, CO6**
	A	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsisbuski*			
	B	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Schistosoma haematobium*			
	C	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Taeniasolium* and *Hymenolepis nana*			
	Unit 4	**Parasitic Nematodes**			**CO4, CO6**
	A	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascarislumbricoides*, *Ancylostomaduodenale*			
	B	Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Wuchereriabancrofti* and *Trichinella spiralis*			
	C	Study of structure, life cycle and importance of *Meloidogyne*(root knot nematode), *Pratylencus* (lesion nematode)			
	Unit 5	**Parasitic Arthropods and Vertebrates**			**CO5, CO6**
	A	Biology, importance and control of ticks, mites, *Pediculushumanus* (head and body louse), *Xenopsyllacheopis*and *Cimexlectularius*			
	B	A brief account of parasitic vertebrates; Cookicutter Shark, Candiru			
	C	A brief account of parasitic vertebrates; Hood Mockingbird and Vampire bat			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	KD Chatterjee, Parasitology Protozoology And Helminthology, 13th edition			

	Other References	V Baweja, Medical Parasitology, 4th edition	

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	1	3	1	1	1
CO3	1	1	3	1	1
CO4	1	1	1	3	1
CO5	1	1	1	1	3
CO6	3	3	3	3	3

BSZ306: EVOLUTIONARY BIOLOGY

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2018-21**	
Program: B.Sc. (H)		**Current Academic Year: 2018-19**	
Branch: Life Sciences		**Semester: 06**	
1	Course Code	**BSZ306**	
2	Course Title	**EVOLUTIONARY BIOLOGY**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to make the students understand the various theories of evolution, various forces and factors of evolution, also the knowledge of population genetic factors with the change of environment.	
6	Course Outcomes	**CO1** Comprehend a student should be able to: understand and explain the main forces of evolution (natural selection, sexual selection, genetic drift) **CO2** Comprehend a student should be able to: understand and explain the main forces of evolution (natural selection, sexual selection, genetic drift) **CO3** Comprehend the knowledge Population genetic consequences of selection, mutation, migration, inbreeding, genetic drift, an important evolutionary force **CO4** Understand about macro evolution and micro evolution **CO5** Understand different application of phylogenetic thinking: why we need phylogenetic for a deeper understanding of all aspects of evolution **CO6** Familiar with how evolutionary thinking gives us insights into human health issues.	
7	Course Description	This course mainly comprises the various theories of evolution. Students will be able to understand the macro evolution and micro evolution of earth, different phylogenetic factors and relation to human health.	
8	Outline syllabus		CO Mapping
	Unit 1		**CO1, CO6**
	A	Life's Beginnings: Chemogeny, RNA world, Biogeny	
	B	Origin of photosynthesis, Evolution of eukaryotes;	
	C	Historical review of evolutionary concept: Lamarckism, Darwinism, Neo-Darwinism	
	Unit 2		**CO2, CO6**
	A	Evidences of Evolution: Fossil record- types of fossils, transitional forms, geological time scale, evolution of horse,	
	B	Molecular - universality of genetic code and protein synthesizing machinery, three domains of life	
	C	neutral theory of molecular evolution, molecular clock, example of globin gene family, rRNA/cyt c; Sources of variations: Heritable variations and their role in evolution	

	Unit 3				**CO3, CO6**
	A	Population genetics: Hardy-Weinberg Law (statement and derivation of equation, application of law to human Population); Evolutionary forces upsetting H-W equilibrium			
	B	. Natural selection (concept of fitness, selection coefficient, derivation of one unit of selection for a dominant allele, genetic load, mechanism of working, types of selection, density-dependent selection, heterozygous superiority, kin selection, adaptive resemblances, sexual selection.			
	C	Genetic Drift (mechanism, founder's effect, bottleneck phenomenon; Role of Migration and Mutation in changing allele frequencies			
	Unit 4				**CO4, CO6**
	A	Product of evolution: Micro evolutionary changes (inter-population variations, clines, races,			
	B	Species concept, Isolating mechanisms, modes of speciation—allopatric, sympatric, Adaptive radiation / macroevolution (exemplified by Galapagos finches);			
	C	Extinctions, Back ground and mass extinctions (causes and effects), detailed example of K-T extinction			
	Unit 5				**CO5, CO6**
	A	Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens			
	B	molecular analysis of human origin, Phylogenetic trees,			
	C	Multiple sequence alignment, construction of phylogenetic trees, interpretation of trees			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	1. Veer bala Rastogi, organic evolution, 13th edition			
	Other References	1. N Arumugam, organic evolution,			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	1	1
CO2	3	3	1	1	1
CO3	3	3	3	1	1
CO4	3	3	3	3	1
CO5	3	3	3	3	3
CO6	3	3	3	3	3

BSZ307: ENDOCRINOLOGY

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2018-21**	
Program: B.Sc. (H)		**Current Academic Year: 2018-19**	
Branch: Life Sciences		**Semester: 06**	
1	Course Code	**BSZ307**	
2	Course Title	**ENDOCRINOLOGY**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to make the students understand the various glands of human body and its functions related to human health. Different glands study includes thyroid gland, adrenal gland, reproductive hormones.	
6	Course Outcomes	**CO1** Students will be able to get knowledge about Endocrine system **CO2** Students will gain knowledge about thyroid gland **CO3** Students will be able to know about adrenal gland **CO4** Students will be able to know in detail about pancreatic gland **CO5** Students will be able to know about male reproductive system in detail **CO6** Students will have in depth knowledge about endocrine system	
7	Course Description	This course mainly comprises the various glands of human body and its functions related to human health. Students will be able to understand the thyroid gland, adrenal gland, reproductive hormones..	
8	Outline syllabus		CO Mapping
	Unit 1		**CO1, CO6**
	A	Scope of Endocrinology, Endocrine glands	
	B	hormones and hormone action,	
	C	Structure, hormone secretion and functions of hypothalamus and pituitary gland, Pineal gland, circadian rhythm	
	Unit 2		**CO2, CO6**
	A	Structure of thyroid gland, Biosynthesis of thyroid hormones	
	B	, Biological functions of Thyroid hormones, Regulation of Thyroid secretion	
	C	Hormones of parathyroid Glands and their biological action	
	Unit 3		**CO3, CO6**

	A	Adrenal Cortex - Glucocorticoids, Mineralocorticoids and their biological function			
	B	Renin Angiotensin System, Adrenal Medulla			
	C	Catecholamines - Synthesis and Biological action			
	Unit 4				**CO4, CO6**
	A	Pancreatic (Islets of Langerhans) hormones			
	B	Insulin, Glucagon – Biosynthesis, Regulation, Biological action			
	C	Gastrointestinal Hormones			
	Unit 5				**CO5, CO6**
	A	Male reproductive system – Structure of Testes, Biosynthesis of testosterone, Regulation and functions			
	B	Female reproduction system – Structure of Ovary, Biosynthesis of estrogen, Feedback regulation and functions			
	C	Female Reproductive Cycle– Estrous, Menstrual, Placental hormones–parturition – Lactation.			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	David Gardener, basic and clinical endocrinology, 10th edition			
	Other References	Williams Textbook of Endocrinology by Shlomo Melmed; Ronald Koenig; Clifford Rosen; Richard Auchus; Allison Goldfine.			

Course Outcome No	PO1	PO2	PO3	PO4	PO5
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**1**	**1**
CO3	**3**	**3**	**3**	**1**	**1**
CO4	**3**	**3**	**3**	**3**	**1**
CO5	**3**	**3**	**3**	**3**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSZ308: BIOLOGY OF INSECTA

L T P: 4-0-0 **Credit: 4**

School: SBSR		**Batch: 2018-21**	
Program: B.Sc. (H)		**Current Academic Year: 2018-19**	
Branch: Life Sciences		**Semester: 06**	
1	Course Code	**BSZ308**	
2	Course Title	**BIOLOGY OF INSECTA**	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	The objective of this course is to make the students understand the taxonomy of insects. It also includes general morphology and physiology of insects. The syllabus includes various interaction of plants with insects	
6	Course Outcomes	**CO1** Students will be able to get knowledge about taxonomy of insects **CO2** Students will gain knowledge about morphology of insects **CO3** Students will be able to know about physiology of insects **CO4** Students will be able to know in detail about plant insect interactions **CO5** Students will be able to know about how insects act as vector **CO6** Students will have in depth knowledge about houseflies and mosquitoes	
7	Course Description	This course mainly comprises understand the taxonomy of insects. Students will be able to understand the general morphology and physiology of insects and also includes various interaction of plants with insects	
8	Outline syllabus		CO Mapping
	Unit 1	**Introduction and Taxonomy**	**CO1, CO6**
	A	General Features of Insects, Distribution and Success of Insects on the Earth	
	B	Basis of insect classification;	
	C	Classification of insects up to orders	
	Unit 2	**General Morphology of Insects**	**CO2, CO6**
	A	External Features; Head – Eyes, Types of antennae, Mouth parts w.r.t. feeding habits	
	B	Thorax: Wings and wing articulation	
	C	Types of Legs adapted to diverse habitat Abdominal appendages and genitalia	
	Unit 3	**Physiology of Insects**	**CO3, CO6**
	A	Structure and physiology of Insect body systems - Integumentary, digestive, excretory	

	B	Structure and physiology of Insect body systems - circulatory, respiratory, endocrine			
	C	Structure and physiology of Insect body systems - reproductive, and nervous system, Sensory receptors, Growth and metamorphosis			
	Unit 4	**Insect Plant Interaction**			**CO4, CO6**
	A	Theory of co-evolution, role of allelochemicals in host plant mediation			
	B	Host-plant selection by phytophagous insects			
	C	Insects as plant pests			
	Unit 5	**Insects as Vectors**			**CO5, CO6**
	A	Insects as mechanical vectors			
	B	Insects as biological vectors			
	C	Brief discussion on houseflies and mosquitoes as important insect vectors			
	Mode of examination	Theory			
	Weightage Distribution	CA	MTE	ETE	
		30%	20%	50%	
	Textbook/s*	MJ lehane, The biology blood sucking in insects, 2nd edition			
	Other References	PJ Gullan, The insects: an outline of entomology, 5th edition.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**1**	**1**	**1**	**1**
CO2	**3**	**3**	**1**	**1**	**1**
CO3	**3**	**3**	**3**	**1**	**1**
CO4	**3**	**3**	**3**	**3**	**1**
CO5	**3**	**3**	**3**	**3**	**3**
CO6	**3**	**3**	**3**	**3**	**3**

BSZ355: Animal Biotechnology Lab

L-T-P: 0-0-3 Credits 2

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 6**	
1	Course Code	BSZ355	
2	Course Title	Animal Biotechnology Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory	
5	Course Objective	1. To understand the methods for the isolation of animal cell from organ and tissues, and the development of cell lines. 2. To know about the different types of media used for the growth of animal cell culture.	
6	Course Outcomes	After the successful completion of this course students will be able: CO1: To know about the various sterilization techniques and source of contamination. CO2: To become familiar with the animal tissue culture media. CO3: To understand the methods of animal cell culture. CO4: To know about the various methods used for cell counting and cell viability testing. CO5: To learn the method of cell preservation. CO6: To get a complete knowledge about various techniques and methodology used in animal biotechnology.	
7	Course Description	The aim of this course is to provide better understanding about the practical aspects of animal biotechnology. The student get acquainted with different experimental techniques and protocols used in animal biotechnology.	
8	Outline syllabus		CO Mapping
	Unit 1	**Practical related to – Sterilization**	
	a, b	Preparation and sterilization of glassware	CO1, CO6
		To perform media sterilization.	
		To perform laboratory sterilization	
	c	To study the sources of contamination and decontamination measures in ATC lab	
	Unit 2	**Practical related to – Media Preparation**	
	a, b	Preparation of hanks balanced salt solution	CO2, CO6
	c	Preparation of Minimal essential growth medium	
	Unit 3	**Practical related to – Cell Culture**	
	a, b	To perform primary cell culture of tissue	CO3, CO6
	c	Preparation of established cell lines	
	Unit 4	**Practical related to – Cell Counting and Cell Viability**	

	a, b	Cell counting and viability – Use of Haemocytometer & Trypan Blue			CO4, CO6
	c	To check cell viability and cell proliferation by MTT assay			
	Unit 5	**Practical related to – Preservation of Cells**			
	a, b, c	To preserve the cells in viable condition for future works by using proper preservative			CO5, CO6
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	1. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005.			
	Other References	1. Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006. 2. Shenoy M., "Animal Biotechnology", Laxmi Pub, 2007.			

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**3**	**2**	**3**	**3**	**2**
CO2	**3**	**2**	**3**	**2**	**3**
CO3	**3**	**3**	**2**	**1**	**3**
CO4	**3**	**3**	**2**	**3**	**2**
CO5	**3**	**3**	**2**	**2**	**2**
CO6	**3**	**2**	**3**	**3**	**2**

BSZ354: Parasitology lab

L-T-P 0-0-3 Credits 2

School: SBSR		**Batch: 2020-2023**	
Program: B.Sc (H)		**Current Academic Year: 2020-21**	
Branch: Life Sciences		**Semester: 6**	
1	Course Code	**BSZ354**	
2	Course Title	**Parasitology lab**	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-3	
	Course Status	Compulsory/Elective	
5	Course Objective	• To develop practical knowledge of various parasites • To teach students about life cycle of parasites, their pathogenicity • To teach about cure and medication from the parasites	
6	Course Outcomes	CO1:Practical knowledge of Parasitism, Parasite, Parasitoid and Vectors CO2: Practical knowledge of Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis of various parasites CO3: Practical knowledge of Study of Morphology, Life Cycle of Parasitic Platyhelminthes. CO4: Able to understand Parasitic Nematodes CO5: Cradle to grave knowledge of Parasitic Arthropods and Vertebrates. CO6: Expanded knowledge on parasitic microbes	
7	Course Description	Parasitology lab, is a specialization of parasites and its pathogenicity. It deals with the parasites morphology, life cycle, prevalence, epidemiology pathogenesis, diagnosis phrophylaxis etc.	
8	Outline syllabus		CO Mapping
	Unit 1	**Parasitology**	**CO1, CO5**
		Introduction of Parasitism, Parasite	
		Identify live examples of Parasitoid and Vectors	
		Identify live examples of Host parasite relationship	
	Unit 2	**Parasitic Protists**	**CO2, CO5**
		Practical knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of of *Entamoeba histolytica*	
		Practical knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of of *Trypanosoma gambiense*	
	Unit 3	**Parasitic Platyhelminthes**	**CO2, CO5**

		Practical knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Fasciolopsis buski*			
		Practical knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Taenia solium*			
	Unit 4	**Parasitic Nematodes**			**CO2, CO3, CO5**
		Practical knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Ascaris lumbricoides*			
	Unit 5	**Parasitic Arthropods and Vertebrates**			**CO3, CO4, CO5**
		Practical knowledge of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of *Pediculus humanus*			
		A brief account of parasitic vertebrates; Cookicutter Shark and Vampire bat			
	Mode of examination	Practical/Viva			
	Weightage Distribution	CA	MTE	ETE	
		60%	0%	40%	
	Text book/s*	-			
	Other References				

Course Outcome No	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
CO1	**2**	**3**	**2**	**3**	**2**
CO2	**3**	**1**	**2**	**2**	**3**
CO3	**3**	**2**	**3**	**1**	**2**
CO4	**2**	**3**	**2**	**1**	**3**
CO5	**3**	**2**	**1**	**3**	**2**
CO6	**3**	**2**	**1**	**3**	**2**