



## **Programme Structure**

**BACHELOR OF SCIENCE (Hons.) IN ZOOLOGY**

**BACHELOR OF SCIENCE (Hons. with Research) IN  
ZOOLOGY**

**Course Code: SBR0407**

**Department of Life Sciences**

**School of Basic Sciences & Research**

**Sharda University**

**(Batch - 2023-2027)**



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in Zoology (SEMESTER: 01)**  
**Session: 2023-2024**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BSZ124	Cytology, Genetics and Infectious diseases	4	0	0	4	Major
2.	BBI101	Basics of Microbiology	3	0	0	3	Discipline Specific Elective (DSE)/ Multidisciplinary
	OR BBI102	OR Application of Biomolecules	4	0	0	4	
3.	CHE112	MINOR/ Chemistry III	3	0	0	3	Minor/Open Elective
4.	ARP101	Communicative English-1	2	0	0	2	Ability Enhancement Courses (AEC)
<b>PRACTICAL COURSES</b>							
6.	*BBT103	Basics of Microbiology Lab	0	0	2	1	Discipline Specific Elective (DSE)/ Multidisciplinary
7.	VOL101	Essential techniques in Life Sciences	0	0	6	3	Skill Enhancement Course (Vocational)
8.	BZO101	Introduction of Cell Biology and Cytogenetics Lab	0	0	2	1	Major
9.	VAC103	Environment Management	0	0	3	3	Value Added Courses (VAC)
<b>TOTAL CREDITS</b>						<b>20</b>	

\*BBT103 is part of BBI101



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in Zoology (SEMESTER: 02)**  
**Session: 2023-2024**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BZO111	Biochemistry and Physiology	4	0	0	4	Major
2.	BZO112	Human Physiology	3	0	0	3	Major
3.	PHR101	Minor/ Introduction to Renewable energy and management	3	0	0	3	Minor/Open Elective
4.	ARP102	Communicative English-2	2	0	0	2	Ability Enhancement Courses (AEC)
5	VOL102	Essential techniques in Life Sciences	0	0	6	3	Skill Enhancement Course (Vocational)
<b>PRACTICAL COURSES</b>							
6.	BZO114	Introduction to Physiological, Biochemical & Hematology Lab	0	0	2	1	Major
7.	BZO113	Human Physiology Lab	0	0	2	1	Major
8.	VAC110	Yoga for Holistic Development	0	0	4	3	Value Added Courses (VAC)
<b>TOTAL CREDITS</b>						<b>20</b>	



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in Zoology (SEMESTER: 03)**  
**Session: 2024-2025**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BSZ205	Molecular Biology, Bioinstrumentation & Bio techniques	4	0	0	4	Major
2.	BZO201	Medical Diagnostics and monitoring of public health	3	0	0	3	Major
3.	BSZ206 OR BMB111	Animal Biotechnology	4	0	0	4	Discipline Specific Elective (DSE)/ Multidisciplinary
		OR Physical and Chemical Aspects of Biological Sciences	4	0	0	4	
4.	PHR201	Renewable Energy Resources/Minor	3	0	0	3	Minor/Elective
5.	ARP207	Logical Skill Building and Soft Skills	2	0	0	2	Ability Enhancement Courses (AEC)
<b>PRACTICAL COURSES</b>							
6.	VOL201	Essential techniques in Life Sciences	0	0	6	3	Skill Enhancement Course (Vocational)
7.	BZO202	Molecular techniques and Bio-instruments lab	0	0	2	1	Major
8.	BZO203	Medical Diagnostics and monitoring of public health Lab	0	0	2	1	Major
9.	RBL001	Research Based Learning (RBL1)	0	0	2	0	Major (Project)
<b>TOTAL CREDITS</b>						<b>21</b>	



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in Zoology (SEMESTER: 04)**  
**Session: 2024-2025**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BSZ207	Gene Technology, Immunology and Computational Biology	4	0	0	4	Major
2.	BZO211	Serological tools for Forensic science	3	0	0	3	Discipline Specific Elective (DSE)/ Multidisciplinary
	OR BBI213	Introduction to Genetic Engineering	3	0	0	3	
3.	BBT213	Nanotoxicology	4	0	0	4	Major
4.	CHE113	Minor/Chemistry IV	3	0	0	3	Minor/Elective
5.	ARP305	Personality Development and Decision Making	2	0	0	2	Ability Enhancement Courses (AEC)
<b>PRACTICAL COURSES</b>							
7.	BZO212	Genetic Engineering & Genetic Counselling Lab	0	0	2	1	Major
8.	BZP203*	Forensic Serology Lab	0	0	4	2	Major
9.	BSP205**	Genetic Engineering Lab	0	0	4	2	Major
10.	RBL002	Research Based Learning (RBL 2)	0	0	4	0	Major (Project)
<b>TOTAL CREDITS</b>						<b>19</b>	

\*BZP203 is part of BZO211: \*\* BSP205 is part of BBI213



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in Zoology (SEMESTER: 05)**  
**Session: 2025-2026**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BZO301	Non-Chordates and Economic Zoology	3	0	0	3	Major
2.	BBI211	Comparative diversity in Chordates	3	0	0	3	Major
3.	BSZ312	Endocrinology & Reproductive Biology	4	0	0	4	Major
4.	BZO303	Introduction to Medical virology	3	0	0	3	Discipline Specific Elective (DSE)/ Multidisciplinary
	OR	OR					
	FST314	Food Waste Management	3	0	0	3	
<b>PRACTICAL COURSES</b>							
6.	BZO304	Lab on Non-Chordates and Economic Zoology	0	0	4	2	Major
7.	BZO305	Lab on Comparative diversity in Chordates	0	0	4	2	Major
8.	INC001	Industry Connect	0	0	4	2	Survey (Value Added Course)
9.	RBL003	Research Based Learning -RBL3 (Project)	0	0	2	1	Major (Project)
<b>TOTAL CREDITS</b>						<b>20</b>	



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in ZOOLOGY (SEMESTER: 06)**  
**Session: 2025-2026**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BZO311	Evolution of life & Embryology	3	0	0	3	Major
2.	BZO312	Environmental and Ecological sciences	3	0	0	3	Major
3.	BMB312	Advanced Immunology	4	0	0	4	Major
4.	CHE111	Minor/Chemistry II/MOOC	3	0	0	3	Minor/Open elective
<b>PRACTICAL COURSES</b>							
5.	BZP302	Embryology Lab	0	0	4	2	Major
6.	BZO313	Lab on Environmental and Ecological sciences	0	0	4	2	Major
7.	CCU108	Community Connect	0	0	4	2	Value Added Courses (VAC/Survey)
8.	RBL004	Research Based Learning--RBL4 (Project)	0	0	2	1	Major (Project)
<b>TOTAL CREDITS</b>						<b>20</b>	



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in ZOOLOGY (SEMESTER: 07)**  
**Session: 2026-2027**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BSZ404	Cognitive Science	4	0	0	4	Major
2.	BSZ402 OR FST413	Epidemiology & Disease Surveillance	4	0	0	4	Discipline Specific Elective (DSE)/ Multidisciplinary
		Functional Food and Nutraceuticals	4	0	0	4	
3.	BZO401	Omics in Biological sciences	3	0	0	3	Multidisciplinary
4.	BBI401	Biostatistics, Bioethics and IPR	4	0	0	4	Major
5.	CHE101	Minor/Fundamentals of Chemistry/MOOC	4	0	0	4	Minor/Open Elective
<b>PRACTICAL COURSES</b>							
6.	BZO402	Omics in Biological sciences Lab	0	0	2	1	Major
<b>TOTAL CREDITS</b>						<b>20</b>	





**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons.) in ZOOLOGY (SEMESTER: 08)**  
**Session: 2026-2027**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BSZ407	Pollution & Diseases	4	0	0	4	Major
2.	BSZ408	Drug development & Vaccinology	4	0	0	4	Major
3.	BSZ409	Genetic Disorders & Cancer	4	0	0	4	Discipline Specific Elective (DSE) / Multidisciplinary
	OR FST419	OR Basic Concepts of Research and Design and Methodology	4	0	0	4	
4.	BZO411	Techniques in Bioprocessing & Enzyme Engineering	3	0	0	3	Major
5.		Minor/MOOC	4	0	0	4	Minor (Open Elective)
<b>PRACTICAL COURSES</b>							
6.	BZO412	Techniques in Bioprocessing & Enzyme Engineering Lab	0	0	2	1	Major
<b>TOTAL CREDITS</b>						<b>20</b>	



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons. with Research.) in ZOOLOGY (SEMESTER: 07)**  
**Session: 2026-2027**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BSZ404	Cognitive Science	4	0	0	4	Major
2.	BSZ402	Epidemiology & Disease Surveillance	4	0	0	4	Major
3.	BZO401	Omics in Biological sciences	3	0	0	3	Major
4.	BBI401	Biostatistics, Bioethics and IPR	4	0	0	4	Major
5.	CHE101	Minor/Fundamentals of Chemistry/MOOC	4	0	0	4	Minor/Open Elective
6.	BZO402	Omics in Biological sciences Lab	0	0	2	1	Major
7.	PJI401	Project	0	0	6	3	Value Added Courses (VAC/Project)
<b>TOTAL CREDITS</b>						<b>23</b>	



**Programme Structure**  
**School of Basic Sciences & Research**  
**B.Sc. (Hons. with Research.) in ZOOLOGY (SEMESTER: 08)**  
**Session: 2026-2027**

S. No.	Course Code	Course Name	Teaching Load			Credits	Type of Course
			L	T	P		
<b>THEORY COURSES</b>							
1.	BSZ409	Genetic Disorders	4	0	0	4	Major
2.	PHR401	Biogenerators	4	0	0	4	Major
<b>PRACTICAL COURSES</b>							
3.	PJI402	Project	0	0	18	9	Research Project (Value Added Course)
<b>TOTAL CREDITS</b>						<b>17</b>	



# **COURSE MODULE**



# SEMESTER I

## **B.Sc. (Hons.) in Zoology**



## BSZ124 CYTOLOGY, GENETICS AND INFECTIOUS DISEASES

School: SBSR		Batch: 2023-2027	
Programme: B.Sc.		Current Academic Year: 2023-2024	
Branch: Zoology		SEMESTER: I	
1	Course Code	BSZ124	
2	Course Title	Cytology, Genetics and Infectious Diseases	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To provide detailed knowledge and understanding of the cell, its structure organelles and also the genome organization within alongwith knowledge of pathogenic organisms infecting cells & tissues	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Recall the structure and function of all the cell organelles.</p> <p>CO2: Demonstrate the chromatin structure and gene and its organization.</p> <p>CO3: Apply knowledge on the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms and how one cell communicates with its neighboring cells</p> <p>CO4: Analyze the basic principles of genetics and how genes are inherited from one generation to another. Understand the Mendel's laws and the deviations from conventional patterns of inheritance. Comprehend how environment plays an important role by interacting with genetic factors.</p> <p>CO5: Interpret and detect chromosomal aberrations in humans and study the pattern of inheritance by pedigree analysis in families</p> <p>CO6: Maximize the existing of intracellular processes and its various interactions from cellular to molecular and genetic level to extrapolate it over disease etiology.</p>	
8	Course Description	This course will provide students a full exposure to the basic principles and essential concepts of Cell, its structure and functioning at macro and microlevel and the way cell division occurs. The detailed knowledge at chromosomal level i.e. Gene and its inheritance, mapping and expression as well as pathogens invading our system have also been included.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Cell and Cell Organelles: Structure &amp; Function</b>	



A	Plasma membrane: chemical structure—lipids and proteins Cell-cell interaction: cell adhesion molecules, cellular junctions Endomembrane system: protein targeting and sorting, endocytosis, exocytosis	CO1, CO6
B	Introduction to all national and international Biologists (Zoologists) who have contributed/contributing to Zoological and Life Sciences as a mark of tribute to ancient and modern biology. Cytoskeleton: microtubules, microfilaments, intermediate filaments	CO1, CO6
C	Mitochondria: Structure, oxidative phosphorylation Peroxisome and ribosome: structure and function	CO1, CO6
<b>Unit 2</b>	<b>Nucleus and Chromatin Structure</b>	
A	Structure and function: Nucleus in Eukaryotes	CO2, CO6
B	Chromatin organization, structure of chromosomes	CO2, CO6
C	Chemical structure and base composition of DNA and RNA, Types of DNA and RNA, DNA supercoiling	CO2, CO6
<b>Unit 3</b>	<b>Cell cycle, Cell Division and Cell Signaling</b>	
A	Cell division: Mitosis and Meiosis	CO3, CO6
B	Cell cycle and its regulation, Apoptosis	CO3, CO6
C	Signal transduction: intracellular signaling and cell surface receptors, via G-protein linked receptors, JAK-STAT pathway	CO3, CO6
<b>Unit 4</b>	<b>Mendelism, Genes &amp; Environment and Sex Determination</b>	
A	Basic principles of heredity: Mendel's laws; Monohybrid and Dihybrid cross Complete and Incomplete Dominance; Penetration and Expressivity	CO4, CO6
B	Genic Sex-Determining Systems, Environmental Sex Determination, Sex Determination in <i>Drosophila</i> , Sex Determination in Humans Sex-linked characteristics and Dosage compensation	CO4, CO6
C	Extension of Mendelism: Multiple Alleles, Gene Interaction The Interaction Between Sex and Heredity: Sex-Influenced and Sex-Limited Characteristics Cytoplasmic Inheritance, Genetic Maternal Effects Genomic Imprinting, Anticipation Interaction Between Genes and Environment: Environmental Effects on Gene Expression, Inheritance of Continuous Characteristics	CO4, CO6
<b>Unit 5</b>	<b>Human Chromosomes &amp; Related techniques; Infectious Diseases</b>	
A	Human karyotype; Karyotyping technique; Chromosomal anomalies: Structural and numerical aberrations with examples, Pedigree analysis	CO5, CO6
B	Patterns of inheritance: autosomal dominant, autosomal recessive, X-linked recessive, X-linked dominant	CO5, CO6
C	Introduction to pathogenic organisms: viruses, bacteria, fungi, protozoa, and worms.	CO5, CO6



		Structure, life cycle, pathogenicity, including diseases, causes, symptoms and control of common parasites: Trypanosoma, Giardia and Wucheria		
Mode of examination	Theory 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction			
Weightage Distribution	CA	MTE	ETE	
	25%	25%	75%	
Text book/s*	<ol style="list-style-type: none"> <li>Lodish et al: Molecular Cell Biology: Freeman &amp; Co, USA (2004).</li> <li>Alberts et al: Molecular Biology of the Cell: Garland (2002).</li> <li>Cooper: Cell: A Molecular Approach: ASM Press (2000).</li> <li>Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).</li> <li>Lewin B. Genes VIII. Pearson (2004).</li> <li>Watson et al. Molecular Biology of the Gene. Pearson (2004).</li> </ol>			
Other References	<ol style="list-style-type: none"> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>Swayam Prabha - DTH Channel,</li> <li><a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>			

### Course Articulation Matrix for BSZ124 Cytology, Genetics and Infectious Diseases

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	2	3	1	3	2	3	-	1	3	1	1
CO2	1	3	2	1	1	3	2	3	-	1	1	2	2
CO3	1	3	2	2	1	3	2	3	-	1	2	2	1
CO4	2	3	3	1	2	3	2	3	-	1	1	3	3
CO5	3	3	2	1	3	2	3	3	-	1	2	3	3
CO6	3	3	2	1	3	3	2	3	-	1	2	3	3
Average	1.83	2.83	2.17	1.50	1.83	2.83	2.17	3.00	-	1.00	1.83	2.33	2.17

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





### BZO101 Introduction of Cell Biology and Cytogenetics Lab

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: I</b>	
1	Course Code	<b>BZO101</b>	
2	Course Title	Introduction of Cell Biology and Cytogenetics Lab	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Type	Compulsory (CC)	
6	Course Objective	To provide detailed knowledge and understanding of the practical aspects of cell, its structure and chromosomes and its organization and genetic utility.	
7	Course Outcomes	<p>At the completion of the course students will learn hands-on:</p> <p>CO1: Show working of simple and compound microscopes and to prepare slides to see the cell structure and cell organelles, how a cell divides leading to the growth of an organism and also reproduces to form new organisms</p> <p>CO2: Illustrate the basic preparation of microscopic slides</p> <p>CO3: Demonstrate the chromosomal study in different organisms</p> <p>CO4: Simplify the fundamentals of chromosomal aberrations by preparing karyotypes.</p> <p>CO5: Explain the integration of gene with in the family via pedigree analysis in families.</p> <p>CO6: Solve issues with the applicability of chromosomal techniques</p>	
8	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Microscope basics &amp; Cell structure and its division</b>	
	A	<ul style="list-style-type: none"> <li>To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue.</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>To study the different stages of Meiosis in grasshopper testis.</li> <li>To study the different stages of Mitosis in root tip of onion.</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method.</li> <li>To check the permeability of cells using salt solution of different concentrations.</li> </ul>	CO1,CO6



	<b>Unit 2</b>	<b>Parasites slide preparation</b>		
	A	<ul style="list-style-type: none"> <li>Study of parasites (eg. Protozoans) from permanent slides.</li> </ul>		CO2, CO6
	B	<ul style="list-style-type: none"> <li>Study of parasites (eg. Helminths etc.) from permanent slides.</li> </ul>		CO2, CO6
	C	<ul style="list-style-type: none"> <li>To learn the procedures for preparation of temporary and permanent stained/unstained slides</li> </ul>		CO2, CO6
	<b>Unit 3</b>	<b>Chromosomal studies</b>		
	A	<ul style="list-style-type: none"> <li>Study of mutant phenotypes of <i>Drosophila</i>.</li> </ul>		CO3, CO6
	B	<ul style="list-style-type: none"> <li>Preparation of polytene chromosomes.</li> </ul>		CO3, CO6
	C	<ul style="list-style-type: none"> <li>Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells(Human).</li> </ul>		CO3, CO6
	<b>Unit 4</b>	<b>Karyotyping and aberration studies</b>		
	A	<ul style="list-style-type: none"> <li>Preparation of human karyotype</li> </ul>		CO4, CO6
	B	<ul style="list-style-type: none"> <li>Study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided</li> </ul>		CO4, CO6
	C	<ul style="list-style-type: none"> <li>To prepare family pedigrees.</li> </ul>		CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>		
	A	<ul style="list-style-type: none"> <li><a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li><a href="https://zoologysan.blogspot.Com">https://zoologysan.blogspot.Com</a></li> </ul>		CO5, CO6
	B	<ul style="list-style-type: none"> <li><a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li><a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> </ul>		CO5, CO6
	C	<ul style="list-style-type: none"> <li><a href="http://www.powershow.com">www.powershow.com</a></li> <li><a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li><a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>		CO5, CO6
	Mode of examination	<b>Practical/Viva</b> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)		
	Weightage Distribution	CA		ETE
		25%		75%
	Text book/s*	1. Lodish et al: Molecular Cell Biology: Freeman & Co, USA (2004). 2. Alberts et al: Molecular Biology of the Cell: Garland (2002). 3. Cooper: Cell: A Molecular Approach: ASM Press (2000). 4. Karp: Cell and Molecular Biology: Wiley (2002). Pierce B. Genetics. Freeman (2004).		



		5. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi	
Other References		1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a> 2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 3. Swayam Prabha - DTH Channel, 4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a> 5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> 6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> 7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> 8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a>	

### Course Articulation Matrix for BZO101 INTRODUCTION of CELL BIOLOGY and CYTOGENETICS LAB

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO1 0	PSO 1	PSO 2	PSO 3
CO1	1	2	3	3	2	2	2	3	-	1	1	1	2
CO2	1	3	2	2	1	3	2	3	-	1	2	2	1
CO3	1	3	2	2	1	3	2	3	-	1	2	3	3
CO4	1	2	3	2	1	3	2	2	-	1	2	2	2
CO5	2	3	3	2	1	2	3	3	-	1	3	1	2
CO6	1	3	3	3	2	3	2	3	-	1	3	1	2
Average	1.17	2.67	2.67	2.33	1.33	2.67	2.17	2.83	-	1.00	2.17	1.67	2.00

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



### BBI101 Basics of Microbiology

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: I</b>	
1	Course Code	<b>BBI101</b>	
2	Course Title	<b>Basic of Microbiology</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To provide detailed knowledge and understanding of the microbial forms and their interaction with the host at macro and micro levels.	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p>CO1: Recall the various microbial life forms and their classification.</p> <p>CO2: Explain the morphology and growth process of bacteria and their isolation techniques.</p> <p>CO3: Apply the knowledge about the structure and properties of viruses, their life cycle and their isolation techniques.</p> <p>CO4: Analyze and update the knowledge on host pathogen interactions and also on the various antimicrobial agents existing</p> <p>CO5: Interpret the knowledge about the various applications of microbes in industries.</p> <p>CO6: Compose a holistic understanding of how the various microbial forms invade our body and ways to control them</p>	
8	Course Description	This course will inculcate in the students' knowledge about the different microbial forms that exists. Since microbial fauns are invisible to human eyes so methods on how to isolate and control them are also added in this course.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Microbes</b>	
	A	<ul style="list-style-type: none"> <li>• History of Microbiology</li> <li>• Types of microbes; Spontaneous generation; Koch Postulates</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>• Systems classification</li> </ul>	CO1,CO6



C	<ul style="list-style-type: none"> <li>• Overview of Archaea; Cyanobacteria</li> <li>• Fungi, Algae, PPLO, Protozoa</li> </ul>	CO1,CO6
<b>Unit 2</b>	<b>Bacteria; structure, cell division &amp; isolation techniques</b>	
A	<ul style="list-style-type: none"> <li>• Morphology and fine structure of Bacteria</li> <li>• Classification of bacteria</li> <li>• Modes of cell division</li> <li>• Growth curve</li> <li>• Growth inhibitory substances (temperature, acidity, alkalinity, water availability, oxygen)</li> </ul>	CO2, CO6
B	<ul style="list-style-type: none"> <li>• Methods of bacterial Isolations: Pure culture, Method of isolating pure culture (Streak method, Pour-plate and spread plate technique)</li> <li>• Synchronous and asynchronous Growth</li> </ul>	CO2, CO6
C	<ul style="list-style-type: none"> <li>• Control of Bacterial Growth: Physical and chemical methods</li> <li>• Pasteurization</li> </ul>	CO2, CO6
<b>Unit 3</b>	<b>Viruses: Structure, Life Cycle and isolation techniques</b>	
A	<ul style="list-style-type: none"> <li>• General properties of viruses</li> <li>• Structure of viruses</li> <li>• Classification of viruses</li> <li>• Life Cycle</li> </ul>	CO3, CO6
B	<ul style="list-style-type: none"> <li>• Methods of virus isolation and diagnosis</li> </ul>	CO3, CO6
C	<ul style="list-style-type: none"> <li>• Lytic vs Lysogenic cycle of Bacteriophage</li> </ul>	CO3, CO6
<b>Unit 4</b>	<b>Microbial diseases and their control</b>	
A	<ul style="list-style-type: none"> <li>• Host pathogen interactions; host parasite relationship</li> </ul>	CO4, CO6
B	<ul style="list-style-type: none"> <li>• Some important Human diseases cause by microbes: Bacteria, Viruses, Fungi, Protozoa, etc</li> </ul>	CO4, CO6
C	<ul style="list-style-type: none"> <li>• Antimicrobial chemotherapy:</li> <li>• General characteristics of antimicrobial drugs</li> <li>• Antibiotics, Antivirals, Antifungals</li> <li>• Mechanism of action of antimicrobial agents</li> </ul>	CO4, CO6
<b>Unit 5</b>	<b>Applications of microbes</b>	
A	Applications of microbes in Food Industry	CO5, CO6
B	Applications of microbes in welfare of Human; Chemical and Medical Industry	CO5, CO6
C	Applications of microbes in Environmental Remedies	CO5, CO6



Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
Weightage Distribution	CA	MTE	ETE
	25%		75%
Text book/s*	<ol style="list-style-type: none"> <li>1. Pelezar, M.J. Reid, R.D. and E.C.S.Chan, Tata McGraw Hill, New Delhi. (2004). Microbiology. (5<sup>th</sup>ed.)</li> <li>2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9<sup>th</sup> Edition. McGrawHill International.</li> <li>3. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International Edition.</li> <li>4. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9<sup>th</sup> edition. Pearson Education.</li> <li>5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5<sup>th</sup> edition. McMillan.</li> <li>6. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis Kuby Kuby Immunology. W H Freeman (2007).</li> <li>7. Delves Peter J., Martin Seamus J., Burton Dennis R., Roitt Ivan M. Roitt's Essential Immunology, 13<sup>th</sup> Edition. Wiley Blackwell (2017).</li> </ol>		
Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>		

### Course Articulation Matrix for BBI101 Basics of Microbiology

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	2	2	3	-	1	1	1	1
CO2	1	3	1	2	2	2	2	3	-	1	1	1	1
CO3	1	3	1	2	1	3	2	3	-	1	3	1	1
CO4	3	1	1	2	3	2	3	3	-	1	1	1	1
CO5	1	3	1	2	1	2	3	3	-	1	1	1	1
CO6	2	2	1	1	3	3	2	3	-	1	1	1	1
Average	1.83	2.33	1.00	1.67	1.83	2.33	2.33	3.00	-	1.00	1.33	1.00	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BBI103 BASICS OF MICROBIOLOGY LAB

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>
<b>Branch: Zoology</b>		<b>SEMESTER: I</b>
1	Course Code	<b>BBI103</b>
2	Course Title	<b>BASICS OF Microbiology Lab</b>
3	Credits	1
4	Contact Hours (L-T-P)	0-0-2
5	Course Type	Compulsory (CC)
6	Max. Marks	25+75 = 100
7	Min. Marks	As per rules
8	Course Objective	To provide comprehensive knowledge and clarity on the various microbes, how to identify and isolate them and how to detect them using in environmental sources.
9	Course Outcomes	The student at the completion of the course will be able to:  CO1: Demonstrate good laboratory practices, how to make various media preparations and the precautions to be taken while working in microbiology lab. CO2: Expand their knowledge on usage of various aseptic culture techniques and sterilization protocols/equipments while working with microorganisms. CO3: Acquaint with the various types of methods in microorganism culture methods. CO4: Work on various techniques used to isolate pure form of microorganism from different sources CO5: Isolate and culture bacteria in laboratory under aerobic conditions. CO6: Gain an experience on efficiently handling various microbial techniques available at a basic level.
10	Course Description	This course will provide students a wide knowledge on the various microbes existing and how they interact with the host when they invade a host body. Topics like isolation of microbes and ways to detect them as provided in this course.
11	Outline syllabus	CO Mapping
	<b>Unit 1</b>	<b>General microbial lab SOPs</b>



	A	<ul style="list-style-type: none"> <li>General lab rules</li> <li>Safety measures in microbiology lab</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Preparations of cotton plugs</li> <li>Aseptic culture techniques</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>Preparation of LB media</li> <li>Preparation of nutrient agar media</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Microbiology related equipment's and their working</b>	
	A	<ul style="list-style-type: none"> <li>Sterilization techniques</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Working of an Autoclave</li> <li>Working of Laminar air flow</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Working of a Hot Air Oven</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Culture basics</b>	
	A	To obtain the pure culture of microorganism <ul style="list-style-type: none"> <li>Streak Plate Method</li> <li>Spread Plate Method</li> <li>Pour Plate Method</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Sub-culturing (picking of technique) of microorganisms from one medium to another</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Counting of bacterial colonies using a colony counter.</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Microbial isolation</b>	
	A	<ul style="list-style-type: none"> <li>Gram's Staining- Differentiate between Gram's positive and Gram's negative bacteria</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Isolation and enumeration of microorganisms of soil by serial dilution.</li> <li>Isolation and enumeration of microorganisms from air.</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Isolation and enumeration of microorganisms from water.</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>	
	A	<ul style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=N21SbC7_Tco">https://www.youtube.com/watch?v=N21SbC7_Tco</a></li> <li><a href="https://www.youtube.com/watch?v=LSu8YmW4mhM&amp;t=44s">https://www.youtube.com/watch?v=LSu8YmW4mhM&amp;t=44s</a></li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=o9kbHGokemA">https://www.youtube.com/watch?v=o9kbHGokemA</a></li> <li><a href="https://www.youtube.com/watch?v=5tWHsr2U81U">https://www.youtube.com/watch?v=5tWHsr2U81U</a></li> <li><a href="https://www.youtube.com/watch?v=VCM4tpSwyDM">https://www.youtube.com/watch?v=VCM4tpSwyDM</a></li> <li><a href="https://www.youtube.com/watch?v=xW3ljnvqMJK">https://www.youtube.com/watch?v=xW3ljnvqMJK</a></li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=c6v84FQ36kM">https://www.youtube.com/watch?v=c6v84FQ36kM</a></li> <li><a href="https://www.youtube.com/watch?v=sxa46xKfIOY&amp;t=1s">https://www.youtube.com/watch?v=sxa46xKfIOY&amp;t=1s</a></li> </ul>	CO5, CO6
	Mode of examination	<b>Practical/Viva</b>  Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks	





		ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)		
Weightage Distribution	CA		ETE	
	25%		75%	
Text book/s*	1. Basic practical microbiology: A manual. Dariel Burdass, John Grainger & Janet Hurst. Published by the Microbiology Society, Charles Darwin House, 12 Roger Street, London, UK 2. Practical manual of Biotechnology. RK Mahajan, J Sharma and R Mahajan. Vayu Education of India.			
Suggestive Digital Platforms / Web Links	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a> 2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 3. Swayam Prabha - DTH Channel, <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a> 4. Amrita Vishwa Vidhyapeeth Labs <a href="https://vlab.amrita.edu/">https://vlab.amrita.edu/</a>			
Suggested Equivalent Online Courses	1. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> 2. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> 3. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> 4. edX, <a href="https://www.edx.org/">https://www.edx.org/</a>			

### Course Articulation Matrix for BBI103 BASICS OF MICROBIOLOGY LAB

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	3	2	2	3	2	3	-	1	1	1	1
CO2	1	2	3	2	1	3	2	3	-	1	3	1	1
CO3	1	3	3	2	1	3	2	3	-	1	3	1	1
CO4	1	2	3	2	1	3	2	2	-	1	3	1	1
CO5	1	2	3	2	-	3	2	3	-	1	3	1	1
CO6	2	2	3	3	2	3	2	3	-	1	3	1	1
Average	1.17	2.33	3.00	2.17	1.40	3.00	2.00	2.83	-	1.00	2.67	1.00	1.00

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



## VOL101-ESSENTIAL TECHNIQUES IN LIFE SCIENCES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: I</b>	
1	Course Code	<b>VOL101</b>	
2	Course Title	<b>Essential techniques in Life Sciences</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
5	Course status	Compulsory (SEC)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in biological experiments, project writing and oral presentation.</li> </ul>	
7	Course Outcomes	The student upon the completion of the course will be able to: <b>CO1:</b> Relate to the working principle of autoclave <b>CO2:</b> Demonstrate the the working principle of hot air oven <b>CO3:</b> Make use of the working principle of centrifugation <b>CO4:</b> Simplify the working principle of electrophoresis. <b>CO5:</b> Assess the importance of Pure culture of E. coli. <b>CO 6:</b> Identify E. coli using gram staining. methodological approaches	
8	Course Description	Vocational education is concerned with the training on vocation. It is related to productivity. Vocational education prepares individuals for jobs. It has adequate employment potentialities. It helps in broadening of horizon. It leads to dignity of labour. It is helpful in the maximum utilization of the material resources of the country..	
9	Outline syllabus		CO Mapping
		<b>Basic Instrumentation Techniques</b>	
	<b>Unit 1</b>	A) To understand the working principle of autoclave.	<b>CO1</b>
		B) To understand the working principle of hot air oven.	
		C) To understand the working principle of centrifugation.	



	<b>Unit 2</b>	A)To understand the working principle of chromatography.		<b>CO2</b>
		B)To understand the working principle of electrophoresis		
		C)Pure culture of E. coli.		
	<b>Unit3</b>	A)Identification of E. coli using gram staining.		<b>CO3, CO4</b>
		B)Isolation of genomic DNA from E. coli culture.		
		C)Isolation of crude proteins from E. coli culture		
	<b>Unit4</b>	A)Characterizations of genomic DNA and proteins using UV/visible spectrophotometer.		<b>CO5, CO6</b>
		B) To prepare the buffer solutions of different ionic strength. Calculate the pH of an unknown solution		
		C) To estimate the protein concentration using Lowry method. To estimate the DNA concentration using spectrophotometry method.		
Mode of examination	<u>Practical/Viva</u> 1. Rubric assessment 2. Monthly Presentation to be audited by supervisor 3. Mid Term Presentation and End Term Presentation			
Weightage Distribution	CA	CE (Viva + PPT)	ETE	
	25	25	50	
Text book/s*	10 Recent International Journal Articles of repute.			

### Course Articulation Matrix for VOL101 Essential Techniques in Life Sciences

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	3	2	3	-	1	1	1	1
CO2	1	1	3	2	1	2	2	3	-	1	1	3	3
CO3	1	1	3	2	1	3	2	3	-	1	1	2	1
CO4	1	1	3	2	1	3	3	2	-	1	1	3	1
CO5	1	1	3	2	1	2	3	3	-	1	1	3	1
CO6	1	1	3	2	1	3	2	3	-	1	1	3	1
Average	1.00	1.00	3.00	2.00	1.00	2.67	2.33	2.83	-	1.00	1.00	2.50	1.33

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### Communicative English-1

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: I</b>	
1	Course Code	<b>ARP101</b>	
2	Course Title	Communicative English-1	
3	Credits	2	
4	Contact Hours (L-T-P)	1-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To minimize the linguistic barriers that emerges in varied socio-linguistic environments through the use of English. Help students to understand different accents and standardise their existing English. Guide the students to hone the basic communication skills - listening, speaking, reading and writing while also uplifting their perception of themselves, giving them self-confidence and building positive attitude.	
7	Course Outcomes	After completion of this course, students will be able to: <b>CO1:</b> Develop a better understanding of advanced grammar rules and write grammatically correct sentences <b>CO2:</b> Acquire wide vocabulary and punctuation rules and learn strategies for error-free communication. <b>CO3:</b> Interpret texts, pictures and improve both reading and writing skills which would help them in their academic as well as professional career <b>CO4:</b> Comprehend language and improve speaking skills in academic and social contexts <b>CO5:</b> Develop, share and maximise new ideas with the concept of brainstorming and the documentation of key critical thoughts articulated towards preparing for a career based on their potentials and availability of opportunities. <b>CO6 :</b> Function effectively in multi-disciplinary teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality	
8	Course Description	The course is designed to equip students, who are at a very basic level of language comprehension, to communicate and work with ease in varied workplace environment. The course begins with basic grammar structure and pronunciation patterns, leading up to apprehension of oneself through written and verbal expression as a first step towards greater employability	
9	Outline syllabus		CO Mapping
	<b>Unit A</b>	<b>Sentence Structure</b>	



	Topic 1	Subject Verb Agreement	CO1
	Topic 2	Parts of speech	CO1
	Topic 3	Writing well-formed sentences	CO1
	<b>Unit B</b>	<b>Vocabulary Building &amp; Punctuation</b>	
	Topic 1	Homonyms/ homophones, Synonyms/Antonyms	CO1, CO2
	Topic 2	Punctuation/ Spellings (Prefixes-suffixes/Unjumbled Words)	CO1, CO2
	Topic 3	Conjunctions/Compound Sentences	CO1, CO2
	<b>Unit C</b>	<b>Writing Skills</b>	
	Topic 1	Picture Description – Student Group Activity	CO3
	Topic 2	Positive Thinking - Dead Poets Society-Full-length feature film - Paragraph Writing inculcating the positive attitude of a learner through the movie   SWOT Analysis – Know yourself	CO3, CO2, CO3
	Topic 3	Story Completion Exercise –Building positive attitude - The Man from Earth (Watching a Full length Feature Film )	CO2, CO3
	Topic 4	Digital Literacy   Effective Use of Social Media	CO3
	<b>Unit D</b>	<b>Speaking Skill</b>	
	Topic 1	Self-introduction/Greeting/Meeting people – Self branding	CO4
	Topic 2	Describing people and situations - To Sir With Love ( Watching a Full length Feature Film )	CO4
	Topic 3	Dialogues/conversations (Situation based Role Plays)	CO4
	<b>Unit E</b>	<b>Professional Skills   Career Skills</b>	
	Topic 1	Exploring Career Opportunities	CO4, CO5
	Topic 2	Brainstorming Techniques & Models	CO4, CO5
	Topic 3	Social and Cultural Etiquettes	CO4, CO5
	Topic 4	Internal Communication	CO4, CO5
	<b>Unit F</b>	<b>Leadership and Management Skills</b>	
	Topic 1	Managerial Skills	CO6
	Topic 2	Entrepreneurial Skills	CO6
10	Evaluations	<i>Class Assignments/Free Speech Exercises / JAM Group Presentations/Problem Solving Scenarios/GD/Simulations ( 60% CA and 40% ETE</i>	N/A
	Texts & References   Library Links	<ul style="list-style-type: none"> <li>Blum, M. Rosen. <i>How to Build Better Vocabulary</i>. London: Bloomsbury Publication</li> <li>Comfort, Jeremy (et.al). <i>Speaking Effectively</i>. Cambridge University Press</li> </ul>	



### Course Articulation Matrix for ARP101 Communicative English-1

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	3	-	-	-
CO2	-	-	-	-	-	-	-	-	1	3	-	-	-
CO3	-	-	-	-	-	-	-	-	1	3	-	-	-
CO4	-	-	-	-	-	-	-	-	1	2	-	-	-
CO5	-	-	-	-	-	-	-	-	1	2	-	-	-
CO6	-	-	-	-	-	-	-	-	1	2	-	-	-
Average	-	-	-	-	-	-	-	-	1.00	2.50	-	-	-

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



## Environment Management

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-24</b>
<b>Branch: All</b>		<b>Semester: I</b>
1	Course Code	VAC109
2	Course Title	Environment Management
3	Credits	03
4	Contact Hours (L-T-P)	3-0-0
Course Status		Compulsory
5	Course Objective	<ol style="list-style-type: none"> <li>1. Enable students to learn the concepts, principles and importance of environmental science</li> <li>2. Provide students an insight of various causes of natural resource depletion and its conservation</li> <li>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.</li> <li>4. Provide knowledge of different methods of water conservation</li> <li>5. Provide and enrich the students about sustainable practices and environmental management</li> </ol>
6	Course Outcomes	<p>After completion of this course, students will be able to:</p> <p>CO1. Develop a better understanding of the principles and scope of environmental science</p> <p>CO2. Acquire to learn various pollution causes, effects and control and solid waste management.</p> <p>CO3. Interpret the effect of global warming and ozone layer depletion</p> <p>CO4. Comprehend about various types of natural resources and its conservation</p> <p>CO5. Develop a better understanding about sustainable practices and environmental management</p> <p>CO6. Function effectively an overall understanding of various environmental components, its protection and management.</p>
7	Course Description	<p>Environmental Science emphasises on various factors as</p> <ol style="list-style-type: none"> <li>1. Importance and scope of environmental science</li> <li>2. Natural resource conservation</li> <li>3. Pollution causes, effects and control methods</li> <li>4. Sustainable and Environmental environment</li> </ol>
8	Outline syllabus	CO Mapping
	<b>Unit 1</b>	<b>Natural resource management</b>
	A	Introduction to Natural Resources
	B	Management of Land and Forest Resources
	C	Water and Energy resource Management
		CO1, CO6
	<b>Unit 2</b>	<b>Environmental Pollution Management</b>
	A	Air pollution Control and Water Pollution treatment Methods
	B	Soil and Noise Pollution Management
		CO2, CO6



	C	Solid waste management	CO2, CO6						
	<b>Unit 3</b>	<b>Climate Change Mitigation</b>							
	A	Concept of Global Warming and greenhouse effect	CO3, CO6						
	B	Ozone layer Depletion and its consequences	CO3, CO6						
	C	Climate change, its effect on ecosystem and its mitigation. Kyoto protocol and IPCC concerns on changing climate.	CO3, CO6						
	<b>Unit 4</b>	<b>Natural resource conservation and management</b>							
	A	Hot spots, Endangered and endemic species of India	CO4, CO6						
	B	Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions	CO4, CO6						
	C	Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	CO4, CO6						
	<b>Unit 5</b>	<b>Sustainable practices and environmental management</b>							
	A	Sustainable development and sustainable consumption	CO4, CO6						
	B	Environmental Issues and Management in India	CO4, CO6						
	C	Environmental Management System (EMS)	CO4, CO6						
	Mode of examination	Theory							
	Weightage Distribution	<table border="1"> <tr> <td>CA</td> <td>MTE</td> <td>ETE</td> </tr> <tr> <td>25%</td> <td>25%</td> <td>50%</td> </tr> </table>	CA	MTE	ETE	25%	25%	50%	
CA	MTE	ETE							
25%	25%	50%							
	Text book/s*	Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha, Pub: Orient Blackswan Pvt Ltd							
	Other References	Environmental Science by G. Tyler Miller, JR. and Scott E. Spoolman; Broks/Cole.							

### Course Articulation Matrix for Environment Management

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	3	2	1	3	2	3	-	3	1	1	1
CO2	1	2	3	2	1	3	2	3	-	3	1	1	1
CO3	1	3	3	1	1	3	2	2	-	3	1	1	1
CO4	1	2	3	2	1	3	2	3	-	3	2	1	1
CO5	1	1	3	1	1	2	2	3	-	3	2	1	1
CO6	1	2	3	1	2	3	2	3	-	3	1	1	1
Average	1.00	2.00	3.00	1.50	1.17	2.83	2.00	2.83	-	3.00	1.33	1.00	1.00

1-Slight (Low)

2-Moderate (Medium)

3-Substantial (High)





# SEMESTER II

## **B.Sc. (Hons.) in Zoology**



## BZO111 BIOCHEMISTRY AND PHYSIOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>BZO111</b>	
2	Course Title	<b>Biochemistry and Physiology</b>	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Status	Compulsory (CC)	
6	Course Objective	To strengthen the concept of biochemistry of macromolecules and to understand the physiology of the systems involved.	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Show a deep understanding of structure of biomolecules like proteins, lipids and carbohydrates CO2: Explain the metabolism of different macromolecules CO3: Identify the systems biology and various functional components of an organism w.r.t digestive and respiratory systems CO4: Categorize the systems biology and various functional components of an organism w.r.t circulatory and excretory systems CO5: Explain the systems biology and various functional components of an organism w.r.t Nervous, Muscles and endocrine systems CO6: Comprehend the regulatory mechanisms for maintenance of function in the body.	
8	Course Description	The course is a combination of macro and micro level i.e. biochemical basis of life and its working to manage the physiology of important body organs.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Structure and Function of Biomolecules &amp; Bioenergetics</b>	
	A	<ul style="list-style-type: none"> <li>• Structure and Biological importance of carbohydrates (Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates)</li> <li>• Structure and Biological importance of Lipids (saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids)</li> </ul>	CO1, CO6



B	<ul style="list-style-type: none"> <li>Structure, Classification and General properties of <math>\alpha</math>-amino acids; Essential and non-essential <math>\alpha</math>-amino acids, Levels of organization in proteins; Simple and conjugate proteins</li> </ul>	CO1, CO6	
C	<ul style="list-style-type: none"> <li>Principles of Bioenergetics, Bioenergetics and Thermodynamics</li> <li>Biological Oxidation-Reduction Reactions, Free Energy Calculations, The Cell's Energy Currency- Phosphoryl Group Transfers and ATP</li> <li>Free-Energy-Driven Transport across Membranes</li> </ul>	CO1, CO6	
<b>Unit 2</b>	<b>Metabolism of Carbohydrates, Lipids, Proteins and Nucleotides</b>		
A	Metabolism of Carbohydrates: <ul style="list-style-type: none"> <li>Glycolysis</li> <li>Citric acid cycle</li> <li>Gluconeogenesis</li> <li>Phosphate pentose pathway</li> <li>Glycogenolysis and Glycogenesis</li> <li>Review of mitochondrial respiratory chain, Oxidative phosphorylation, and its regulation</li> </ul>	CO2, CO6	
B	Metabolism of Lipids: <ul style="list-style-type: none"> <li>Biosynthesis of palmitic acid</li> <li>Ketogenesis</li> <li><math>\beta</math>-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms</li> </ul>	CO2, CO6	
C	Metabolism of Proteins & Nucleotides: <ul style="list-style-type: none"> <li>Catabolism of amino acids: Transamination, Deamination</li> <li>Urea cycle</li> <li>Nucleotides and vitamins</li> </ul>	CO2, CO6	
<b>Unit 3</b>	<b>Digestion and Respiration</b>		
A	<ul style="list-style-type: none"> <li>Structural organization and functions of gastrointestinal tract and associated glands;</li> <li>Mechanical and chemical digestion of food</li> </ul>	CO3, CO6	
B	<ul style="list-style-type: none"> <li>Absorption of carbohydrates, lipids, proteins, water, minerals and vitamins</li> </ul>	CO3, CO6	
C	<ul style="list-style-type: none"> <li>Histology of trachea and lung</li> <li>Mechanism of respiration, Pulmonary ventilation</li> <li>Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood</li> <li>Respiratory pigments</li> <li>Dissociation curves and the factors influencing</li> <li>Control of respiration</li> </ul>	CO3, CO6	
<b>Unit 4</b>	<b>Circulation and Excretion</b>		
A	<ul style="list-style-type: none"> <li>Components of blood and their functions</li> <li>Hemostasis: Blood clotting system, Blood groups: Rh factor, ABO and MN</li> </ul>	CO4, CO6	



B	<ul style="list-style-type: none"> <li>Structure of mammalian heart</li> <li>Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation</li> </ul>	CO4, CO6
C	<ul style="list-style-type: none"> <li>Structure of kidney and its functional unit; Mechanism of urine formation</li> </ul>	CO4, CO6
<b>Unit 5</b>	<b>Nervous System, Muscle system and Endocrinology</b>	
A	<ul style="list-style-type: none"> <li>Structure of neuron, resting membrane potential</li> <li>Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers</li> <li>Types of synapse</li> </ul>	CO5, CO6
B	<ul style="list-style-type: none"> <li>Histology of different types of muscle</li> <li>Ultra-structure of skeletal muscle</li> <li>Molecular and chemical basis of muscle contraction</li> <li>Characteristics of muscle twitch; Motor unit, summation and tetanus</li> </ul>	CO5, CO6
C	<ul style="list-style-type: none"> <li>Endocrine glands - pineal, pituitary, thyroid, parathyroid, pancreas, adrenal; hormones secreted by them</li> <li>Classification of hormones; Mechanism of Hormone action</li> </ul>	CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
Weightage Distribution	CA	MTE & ETE
	25%	75%
Text book/s*	1. Nelson & Cox: Lehninger's Principles of Biochemistry: McMillan (2000) 2. Zubay <i>et al</i> : Principles of Biochemistry: WCB (1995) 3. Voet & Voet: Biochemistry Vols 1 & 2: Wiley (2004) 4. Murray <i>et al</i> : Harper's Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press 5. Guyton, A.C. & Hall, J.E. Textbook of Medical Physiology. XI Edition. Harcourt Asia PTE Ltd. /W.B.Saunders Company. (2006). 6. Tortora, G.J. & Grabowski, S. Principles of Anatomy & Physiology. XI Edition John Wiley & sons(2006). 7. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, Hill, 8. Richard W., et al. Animal physiology. Vol. 2. Sunderland, MA: Sinauer Associates, (2004). 9. Chatterjee C C Human Physiology Volume 1 & 2. 11th edition. CBS Publishers (2016).	
Other References	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a>	



	<ol style="list-style-type: none"><li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li><li>3. Swayam Prabha - DTH Channel,</li><li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li><li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li><li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li><li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li><li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li></ol>	
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### Course Articulation Matrix for BZO111 BIOCHEMISTRY AND PHYSIOLOGY

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	2	1	1	3	2	3	-	1	1	1	1
CO2	1	3	2	1	1	2	2	3	-	1	2	1	1
CO3	1	3	2	1	1	3	2	3	-	1	2	1	1
CO4	1	3	2	1	1	3	2	2	-	1	2	1	1
CO5	1	3	2	1	1	2	3	3	-	1	2	1	1
CO6	1	3	2	1	1	3	2	3	-	1	2	1	1
Average	1.00	3.00	2.00	1.00	1.00	2.67	2.17	2.83	-	1.00	1.83	1.00	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



## BZO114 INTRODUCTION TO PHYSIOLOGICAL, BIOCHEMICAL & HEMATOLOGY LAB

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>BZO114</b>	
2	Course Title	<b>Introduction to Physiological, Biochemical &amp; Hematology Lab</b>	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students an understanding of the various biochemical, physiological processes undergoing in the various systems of our body and also to undertake test related to haematological techniques.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Relate the haemoglobin content and blood glucose level of human body</p> <p>CO2: Demonstrate muscular actions of the body</p> <p>CO3: Make use of the structure of biomolecules like proteins, lipids and carbohydrates</p> <p>CO4: Analyze the samples for the presence of different biomolecules</p> <p>CO5: Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases.</p> <p>CO6: Estimate modern biochemical and various haematological tests available at virtual level.</p>	
8	Course Description	The course has been designed such that students get an exposure of the basic haematological techniques being carried out in a diagnostic laboratory. Also it will help students carry out some histology related experiments specially of the muscle tissues and to identify the chemistry of various macromolecules using biochemical assays.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Experiments related to Hematology</b>	
	A	<ul style="list-style-type: none"> <li>• Estimation of haemoglobin using Sahli's haemoglobinometer</li> <li>• Preparation of haemin and haemochromogen crystals</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>• Recording of blood pressure using a sphygmomanometer</li> <li>• Counting of RBCs and WBCs using Haemocytometer</li> </ul>	CO1,CO6



	C	<ul style="list-style-type: none"> <li>Recording of blood glucose level by using glucometer</li> <li>To study different mammalian blood cell types using Leishman stain</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Experiments related to Physiology</b>	
	A	<ul style="list-style-type: none"> <li>Study of permanent slides of Muscles, Pancreas, Testis, Ovary, Adrenal, Thyroid and Parathyroid</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Recording of simple muscle twitch with electrical stimulation (or Virtual)</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Qualitative tests of functional groups in carbohydrates and lipids</b>	
	A	<ul style="list-style-type: none"> <li>Ninhydrin test for amino acids.</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Benedict's test for reducing sugar and iodine test for starch.</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Test for sugar and acetone in urine.</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Qualitative tests of functional groups in proteins.</b>	
	A	<ul style="list-style-type: none"> <li>Preparation of molecular models of amino acids, dipeptides etc</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Paper chromatography of amino acids.</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Action of salivary amylase under optimum conditions.</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>	
	A	<ul style="list-style-type: none"> <li><a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li><a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> <li></li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li><a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li><a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> <li></li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li><a href="http://www.powershow.com">www.powershow.com</a></li> <li><a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li><a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>	CO5, CO6
	Mode of examination	<u>Practical/Viva</u> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)	
	Weightage Distribution	CA	ETE
		25%	75%
	Text book/s*	1. Cox, M.M and Nelson, D.L. (2008). Lehninger's Principles of Biochemistry, V Edition, W.H. Freeman and Co., New York. 2. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition,	



	<p>W.H. Freeman and Co., New York.</p> <p>3. Guyton, A.C. &amp; Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B.Saunders Company.</p> <p>4. Tortora, G.J. &amp; Grabowski, S. (2006). Principles of Anatomy &amp; Physiology. XI Edition John Wiley &amp; sons</p> <p>5. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XIIEdition.Lippincott W. &amp; Wilkins.</p> <p>6. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.</p> <p>7. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual.HeritagePublishers, New Delhi</p>	
Other References	<p>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></p> <p>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></p> <p>3. Swayam Prabha - DTH Channel,</p> <p>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></p> <p>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></p> <p>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></p> <p>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></p> <p>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></p>	

**Course Articulation Matrix for BZO114 INTRODUCTION TO PHYSIOLOGICAL, BIOCHEMICAL & HEMATOLOGY LAB**

COs	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	P O 10	PS O1	PS O2	PS O3
CO1	1	2	3	2	1	3	2	3	-	1	1	1	1
CO2	1	2	3	2	1	3	2	3	-	1	1	1	1
CO3	1	3	3	1	1	3	2	2	-	1	1	1	1
CO4	1	2	3	2	1	3	2	3	-	1	2	1	1
CO5	1	1	3	1	1	2	2	3	-	1	2	1	1
CO6	1	2	3	1	2	3	2	3	-	1	1	1	1
Average	1.00	2.00	3.00	1.50	1.17	2.83	2.00	2.83	-	1.00	1.33	1.00	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**





## BZO112 HUMAN PHYSIOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: Certificate In</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>BZO112</b>	
2	Course Title	<b>Human Physiology</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course Type	Compulsory (CC)	
6	Course Objective	To inculcate in the students, the overall knowledge about the body organization from tissue to organ level. To enhance their knowledge with the various effects of ageing on these organs.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Recall the various levels of organization of the human body</p> <p>CO2: Elaborate the integumentary systems of human body</p> <p>CO3: Identify the human skeletal system</p> <p>CO4: Classify the complete human nervous system</p> <p>CO5: Justify the anatomy and physiology of sense organs</p> <p>CO6: Demonstrate the physiology of how each organ is involved in homeostasis and also demonstrate the effect of aging on all the different tissues of the body</p>	
8	Course Description	The course has been designed keeping in view the various levels of organization mostly those which are involved in the providing covering and strength to the body for eg, the skin, skeletal tissues, nervous tissue etc. Another important aspect that has been added in the course is how each organ is individually been effected by ageing and how to keep the tissues strong so as to remain healthy	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>An Introduction to Human Body and Tissue level of Organization</b>	
	A	<ul style="list-style-type: none"> <li>• Levels of structural organization and body systems</li> <li>• Characteristics of Living Human Organism</li> <li>• Homeostasis</li> </ul>	CO1, CO6



	B	Types of Tissues – <ul style="list-style-type: none"> <li>• Epithelial tissue</li> <li>• Connective tissue</li> </ul>			CO1,CO6
	C	<ul style="list-style-type: none"> <li>• Types of Tissue membranes: Epithelial and synovial membranes</li> <li>• Aging and tissues</li> </ul>			CO1,CO6
	<b>Unit 2</b>	<b>The Integumentary Systems</b>			
	A	<ul style="list-style-type: none"> <li>• Structure of skin</li> </ul>			CO2, CO6
	B	<ul style="list-style-type: none"> <li>• Accessory structures of skin</li> </ul>			CO2, CO6
	C	<ul style="list-style-type: none"> <li>• Types of skins</li> <li>• Functions of skin</li> </ul>			CO2, CO6
	<b>Unit 3</b>	<b>The skeletal system: Bones &amp; Joints</b>			
	A	<ul style="list-style-type: none"> <li>• Structure of bone</li> <li>• Histology of bone tissue</li> <li>• Bone formation</li> <li>• Functions of bone and the skeletal system</li> <li>• Bone's role in Calcium homeostasis</li> </ul>			CO3, CO6
	B	<ul style="list-style-type: none"> <li>• Joint Classification - Fibrous joints and Cartilaginous joints</li> <li>• Synovial joints and its types.</li> </ul>			CO3, CO6
	C	<ul style="list-style-type: none"> <li>• Types of movements at synovial joints</li> <li>• Aging and joints.</li> </ul>			CO3, CO6
	<b>Unit 4</b>	<b>The Brain, Spinal cord and their related Nerves</b>			
	A	<ul style="list-style-type: none"> <li>• Brain organization, protection and blood supply</li> <li>• Cerebrospinal fluid</li> <li>• The brain stem and reticular formation</li> </ul>			CO4, CO6
	B	<ul style="list-style-type: none"> <li>• Functional organization of cerebral cortex</li> <li>• Aging and nervous system</li> </ul>			CO4, CO6
	C	<ul style="list-style-type: none"> <li>• Spinal cord anatomy</li> <li>• Spinal nerves</li> <li>• Spinal cord physiology</li> </ul>			CO4, CO6
	<b>Unit 5</b>	<b>Anatomy and Physiology of Sense organs</b>			
	A	<ul style="list-style-type: none"> <li>• Olfaction: Sense of smell</li> <li>• Gustation: Sense of taste</li> </ul>			CO5, CO6
	B	<ul style="list-style-type: none"> <li>• Vision</li> <li>• Hearing and equilibrium</li> </ul>			CO5, CO6
	C	<ul style="list-style-type: none"> <li>• Aging and the special senses</li> </ul>			CO5, CO6
	Mode of examination	<b>Theory</b> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction			
	Weightage Distribution	CA	MTE	ETE	
		25%	25%	50%	



Text book/s*	<ol style="list-style-type: none"> <li>1. Guyton, A.C. &amp; Hall, J.E. Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B.Saunders Company. (2006).</li> <li>2. Tortora, G.J. &amp; Grabowski, S. Principles of Anatomy &amp; Physiology. XI Edition John Wiley &amp; sons(2006).</li> <li>3. Christopher D. Moyes, Patricia M. Schulte. Principles of Animal Physiology. 3rd Edition, PearsonEducation (2016).</li> </ol>			
Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>			

### Course Articulation Matrix for BZO112 Human Physiology

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	2	2	-	1	3	1	1
CO2	3	1	1	1	-	3	2	3	-	1	3	1	1
CO3	3	1	1	1	2	3	2	3	-	1	3	1	1
CO4	3	1	1	1	3	3	2	2	-	1	3	1	1
CO5	3	1	1	1	2	2	3	3	-	1	3	1	1
CO6	3	1	1	1	1	3	2	3	-	1	3	1	1
Average	3.00	1.00	1.00	1.00	1.80	2.83	2.17	2.67	-	1.00	3.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



### BZO113 HUMAN PHYSIOLOGY LAB

<b>School: SBSR</b>		<b>Batch: 2022-2026</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2022-2023</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>BZO113</b>	
2	Course Title	<b>Human Physiology Lab</b>	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course Type	Compulsory (CC)	
6	Max. Marks	25+75 = 100	
7	Min. Marks	As per rules	
8	Course Objective	To demonstrate the tissues and various components of human body through slides and models.	
9	Course Outcomes	The student at the completion of the course will be able to: CO1: Understand the structure of different types of epithelial tissues CO2: Know the structural organization of connective tissues CO3: Distinguish various types of human tissues CO4: Demonstrate various components of nervous system. CO5: Get complete understanding of vertebrates and bones of human system CO6: Understand the importance of differences in tissues throughout the body	
10	Course Description	The lab course on Histology and Physiology has been framed such that students may get an idea of the internal tissue organization and understand the need of variations in tissues in different organs.	
11	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Permanent Slides of Epithelial Tissues</b>	
	A	<ul style="list-style-type: none"> <li>● Squamous Epithelium</li> <li>● Simple Columnar Epithelium</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>● Stratified Columnar Epithelium - salivary gland ducts</li> <li>● Pseudostratified Ciliated Epithelium</li> </ul>	CO1,CO6



	C	<ul style="list-style-type: none"> <li>Stratified Squamous Epithelium</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Permanent Slides of Connective Tissues</b>	
	A	<ul style="list-style-type: none"> <li>Adipose Tissue</li> <li>Tendon</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Elastic Cartilage</li> <li>Fibrocartilage</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Chondroid Tissue/hyaline cartilage</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Study of Nervous System via permanent slides or virtual images or models</b>	
	A	<ul style="list-style-type: none"> <li>Spinal Cord Thoracic</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Cerebral Cortex</li> <li>Cerebellum</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Medulla</li> <li>Pons</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Models of skeletal system</b>	
	A	<ul style="list-style-type: none"> <li>Study of vertebrae of human system</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Study of girdles of human system</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Study of important bones of human system</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>	
	A	<ul style="list-style-type: none"> <li><a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li><a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li><a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li><a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li><a href="http://www.powershow.com">www.powershow.com</a></li> <li><a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li><a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>	CO5, CO6
	Mode of examination	<b>Practical/Viva</b> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)	
	Weightage Distribution	CA	ETE
		25%	75%
	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	



		<p>3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. &amp; Wilkins.</p> <p>4. Arey, L.B. (1974). Human Histology. IV Edition. W.B. Saunders.</p> <p>5. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi</p>	
	Suggestive Digital Platforms / Web Links	<p>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></p> <p>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></p> <p>3. Swayam Prabha - DTH Channel, <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></p> <p>5. Amrita Vishwa Vidhyapeeth Labs <a href="https://vlab.amrita.edu/">https://vlab.amrita.edu/</a></p>	
	Suggested Equivalent Online Courses	<p>1. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></p> <p>2. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></p> <p>3. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></p> <p>4. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></p>	

### Course Articulation Matrix for BZO113 Human Physiology Lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	3	1	1	3	3	2	-	1	3	1	1
CO2	3	1	3	1	1	3	2	3	-	1	3	1	1
CO3	3	1	3	2	1	3	2	3	-	1	3	1	1
CO4	3	1	3	1	1	3	2	2	-	1	3	1	1
CO5	3	1	3	1	1	2	3	3	-	1	3	1	1
CO6	3	1	3	1	1	3	2	3	-	1	3	1	1
Average	3.00	1.00	3.00	1.17	1.00	2.83	2.33	2.67	-	1.00	3.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## VOL102 ESSENTIAL TECHNIQUES IN LIFE SCIENCES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>VOL102</b>	
2	Course Title	<b>Essential techniques in Life Sciences</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
5	Course status	Compulsory (SEC)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in biological experiments, project writing and oral presentation.</li> </ul>	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO 1:</b> Show the protein concentration using Lowry method.  <b>CO 2:</b> Compare the carbohydrate concentration using Molisch Test  <b>CO 3:</b> Identify the DNA using a thermocycler  <b>CO 4:</b> Examine the working of restriction digestion of a DNA  <b>CO 5:</b> Explain the principle of molecular cloning via different genetic engineering tools  <b>CO 6:</b> Experiment the digested DNA using DNA ligase.</p>	
8	Course Description	Vocational education is concerned with the training on vocation. It is related to productivity. Vocational education prepares individuals for jobs. It has adequate employment potentialities. It helps in broadening of horizon. It leads to dignity of labour. It is helpful in the maximum utilization of the material resources of the country..	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	A)To estimate the protein concentration using Lowry method.	CO1
		B) To estimate the DNA concentration using spectrophotometry method.	
		C) To calculate the carbohydrate concentration using Molisch Test.	
	<b>Unit 2</b>	A)To understand the working principle of chromatography.	CO2
		B) To run the DNA on an agarose gel electrophoresis.	



		C) To run the protein on a polyacrylamide gel electrophoresis.		
<b>Unit 3</b>	A) To amplify the DNA using a thermocycler.			CO3, CO4
	B) To purify DNA from an agarose gel.			
	C) To isolate RNA using a mammalian cell.			
<b>Unit 4</b>	A) To study the restriction digestion of a DNA			CO5, CO6
	B) To ligate the digested DNA using DNA ligase.			
	C) To transform the recombinant plasmid to E. coli cells.			
	D) Selection of recombinant colonies using Blue-White screening.			
Mode of examination	<u>Practical/Viva</u> A) Rubric assessment B) Monthly Presentation to be audited by supervisor C) Mid Term Presentation and End Term Presentation			
Weightage Distribution	CA	CE (Viva + PPT)	ETE	
	25	25	50	
Text book/s*	10 Recent International Journal Articles of repute.			

### Course Articulation Matrix for VOL102 Essential Techniques in Life Sciences

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	3	3	2	-	1	1	1	1
CO2	1	1	3	2	1	3	2	3	-	1	1	3	3
CO3	1	1	3	2	1	3	2	3	-	1	1	2	1
CO4	1	1	3	2	1	3	2	2	-	1	1	3	1
CO5	1	1	3	2	1	2	3	3	-	1	1	3	1
CO6	1	1	3	2	1	3	2	3	-	1	1	3	1
Average	1.00	1.00	3.00	2.00	1.00	2.83	2.33	2.67	-	1.00	1.00	2.50	1.33

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**





## Communicative English-2

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>ARP102</b>	
2	Course Title	Communicative English-2	
3	Credits	2	
4	Contact Hours (L-T-P)	1-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To Develop LSRW skills through audio-visual language acquirement, creative writing, advanced speech et al and MTI Reduction with the aid of certain tools like texts, movies, long and short essays.	
7	Course Outcomes	After completion of this course, students will be able to: <b>CO1</b> Acquire Vision, Goals and Strategies through Audio-visual Language Texts <b>CO2</b> Synthesize complex concepts and present them in creative writing <b>CO3</b> Develop MTI Reduction/Neutral Accent through Classroom Sessions & Practice <b>CO4</b> Determine their role in achieving team success through defining strategies for effective communication with different people <b>CO5</b> Realize their potentials as human beings and conduct themselves properly in the ways of world. <b>CO6</b> Acquire satisfactory competency in use of Quantitative aptitude and Logical Reasoning	
8	Course Description	The course takes the learnings from the previous semester to an advanced level of language learning and self-comprehension through the introduction of audio-visual aids as language enablers. It also leads learners to an advanced level of writing, reading, listening and speaking abilities, while also reducing the usage of L1 to minimal in order to increase the employability chances.	
9	Outline syllabus		CO Mapping
	<b>Unit A</b>	<b>Acquiring Vision, Goals and Strategies through Audio-visual Language Texts</b>	
	Topic 1	Pursuit of Happiness / Goal Setting & Value Proposition in life	CO1
	Topic 2	12 Angry Men / Ethics & Principles	CO1



	Topic 3	The King's Speech / Mission statement in life   strategies & Action Plans in Life	CO1
	<b>Unit B</b>	<b>Creative Writing</b>	
	Topic 1	Story Reconstruction - Positive Thinking	CO2
	Topic 2	Theme based Story Writing - Positive attitude	CO1, CO2
	Topic 3	Learning Diary Learning Log – Self-introspection	CO1, CO2
	<b>Unit C</b>	<b>Writing Skills 1</b>	
	Topic 1	Precis	CO2
	Topic 2	Paraphrasing	CO3, CO2, CO3
	Topic 3	Essays (Simple essays)	CO2, CO3
	<b>Unit D</b>	<b>MTI Reduction/Neutral Accent through Classroom Sessions &amp; Practice</b>	
	Topic 1	Vowel, Consonant, sound correction, speech sounds, Monothongs, Diphthongs and Triphthongs	CO3
	Topic 2	Vowel Sound drills , Consonant Sound drills, Affricates and Fricative Sounds	CO4
	Topic 3	Speech Sounds   Speech Music  Tone   Volume  Diction Syntax  Intonation   Syllable Stress	CO4
	<b>Unit E</b>	<b>Gauging MTI Reduction Effectiveness through Free Speech</b>	
	Topic 1	Jam sessions	CO3
	Topic 2	Extempore	CO4, CO5
	Topic 3	Situation-based Role Play	CO4, CO5
	<b>Unit F</b>	<b>Leadership and Management Skills</b>	
	Topic 1	Innovative Leadership and Design Thinking	CO4
	Topic 2	Ethics and Integrity	CO4
	<b>Unit F</b>	<b>Universal Human Values</b>	
	Topic 1	Love & Compassion, Non-Violence & Truth	CO5
	Topic 2	Righteousness, Peace	CO5
	Topic 3	Service, Renunciation (Sacrifice)	CO5
	<b>Unit G</b>	<b>Introduction to Quantitative aptitude &amp; Logical Reasoning</b>	
	Topic 1	Analytical Reasoning & Puzzle Solving	CO6
	Topic 2	Number Systems and its Application in Solving Problems	CO6
10	Evaluations	<i>Class Assignments/Free Speech Exercises / JAM Group Presentations/Problem Solving Scenarios/GD/Simulations ( 60% CA and 40% ETE</i>	N/A
	Texts & References   Library Links	<ul style="list-style-type: none"> <li>Wren, P.C.&amp;Martin H. <i>High English Grammar and Composition</i>, S.Chand&amp; Company Ltd, New Delhi.</li> <li>Blum, M. Rosen. <i>How to Build Better Vocabulary</i>. London: Bloomsbury Publication</li> </ul>	



		<ul style="list-style-type: none"> <li>Comfort, Jeremy(et.al). <i>Speaking Effectively</i>. Cambridge University Press. The Luncheon by W.Somerset Maugham - <a href="http://mistera.co.nf/files/sm_luncheon.pdf">http://mistera.co.nf/files/sm_luncheon.pdf</a></li> </ul>	
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### Course Articulation Matrix for ARP-102 Communicative English-2

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	1	3	-	-	-
CO2	-	-	-	-	-	-	-	-	1	3	-	-	-
CO3	-	-	-	-	-	-	-	-	1	3	-	-	-
CO4	-	-	-	-	-	-	-	-	1	2	-	-	-
CO5	-	-	-	-	-	-	-	-	1	2	-	-	-
CO6	1	-	-	-	-	-	-	-	1	2	-	-	-
Average	1.00	-	-	-	-	-	-	-	1.00	2.50	-	-	-

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



<b>School: SSHSS</b>		<b>Semester – 1</b>	<b>ACADEMIC SESSION:</b>	<b>FOR VAC – 1 Practical</b>
<b>1</b>	<b>Course code</b>	<b>VAC110</b>		
<b>2</b>	<b>Course Title</b>	<b>Yoga for Holistic health</b>		
<b>3</b>	<b>Credits</b>	<b>3</b>		
<b>4</b>	<b>Learning Hours</b>	<b>0-1-4</b>		
<b>5</b>	<b>Course Objective</b>	To make the students familiar with the different practices of yoga, chanting and meditation techniques and learn the correct teaching skills.		
<b>6</b>	<b>Course Outcomes</b>	<ol style="list-style-type: none"> <li>1. To make the students understand the concept of health and wellness through Yoga</li> <li>2. To define the concept and principles of Yoga.</li> <li>3. To interpret and understand the breathing practice.</li> <li>4. To describe the knowledge about Yoga, its foundations and applications to the aspirants.</li> <li>5. To make students aware of Yogic impact on the positive health and personality development.</li> <li>6. The students will learn primary level of Yoga practices, which will groom their personality.</li> </ol>		
<b>7.1</b>		<b>Unit A</b>	<b>Importance of Health, Wellness through Yoga</b>	<b>CO mapping</b>
7.11		Unit A Topic 1	Meaning, Definition, Aim of Yoga; Concept of health according to WHO and Ayurveda	CO1, CO2, CO4, CO5, CO6
7.12		Unit A Topic 2	Misconception about Yoga, Difference between asana and physical exercise	CO1, CO2, CO4, CO5, CO6
7.13		Unit A Topic 3	Need, Importance of Yoga in health and wellness	CO1, CO2, CO4, CO5, CO6
<b>7.2</b>		<b>Unit B</b>	<b>Schools of Yoga, Modern and Ancient schools of Yoga existing in India, Yogic diet, Yogic attitudes, Sadhak tatva &amp; Badhak tatva</b>	
7.21		Unit B Topic 1	Schools/ Streams of Yoga – Ashtanga Yoga, Bhakti Yoga, Karma Yoga, Jnana Yoga	CO3, CO4, CO5, CO6



7.22		Unit B Topic 2	Modern and ancient schools of Yoga existing in India – Natha Sampradaya, Kaivalyadhama, Bihar School of Yoga, Munger, Pragma Yoga (Shantikunj), Iyengar Yoga, Patanjali Yoga Peeth, Ashtanga Vinyasa Yoga	CO3, CO4, CO5, CO6
7.23		Unit B Topic 3	Yoga Ahaara (Yogic diet), Yogic Attitudes – Maitri Karuna, Mudita, Upeksha, Sadhak Tatva Badhak Tatva (facilitating/helping factors and obstacles in Yoga sadhana)	CO3, CO4, CO5, CO6
<b>7.3</b>		<b>Unit C</b>	<b>Beginner level practices – Sukshma Vyayama and Surya Namaskara</b>	
7.31		Unit C Topic 1	Sukshma Vyayama and their benefits for health Part-1 (Bihar School of Yoga) Part-1	CO4, CO5, CO6
7.32		Unit C Topic 2	Sukshma Vyayama & their benefits for health (Swami Dharendra Brahmachari) Part-1	CO4, CO5, CO6
7.33		Unit C Topic 3	Surya Namaskara (Sun Salutation) with mantra chanting (12 steps) & their benefits for health	CO4, CO5, CO6
<b>7.4</b>		<b>Unit D</b>	<b>Asana - all categories</b>	
7.41		Unit D Topic 1	Standing & Sitting - Tadasana, Vrikshasana, Katichakrasana, Padmasana, Vajrasana, Ushtrasana, Paschimottanasana, Vakrasana	CO4, CO5, CO6
7.42		Unit D Topic 2	Supine and Prone: Uttanapadasana, Pawanamuktasana, Shalabhasana, Bhujangasana	CO4, CO5, CO6
7.43		Unit D Topic 3	Balancing and Inverted: Trivikramasana, Sarvangasana, Viparitakarani mudra	CO4, CO5, CO6
7.5		Unit E	<b>Pre-practices of Pranayama, Pranayama and Dhyana</b>	
7.51		Unit E Topic 1	Kapalabhati, Mukha dhauti, Vibhagiya pranayama (Sectional breathing)	CO1, CO4, CO5, CO6



7.52		Unit E Topic 2	Anuloma – Viloma, Bhastrika, Shitali	CO1, CO4, CO5, CO6
7.53		Unit E Topic 3	Om Dhyana, Aanapaanasati Dhyana (breath meditation)	CO1, CO4, CO5, CO6
<b>8</b>	<b>Course Evaluation</b>			
8.1	Course work:			
8.11	Attendance			
8.12	Homework	Three best out of five assignments: 10 marks		
8.13	Quizzes	Three best out of five tests: 10 marks		
8.14	Projects	None		
8.15	Presentations	One best out of two: 10 marks		
8.2	CA: 60 % Practical			
8.3	End-term examination: 40% Viva			
<b>9</b>	<b>References</b>			
9.1	Text book	<ol style="list-style-type: none"> <li>1. Sri Ananda: The Complete book of Yoga, Orient Course Backs, Delhi, 2003.</li> <li>2. Basavaraddi, I.V. &amp; other: SHATKARMA: A Comprehensive description about Cleansing Process, MDNIY New Delhi, 2009</li> <li>3. Joshi, K.S.: Yogic Pranayama, Oriental Paperback, New Delhi, 2009</li> <li>4. Dr. Nagendra H R: Pranayama, The Art &amp; Science, Swami Vivekananda Yoga Prakashan, Bangalore, 2005.</li> <li>5. Swami Niranjanananda Saraswati: Asana Pranayama Mudra Bandha, Yoga Publication Trust, Munger Bihar.</li> <li>6. Joshi, K.S.: Yogic Pranayama, Oriental Paperback, New Delhi, 2009</li> <li>7. Swami Kuvalyananda: Pranayama, Kaivalyadhama, Lonavla, 2010</li> <li>8. Swami Rama: Science of Breath, A Practical Guide, The Himalayan International Institute, Pennselvenia, 1998.</li> <li>9. Swami Niranjanananda Saraswati: Prana, Pranayama &amp; Pranavidya, Yoga Publications Trust, Munger, Bihar, 2005</li> </ol>		



### CO-PO-PSO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-	-	-
CO6	-	-	-	-	-	-	-	-	3	-	-	-	-
Avg	-	-	-	-	-	-	-	-	3.0	-	-	-	-

1. Slight (Low)

2. Moderate (Medium)

3. Substantial (High)



### PHR101 (Introduction to Renewable energy and management)

<b>School: SSBSR</b>		<b>Batch : 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Physics</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>PHR101</b>	
2	Course Title	<b>Introduction to Renewable energy and management</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course Status	Minor Elective	
6	Course Objective	1. To familiarize the concept of energy and its classification. 2. To know the importance of renewable energy. 3. To provide the awareness about climate change. 4. To familiarize with various renewable energy resources and its management.	
7	Course Outcomes	After the completion of this course, the student will be able to CO1: Comprehend the different types of energy. CO2: Examine the importance of fossil fuels and renewable energy resources. CO3: Apply the concept of greenhouse effect for climate change. CO4: Inculcate the knowledge of renewable energy resources to obtain clean energy and its environmental impact. CO5: Familiarize with energy management and sustainable development. CO6: Obtain asses the importance of various renewable energy resources and their impacts.	
8	Course Description	This course deals with different types of energy and their impact on the climate change. In this course, the students will learn about the energy management and sustainable energy development.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Energy and its classification</b>	
	A	Introduction to energy: Definition and units of energy and power.	CO1, CO2
	B	Forms of energy and conservation of energy.	CO1, CO2
	C	Fossil fuels, renewable and non-renewable energy & their types. Conventional and non-conventional energy.	CO1, CO2
	<b>Unit 2</b>	<b>Fossil fuels and Alternate Sources of Energy</b>	
	A	Fossil Fuels - Types, Uses, Advantages & Disadvantages, need of renewable energy.	CO1, CO3
	B	An overview of renewable energy resources: solar energy, wind energy, hydroelectric energy	CO1, CO3
	C	Wave energy, ocean thermal energy, tidal energy, geothermal energy and biomass energy.	CO1, CO3
	<b>Unit 3</b>	<b>Climate Change</b>	
	A	Greenhouse gases (GHG) types and sources. The greenhouse effect.	CO1, CO3
	B	The link between energy and climate change.	CO3, CO6





	C	Climate change – causes and consequences. global warming.		CO3, CO6
	<b>Unit 4</b>	<b>Renewable energy resources</b>		
	A	Various renewable energy resources- Introduction, availability, classification, relative merits and demerits.		CO4, CO6
	B	Social, economic of renewable energy resources.		CO4, CO6
	C	Environmental impacts of renewable energy resources.		
	<b>Unit 5</b>	<b>Energy Management</b>		
	A	Principles of Energy Management, energy needs of growing economy, energy conservation and its importance.		CO5, CO6
	B	Concept of sustainability		CO5 ,CO6
	C	Renewable energy for sustainable development		CO5 ,CO6
	Mode of examination	20 marks for Test / Quiz / Assignment / Presentation. 05 marks for Class Interaction		
	Weightage Distribution	CA	MSE	MTE+ETE
		15%	10%	75%
	Text book/s	1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi 2. Solar energy - M P Agarwal - S Chand and Co. Ltd. 3. Solar energy - Suhas P Sukhative Tata McGraw - Hill Publishing Company Ltd. 4. Godfrey Boyle, “Renewable Energy, Power for a sustainable future”, 2004, 5. Oxford University Press, in association with The Open University. 6. Dr. P Jayakumar, Solar Energy: Resource Assesment Handbook, 2009 7. J.Balfour, M.Shaw and S. Jarosek, Photovoltaics, Lawrence J Goodrich (USA). 8. <a href="http://en.wikipedia.org/wiki/Renewable_energy">http://en.wikipedia.org/wiki/Renewable_energy</a>		

**Course Articulation Matrix**  
**(Introduction to Renewable energy and management)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	3	2	3	1	1	1	-	2	1	-	-
CO2	1	2	2	1	2	1	1	1	-	1	1	-	-
CO3	1	2	3	1	3	1	1	1	-	2	1	-	-
CO4	1	3	1	2	3	1	1	1	-	2	1	-	-
CO5	1	1	1	2	2	1	1	1	-	1	1	-	-
CO6	1	1	1	2	3	1	1	1	-	2	1	-	-

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



# SEMESTER III

## **B.Sc. (Hons.) in Zoology**



## BSZ205 MOLECULAR BIOLOGY, BIOINSTRUMENTATION & BIO TECHNIQUES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program:</b> <b>B.Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch:</b> <b>Zoology</b>		<b>SEMESTER: III</b>	
1	Course Code	<b>BSZ205</b>	
2	Course Title	Molecular Biology, Bioinstrumentation & Biotechniques	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To demonstrate the knowledge of cellular happenings at molecular level and also to make oneself aware of how to perform diagnosis of these molecules with the help of advance tools and techniques.	
7	Course Outcomes	The student upon the completion of the course will be able to: CO1: Show a detailed and conceptual understanding of molecular processes viz. DNA to trait. CO2: Express how genes are regulated by various processes CO3: Acquaint with how DNA damage occurs and how the cells work together to repair them. CO4: Provide conclusion on the various bioinstruments at a basic level CO5: Compare the utility and applicability of Biotechniques in research. CO6: Create an aptitude related to molecular happenings and related techniques.	
8	Course Description	The course has been designed such that the understanding of central dogma of life and its various components are elaborated. Also along with this, the various instruments and biotechniques utilised for their understanding has also been compiled such that students are able to correlate the application part simultaneously.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Central Dogma of Life</b>	



A	<b>History of Molecular Biology</b> <b>DNA replication</b> <ul style="list-style-type: none"> <li>• Prokaryotic and Eukaryotic DNA replication</li> <li>• Mechanism of DNA replication</li> <li>• Enzymes, factors and other accessory proteins involved in DNA replication.</li> </ul>	CO1, CO6
B	<b>Transcription</b> <ul style="list-style-type: none"> <li>• Prokaryotic and eukaryotic transcription- basis of initiation, elongation and termination</li> <li>• Post transcriptional modifications- polyadenylation capping and RNA splicing</li> </ul>	CO1, CO6
C	<b>Translation</b> <ul style="list-style-type: none"> <li>• Prokaryotic and eukaryotic translation</li> <li>• Mechanisms of initiation, elongation and termination</li> <li>• Regulation of translation, post translational modifications of proteins, Protein folding, Chaperons</li> </ul>	CO1, CO6
<b>Unit 2</b>	<b>Operon Concept &amp; Gene Regulation</b>	
A	<ul style="list-style-type: none"> <li>• Operon Concept; the lac operon and tryptophan operon</li> </ul>	CO2, CO6
B	<ul style="list-style-type: none"> <li>• Introduction to Epigenetics</li> </ul>	CO2, CO6
C	<ul style="list-style-type: none"> <li>• Gene regulation, Types of regulation-Positive and negative</li> </ul>	CO2, CO6
<b>Unit 3</b>	<b>DNA Damage, Repair and Recombination</b>	
A	<ul style="list-style-type: none"> <li>• DNA damage, causes</li> </ul>	CO3, CO6
B	<ul style="list-style-type: none"> <li>• DNA repair mechanisms</li> </ul>	CO3, CO6
C	<ul style="list-style-type: none"> <li>• Homologous recombination, holiday junction</li> </ul>	CO3, CO6
<b>Unit 4</b>	<b>Bioinstrumentation</b>	
A	<ul style="list-style-type: none"> <li>• Principle of Microscopy and Applications</li> <li>• Types of Microscopes: light microscopy, dark field microscopy, phase-contrast microscopy</li> <li>• Fluorescence microscopy, confocal microscopy, electron microscopy</li> </ul>	CO4, CO6
B	Centrifugation and Chromatography: <ul style="list-style-type: none"> <li>• Principle of Centrifugation</li> <li>• Types of Centrifuges: high speed and ultracentrifuge</li> <li>• Types of rotors: Vertical, Swing-out, Fixed-angle etc.</li> <li>• Principle and Types of Chromatography: paper, ionexchange, gel filtration, HPLC, affinity</li> </ul>	CO4, CO6
C	<ul style="list-style-type: none"> <li>• Spectrophotometry and Biochemical Techniques</li> <li>• Biochemical techniques: Measurement of pH, Preparation of buffers and solutions</li> <li>• Principle of Colorimetry/Spectrophotometry: Beer-Lambert law</li> <li>• Measurement, applications and safety measures of radio-tracer techniques</li> </ul>	CO4, CO6



<b>Unit 5</b>	<b>Biotechniques</b>		
A	<ul style="list-style-type: none"> <li>Detection of nucleic acid by gel electrophoresis</li> <li>DNA sequencing, DNA fingerprinting, RFLP</li> </ul>		CO5, CO6
B	<ul style="list-style-type: none"> <li>Polymerase Chain Reaction (PCR)</li> <li>Detection of proteins, PAGE</li> </ul>		CO5, CO6
C	<ul style="list-style-type: none"> <li>ELISA, Western blotting</li> </ul>		CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
Weightage Distribution	CA		MTE & ETE
	25%		75%
Text book/s*	<ol style="list-style-type: none"> <li>Wilson K. and Walker J., "Principles and Techniques of Biochemistry and Molecular Biology", Cambridge University Press, 2010.</li> <li>Ninfa A.J., Ballou D.P. and Benore M., "Fundamental Laboratory Approaches for Biochemistry and Biotechnology", Wiley, 2009.</li> <li>Sheelar D., "Physical Biochemistry: Principles and Applications", Wiley, 2009</li> <li>Lodish et al: Molecular Cell Biology: Freeman &amp; Co, USA (2004).</li> <li>Alberts et al: Molecular Biology of the Cell: Garland (2002).</li> <li>Cooper: Cell: A Molecular Approach: ASM Press (2000).</li> <li>Karp: Cell and Molecular Biology: Wiley (2002).</li> <li>Watson et al. Molecular Biology of the Gene. Pearson (2004).</li> <li>Lewin. Genes VIII. Pearson (2004).</li> <li>Pierce B. Genetics. Freeman (2004).</li> <li>Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>Primrose. Molecular Biotechnology. Panima (2001). 1</li> <li>Clark &amp; Switzer. Experimental Biochemistry. Freeman (2000)</li> </ol>		
Other References	<ol style="list-style-type: none"> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>Swayam Prabha - DTH Channel,</li> <li><a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>		



**Course Articulation Matrix for BSZ205 MOLECULAR BIOLOGY,  
BIOINSTRUMENTATION & BIOTECHNIQUES**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	1	3	1	3	2	2	-	1	3	3	3
CO2	2	3	2	3	1	3	2	3	-	1	3	3	3
CO3	2	3	2	3	1	3	2	3	-	1	3	3	3
CO4	2	3	2	3	1	3	2	2	-	1	3	3	3
CO5	2	3	2	3	1	2	3	3	-	1	3	3	3
CO6	2	3	2	3	1	3	2	3	-	1	3	3	3
Average	2.00	3.00	1.83	3.00	1.00	2.83	2.17	2.67	-	1.00	3.00	3.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BZO202 Molecular techniques and Bio-instruments lab

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program:</b> <b>B. Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch:</b> <b>Zoology</b>		<b>SEMESTER: III</b>	
1	Course Code	<b>BZO202</b>	
2	Course Title	<b>Molecular techniques and Bio-instruments lab</b>	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in students the practical knowledge of preliminary Molecular Biology techniques and also demonstrate the required instruments	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Recall safe laboratory practices and handle the equipment safely. CO2: Demonstrate autoclave, Laminar Air flow and Hot air oven and sterilize glass and plasticwares. CO3: Estimate the quality and quantity of nucleic acids. CO4: Justify the different Bioinstruments available in microbiology. CO6: Acquaint themselves of the various experiments in molecular biology and their related tools and techniques.	
8	Course Description	The course has been designed keeping in view the instruments, the SOP's needed while working in a molecular biology lab and also will provide the students a knowledge of the basic molecular biological technique.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Practical based on introduction to molecular biology lab</b>	
	A	Good lab practices in molecular biology laboratory.	CO1, CO6
	B	Preparation of standard solutions for molecular biology experiments	CO1,CO6



	C	To study the working principle and Simple, Compound and Binocular microscopes	CO1,CO6
	<b>Unit 2</b>	<b>General lab reagent preparation &amp; handling equipment's</b>	
	A	To study the working principle of various lab equipments such as pH Meter	CO2, CO6
	B	Electronic balance, use of glass and micropipettes, Laminar flow, Incubator	CO2, CO6
	C	Water bath, Centrifuge, Chromatography apparatus	CO2, CO6
	<b>Unit 3</b>	<b>Isolation of Nucleic acids and quantification</b>	
	A	Isolation of DNA from cell (prokaryotic & Eukaryotic)	CO3, CO6
	B	Isolation of RNA from cell (Prokaryotic & Eukaryotic)	CO3, CO6
	C	Quantification of the RNA/DNA	CO3, CO6
	<b>Unit 4</b>	<b>Bio-instruments</b>	
	A	To prepare solutions and buffers. To measure absorbance in Colorimeter or Spectrophotometer. Demonstration of differential centrifugation to fractionate different components in a mixture	CO4, CO6
	B	To prepare dilutions of Riboflavin and verify the principle of spectrophotometry. To identify different amino acids in a mixture using paper chromatography.	CO4, CO6
	C	Demonstration of DNA extraction from blood or tissue samples. To estimate amount of DNA using spectrophotometer.	CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>	
	A	<ul style="list-style-type: none"> <li>• <a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li>• <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> <li>•</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>• <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li>• <a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> <li>•</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>• <a href="http://www.powershow.com">www.powershow.com</a></li> <li>• <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li>• <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>	CO5, CO6
	Mode of examination	<b>Practical/Viva</b> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)	
	Weightage Distribution	CA	ETE
		25%	75%





Text book/s*	<ol style="list-style-type: none"> <li>1. Cottenil R.M.S., “Biophysics: An Introduction”, John Wiley and Sons, 2002.</li> <li>2. Gupta A., “Instrumentation and Bioanalytical Techniques”, Pragati Prakashan, 2009.</li> </ol>	
Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	

### Course Articulation Matrix for BZO202 Molecular Techniques and Bio-Instruments Lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	3	3	2	-	1	1	3	1
CO2	1	1	3	2	1	3	2	3	-	1	1	3	1
CO3	1	1	3	2	1	3	2	3	-	1	1	3	1
CO4	1	1	3	2	1	3	2	2	-	1	1	3	1
CO5	1	1	3	2	1	2	3	3	-	1	1	3	1
CO6	1	1	3	2	1	3	2	3	-	1	1	3	1
Average	1.00	1.00	3.00	2.00	1.00	2.83	2.33	2.67	-	1.00	1.00	3.00	1.00

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



## BZO201 Medical Diagnostics and Monitoring of Public Health

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>BZO201</b>	
2	Course Title	<b>Medical Diagnostics and Monitoring of Public Health</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate an idea of the tools and techniques related to medical field and to make the students aware of the community level knowledge of disease operation and distribution.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p><b>CO1:</b> Understand the basic techniques being handled in medical diagnostic lab</p> <p><b>CO2:</b> Understand the fundamentals, terms and tools of public health</p> <p><b>CO3:</b> Knowledge attainment on prevalent communicable diseases and their impact on health.</p> <p><b>CO4:</b> Knowledge attainment on Non-Communicable diseases and its impact on human health</p> <p><b>CO5:</b> Knowledge of the various disease affecting the Women, Child, adult and Geriatric population</p> <p><b>CO6:</b> Exemplify the role of public health in individual and at family level</p>	
8	Course Description	The course has been designed with an intention to inculcate in the students the learning of samples used for diagnostic assays and the various methods in medical diagnostics. The subject also provided the interaction of human health and its role in the society. How different diseases appear at individual level and then at community level and how they create an impact in the lives has been focused here.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Medical Diagnostics</b>	
	A	Type of tests available in medical diagnostic; Tissues & Samples used in medical diagnostic	CO1, CO6
	B	Imaging techniques: CT, MRI, PET; Endoscopy,	CO1,CO6
	C	Measurement of Body function-EEG, ECG, Biopsy; Ultrasonography; CBC	CO1,CO6
	<b>Unit 2</b>	<b>Introduction to Public Health</b>	



A	History, Health, its determinants and public health, Social determinants	CO2, CO6
B	Evolution of global public health initiatives : primary health care, secondary primary health care etc.	CO2, CO6
C	Sources of demographic and Health data : Population census, NFHS, DLHS, National Sample Survey Organization (NSSO)	CO2, CO6
<b>Unit 3</b>	<b>Communicable diseases</b>	
A	Polio, Diphtheria, Tetanus, Measles, Tuberculosis, Leprosy Vector borne: Malaria, Filariasis, Dengue, Leptospirosis Zoonotic: Plague, Rabies	CO3, CO6
B	Intestinal: Diarrhoea, Typhoid, worm infestations Contact: STIs and AIDS	CO3, CO6
C	Neglected tropical diseases	CO3, CO6
<b>Unit 4</b>	<b>Non-Communicable Diseases</b>	
A	Rheumatic heart disease-; endocarditis; Ischaemic heart disease, Stroke; Cardiovascular disorders	CO4, CO6
B	Respiratory diseases; Eye diseases; Cancer	CO4, CO6
C	Metabolic syndrome; Psychiatric disorders-Injuries -Emerging and Re- Emerging – Diseases; Guidelines for prevention of non- communicable diseases	CO4, CO6
<b>Unit 5</b>	<b>Child, Adolescent &amp; Geriatric Health</b>	
A	Reproductive Health with special focus on women health. Various schemes at National and International level	CO5, CO6
B	Child and Adolescent health; Various schemes at National and International level	CO5, CO6
C	Geriatric health, Various schemes at National and International level	CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
Weightage Distribution	CA	ETE
	25%	75%
Text book/s*	<ol style="list-style-type: none"> <li>Todd &amp; Sanford, Clinical Diagnosis by Laboratory Method. 4. Textbook of Pathology, 2014, 7th Edition, Harsh Mohan, Jaypee Brothers Medical Publishers (P) Ltd 5.</li> <li>Essentials in Hematology &amp; Clinical Pathology, 2012, 1st Edition, Ramadas Nayak, Sharada Rai, Astha Gupta.</li> <li>Mukherjee .L.K.(2017), Medical Laboratory Technology, Vol.1-3, 3rd edition, Tata Mcgraw Hill</li> <li>Sood Ramnik,(2015), Text book of Medical Laboratory Technology, 2nd edition, Jaypee Publications</li> <li>Wintrobe's Clinical Haematology,(2014), 13th edition, Lippincott Williams &amp; Wilkins</li> <li>De Gruchy's Clinical Haematology in Medical Practice,(2012), Sixth edition, Wiley Publications</li> </ol>	



		<p>7. Dacie &amp; Lewis Practical Haematology, (2011), 11th edition, Elsevier Publications</p> <p>8. Oxford textbook of Public Health Ed. Roger Detels, James McEwen, Robert Beaglehole, and Heizo Tanaka Oxford University Press (OUP) 4th Edition: 2002.</p> <p>9. International Public Health: Diseases, Programs, Systems, and Policies by Michael Merson, Robert E Black, Anne J Mills - Jones and Bartlett Publishers.</p> <p>10. Gordis Leon. Epidemiology (Fifth edition), Elsevier Saunders, 2013.</p>	
	Other References	<p>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></p> <p>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></p> <p>3. Swayam Prabha - DTH Channel,</p> <p>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></p> <p>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></p> <p>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></p> <p>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></p> <p>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></p>	

### Course Articulation Matrix for BZO201 Medical Diagnostics and Monitoring of Public Health

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	3	3	2	-	1	1	2	3
CO2	3	3	2	1	1	3	3	2	-	1	1	2	3
CO3	3	2	2	1	1	2	3	3	-	1	1	2	3
CO4	3	2	2	1	1	3	3	2	-	1	1	2	3
CO5	3	1	2	1	1	2	3	3	-	1	1	2	3
CO6	3	1	2	1	1	3	2	3	-	1	1	2	3
Average	3.00	1.67	2.00	1.00	1.00	2.67	2.83	2.50	-	1.00	1.00	2.00	3.00

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



### BZO203 Medical Diagnostics and Monitoring of Public Health Lab

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: II</b>	
1	Course Code	<b>BZO203</b>	
2	Course Title	<b>Medical Diagnostics and Monitoring of Public Health Lab</b>	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-1	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate the community level knowledge of disease operation and distribution.	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Tell the various fluids present in our body CO2: Demonstrate the various tests needed by our body CO3: Apply knowledge on the working of various medical devices CO4: Analyze the various techniques for waste management CO5: Explain the importance of medical diagnostics in daily life CO6: Adopt strategy and work flow for various diagnostics and treatment protocols	
8	Course Description	The course has been designed with an intention to inculcate in the students the learning and attitude towards human health and its role in the society. How different diseases appear at individual level and then at community level and how they create an impact in the lives has been focused here.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Study of types of Common Body fluids</b>	
	A	Commonly body fluids used for analysis (blood, urine, CSF, synovial fluid, saliva, sweat)	CO1, CO6
	B	To demonstrate presence of DNA in cheek cells	CO1,CO6
	C	Physiological data acquisition based experiments (ECG )	CO1,CO6
	<b>Unit 2</b>	<b>Blood tests</b>	



	A	Determination of bleeding time and clotting time of blood		CO2, CO6
	B	Preparation of blood smears and identifying various WBC		CO2, CO6
	C	Detection of Blood sugar level Detection of blood parasites		CO2, CO6
	<b>Unit 3</b>	<b>Diagnosis of Important body parameters</b>		
	A	Detection of SGOT & SGPT levels		CO3, CO6
	B	Blood Pressure recordings in humans.		CO3, CO6
	C	To perform Widal test		CO3, CO6
	<b>Unit 4</b>	<b>Bio-Medical Waste Management</b>		
	A	Bio-medical waste, Waste Generation, Segregation, Disposal, Related Policies		CO4, CO6
	B	Record Keeping, Management of Bio-medical Waste, Technologies for Treatment for BMW		CO4, CO6
	C	Criteria for selecting appropriate Medical Waste Technologies		CO4, CO6
	<b>Unit 5</b>	<b>Virtual experiments</b>		
	A	<ul style="list-style-type: none"> <li><a href="https://www.news-medical.net/health/What-is-an-Ultrasound.aspx">https://www.news-medical.net/health/What-is-an-Ultrasound.aspx</a></li> <li><a href="https://www.youtube.com/watch?v=E44W54z_Ykw">https://www.youtube.com/watch?v=E44W54z_Ykw</a></li> </ul>		CO5, CO6
	B	<ul style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=gaiCtdo6CLE">https://www.youtube.com/watch?v=gaiCtdo6CLE</a></li> <li><a href="https://www.youtube.com/watch?v=Xwh4M5LM8X4">https://www.youtube.com/watch?v=Xwh4M5LM8X4</a></li> </ul>		CO5, CO6
	C	<ul style="list-style-type: none"> <li><a href="https://www.youtube.com/watch?v=7kqpOz5VfU0">https://www.youtube.com/watch?v=7kqpOz5VfU0</a></li> <li><a href="https://www.youtube.com/watch?v=P0fgIbFcsbk">https://www.youtube.com/watch?v=P0fgIbFcsbk</a></li> <li><a href="https://www.youtube.com/watch?v=eMu7PN96fqg">https://www.youtube.com/watch?v=eMu7PN96fqg</a></li> </ul>		CO5, CO6
	Mode of examination	Practical/Viva Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)		
	Weightage Distribution	CA		ETE
		25%		75%
	Text book/s*	1. Lab Manual on Blood Analysis and Medical Diagnostics, 1st edition (2012), Dr. GayatrBiostatistics, Bioethics & IPR akash; S. Chand, ISBN: 81-219-3967. 2. Bailey and Scott's Diagnostic Microbiology, 12th edition (2007), Betty A. Forbes, Daniel F. Sahn and Alice S. Weissfeld; Mosby Elsevier Publishers, ISBN-13: 978-0808923640. 3. Medical Laboratory Technology Methods and Interpretations Volume 1 and 2, 6th edition (2009), Ramnik Sood; Jaypee Brothers Medical Publishers, ISBN-13: 978-8184484496. 4. Current Protocols in Human Genetics, 1st edition (1994), Dracopoli and		



		<p>Nicolas C. Dracopoli; John Wiley and Sons, Inc., ISBN-13: 978-0471034209</p> <p>5. Concise Book On Medical Laboratory Technology, 2005 reprint, 1st Edn., C. R. Maiti, New Central Book Agency (p) Ltd, Kolkata, India.</p> <p>6. Introduction of Medical Laboratory Technique, 1998, 7th Edn., Baker F. J., Silverton R. E., Pallister C. J., Butterworth-Heinemann, UK</p>	
	Other References	<p>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></p> <p>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></p> <p>3. Swayam Prabha - DTH Channel,</p> <p>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></p> <p>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></p> <p>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></p> <p>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></p> <p>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></p>	

### Course Articulation Matrix for BZO203 Medical Diagnostics and Monitoring of Public Health Lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	3	3	2	-	1	1	2	3
CO2	3	3	2	1	1	3	2	3	-	1	1	2	3
CO3	3	2	2	1	1	3	3	2	-	1	1	2	3
CO4	3	2	2	1	1	3	2	2	-	1	1	2	3
CO5	3	1	2	1	1	2	3	3	-	1	1	2	3
CO6	3	1	2	1	1	3	2	3	-	1	1	2	3
Average	3.00	1.67	2.00	1.00	1.00	2.83	2.50	2.50	-	1.00	1.00	2.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BSZ206 ANIMAL BIOTECHNOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: III</b>	
1	Course Code	<b>BSZ206</b>	
2	Course Title	Animal Biotechnology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students an understanding of animal culture, cloning and production of transgenic animals.	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p>CO1: Tell the methods of obtaining cells from the tissue for cell culture.            CO2: Demonstrate the techniques of cell culture            CO3: Appraise with the methods of cell cloning and production of GMOs            CO4: Familiarize with the concept of transgenics and the related products            CO5: Explain the concept of stem culture and applications of animal culture            CO6: Develop a complete knowledge about various techniques and methodology used in animal cell biotechnology.</p>	
8	Course Description	The course has a special focus towards production and rearing of animals via culturing and cloning techniques. It also deals with the environmental concerns while production of transgenic stocks.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Animal Cell Culture</b>	
	A	<ul style="list-style-type: none"> <li>• Animal tissue culture, history, requirements for animal cell culture</li> <li>• Types of cell culture, Equipments required for animal cell culture</li> </ul>	CO1, CO6
	B	Substrate, liquids, culture mediums-Natural (Clots, Biological fluids, Tissue extracts), complex natural and chemically defined media	CO1,CO6
	C	<ul style="list-style-type: none"> <li>• Explant-culture of explants, Cell culture technique- initiation, preparation and sterilization of media, isolation of explants, disaggregation of explants, culture, subculture</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Primary &amp; Secondary Cell lines</b>	





	A	<ul style="list-style-type: none"> <li>Cell lines, evolution of cell lines, maintenance of cell lines, Large scale culture of cell lines- monolayer, suspension and immobilized cell culture, Development of primary culture and cell lines, subculture</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Cultured cells and evolution of continuous cell lines (established cell lines)</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Commonly used cell lines - their origin and characteristics</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Genetically Modified Organisms &amp; Animal Cell Cloning</b>	
	A	Cloning, types of cell cloning methods of cloning; Genetically modified organisms	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Gene therapy: Genetic disorders, vector engineering, types of gene therapy, strategies of gene delivery, targeted gene replacement/augmentation, gene editing, gene correction, gene silencing</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Cell line preservation and characterization</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Transgenic animals</b>	
	A	<ul style="list-style-type: none"> <li>Transfection methods of animal cells (Calcium phosphate, DEAE-dextran, Lipofection, Electroporation, Microinjection, Embryonic stem cell transfer)</li> <li>Development of Transgenic animals</li> <li>Knockout mice generation</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Selection of recombinant cells with various marker genes (Thymidine Kinase, Dihydrofolate reductase, CAD protein, XGPRT, HAT, Neomycin phosphotransferase )</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Organ culture, Histotypic &amp; organotypic culture, rearing animal models and advantages</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Stem Cell Culture &amp; Applications of Animal biotechnology</b>	
	A	<ul style="list-style-type: none"> <li>Stem cell technology; Methods to study repopulation assay, in vitro cloning assay, long term culture</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>Embryonic stem cell culture, Application of stem cell culture.</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>Ethical and value issues in animal biotechnology; Applications in the field of therapeutics; as bioreactors and bioindicators; transgenic animals</li> </ul>	CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
Weightage Distribution	CA		MTE & ETE
	25%		75%
Text book/s*	1. Jenkins N., "Animal Cell Biotechnology: Methods and Protocols", Humana Press, 2006. 2. Shenoy M., "Animal Biotechnology", Laxmi Pub, 2007. 3. Freshney I.R., "Culture of Animal Cells: A Manual of Basic Technique", Wiley, 2005.		



Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>
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### Course Articulation Matrix for BSZ206 ANIMAL BIOTECHNOLOGY

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	3	3	2	-	1	1	2	3
CO2	3	3	2	1	1	3	2	3	-	1	1	2	3
CO3	3	3	2	2	2	3	3	2	-	1	1	2	3
CO4	3	3	2	1	1	3	2	2	-	1	1	2	3
CO5	3	3	2	1	2	2	3	3	-	1	1	2	3
CO6	2	1	1	2	2	3	2	3	-	1	1	2	3
Average	2.83	2.67	1.67	1.33	1.50	2.83	2.50	2.50	-	1.00	1.00	2.00	3.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## VOL201- ESSENTIAL TECHNIQUES IN LIFE SCIENCES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: III</b>	
1	Course Code	<b>VOL201</b>	
2	Course Title	<b>Essential techniques in Life Sciences</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
5	Course status	Compulsory (SEC)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in biological experiments, project writing and oral presentation.</li> </ul>	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO 1:</b> Show the basic principles of Blood grouping analysis</p> <p><b>CO 2:</b> Explain the hemagglutination and precipitation</p> <p><b>CO 3:</b> Construct a Vertical sectioning of plant stem and root.</p> <p><b>CO 4:</b> Analyze Hematological analysis using light microscope.</p> <p><b>CO 5:</b> Explain of a permanent slide of plant tissue</p> <p><b>CO 6:</b> Organize a permanent slide of plant tissue</p>	
8	Course Description	Vocational education is concerned with the training on vocation. It is related to productivity. Vocational education prepares individuals for jobs. It has adequate employment potentialities. It helps in broadening of horizon. It leads to dignity of labour. It is helpful in the maximum utilization of the material resources of the country..	
9	Outline syllabus		CO Mapping
		<b>Immunological techniques</b>	
	<b>Unit 1</b>	A) Blood grouping analysis; Rh factor antigen analysis.	CO1
		B) Studying the hemagglutination and precipitation.	
		C) Quantitative estimation of antigen by radial immunodiffusion assay. Quantitative estimation of antigen by double immunodiffusion assay.	
	<b>Unit 2</b>	A) Vertical sectioning of plant stem and root.	<b>CO2</b>



		B) Transverse sectioning of plant stem and root.			
	<b>Unit 3</b>	Studying different plant tissue under compound light microscope.			CO3, CO4
	<b>Unit 4</b>	A) Hematological analysis using light microscope.			CO5, CO6
		B) Preparation of a permanent slide of plant tissue			
	Mode of examination	<u>Practical/Viva</u> <ul style="list-style-type: none"> <li>• Rubric assessment</li> <li>• Monthly Presentation to be audited by supervisor</li> <li>• Mid Term Presentation and End Term Presentation</li> </ul>			
	Weightage Distribution	CA	CE (Viva + PPT)	ETE	
		25	25	50	
	Text book/s*	10 Recent International Journal Articles of repute.			

### Course Articulation Matrix for VOL201 Essential Techniques in Life Sciences

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	3	2	2	-	1	1	1	1
CO2	1	1	3	2	1	3	2	3	-	1	1	3	3
CO3	1	1	3	2	1	3	2	2	-	1	1	2	1
CO4	1	1	3	2	1	3	2	2	-	1	1	3	1
CO5	1	1	3	2	1	2	2	3	-	1	1	3	1
CO6	1	1	3	2	1	3	2	3	-	1	1	3	1
Average	1.00	1.00	3.00	2.00	1.00	2.83	2.00	2.50	-	1.00	1.00	2.50	1.33

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



### PHR201- Renewable Energy Resources

<b>School: SSBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2023-2024</b>	
<b>Branch: Physics</b>		<b>SEMESTER: III</b>	
1	Course Code	<b>PHR201</b>	
2	Course Title	<b>Renewable Energy Resources</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course Status	Minor	
8	Course Objective	This course provides an opportunity to develop knowledge and understanding of the key principles and applications of biomass energy and resources	
9	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p>CO1: Understand and develop knowledge about the different kinds of renewable energy resources.</p> <p>CO2: Analyse the energy consumption (both in rural and urban areas) and energy demand and current Indian energy scene.</p> <p>CO3: Understand the Impact on environmental degradation due to production and utilization of energy.</p> <p>CO4: Understand and Analyse the solar cells</p> <p>CO5: Understand and develop knowledge about the Geothermal, wind, ocean and bioenergy resources.</p> <p>CO6: Students will have deep knowledge about the various renewable resources including solar energy, geothermal energy, wind and ocean energy and adverse effect of energy consumption on environment.</p>	
10	Course Description	This course provides deep knowledge about the different forms of energy, various renewable resources including solar energy, geothermal energy, wind and ocean energy, solar cells (1 <sup>st</sup> , 2 <sup>nd</sup> , and 3 <sup>rd</sup> generation), and adverse effect of energy consumption on environment.	
11	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Renewable energy and its Resources</b>	
	A	Definition, units, and power of energy, Forms of energy, Second law of thermodynamics and conversion of energy, Origin and time scale of fossil fuels.	CO1
	B	Conventional and nonconventional energy sources, Renewable-non-renewable energy resources, Green energy, clean energy (definition and example only),	CO1
	C	Energy resources, coal, oil, natural gas, nuclear and hydroelectric power, Concepts of ecological footprint, green footprint, and carbon footprint.	CO1
	<b>Unit 2</b>	<b>Energy demand, Energy Consumption, and Indian Energy Scene:</b>	
	A	Role of energy in economic development, Energy consumption in various sectors, Exponential increase in energy consumption and its impact on global economy, Energy demand and Energy trilemma index.	CO2



	B	Indian Energy Scene: Energy resources available in India, Urban and rural energy consumption, Nuclear energy (scope and future) variation of energy consumption as a function of energy,	CO2						
	C	Need of new renewable resources, National Green Tribunal (NGT) act and activities.	CO2						
	<b>Unit 3</b>	<b>Environmental effects on energy consumption</b>							
	A	Environmental degradation due to production and utilization of energy, Impact of environmental degradation activities on biological damage.	CO3						
	B	Environmental effects of thermal power stations and nuclear power generation, Air and water pollution, Effect on Ozone layer, Global warming.	CO3						
	C	Hydroelectric power, Geothermal power, Energy harvesting (Ocean, wind, solar and bioenergy).	CO3, CO6						
	<b>Unit 4</b>	<b>Solar Energy and Solar Cells</b>							
	A	Need of Solar energy, Solar Energy, Solar constant, Solar radiation spectrum	CO4						
	B	Classification of solar cells: 1st generation (single vs polycrystalline), 2nd generation, 3rd generation.	CO4, CO6						
	C	Key elements of silicon solar cells, PV solar cell, Module, Panel and array, solar thermal system types. Applications of solar thermal systems.	CO4, CO6						
	<b>Unit 5</b>	<b>Geothermal, Wind, Ocean and Bioenergy</b>							
	A	Geothermal Energy: Introduction, Geothermal power, Geothermal resources, Advantage and disadvantage of geothermal energy over other form of energy.	CO5						
	B	Wind energy: Introduction, Principle of wind energy conversion, Advantage and Disadvantage of wind mills, Application of wind energy.	CO5, CO6						
	C	Ocean Energy: Introduction, Principle of ocean thermal energy conversion, Tidal power generation, tidal energy technologies, Wave energy conversion, Advantages and Disadvantages. Bio Energy: Introduction, Sources of biomass, Advantage and disadvantage of bio energy over other form of energy.	CO5, CO6						
	Mode of examination	20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction							
	Weightage Distribution	<table border="1"> <tbody> <tr> <td>CA</td> <td>MSE</td> <td>ESE</td> </tr> <tr> <td>15%</td> <td>10%</td> <td>75%</td> </tr> </tbody> </table>	CA	MSE	ESE	15%	10%	75%	
CA	MSE	ESE							
15%	10%	75%							
	Text book/s*	<b>PART A</b> 1. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle. 2. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki							
	Reference book/s*	<b>PART B</b> 1. Physics of Energy Sources, G. C. King 2. Physics and Technology of Sustainable Energy; E L Wolf 3. Advanced renewable Energy Systems, S C Bhatia 3. D.P.Kothari, K.C Singal and Rakesh Ranjan "Renewable Energy Sources And Emerging Technologies", 2011, PHI Learning Private Ltd, New Delhi.							
	Suggestive Digital Platforms / Web Links	<ol style="list-style-type: none"> <li><a href="https://www.edx.org/learn/renewable-energy">https://www.edx.org/learn/renewable-energy</a></li> <li><a href="https://www.coursera.org/courses?query=renewable%20energy">https://www.coursera.org/courses?query=renewable%20energy</a></li> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://onlinecourses.nptel.ac.in/noc21_ch11/preview">https://onlinecourses.nptel.ac.in/noc21_ch11/preview</a></li> </ol>							



Suggested Equivalent Online Courses	1. The Renewable Energy Institute, renewable energy course, 2. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://onlinecourses.nptel.ac.in/noc21_ch11/preview">https://onlinecourses.nptel.ac.in/noc21_ch11/preview</a> 3. <a href="https://onlinecourses.nptel.ac.in/noc22_ph44/preview">https://onlinecourses.nptel.ac.in/noc22_ph44/preview</a> (swayam course)	
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### Course Articulation Matrix for Renewable Energy Resources

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	2	1	1	1	2	1	1	3	-	-	-
CO2	1	2	3	1	1	1	2	1	1	3	-	-	-
CO3	1	2	2	1	3	1	2	1	1	3	-	-	-
CO4	1	1	2	1	2	1	2	1	1	3	-	-	-
CO5	1	1	3	1	2	1	2	1	1	3	-	-	-
CO6	1	2	2	1	1	1	2	1	1	3	-	-	-
Average													

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### RBL001 RESEARCH BASED LEARNING-1

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: III</b>	
1	Course Code	<b>RBL001</b>	
2	Course Title	Research Based Learning-1	
3	Credits	0 -Audit Based	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (Survey)	
6	Course Objective	Develop an interest towards research	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO 1:</b> Recognize research-based investigation carried out on problems in zoology and interdisciplinary science</p> <p><b>CO 2:</b> Comprehend and compare a research article with a review article or a survey-based article</p> <p><b>CO 3:</b> Demonstrate capacity to follow research articles</p> <p><b>CO 4:</b> Identify concepts of zoology referred in research articles</p> <p><b>CO 5:</b> Extract important results of research findings</p> <p><b>CO 6:</b> Report research findings in written and verbal forms</p>	
8	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
9	Outline syllabus		CO Mapping
	<b>Part 1</b>	<b>Introduction to various research problems</b>	<b>CO1</b>
	<b>Part 2</b>	<b>Identify a research question</b>	<b>CO2, CO3</b>





	<b>Part 3</b>	<b>Literature survey</b>	<b>CO4</b>
	<b>Part 4</b>	<b>Report writing</b>	<b>CO5</b>
	<b>Part 5</b>	<b>Presentation</b>	<b>CO6</b>
	Mode of examination	1. Rubric assessment 2. Monthly Presentation to be audited by supervisor 3. Mid Term Presentation and End Term Presentation	
	Text book/s*	10 Recent International Journal Articles of repute.	
	Other References	NA	

**Course Articulation Matrix for BBP212 Research Based Learning-1**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	1	3	2	3	2	2	1	1	3	3	3
CO2	1	1	1	3	2	3	2	2	1	1	3	3	3
CO3	1	1	1	3	2	3	3	2	1	1	3	3	3
CO4	1	1	1	3	2	3	2	2	1	1	3	3	3
CO5	1	1	1	3	2	2	3	3	1	1	3	3	3
CO6	1	1	1	3	2	3	2	3	1	1	3	3	3
Average	1.00	1.00	1.00	3.00	2.00	2.83	2.33	2.33	1.00	1.00	3.00	3.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



# SEMESTER IV

## **B.Sc. (Hons.) in Zoology**



## BSZ207-GENE TECHNOLOGY, IMMUNOLOGY & COMPUTATIONAL BIOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: IV</b>	
1	Course Code	<b>BSZ207</b>	
2	Course Title	<b>Gene Technology, Immunology &amp; Computational Biology</b>	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To familiarise the students with the tools and techniques of genetic engineering and the advancement in the field. Also to understand the basics of immunology and introductory bioinformatics	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO1:</b> Understand the principles of genetic engineering, how genes can be cloned in bacteria and the various technologies involved in it.</p> <p><b>CO2:</b> Explore the applications of Genetics Engineering in various fields like agriculture, industry and human health.</p> <p><b>CO3:</b> Develop an in depth understanding about Immune System &amp; its mechanisms.</p> <p><b>CO4:</b> Acquaint themselves with use of biostatistics in scientific reach</p> <p><b>CO5:</b> Acquaint themselves with the use of computers and in handling various bioinformatics tools.</p> <p><b>CO6:</b> Develop techniques in pathology/Hospital and/or take up research in biological sciences.</p>	
8	Course Description	Genetic engineering and tools is the advanced field which aims to upgrade the knowledge, skill and aptitude of the students towards the research areas. Also the introduction of Immunology, Biostatistics and Bioinformatics have been done here to correlate with its utility with Genetic Engineering.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Principles of Gene Manipulation</b>	
	A	<ul style="list-style-type: none"> <li>● Recombinant DNA Technology</li> <li>● Selection and identification of recombinant cells</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>● Restriction Enzymes, DNA modifying enzymes, Cloning Vectors, Ligation</li> </ul>	CO1, CO6



	C	<ul style="list-style-type: none"> <li>Gene transfer techniques, Gene therapy</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>DNA Diagnostics &amp; Applications of Genetic Engineering</b>	
	A	<ul style="list-style-type: none"> <li>Single cell proteins; Biosensors; Biochips</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Crop and livestock improvement, development of transgenics; Development of DNA drugs and vaccines</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Genetic analysis of human diseases, detection of known and unknown mutations</li> <li>Concept of pharmacogenomics and pharmacogenetics</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Immune System and its Components</b>	
	A	<ul style="list-style-type: none"> <li>Historical perspective of Immunology, Innate and Adaptive Immunity, clonal selection, complement system</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Humoral immunity and cell mediated immunity; Structure and functions of different classes of immunoglobulins,</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Hypersensitivity; HLA complex: organization, class I and II HLA molecules</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Biostatistics</b>	
	A	<ul style="list-style-type: none"> <li>Calculations of mean, median, mode, variance, standard deviation</li> <li>Concepts of coefficient of variation, Skewness, Kurtosis</li> <li>Elementary idea of probability and application</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Data summarizing: frequency distribution, graphical presentation—bar, pie diagram, histogram</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Tests of significance: one and two sample tests, t-test and Chi-square test</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Basics of Computers &amp; Bioinformatics</b>	
	A	<ul style="list-style-type: none"> <li>Basics (CPU, I/O units) and operating systems</li> <li>Concept of homepages and websites, World Wide Web, URLs, using search engines; Bibliography</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>Databases: nucleic acids, genomes, protein sequences and structures</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>Sequence analysis (homology): pairwise and multiple sequence alignments-BLAST, CLUSTALW</li> <li>Phylogenetic analysis</li> </ul>	CO5, CO6
	Mode of examination	<p><u>Theory</u>                  20 marks for Test / Quiz / Assignment / Seminar.                  05 marks for Class Interaction</p>	



Weightage Distribution	CA		MTE & ETE	
	25%		75%	
Text book/s*	<ol style="list-style-type: none"> <li>1. Primrose &amp; Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).</li> <li>2. Hartl &amp; Jones. Genetics: principles &amp; Analysis of Genes &amp; Genomes. Jones &amp; Bartlett (1998).</li> <li>3. Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>4. Primrose. Molecular Biotechnology. Panima (2001).</li> <li>5. Clark &amp; Switzer. Experimental Biochemistry. Freeman (2000)</li> <li>6. Sudbery. Human Molecular Genetics. Prentice-Hall (2002).</li> <li>7. Wilson. Clinical Genetics-A Short Course, Wiley (2000).</li> <li>8. Pasternak. An Introduction to Molecular Human Genetics. Fitzgerald (2000).</li> <li>9. Biostatistical Analysis (Fourth Edition) by Jerrold H. Zarr, Pearson Education Inc., Delhi.</li> <li>10. Statistical Methods (Eighth Edition) by G. W. Snecdecor and W. G. Cochran, Willey Blackwell</li> <li>11. Biostatistics (Tenth Edition) by W.W. Daniel and C. L. Cross, Wiley</li> <li>12. Introductory Biological Statistics (Fourth Edition) by John E. Havel, Raymond E. Hampton and Scott J. Meiners</li> <li>13. Westhead et al Bioinformatics: Instant Notes. Viva Books (2003).</li> </ol>			
Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>			

### **Course Articulation Matrix for BSZ207 GENE TECHNOLOGY, IMMUNOLOGY & COMPUTATIONAL BIOLOGY**



COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	2	1	3	3	3	2	2	-	1	2	1	1
CO2	1	2	1	3	3	3	2	3	-	1	2	2	1
CO3	1	2	1	3	3	3	3	2	-	1	2	1	1
CO4	1	2	1	3	3	3	2	2	-	1	2	1	1
CO5	1	2	1	3	3	2	3	3	-	1	2	1	1
CO6	1	2	1	3	3	3	2	3	-	1	2	1	1
Average	1.00	2.00	1.00	3.00	3.00	2.83	2.33	2.50	-	1.00	2.00	1.17	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BZO212 GENETIC ENGINEERING AND COUNSELLING LAB

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: IV</b>	
1	Course Code	<b>BZO212</b>	
2	Course Title	Genetic Engineering And Counselling Lab	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To make the students learn the different techniques involved in genetic engineering and their importance in medical research	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p><b>CO1:</b> Recall basic concepts of lab experiments</p> <p><b>CO2:</b> Illustrate the DNA testing and utility of genetic engineering in forensic sciences</p> <p><b>CO3:</b> Organize the principles of genetic engineering with hands-on experiments in mutation detection, testing of infectious diseases like Covid 19.</p> <p><b>CO4:</b> Assess bioinformatics tools to find out evolutionary/phylogenetic relationship of organisms using gene sequences.</p> <p><b>CO5:</b> Illustrate applied Genetic counselling techniques</p> <p><b>CO6:</b> Explore the employment opportunities in Hospitals/Diagnostic and forensic labs/Counsel families with genetic disorders and will enable students to take up research in biological sciences</p>	
8	Course Description	The course has been designed with the intention to make students have a hands on knowledge on the basic genetic engineering techniques and its requirements. Also Computational biology platforms, tools and database of bachelors level have been added.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Basic lab experiments</b>	
	A	<ul style="list-style-type: none"> <li>Measure the pre and post clitellar lengths of earthworms and calculate mean, median, mode, standard deviation etc.</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Measure the height of all students in the class and apply statistical measures.</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>Measure the weight of all students in the class and apply statistical measures.</li> </ul>	CO1,CO6



<b>Unit 2</b>	<b>Genetic engineering lab techniques-I</b>	
A	<ul style="list-style-type: none"> <li>Determination of ABO Blood group 2</li> </ul>	CO2, CO6
B	<ul style="list-style-type: none"> <li>To perform bacterial culture and calculate generation time of bacteria.</li> </ul>	CO2, CO6
C	<ul style="list-style-type: none"> <li>To study Restriction enzyme digestion using teaching kits.</li> </ul>	CO2, CO6
<b>Unit 3</b>	<b>Genetic engineering lab techniques-II</b>	
A	<ul style="list-style-type: none"> <li>To detect genetic mutations by Polymerase Chain Reaction (PCR) using teaching kits.</li> <li>Demonstration of agarose gel electrophoresis for detection of DNA.</li> </ul>	CO3, CO6
B	<ul style="list-style-type: none"> <li>Demonstration of Polyacrylamide Gel Electrophoresis (PAGE) for detection of proteins</li> </ul>	CO3, CO6
C	<ul style="list-style-type: none"> <li>To calculate molecular weight of unknown DNA and protein fragments from gel pictures.</li> </ul>	CO3, CO6
<b>Unit 4</b>	<b>Computational Biology Lab experiments</b>	
A	<ul style="list-style-type: none"> <li>To learn the basics of computer applications</li> </ul>	CO4, CO6
B	<ul style="list-style-type: none"> <li>To learn sequence analysis using BLAST</li> <li>To learn Multiple sequence alignment using <b>CLUSTALW</b></li> </ul>	CO4, CO6
C	<ul style="list-style-type: none"> <li>To learn about Phylogenetic analysis using the programme PHYLIP.</li> <li>To learn how to perform Primer designing for PCR using available softwares etc.</li> </ul>	CO4, CO6
<b>Unit 5</b>	<b>Virtual Labs</b>	
A	<ul style="list-style-type: none"> <li>Gel Documentation System-<a href="https://youtu.be/WPpt3-FanNE">https://youtu.be/WPpt3-FanNE</a></li> <li>Colorimeter- <a href="https://youtu.be/v4aK6G0bGuU">https://youtu.be/v4aK6G0bGuU</a></li> <li>PCR Part 1- <a href="https://youtu.be/CpGX1UFS14A">https://youtu.be/CpGX1UFS14A</a></li> <li>PCR Part 2- <a href="https://youtu.be/6IcHAYPTAEw">https://youtu.be/6IcHAYPTAEw</a></li> <li>DNA isolation Part 1- <a href="https://youtu.be/QE7UI0JnY9A">https://youtu.be/QE7UI0JnY9A</a></li> <li>DNA isolation part 2- <a href="https://youtu.be/-efr_HFeHxM">https://youtu.be/-efr_HFeHxM</a></li> <li>DNA curve- <a href="https://youtu.be/ubL8QxTeuG4">https://youtu.be/ubL8QxTeuG4</a></li> </ul>	CO5, CO6
B	<ul style="list-style-type: none"> <li>Spectrophotometer-<a href="https://youtu.be/ubL8QxTeuG4">https://youtu.be/ubL8QxTeuG4</a></li> <li>Agarose Part 1- <a href="https://youtu.be/7gvHPFww--g">https://youtu.be/7gvHPFww--g</a></li> <li>Agarose part 2- <a href="https://youtu.be/j_bOZCHNsSg">https://youtu.be/j_bOZCHNsSg</a></li> <li>Use softwares like Primer3, NEB cutter</li> <li>NCBI, BLAST, CLUSTAL W, PHYLIP</li> <li>.</li> </ul>	CO5, CO6
C	<ul style="list-style-type: none"> <li><a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li><a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> <li><a href="http://www.powershow.com">www.powershow.com</a></li> <li><a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li><a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> <li><a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> </ul>	CO5, CO6





		<ul style="list-style-type: none"> <li>www.onlinelabs.in</li> </ul>	
Mode of examination	<p>Practical/Viva Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)</p>		
Weightage Distribution	CA		ETE
	25%		75%
Text book/s*	<ol style="list-style-type: none"> <li>Mitra S. Genetic Engineering. 2nd Edition. McGraw Hill. @2015. ISBN: 9789339203535</li> <li>Primrose &amp; Twyman. Principles of Genome Analysis and Genomics. Blackwell (2003).</li> <li>Hartl &amp; Jones. Genetics: principles &amp; Analysis of Genes &amp; Genomes. Jones &amp; Bartlett (1998).</li> <li>Sambrook et al. Molecular Cloning Vols I, II, III. CSHL (2001).</li> <li>Primrose. Molecular Biotechnology. Panima (2001)</li> </ol>		
Other References	<ol style="list-style-type: none"> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>Swayam Prabha - DTH Channel,</li> <li><a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>		

### Course Articulation Matrix for BZO212 GENETIC ENGINEERING & GENETIC COUNSELLING LAB

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	3	3	2	3	2	2	-	1	1	1	1
CO2	3	3	3	3	3	3	2	3	-	1	3	2	1
CO3	3	3	3	3	3	3	3	2	-	1	3	2	1
CO4	3	3	3	3	3	2	3	2	-	1	3	2	1
CO5	3	3	3	3	3	2	3	3	-	1	3	2	1
CO6	3	3	3	3	3	3	2	3	-	1	3	2	1
Average	2.67	2.67	3.00	3.00	2.83	2.67	2.50	2.50	-	1.00	2.67	1.83	1.00

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



## BBT213 NANOTOXICOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: IV</b>	
1	Course Code	<b>BBT213</b>	
2	Course Title	<b>Nanotoxicology</b>	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course Type	Compulsory (CC)	
6	Course Objective	To inculcate in students, the understand of how nanomaterial work and how we can identify Nano toxicity levels.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p><b>CO1:</b> Tell about nanomaterials and toxicity of nanomaterials</p> <p><b>CO2:</b> Explain the various effects of nanomaterials on human health</p> <p><b>CO3:</b> Analyze the toxicity on nanomaterials on various platforms</p> <p><b>CO4:</b> Demonstrate the various factors and their effects on the level of nanotoxicity</p> <p><b>CO5:</b> Define the risk and reach analysis emphasizing the role of regulatory guidelines</p> <p><b>CO6:</b> Compile the toxicity level of nanomaterials prior to clinical use</p>	
8	Course Description	The course has been designed such that students can understand the concept of nanomaterials, how they are prepared and their utility. Also what do we mean by toxicity levels at nanoscale has also been appraised herewith.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Nanomaterials and Nanotoxicology</b>	
	A	Natural and synthetic nanomaterials	CO1, CO6
	B	Biological and Environmental applications of nanomaterials	CO1,CO6
	C	Study of nano-bio interface	CO1,CO6
	<b>Unit 2</b>	<b>Nanotoxicity and human health</b>	
	A	Fate of nanomaterials in human body: short term and long-term effects	CO2, CO6



	B	Acute and chronic toxicity		CO2, CO6
	C	Study of different levels toxicity based on organs		CO2, CO6
	<b>Unit 3</b>	<b>Determination of nanotoxicity</b>		
		A) B) C) In vitro, in vivo, and ex vivo models to study the effects of nanomaterials on mammalian cells and tissues, histological analysis, hematological analysis, serum biochemical analysis		CO3, CO6
	<b>Unit 4</b>	<b>Factors for determining nanotoxicity</b>		
	A	Size, shape, charge, aggregation, and interaction behavior of nanomaterials for determining the toxicity level		CO4, CO6
	B	Nanomaterials interactions with serum proteins		CO4, CO6
	C	Protein-corona formation		CO4, CO6
	<b>Unit 5</b>	<b>Regulatory guidelines for nanomaterials</b>		
	A	Risk assessment analysis		CO5, CO6
	B	Regulatory guidelines like ISO guidelines		CO5, CO6
	C	ASTM guidelines, CDSO and reach analysis		CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
	Weightage Distribution	CA		MTE+ETE
		25%		75%
	Text book/s*	14. Nanotoxicity: From In Vivo and In Vitro Models to Health Risks, Editor(s): Saura C. Sahu Daniel A. Casciano 15. Nanotoxicity Methods and Protocols, Editors Joshua Reineke 3- Recent research articles		
	Other References	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a> 2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 3. Swayam Prabha - DTH Channel, 4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a> 5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> 6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> 7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> 8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a>		



### Course Articulation Matrix for BBT 213 NANOTOXICOLOGY

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	2	3	3	2	2	-	1	1	2	1
CO2	1	3	1	2	3	3	2	3	-	1	1	2	1
CO3	1	3	1	2	3	3	3	2	-	1	1	2	1
CO4	1	3	1	2	3	3	2	3	-	1	1	2	1
CO5	1	3	1	2	3	2	3	3	-	1	1	2	1
CO6	1	3	1	2	3	3	2	3	-	1	1	2	1
Average	1.00	3.00	1.00	2.00	3.00	2.83	2.33	2.67	-	1.00	1.00	2.00	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BZO211 Serological tools for Forensic science

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: IV</b>	
1	Course Code	<b>BZO211</b>	
2	Course Title	Serological tools for Forensic science	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the student the concept of evidence based biology with the help of tools, technique and methods used in forensics	
7	Course Outcomes	At the completion of this syllabus, students will be able to: CO1: Recall the concept of Forensics and its need CO2: Analyze the use of fingerprint and the related techniques in the field of forensics. CO3: Comprehend idea on the various tools and techniques involved in crime investigations CO4: Demonstrate the role of molecular biology technique in forensic investigations CO5: Demonstrate the role of serological techniques in forensic investigations CO6: Familiarize with the basic concepts in forensics about the various organizations working on it.	
8	Course Description	The course has been designed to make students aware of the concept and need of forensic sciences. A basic course has been framed so as to cover the important points such as fingerprinting, crime science investigation tools and molecular and serological detection of samples.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Background</b>	
	A	<ul style="list-style-type: none"> <li>Definition of Forensics, History of forensic science</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Forensic labs and organization at National and International level, International Investigative Agencies</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>Crime Baeureas and systems of Forensic Science in India</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Fingerprinting in forensics</b>	



	A	<ul style="list-style-type: none"> <li>Definition of fingerprint, History, Fingerprint as forensic Evidence, Visible and Latent Fingermarks</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Dactylography, Dermatoglyphics, and Dactyloscopy, science of fingerprinting</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Classification of Fingerprints, Methods &amp; Techniques used in fingerprinting</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Crime scene investigations</b>	
	A	<ul style="list-style-type: none"> <li>Steps involved in crime scene investigations</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Forensic Podiatry, Biometrics in Personal Identification</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Forensic chemistry, Forensic Toxicology, Measuring toxicity LD50, ED50</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Forensic Molecular Biology &amp; Genetics</b>	
	A	<ul style="list-style-type: none"> <li>DNA Profiling: Definitions, History, structure of DNA, variations, polymorphism,</li> <li>DNA Extraction-Organic and Inorganic extraction, Comparison of Extraction methods</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>DNA typing techniques- RFLP analysis, PCR amplifications, sequence polymorphism.</li> <li>Analysis of SNP, YSTR, Mitochondrial DNA</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Forensic Significance of DNA profiling: Applications of forensics in paternity and child identification</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Forensics serology &amp; Types of Biological evidences</b>	
	A	<ul style="list-style-type: none"> <li>Characterization of hair pattern, Morphology and types, location, collection, methods for their identification</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>Characterization of Blood pattern, its Chemistry and properties, related tests: Individualization (Blood Grouping, Polymorphic enzyme typing).</li> <li>Characterization of Semen, Formation, Composition, Morphology of spermatozoa, forensic significance, Presumptive and Confirmatory tests</li> <li>Individualization (Blood Grouping, seminal fluid isozymes typing, forensic significance).</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>Blood grouping from samples (blood, semen, saliva and other body fluids) Absorption-inhibition, Absorption-elution and mixed agglutination techniques</li> <li>Serological Techniques: ELISA, Immunochromatographic assays, Precipitation based assays, Agglutination based assays</li> </ul>	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA	MTE & ETE
		25%	75%
	Text book/s*	<ul style="list-style-type: none"> <li>Kirby : DNA Fingerprinting Technology.</li> <li>DNA structure and functions by Richard R. Sinden; Academic Press, Inc. 1994.</li> </ul>	



	<ul style="list-style-type: none"> <li>DNA Profiling and DNA fingerprinting (1999) Edited by Jorg T. Epplen and Thomas Lubjuhn; Birkhauser Verlag, Switzerland.</li> <li>Forensic DNA Profiling Protocols (1998) Patrick J. Lincoln and Jim Thomson; Humana Press, Inc</li> <li>Nanda, B.B. and Tewari, R.K. (2001) Forensic Science in India: A vision for the twenty first century Select Publisher, New Delhi. 2. James, S.H and Nordby, J.J. (2003) Forensic Science: An introduction to scientific and investigative techniques CRC Press</li> <li>E. Roland Menzel (1999) Fingerprint Detection with Lasers, 2nd Ed., Marcel Dekker, Inc. USA.</li> </ul>	

### Course Articulation Matrix for BZO211 Serological tools for Forensic Sciences

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PSO 1	PSO 2	PSO 3
CO1	2	3	1	2	3	3	2	3	-	1	1	2	1
CO2	2	3	1	2	3	3	2	3	-	1	1	2	1
CO3	2	3	1	2	3	3	3	2	-	1	1	2	1
CO4	2	3	1	2	3	3	2	2	-	1	1	2	1
CO5	2	3	1	2	3	2	3	3	-	1	1	2	1
CO6	2	3	1	2	3	3	2	3	-	1	1	2	1
Average	2.00	3.00	1.00	2.00	3.00	2.83	2.33	2.67	-	1.00	1.00	2.00	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BZP203 FORENSIC SEROLOGY LAB

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: IV</b>	
1	Course Code	<b>BZP203</b>	
2	Course Title	<b>Forensic Serology Lab</b>	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory (CC)	
6	Course Objective	To train the students on various aspects of forensic serology techniques	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Show Work on the molecular methods and techniques related for forensic tissues</p> <p>CO2: Demonstrate the techniques used in fingerprinting</p> <p>CO3: Experiment with the techniques used in identifying other items of evidence</p> <p>CO4: Familiarize with the biochemical technique used in forensics</p> <p>CO5: Appraise the usage of chromatography techniques in forensics</p> <p>CO6: Acquaint with the preliminary knowledge of concepts and techniques needed in a forensic lab.</p>	
8	Course Description	The lab course has been designed keeping in mind to inculcate in the students a basic awareness of the techniques, methods and their utility in forensic diagnosis. The topics covered here will help in analysing how minute differences in blood pattern, hair patterns, fingerprints etc can help resolve forensic issues.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Molecular methods &amp; Techniques</b>	
	A	<ul style="list-style-type: none"> <li>To determine blood group from fresh blood and blood stains.</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Organic extraction of DNA from blood.</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>PCR for DNA samples</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Fingerprint Identification methods</b>	





A	<ul style="list-style-type: none"> <li>To perform Ridge tracing and Ridge counting.</li> </ul>	CO2, CO6
B	<ul style="list-style-type: none"> <li>To obtain Plain and rolled inked finger prints</li> </ul>	CO2, CO6
C	<ul style="list-style-type: none"> <li>To identify the finger Print Patterns.</li> </ul>	CO2, CO6
<b>Unit 3</b>	<b>Methods of evidence detection</b>	
A	<ul style="list-style-type: none"> <li>To understand the Comparison of handwritings.</li> </ul>	CO3, CO6
B	<ul style="list-style-type: none"> <li>To examine the Currency notes and discrepancies.</li> </ul>	CO3, CO6
C	<ul style="list-style-type: none"> <li>To prepare slides of scale patterns of human hair.</li> <li>Use of chromatography techniques in forensics</li> <li>Precipitation based assays for sample analysis</li> </ul>	CO3, CO6
<b>Unit 4</b>	<b>Biochemical tests in forensics</b>	
A	Starch-Iodine test	CO4, CO6
B	General characteristics and identification of Human Hair	CO4, CO6
C	Examination of fibers	CO4, CO6
<b>Unit 5</b>	<b>Virtual Labs</b>	
A	<ul style="list-style-type: none"> <li><a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li><a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> </ul>	CO5, CO6
B	<ul style="list-style-type: none"> <li><a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li><a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> </ul>	CO5, CO6
C	<ul style="list-style-type: none"> <li><a href="http://www.powershow.com">www.powershow.com</a></li> <li><a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li><a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>	CO5, CO6
Mode of examination	Practical/Viva Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)	
Weightage Distribution	CA	ETE
	25%	75%
Text book/s*	Mitra S. Genetic Engineering. 2nd Edition. McGraw Hill. @2015. ISBN: 9789339203535	
Suggestive Digital Platforms / Web Links	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a> 2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 3. Swayam Prabha - DTH Channel, <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a>	



		6. Amrita Vishwa Vidhyapeeth Labs <a href="https://vlab.amrita.edu/">https://vlab.amrita.edu/</a>	
	Other references	1. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> 2. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> 3. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> 4. edX, <a href="https://www.edx.org/">https://www.edx.org/</a>	

### Course Articulation Matrix for BZP203 Forensic Serology Lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	3	1	2	3	2	2	-	1	2	1	1
CO2	1	3	3	1	2	3	2	3	-	1	2	1	1
CO3	1	3	3	1	2	3	3	2	-	1	2	1	1
CO4	1	3	3	1	2	3	3	2	-	1	2	1	1
CO5	1	3	3	1	2	2	3	3	-	1	2	1	1
CO6	1	3	3	1	2	3	2	3	-	1	2	1	1
Average	1.00	3.00	3.00	1.00	2.00	2.83	2.50	2.50	-	1.00	2.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## RBL002 RESEARCH BASED LEARNING-2

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: B.Sc.</b>		<b>Current Academic Year: 2024-2025</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: IV</b>	
1	Course Code	<b>RBL002</b>	
2	Course Title	Research Based Learning-2	
3	Credits	0--Audit Based	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory (Survey)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in project writing and oral presentation</li> </ul>	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO 1: Articulate research-based investigation done on a topic            CO 2: Demonstrate capacity to identify theoretical/ experimental method followed in the research articles            CO3: Demonstrate an understanding of the ethical issues associated with practitioner research            CO4: Compare research data and extract the outstanding results            CO5: Report research findings in written and verbal forms            CO 6: Deduce the research findings to advance education theory and practice</p>	
8	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
9	Outline syllabus		CO Mapping
	<b>Part 1</b>	<b>Introduction to various research problems</b>	<b>CO1</b>
	<b>Part 2</b>	<b>Identify a research question</b>	<b>CO2, CO3</b>
	<b>Part 3</b>	<b>Literature survey</b>	<b>CO4</b>



	<b>Part 4</b>	<b>Report writing</b>	<b>CO5</b>
	<b>Part 5</b>	<b>Presentation</b>	<b>CO6</b>
	Text book/s*	10 Recent International Journal Articles of repute.	
	Suggestive Digital Platforms / Web Links	NA	
	Other references	NA	

**Course Articulation Matrix for RBL002 Research Based Learning 2 (RBL-2)**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	1	1	1	1	3	2	3	1	1	1	1	1
CO2	2	1	1	1	1	3	2	3	1	1	1	1	1
CO3	2	1	1	1	1	3	3	2	1	1	1	1	1
CO4	2	1	1	1	1	3	2	2	1	1	1	1	1
CO5	2	1	1	1	1	2	3	3	1	1	1	1	1
CO6	2	1	1	1	1	3	2	3	1	1	1	1	1
Average	2.00	1.00	1.00	1.00	1.00	2.83	2.33	2.67	1.00	1.00	1.00	1.00	1.00

**-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



# SEMESTER V

## **B.Sc. (Hons.) in Zoology**



## BZO301 Non-Chordates and Economic Zoology

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: V</b>	
1	Course Code	<b>BZO301</b>	
2	Course Title	Non-Chordates and Economic Zoology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students a thorough understanding of the invertebrate forms of life and also about the economic utility some of these have in our daily lives.	
7	Course Outcomes	<p>After successfully completion of this course students will be able to:</p> <p>CO1: Relate common and distinctive features of lower invertebrate phyla, including porifera, protists, protozoa, Cnidaria and ctenophora</p> <p>CO2: Assess distinctive measurable features of different group of helminthes and pathogenicity caused by them.</p> <p>CO3: Organize the characteristics of Annelids and Arthropods with their economic importance.</p> <p>CO4: Showcase the importance of evolution of mollusks and echinoderms as higher invertebrates and predict their role in zoology.</p> <p>CO5: Summarize the different parasitic forms from all the groups of invertebrates and also those which of are economic importance.</p> <p>CO6: Combine the characteristic of different phyla to formulate and prepare phylogenetic relationship amongst invertebrates</p>	
8	Course Description	The course is divided into two parts, one dedicated toward understanding the simplest forms of life i.e. from protists onwards till Echinodermata. Other part is focused on the economic importance of these life forms.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Protista, Metazoa, Porifera, Cnidaria and Ctenophora</b>	
	A	<ul style="list-style-type: none"> <li>General characteristics and Classification of Protista; General account of locomotion in Protista</li> <li>Study of Euglena; Life cycle of Paramecium, Segmentation of Metazoa;</li> </ul>	CO1, CO6



		Paramecium (Morphology and Reproduction)	
B		<ul style="list-style-type: none"> <li>General characteristics and classification of sponges</li> <li>Canal system in Porifera (Sycon)</li> </ul>	CO1,CO6
C		<ul style="list-style-type: none"> <li>General characteristics and Classification up to classes in Cnideria</li> <li>Structure and life cycle of Obelia</li> <li>Polymorphism in Obelia</li> <li>Evolutionary significance of Ctenophora</li> </ul>	CO1,CO6
<b>Unit 2</b>		<b>Platyhelminthes and Nemathelminthes</b>	
A		<ul style="list-style-type: none"> <li>General characteristics and Classification of Platyhelminthes; Taenia (Tape worm) (Morphology and Reproduction)</li> </ul>	CO2, CO6
B		<ul style="list-style-type: none"> <li>General characteristics and Classification of Nemathelminthes; Ascaris lumbricoides (Morphology and Reproduction)</li> </ul>	CO2, CO6
C		<ul style="list-style-type: none"> <li>Life cycle of <i>Taenia solium</i> and <i>Wuchereria bancrofti</i></li> </ul>	CO2, CO6
<b>Unit 3</b>		<b>Annelida and Arthropoda</b>	
A		<ul style="list-style-type: none"> <li>General characteristics and Classification up to classes in Annelida; Hirudinaria (Leech) (Morphology and Reproduction)</li> </ul>	CO3, CO6
B		<ul style="list-style-type: none"> <li>General characteristics and Classification up to classes in Arthropoda</li> </ul>	O3, CO6
C		<ul style="list-style-type: none"> <li>Excretion in Annelida; Vision and Respiration in Arthropoda</li> <li>Palaemon (Prawn) (Morphology, Appendages, Nervous System and Reproduction)</li> </ul>	CO3, CO6
<b>Unit 4</b>		<b>Mollusca and Echinodermata</b>	
A		<ul style="list-style-type: none"> <li>General characteristics and Classification up to classes of mollusks</li> <li>Respiration in Mollusca</li> <li>Pila (Morphology, Shell, Respiration, Nervous System and Reproduction)</li> </ul>	CO4, CO6
B		<ul style="list-style-type: none"> <li>General characteristics and Classification up to classes of echinoderms</li> </ul>	CO4, CO6
C		<ul style="list-style-type: none"> <li>Pentaceros (Morphology and Water Vascular System)</li> </ul>	CO4, CO6
<b>Unit 5</b>		<b>Parasitology &amp; Economic Zoology</b>	
A		<ul style="list-style-type: none"> <li>Insects of Economic Importance</li> <li>Mites and Ticks as Human and Animal Parasites</li> <li>Helminths as Human and Animal Parasites</li> <li>Life cycle and their control of following pests: Gundhi bug, Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control</li> </ul>	CO5, CO6
B		<ul style="list-style-type: none"> <li>Nematodes that Affect Plants.</li> <li>Protozoan Parasites of Man and Animals</li> </ul>	CO5, CO6
C		<ul style="list-style-type: none"> <li>Animal breeding and culture: Pisciculture</li> <li>Sericulture, Apiculture, Lac-culture, Vermiculture</li> </ul>	CO5, CO6
Mode of examination		<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
		CA	MTE & ETE



Weightage Distribution	25%	75%
Text book/s*	<ol style="list-style-type: none"> <li>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.</li> <li>2. Campbell, N., and J. Reece. "Biology 7th edition, AP." (2005)</li> <li>2. Kotpal, R. L. Modern Text Book of Zoology: Invertebrates. Rastogi Publications, 2012.</li> <li>3. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17</li> <li>4. Hunter: Life of Invertebrates (1979, Collier Macmillan)</li> <li>5. Marshall: Parker &amp; Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)</li> <li>6. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)</li> <li>7. Brusca and Brusca (2016) Invertebrates. Sinauer</li> <li>8. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill</li> <li>9. Neilsen (2012). Animal Evolution: Interrelationships amongst living Phyla. Oxford</li> <li>10. Parasitology- Chatterjee</li> <li>11. Parasitology- Chakraborty 10. Thomas C. Chung. General Parasitology. Harcourt Brace and Co. Ltd. Asia, New Delhi.</li> <li>12. Gerard D. Schmidt and Larry S Roberts. Foundations of Parasitology. McGraw Hill.</li> <li>13. Bisht. D.S., Apiculture, ICAR Publication.</li> <li>14. Singh S., Beekeeping in India, Indian council of Agricultural Research, New Delhi.</li> <li>15. Jhingran. V.G. Fish and fisheries in India.</li> <li>16. Khanna. S.S, An introduction to fishes</li> <li>17. Boyd. C.E. &amp; Tucker. C.S, Pond aquaculture water quality management</li> <li>18. Biswas. K.P, Fish and prawn diseases</li> <li>19. Pedigo, L.P. (2002). Entomology and Pest Management, Prentice Hall.</li> <li>20. Lee, Earthworm Ecology 20. Stevenson, Biology of Earthworms</li> <li>21. Destructive and Useful Insects by C. L. Metcalf</li> <li>22. Sericulture for Rural Development : Hanumappa (1978), Himalaya Publication</li> <li>23. Sericulture in India Sarkar, D.C. (1988), CSB, Bangalore.</li> </ol>	
Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	





### Course Articulation Matrix for BZO301 Non-Chordates and Economic Zoology

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	3	2	3	-	1	3	2	2
CO2	3	2	1	1	1	3	2	3	-	1	3	2	2
CO3	3	2	1	1	1	3	3	2	-	1	3	2	2
CO4	3	2	1	1	1	3	2	2	-	1	1	2	2
CO5	3	2	1	1	1	2	3	3	-	1	1	2	2
CO6	3	2	1	1	1	3	2	3	-	1	1	2	2
Average	3.00	2.00	1.00	1.00	1.00	2.83	2.33	2.67	-	1.00	2.00	2.00	2.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BZO302 Comparative Diversity in Chordates

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: V</b>	
1	Course Code	<b>BZO302</b>	
2	Course Title	<b>Comparative diversity in Chordates</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To familiarise the students with through knowledge of different chordates forms available and how their development occurred.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Tell the salient features of Chordates, Urochordates, Hemichordates and Cephalochordates</p> <p>CO2: Explain the salient features of chordates as well as the special characteristics of each class</p> <p>CO3: Make use of the comparative anatomy of Integumentary and skeletal system among chordates</p> <p>CO4: Elaborate the comparative anatomy of Digestive, Respiratory &amp; Circulatory system among chordates</p> <p>CO5: Illustrate the comparative anatomy of Urogenital, Nervous and Sensory system among chordates</p> <p>CO6: Explain the different systems of chordates and understand their similarities and differences.</p>	
8	Course Description	The course has been formulated with an intention to explore the various characteristic each chordate group has and to closely analyse the differences and unique features of these chordates. Comparison of different systems have also been done here which will help students learn the process of how different system have evolved from lower to higher organisms.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Origin of Chordates; Hemichordata; Cephalochordata and Urochordata</b>	
	A	<ul style="list-style-type: none"> <li>Origin of Chordates. Classification of Phylum Chordata upto the class</li> <li>Salient features of Protochordates</li> <li>Differences between Chordates &amp; Non chordates</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Hemichordata: General characteristics, classification)</li> <li>Detailed study of Balanoglossus (Habit and Habitat, Morphology, Anatomy, Physiology and Development)</li> <li>General features of Branchiostoma</li> </ul>	CO1,CO6



	C	<ul style="list-style-type: none"> <li>• Cephalochordata: General characteristics, classification.</li> <li>• Detailed study of Branchiostoma (Amphioxus) (Habit and Habitat, Morphology, Anatomy, Physiology).</li> <li>• Urochordata : General characteristics, classification and detailed study of Herdmania (Habit and Habitat, Morphology, Anatomy, Physiology and Post Embryonic Development).</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Classification; General and Special Characteristics of different classes of Vertebrates</b>	
	A	<ul style="list-style-type: none"> <li>• General characters and Classification of different classes of vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia) up to the order with examples.</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>• Migration in Fishes; Scales, respiration, osmoregulation in fishes</li> <li>• Adaptations for living on land in Amphibia</li> <li>• Terrestrial adaptations in reptiles; Poisonous and Non Poisonous Snakes and biting mechanism.</li> <li>• Neoteny and Paedogenesis</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>• Flight adaptation &amp; Migration in birds</li> <li>• Dentition in Mammals</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Comparative Anatomy and Physiology of Vertebrates: Integumentary System &amp; Skeletal System</b>	
	A	<ul style="list-style-type: none"> <li>• Structure, functions and derivatives of integument</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>• Overview of axial and appendicular skeleton</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>• Jaw suspensorium, Visceral arches</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Comparative Anatomy and Physiology of Vertebrates: Digestive System; Respiratory System &amp; Circulatory System</b>	
	A	<ul style="list-style-type: none"> <li>• Alimentary canal and associated glands, dentition</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>• Skin, gills, lungs and air sacs; Accessory respiratory organs</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>• General plan of circulation, evolution of heart and aortic arches</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Comparative Anatomy and Physiology of Vertebrates: Urinogenital System, Nervous System &amp; Sense Organs</b>	
	A	<ul style="list-style-type: none"> <li>• Succession of kidney, Evolution of urinogenital ducts, Types of mammalian uteri</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>• Comparative account of brain Autonomic nervous system, Spinal cord, Cranial nerves in mammals</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>• Classification of receptors Brief account of visual and auditory receptors in man</li> </ul>	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA	MTE & ETE
25%		75%	



Text book/s*	<ol style="list-style-type: none"> <li>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.</li> <li>Campbell, N., and J. Reece. "Biology 7th edition, AP." (2005).</li> <li>Kotpal, R. L. Modern Text Book of Zoology: Invertebrates. Rastogi Publications, 2012.</li> <li>Harvey et al: The Vertebrate Life (2006)</li> <li>Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboneed animals through time (5th ed 2002, Wiley - Liss)</li> <li>Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)</li> <li>Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill</li> <li>McFarland et al: Vertebrate Life (1979, Macmillan Publishing)</li> <li>Parker and Haswell: Text Book of Zoology, Vol. II (1978, ELBS)</li> <li>Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)</li> <li>Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)</li> <li>Weichert C.K and William Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills</li> </ol>	
Other References	<ol style="list-style-type: none"> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> </ol>	

### Course Articulation Matrix for BZO302 Comparative Diversity in Chordates

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	1	1	3	2	3	-	1	3	2	3
CO2	3	1	2	1	1	3	2	3	-	1	3	2	3
CO3	3	1	2	2	2	3	3	2	-	1	3	2	3
CO4	3	1	3	1	1	3	2	2	-	1	3	2	3
CO5	3	1	2	1	2	2	3	3	-	1	3	2	3
CO6	3	1	2	1	2	3	2	3	-	1	3	2	3
Average	3.00	1.00	2.00	1.17	1.50	2.83	2.33	2.67	-	1.00	3.00	2.00	3.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## BZO304 LAB ON NON-CHORDATES AND ECONOMIC ZOOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: V</b>	
1	Course Code	<b>BZO304</b>	
2	Course Title	Lab on Non-Chordates and Economic Zoology	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory (CC)	
6	Course Objective	To make the students gain knowledge on how various systems look like and the major phyla's and species which are responsible for causing disease in humans.	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Show the microscopic structure of some important species of Non Chordates CO2: Illustrate the internal structures of some important species of Non-Chordates CO3: Acquaint with the parasitic species of economic importance CO4: Appraise with the life cycle of some important pests of economic utility CO5: Interpret the practical applicability of animal species by viewing their internal structures CO6: Compose an understanding on the various species existing in animal kingdom and how the diseases can spread within them	
8	Course Description	The course has been designed with the intention to explore the important systems and tissues of non-chordates and also understand the way pathogens invade them and learn about the important pathogens infecting our system	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Microscopic slide study of Non Chordates</b>	
	A	Study of microscopic slides of various animal phyla –Protozoa (Amoeba), Porifera (Sponges), Coelenterate (Hydra) Permanent Preparation of: Euglena, Paramecium	CO1, CO6
	B	To take out the nerve ring of earthworm. To prepare permanent stained slide of septal nephridia of earthworm.	CO1,CO6



	C	To take out hastate plate from Palaemon.	CO1,CO6
	<b>Unit 2</b>	<b>Virtual dissections- Non Chordates</b>	
	A	Study of specimens of various animal phyla –Platyhelminthes (earthworm), Nematelminths (Neries), Annelida (Leech), Arthropoda (Housefly, Anopheles, Culex, Aedes), Mollusca (Pila, Unio), Echinodermata (Star fish)	CO2, CO6
	B	Dissection of Earthworm to view the internal structures <a href="https://thesciencebank.org/pages/online-dissection-resources#earthworm">https://thesciencebank.org/pages/online-dissection-resources#earthworm</a> <a href="https://www.oh-worm.com/navigate">https://www.oh-worm.com/navigate</a>	CO2, CO6
	C	Dissections: through multimedia / models: Cockroach : Central nervous system Wallago: Afferent and efferent branchial vessels, Cranial nerves, Weberian ossicles.	CO2, CO6
	<b>Unit 3</b>	<b>Parasitology</b>	
	A	Study of prepared slides/specimens of Entamoeba, Giardia, Leishmania, Trypanosoma, Plasmodium, Fasciola, Cotugnia, Taenia, Rallietina, Polystoma Schistosoma, Echinococcus, Enterobius, Ascaris and Ancylostoma Life cycle of important parasitic organisms	CO3, CO6
	B	Permanent Preparation of Cimex (bed bug)/ Pediculus (Louse), Haematopinus (cattle louse), fresh water annelids, arthropods; and soil arthropods. Larval stages of helminths and arthropods.	CO3, CO6
	C	Permanent mount of wings, mouth parts and developmental stages of mosquito and house fly. Permanent preparation of ticks/ mites, abdominal gills of aquatic insects viz. Chironomus larva, dragonfly and mayfly nymphs, preparation of antenna of housefly.	CO3, CO6
	<b>Unit 4</b>	<b>Economic Zoology</b>	
	A	Identification of pests. Life history of silkworm, honeybee and lac insect.	CO4, CO6
	B	Study of an aquatic ecosystem, its biotic components and food chain. Different types of important edible fishes of India.	CO4, CO6
	C	Slides of plant nematodes. Project Report/ model chart making.	CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>	
	A	<ul style="list-style-type: none"> <li>• <a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li>• <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>• <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li>• <a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>• <a href="http://www.powershow.com">www.powershow.com</a></li> <li>• <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li>• <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>	CO5, CO6
	Mode of examination	<b>Practical/Viva</b> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)	



Weightage Distribution	CA	ETE
	25%	75%
Text book/s*	<ol style="list-style-type: none"> <li>1. Pedigo, L.P. (2002). <i>Entomology and Pest Management</i>, Prentice Hall.</li> <li>2. G. S. Shukla and V. B. Upadhyay (2017) <i>Economic Zoology: A textbook for University students</i>, Fifth Edition, Rastogi publication, Meerut.</li> <li>3. Parker and Haswell: <i>TextBook of Zoology</i>, Vol. II (1978, ELBS)</li> <li>4. Barnes et al (2009). <i>The Invertebrates: A synthesis</i>. Wiley Backwell 17</li> <li>5. Marshall: <i>Parker &amp; Haswell Text Book of Zoology</i>, Vol. I (7th ed 1972, Macmillan)</li> <li>6. Moore: <i>An Introduction to the Invertebrates</i> (2001, Cambridge University Press)</li> <li>7. Brusca and Brusca (2016) <i>Invertebrates</i>. Sinauer</li> <li>8. Jan Pechenik (2014) <i>Biology of the invertebrates</i>. McGraw Hill</li> <li>9. Boradale, L.A. and Potts, E.A. (1961). <i>Invertebrates: A Manual for the use of Students</i>. Asia Publishing Home</li> <li>10. <i>Handbook of Practical Sericulture</i>: Ullal, S.R. and Narasimhanna, M.N. (1987), Central Silk Board Publication, Bangalore.</li> <li>11. Prost, P. J. (1962). <i>Apiculture</i>. Oxford and IBH, New Delhi.</li> <li>12. Bisht. D.S., <i>Apiculture</i>, ICAR Publication.</li> <li>13. Singh S., <i>Beekeeping in India</i>, Indian council of Agricultural Research, New Delhi.</li> <li>14. Ullal S.R. and Narasimhanna, M.N. <i>Handbook of Practical Sericulture</i>: CSB, Bangalore</li> <li>15. Jolly. M. S. <i>Appropriate Sericultural Techniques</i>; Ed., Director, CSR &amp; TI, Mysore.</li> <li>16. <i>Handbook of Silkworm Rearing: Agriculture and Technical Manual-1</i>, Fuzi Pub. Co.</li> <li>17. Santanam, B. et al, <i>A manual of freshwater aquaculture</i></li> <li>18. Boyd. C.E. &amp; Tucker. C.S, <i>Pond aquaculture water quality management</i></li> <li>19. Pedigo, L.P. (2002). <i>Entomology and Pest Management</i>, Prentice Hall.</li> <li>20. Ranganathan L.S, <i>Vermicomposting technology- soil health to human health</i></li> </ol>	
Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	



### Course Articulation Matrix for BZO304 Lab on Non-Chordates and Economic Zoology

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	3	2	3	-	1	3	2	1
CO2	3	1	2	1	1	3	2	3	-	1	3	2	1
CO3	3	1	2	1	1	3	3	2	-	1	3	2	1
CO4	3	1	2	1	1	3	2	2	-	1	3	2	1
CO5	3	1	2	1	1	2	3	3	-	1	3	2	1
CO6	3	1	2	1	1	3	2	3	-	1	3	2	1
Average	3.00	1.00	2.00	1.00	1.00	2.83	2.33	2.67	-	1.00	3.00	2.00	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**





### BZO305 LAB ON COMPARATIVE DIVERSITY IN CHORDATES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: V</b>	
1	Course Code	<b>BZO305</b>	
2	Course Title	Lab on Comparative Diversity in Chordates	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory (CC)	
6	Course Objective	To make the students gain knowledge on comparative structures and the way they evolved from lower to higher chordates	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Show the microscopic and internal structures of chordates CO2: Demonstrate the structure of major systems in Humans CO3: Construct with the skeletal system of chordates CO4: Compare the various systems of chordates CO5: Prioritize the internal environment of various chordate systems CO6: Predict a comparative understanding w.r.t evolution of different systems of chordates	
8	Course Description	The course has been designed with the importance of a comparative understanding needed to correlate the evolution of chordate life.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Microscopic slide study &amp; Virtual Dissection of Chordates</b>	
	A	Study on use and ethical handling of model organisms (Mice, rats, rabbit and pig). To prepare stained/unstained slide of placoid scales.	CO1, CO6
	B	Dissection of Fish to view the internal structures <a href="https://thesciencebank.org/pages/online-dissection-resources#fish">https://thesciencebank.org/pages/online-dissection-resources#fish</a> <a href="https://www.oh-worm.com/navigate">https://www.oh-worm.com/navigate</a>	CO1,CO6



	C	Dissection of Frog to view the internal structures <a href="https://thesciencebank.org/pages/online-dissection-resources#frog">https://thesciencebank.org/pages/online-dissection-resources#frog</a> <a href="https://www.oh-worm.com/navigate">https://www.oh-worm.com/navigate</a>	CO1,CO6						
	<b>Unit 2</b>	<b>Virtual dissections-Human systems</b>							
	A	Dissection and viewing of the Human system-Digestive <a href="https://thesciencebank.org/pages/online-dissection-resources#human">https://thesciencebank.org/pages/online-dissection-resources#human</a>	CO2, CO6						
	B	Dissection and viewing of the Human system-Nervous system	CO2, CO6						
	C	Dissection and viewing of the Human system-Respiratory	CO2, CO6						
	<b>Unit 3</b>	<b>Comparative study of bones of chordates</b>							
	A	Comparative study of Vertebral bones of all chordates	CO3, CO6						
	B	Comparative study of Humerus and Femur of all chordates	CO3, CO6						
	C	Comparative study of Tibia-Fibula and Radio-Ulna of all chordates	CO3, CO6						
	<b>Unit 4</b>	<b>Comparative study of systems of chordates</b>							
	A	Comparative study of heart of Pisces, Amphibian, Reptiles, Aves and Mammals	CO4, CO6						
	B	Comparative study of digestive system of Pisces, Amphibian, Reptiles, Aves and Mammals	CO4, CO6						
	C	Comparative study of skin of Pisces, Amphibian, Reptiles, Aves and Mammals	CO4, CO6						
	<b>Unit 5</b>	<b>Virtual Labs</b>							
	A	<ul style="list-style-type: none"> <li>• <a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li>• <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> </ul>	CO5, CO6						
	B	<ul style="list-style-type: none"> <li>• <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li>• <a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> </ul>	CO5, CO6						
	C	<ul style="list-style-type: none"> <li>• <a href="http://www.powershow.com">www.powershow.com</a></li> <li>• <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li>• <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>	CO5, CO6						
	Mode of examination	Practical/Viva Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)							
	Weightage Distribution	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>CA</td> <td></td> <td>ETE</td> </tr> <tr> <td>25%</td> <td></td> <td>75%</td> </tr> </table>	CA		ETE	25%		75%	
CA		ETE							
25%		75%							
	Text book/s*	<ol style="list-style-type: none"> <li>1. Harvey et al: The Vertebrate Life (2006)</li> <li>2. Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (5th ed 2002,Wiley - Liss)</li> <li>3. Hildebrand: Analysis of Vertebrate Structure (4th ed 1995, John Wiley)</li> <li>4. Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill</li> </ol>							



		<ol style="list-style-type: none"> <li>5. McFarland et al: Vertebrate Life (1979, Macmillan Publishing)</li> <li>6. Parker and Haswell: TextBook of Zoology, Vol. II (1978, ELBS)</li> <li>7. Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan)</li> <li>8. Young: The Life of vertebrates (3rd ed 2006, ELBS/Oxford)</li> <li>9. Barnes et al (2009). The Invertebrates: A synthesis. Wiley Backwell 17</li> <li>10. Marshall: Parker &amp; Haswell Text Book of Zoology, Vol. I (7th ed 1972, Macmillan)</li> <li>11. Moore: An Introduction to the Invertebrates (2001, Cambridge University Press)</li> <li>12. Brusca and Brusca (2016) Invertebrates. Sinauer</li> <li>13. Jan Pechenik (2014) Biology of the invertebrates. McGraw Hill</li> <li>14. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home</li> <li>15. Robert Leo Smith Ecology and field biology Harper and Row publisher</li> </ol>	
	Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	

### Course Articulation Matrix for BZO305 Lab on Comparative diversity in Chordates

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO3
CO1	3	1	2	1	1	3	2	3	-	1	3	2	1
CO2	3	1	2	1	1	3	2	3	-	1	3	2	1
CO3	3	1	2	1	1	3	3	2	-	1	3	2	1
CO4	3	1	2	1	1	3	2	2	-	1	3	2	1
CO5	3	1	2	1	1	2	3	3	-	1	3	2	1
CO6	3	1	2	1	1	3	2	3	-	1	3	2	1

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



## BSZ312 ENDOCRINOLOGY & REPRODUCTIVE BIOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: V</b>	
1	Course Code	<b>BSZ312</b>	
2	Course Title	<b>Endocrinology &amp; Reproductive Biology</b>	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students, the endocrine system and its parts which play a major role in providing functionality to the human body	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Define the basics of Endocrine glands and its hormones CO2: Explain the role of Thyroid gland and its hormone and their mode of action CO3: Extrapolate the role of Adrenal gland and its hormone and their mode of action CO4: Demonstrate the role of Gland related to the Gastro-intestinal tract; its hormone and their mode of action CO5: Perceive the Biology of Reproductive System and its related hormones CO6: Develop approach towards their usage in various fields of research	
8	Course Description	The course has been designed to focus students with a preliminary knowledge of Endocrine system; its various functional points along with emphasis on Reproductive system and its working	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Endocrinology</b>	
	A	<ul style="list-style-type: none"> <li>Scope of Endocrinology, Endocrine glands; Structural features</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Hormones, Classification, Peptide hormones; Thyroid hormones; Steroid hormones; Hormone action; regulation</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>Hypothalamus, Pituitary gland, Pineal gland; Thymus</li> <li>Hormones and human health.</li> <li>Production of hormones as Pharmaceuticals</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Thyroid Gland: Structure &amp; Function</b>	
	A	Structure of thyroid gland, Biosynthesis of thyroid hormones	CO2, CO6



	B	Biological functions of Thyroid hormones, Regulation of Thyroid secretion,	CO2, CO6
	C	Hormones of parathyroid Glands and their biological action	CO2, CO6
	<b>Unit 3</b>	<b>Adrenal cortex: Structure &amp; Function</b>	
	A	Adrenal Cortex - Glucocorticoids, Mineralocorticoids and their biological function,	CO3, CO6
	B	Renin Angiotensin System and its function	CO3, CO6
	C	Adrenal Medulla- Catecholamines - Synthesis and Biological action	CO3, CO6
	<b>Unit 4</b>	<b>Gastro intestinal related Hormones: Structure &amp; Function</b>	
	A	Pancreatic (Islets of Langerhans) hormones	CO4, CO6
	B	Insulin – Biosynthesis, Regulation, Biological action	CO4, CO6
	C	Glucagon – Biosynthesis, Regulation, Biological action	CO4, CO6
	<b>Unit 5</b>	<b>Reproductive Biology &amp; related hormones</b>	
	A	Male reproductive system – Structure of Testes, Biosynthesis of testosterone; Regulation and functions	CO5, CO6
	B	Female reproduction system – Structure of Ovary, Biosynthesis of estrogen, Feedback regulation and functions	CO5, CO6
	C	Sexual differentiation: Genetic sex- gonadal sex- somatic sex. Female Reproductive Cycle– Estrous, Menstrual, Placental hormones–parturition – Lactation.	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA 25%	MTE & ETE 75%
	Text book/s*	1. Mac E Hadley, 1992 Endocrinology, Third edition, prentice Hall, New Delhi Jersey. 2. Wilson J.D and Foster D.W 1992, William’s textbook of endocrinology, 8th edition, WB saunders company, Philadelphia. 3. Turner C.D and Bagnarr, J.T., 1994, General Endocrinology, 6th edition, WB saunder’s company, Philadelphia [saunder’s international students edition].	
	Other References	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a> 2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a>	



		<ol style="list-style-type: none"><li>3. Swayam Prabha - DTH Channel,</li><li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li><li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li><li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li><li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li><li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li></ol>	
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### Course Articulation Matrix for BSZ312 Endocrinology & Reproductive Biology

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO3
CO1	2	3	1	1	1	3	2	3	-	1	1	1	3
CO2	2	3	1	1	1	3	2	3	-	1	1	1	3
CO3	2	3	1	1	1	2	3	2	-	1	1	1	3
CO4	2	3	1	1	1	3	2	2	-	1	1	1	3
CO5	2	3	1	1	1	2	3	3	-	1	1	1	3
CO6	2	3	1	1	1	3	2	3	-	1	1	1	3

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



### BZO303 INTRODUCTION TO MEDICAL VIROLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BZO303</b>	
2	Course Title	<b>Introduction to Medical virology</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To induce into the students the knowledge of viruses of medical importance and application of knowledge for diagnosis and surveillance	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Recall the knowledge of systemic and structural virology. CO2: Interpret the various ways in which virus replicates and causes pathogenicity CO3: Identify the different viral diseases and their life cycle. CO4: Acquaint with the knowledge of transmission strategies, prevention and control of the viral diseases. CO5: Perceive detailed knowledge of arthropods transmitting viruses and vector control CO6: Maximize the medical importance of plant and animal viruses.	
8	Course Description	The course has been developed with the intention of involving students with the latest knowledge in the field of Introduction to Medical virology. All the concepts have been included in this, right from its structure to the way in which the replicates and transmits disease and then how to control and prevent viral diseases. Also vectors of viral diseases have also been included.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Virology</b>	
	A	History, General properties of viruses; Virions, Viroids, Prions, Bacteriophages	CO1, CO6
	B	Classifications of virus; plant and animal viruses; Baltimore classification	CO1,CO6
	C	Structure of viruses: plant and animal viruses; Ultrastructure	CO1,CO6



	<b>Unit 2</b>	<b>Viral Replication</b>		
	A	Replication strategies in DNA, RNA and RT viruses		CO2, CO6
	B	Mechanism of Infection and Virus induced changes in cells		CO2, CO6
	C	Viral pathogenesis		CO2, CO6
	<b>Unit 3</b>	<b>Viral Diseases of medical importance</b>		
	A	Viral Enteric Diseases; Viral Respiratory Diseases		CO3, CO6
	B	Viral Encephalitis; Viral Hemorrhagic Fevers;; Viral Exanthematous Diseases;		CO3, CO6
	C	HIV/AIDS; Spongiform encephalopathies; Viral diseases in plant and animals		CO3, CO6
	<b>Unit 4</b>	<b>Transmission, prevention, control and diagnosis of viruses</b>		
	A	Mode of transmission in plant and animals; Arborial, Non persistent, Semi-persistent and persistent etc.		CO4, CO6
	B	Prevention and Control of Viral Diseases		CO4, CO6
	C	Laboratory diagnosis of Viral infections		CO4, CO6
	<b>Unit 5</b>	<b>Vectors transmitting viruses</b>		
	A	Vectors; Carriers, Biology and lifecycle of important vectors: <i>Aedes</i> , <i>Culex</i> , Sandflies, Fleas, Lice, Cuclicoides, Aphids, Thrips, White fly, mites, ticks,		CO5, CO6
	B	Disease transmission by <i>Aedes</i> , <i>Culex</i> , Sandflies, Fleas, Lice, Cuclicoides, Aphids, Thrips, White fly		CO5, CO6
	C	Strategies for control of vectors, Vectorial capacity and Vector competence		CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
	Weightage Distribution	CA		MTE & ETE
		25%		75%
	Text book/s*	1. Viruses and Human Disease; 2 <sup>nd</sup> Edition 2007; By Ellen Strauss; ISBN: 978-0-12-373741-0 2. athology and Pathogenesis of Human Viral Disease; 2000; Edited by: John E. Craighead, MD; ISBN: 978-0-12-195160-3 3. Kettle DS (1984) Medical and veterinary entomology CAB international 4. Richard and Davies Imm's general Text book of Entomology, Vol I & II. Chapman and Hall 5. Imms, A.D. (1977). A General Text Book of Entomology. Chapman and Hall, UK.		
	Other References	9. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a>		





	<p>10. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></p> <p>11. Swayam Prabha - DTH Channel,</p> <p>12. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></p> <p>13. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></p> <p>14. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></p> <p>15. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> edX, <a href="https://www.edx.org/">https://www.edx.org/</a></p>	
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### Course Articulation Matrix for BZO303 Introduction to Medical virology

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	3	2	3	-	1	3	1	1
CO2	2	3	1	1	1	3	2	3	-	1	3	1	1
CO3	2	3	1	1	1	3	3	2	-	1	3	1	1
CO4	2	3	1	1	1	3	2	2	-	1	3	1	1
CO5	2	3	1	1	1	2	3	3	-	1	3	1	1
CO6	2	3	1	1	1	3	2	3	-	1	3	1	1
Average	2.00	3.00	1.00	1.00	1.00	2.83	2.33	2.67	-	1.00	3.00	1.00	1.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### RBL003 RESEARCH BASED LEARNING-3

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: V</b>	
1	Course Code	<b>RBL003</b>	
2	Course Title	Research Based Learning-3	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (Project)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in project writing and oral presentation.</li> </ul>	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO1:</b> Apply the understanding of various research articles to identify research gap on a given topic</p> <p><b>CO2:</b> Extract line of approach to overcome the research gap</p> <p><b>CO3:</b> Conclude appropriate method/s suitable for a given problem</p> <p><b>CO4:</b> Identify characterization techniques/theoretical analysis for obtaining result</p> <p><b>CO5:</b> Explain graphs, diagrams, flow chart etc.</p> <p><b>CO6:</b> Report research findings in written and verbal forms</p>	
8	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
9	Outline syllabus		CO Mapping
	<b>Part 1</b>	<b>Introduction to various research problems</b>	<b>CO1</b>
	<b>Part 2</b>	<b>Identify a research question</b>	<b>CO2, CO3</b>
	<b>Part 3</b>	<b>Literature survey</b>	<b>CO4</b>



	<b>Part 4</b>	<b>Report writing</b>	<b>CO5</b>
	<b>Part 5</b>	<b>Presentation</b>	<b>CO6</b>
	Mode of examination	4. Rubric assessment 5. Monthly Presentation to be audited by supervisor 6. Mid Term Presentation and End Term Presentation	
	Text book/s*	10 Recent International Journal Articles of repute.	
	Suggestive Digital Platforms / Web Links	NA	
	Suggested Equivalent Online Courses	NA	

### Course Articulation Matrix for RBL003 Research Based Learning-3 (RBL3)

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO3
CO1	3	1	1	3	2						3	3	3
CO2	3	1	1	3	2						3	3	3
CO3	3	1	1	3	2						3	3	3
CO4	3	1	1	3	2						3	3	3
CO5	3	1	1	3	2						3	3	3
CO6	3	1	1	3	2						3	3	3

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



## INDUSTRY CONNECT

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: V</b>	
1	Course Code		
2	Course Title	<b>Industry Connect</b>	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory	
6	Course Objective	This course will expose students to apply theories learned in the classroom and provides current technological developments relevant to the subject area of training. Students will be able to identify the career preferences and professional goals.	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Define the industry principles and practices. CO2: Explain and analyze an appropriate problem. CO3: Build a teamwork and apply prior acquired knowledge in problem solving. CO4: Demonstrate effective verbal and written communication skills. CO5: Appraise scientists' responsibilities, self-understanding, self-discipline and ethical standards. CO6: Develop the career preferences and professional goals	
8	Course Description	The Internship aims to offer students the opportunity to apply their prior acquired knowledge in problem solving. Students will acquire skills important for time management, discipline, self learning, and effective communication and so on.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>		
	A, B, C	Define objectives and conditions for the internship, ensuring students that it is related to the study path carried out at the University	CO1, CO6
	<b>Unit 2</b>		
	A, B, C	Problem Definition and identification, Team/Group formation and Project Assignment. Finalizing the problem statement, resource requirement, if any.	CO2, CO6
	<b>Unit 3</b>		



A, B, C	The internship work plan is drawn up by developing team work and applies prior acquired knowledge in problem solving.	CO3, CO6
<b>Unit 4</b>		
A, B, C	Demonstrate and execute Project with the team. Submission of evaluation form and final report completed by the intern.	CO4, CO6
<b>Unit 5</b>		
A, B, C	Final evaluation form completed by the supervisor at the Host Organization and final presentation before departmental committee.	CO5, CO6
Mode of examination	Jury+Practical+Viva	
Weightage Distribution	CA	ETE
	25%	75%
Text book/s*		
Other references	NA	

### Course Articulation Matrix for Industry Connect

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	3	2	1	3	3	2	-	2	1	1	1
CO2	1	1	3	2	1	3	3	2	-	2	1	1	1
CO3	1	1	3	2	1	3	3	2	-	2	1	1	1
CO4	1	1	3	2	1	3	3	2	-	2	1	1	1
CO5	1	1	3	2	1	2	3	3	-	2	1	1	1
CO6	1	1	3	2	1	3	3	3	-	2	1	1	1
Average	1.00	1.00	3.00	2.00	1.00	2.83	3.00	2.33	-	2.00	1.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



# SEMESTER VI

## **B.Sc. (Hons.) in Zoology**



### BZO311 Evolution of Life & Embryology

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VI</b>	
1	Course Code	<b>BZO311</b>	
2	Course Title	Evolution of life & Embryology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To familiarize the students with the knowledge of sub-disciplines of zoology i.e. Evolutionary biology & developmental biology	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Tell the concept and theories related to evolution.</p> <p>CO2: Explain the theories of Population genetics and related equations</p> <p>CO3: Organize an understanding of the concept of species, its process and extinction</p> <p>CO4: Inspect the basis of developmental biology, how zygote develops.</p> <p>CO5: Deduce an Understanding of the step by step basis of developmental processes, the concept of regeneration and aging</p> <p>CO6: Demonstrate a holistic idea of life, from evolution to aging and extinction of species.</p>	
8	Course Description	The course has been designed to connect two disciplines of zoology, one which describes about how species evolved, how they survive and get extinct when faced with competition for survival. Also it discusses the origin of life i.e. the development of zygote and how each cells are destined to completely make a living species, the fate of each cell etc.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Concept and Theories of Evolution</b>	
	A	<ul style="list-style-type: none"> <li>• Origin of Life</li> <li>• Historical review of evolutionary concept: Lamarckism, Darwinism (Natural, Sexual and Artificial selection)</li> <li>• Modern synthetic theory of evolution</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>• Patterns of evolution (Divergence, Convergence, Parallel, Coevolution)</li> </ul>	CO1, CO6



	C	<ul style="list-style-type: none"> <li>Direct Evidences of Evolution: Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse</li> </ul>	CO1, CO6
	<b>Unit 2</b>	<b>Population Genetics</b>	
	A	<ul style="list-style-type: none"> <li>Microevolution and Macroevolution: allele frequencies, genotype frequencies</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Hardy-Weinberg equilibrium and conditions for its maintenance</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Forces of evolution: mutation, selection, genetic drift</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Species; Speciation and Extinction</b>	
	A	<ul style="list-style-type: none"> <li>Biological species concept (Advantages and Limitations)</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Modes of speciation (Allopatric, Sympatric)</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Mass extinction (Causes, Names of five major extinctions)</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Developmental Biology: Gamete Fertilization and Early Development</b>	
	A	<ul style="list-style-type: none"> <li>Gametogenesis, Fertilization</li> <li>Cleavage pattern</li> <li>Gastrulation, fate maps</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Developmental mechanics of cell specification</li> <li>Morphogenesis and cell adhesion</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Developmental Genes</li> <li>Genes and development</li> <li>Molecular basis of development</li> <li>Differential gene expression</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Early &amp; Late Vertebrate Developmental processes</b>	
	A	<ul style="list-style-type: none"> <li>Early development of vertebrates (fish, birds &amp; mammals), fate maps</li> <li>Metamorphosis, regeneration and stem cells</li> <li>Environmental regulation of development</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>The dynamics of organ development</li> <li>Development of eye, kidney, limb</li> <li>Metamorphosis: the hormonal reactivation of development in amphibians, insects</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>Regeneration: salamander limbs, mammalian liver, Hydras</li> <li>Aging: the biology of senescence</li> </ul>	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA	MTE & ETE
		25%	75%
	Text book/s*	1. Ridley, M. (2004). <i>Evolution</i> . III Edition. Blackwell Publishing 2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). <i>Evolution</i> . ColdSpring, Harbour Laboratory Press.	





		3. Hall, B. K. and Hallgrímsson, B. (2008). <i>Evolution</i> . IV Edition. Jones and Bartlett Publishers 4. Campbell, N. A. and Reece J. B. (2011). <i>Biology</i> . IX Edition, Pearson, Benjamin, Cummings. 5. Douglas, J. Futuyma (1997). <i>Evolutionary Biology</i> . Sinauer Associates. 6. Developmental Biology: T. Subramaniam, (Reprint), Narosa Publishing House Pvt. Ltd., New Delhi(2013).	
	Other References	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a> 2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 3. Swayam Prabha - DTH Channel, 4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a> 5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> 6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> 7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> 8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a>	

### Course Articulation Matrix for BZO311 Evolution of life & Embryology

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	3	2	3	-	1	3	3	2
CO2	3	1	2	1	1	3	2	3	-	1	3	3	2
CO3	3	1	2	1	1	3	3	2	-	1	3	3	2
CO4	3	1	2	1	1	3	2	2	-	1	3	3	2
CO5	3	1	2	1	1	2	3	3	-	1	3	3	2
CO6	3	1	2	1	1	3	2	3	-	1	3	3	2
Average	3.00	1.00	2.00	1.00	1.00	2.83	2.33	2.67	-	1.00	3.00	3.00	2.00

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



### BZO312 Environmental and Ecological sciences

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VI</b>	
1	Course Code	<b>BZO312</b>	
2	Course Title	Environmental and Ecological sciences	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in students, the interdisciplinary relationship of zoology with Ecology, Ethology, Environmental and Wildlife sciences.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Relate the theories of ecology and its organization</p> <p>CO2: Elaborate the ecosystems, the various types existing and the population and community form of ecology</p> <p>CO3: Discuss the long term impact of pollution as a hazard to the environment and Understand the effect of Climate change on the existing population</p> <p>CO4: Interpret the cause and effect of lifestyle disorders contributing to public understanding of biological timing</p> <p>CO5: Simplify the importance of wildlife conservation.</p> <p>CO6: Extend the underlying basis of existence demarcated in terms of population, community, environment etc.</p>	
8	Course Description	The course has been designed keeping in view the correlative subjects of Ecology and Environment. The important concepts of Ethology have all been summed up in the course. Also the importance of wildlife its protection and conservation have all been covered here.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Ecology &amp; its Organization</b>	
	A	• History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors	CO1, CO6
	B	• Levels of organization, Laws of limiting factors, Study of physical factors	CO1, CO6
	C	• Population: Density, natality, mortality, life tables, fecundity tables,	CO1, CO6



		survivorship curves, ageratio, sex ratio, dispersal and dispersion, Exponential and logistic growth	
<b>Unit 2</b>	<b>Ecosystems; Population &amp; Community Ecology</b>		
A	<ul style="list-style-type: none"> <li>Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem</li> <li>Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycles</li> </ul>	CO2, CO6	
B	<ul style="list-style-type: none"> <li>Population ecology and its fundamentals</li> </ul>	CO2, CO6	
C	<ul style="list-style-type: none"> <li>Community characteristics: species richness, dominance, diversity, abundance, Ecological succession with examples</li> </ul>	CO2, CO6	
<b>Unit 3</b>	<b>Environmental Hazards &amp; Effects of Climate Change</b>		
A	<ul style="list-style-type: none"> <li>Sources of Environmental hazards</li> <li>Climate changes</li> <li>Greenhouse gases and global warming</li> <li>Acid rain, Ozone layer destruction</li> </ul>	CO3, CO6	
B	<ul style="list-style-type: none"> <li>Effect of climate change on public health</li> <li>Sources of waste, types and characteristics, Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal</li> </ul>	CO3, CO6	
C	<ul style="list-style-type: none"> <li>Nuclear waste handling and disposal, Waste from thermal power plants</li> <li>Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath</li> </ul>	CO3, CO6	
<b>Unit 4</b>	<b>Behavioural Ecology and Chronobiology</b>		
A	<ul style="list-style-type: none"> <li>Origin and history of Ethology</li> <li>Instinct vs. Learnt Behaviour</li> </ul>	CO4, CO6	
B	<ul style="list-style-type: none"> <li>Associative learning, classical and operant conditioning, Habituation, Imprinting,</li> </ul>	CO4, CO6	
C	<ul style="list-style-type: none"> <li>Circadian rhythms; Tidal rhythms and Lunar rhythms</li> <li>Chronomedicine</li> </ul>	CO4, CO6	
<b>Unit 5</b>	<b>Introduction to Wild Life and Protected areas</b>		
A	<ul style="list-style-type: none"> <li>Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies</li> </ul>	CO5, CO6	
B	<ul style="list-style-type: none"> <li>National parks &amp; sanctuaries, Community reserve; Important features of protected areas in India</li> </ul>	CO5, CO6	
C	<ul style="list-style-type: none"> <li>Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve</li> </ul>	CO5, CO6	
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
Weightage Distribution	CA		MTE & ETE
	25%		75%



Text book/s*	<ol style="list-style-type: none"> <li>1. Ecology: Theories &amp; Applications. Peter D. Stiling, 2001, Prentice Hall.</li> <li>2. Ecological Modeling. 2008. Grant, W.E. and Swannack, T.M., Blackwell.</li> <li>3. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.</li> <li>4. Elements of Ecology. T.M. Smith and R.L. Smith, 2014, Pearson Education Inc.</li> <li>5. Environmental Chemistry. 2010. Stanley and Manahan, E. CRC, Taylor &amp; Francis. London.</li> <li>6. Environment. Raven, Berg, Johnson, 1993, Saunders College Publishing.</li> </ol>	
Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	

### Course Articulation Matrix for BZO312 Environmental and Ecological sciences

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	1	1	3	2	3	-	3	2	2	3
CO2	2	3	2	1	1	3	2	3	-	3	2	2	3
CO3	2	3	2	1	1	3	3	2	-	3	2	2	3
CO4	2	3	2	1	1	3	2	2	-	3	2	2	3
CO5	2	3	2	1	1	2	3	3	-	3	2	2	3
CO6	2	3	2	1	1	3	2	3	-	3	2	2	3
Average	2.00	3.00	2.00	1.00	1.00	2.83	2.33	2.67	-	3.00	2.00	2.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### BZP302 EMBRYOLOGY LAB

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VI</b>	
1	Course Code	BZP302	
2	Course Title	Embryology Lab	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory (CC)	
6	Course Objective	To make the students aware of various developmental stages of an organism, how single cells are destined to form organs and then organism as a whole.	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Recall the various stages of non-chordate development CO2: Explain the various stages of frog development CO3: Develop knowledge on the various growth phases of chick embryo CO4: Familiarize with the various growth and developmental phases of mammals CO5: Demonstrate the step by step growth of development from fetus to new born CO6: Construct the models and fate maps of various organisms	
8	Course Description	The study aims to familiarize the students with the various concept of embryology like fertilization, cleavage, early development, fate map etc.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Developmental stages of non-chordates</b>	
	A	Developmental stages of Ascidia larvae- Chart	CO1, CO6
	B	Developmental stages of Amphioxus –Chart	CO1,CO6
	C	Fate map and Metamorphosis of Ascidian larva & Amphioxus	CO1,CO6
	<b>Unit 2</b>	<b>Developmental stages of Frog</b>	
	A	Slides/model/chart presentation of Zygote and Embryo	CO2, CO6



	B	Slides/model/chart presentation of developmental stages of Tadpole		CO2, CO6
	C	Slides/model/chart presentation of Fate map of Frog		CO2, CO6
	<b>Unit 3</b>	<b>Developmental stages of Chick</b>		
	A	Slides/model/chart presentation of Stages in fertilization of egg		CO3, CO6
	B	Slides/model/chart presentation of developmental stages of chick embryo (18 hours, 24 hours, 48 hours, 72 hours etc.)		CO3, CO6
	C	Slides/model/chart presentation of Fate map of Chick		CO3, CO6
	<b>Unit 4</b>	<b>Developmental stages of Mammals</b>		
	A	• Slides/model/chart presentation of Stages in fertilization of egg		CO4, CO6
	B	• Slides/model/chart presentation of developmental stages of embryo (18 hours, 24 hours, 48 hours, 72 hours etc.)		CO4, CO6
	C	• Slides/model/chart presentation of Fate map of endometrium ; extra embryonic membranes		CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>		
	A	<ul style="list-style-type: none"> <li>• <a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li>• <a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> </ul>		CO5, CO6
	B	<ul style="list-style-type: none"> <li>• <a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li>• <a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> </ul>		CO5, CO6
	C	<ul style="list-style-type: none"> <li>• <a href="http://www.powershow.com">www.powershow.com</a></li> <li>• <a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li>• <a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>		CO5, CO6
	Mode of examination	Practical/Viva Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)		
	Weightage Distribution	CA		ETE
		25%		75%
	Text book/s*	1. An introduction to Embryology. AK Berry. 2000. Emkay publications, Delhi 2. Experimental Embryology and teratology. Woolam & Morriss. 1974. Harper Collins Ltd. 3. Inderbir Singh's Human Embryology. 2017. Jaypee Brothers Medical Publishers Ltd. Edited by V Subhadra Devi. 4. Langman's Medical Embryology. 2016. Edited by TW Sadler. Wolters Kluwer Publisher. India		



Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	
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### Course Articulation Matrix for BZP302 Embryology Lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	3	2	3	-	1	1	2	2
CO2	3	2	2	1	1	3	2	2	-	1	1	2	2
CO3	3	2	2	1	1	3	2	3	-	1	1	2	2
CO4	3	2	2	1	1	3	2	2	-	1	1	2	2
CO5	3	2	2	1	1	2	3	3	-	1	1	2	2
CO6	3	2	2	1	1	3	2	3	-	1	1	2	2
Average	3.00	2.00	2.00	1.00	1.00	2.83	2.17	2.67	-	1.00	1.00	2.00	2.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



### BZO313 LAB ON ENVIRONMENTAL AND ECOLOGICAL SCIENCES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VI</b>	
1	Course Code	<b>BZO313</b>	
2	Course Title	Lab on Environmental and Ecological sciences	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory (CC)	
6	Course Objective	To make the students aware of the various ecological micro happenings, to determine the environmental effects on water and soil samples. To train students in identifying the tools and techniques for wildlife related field work.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Show the ecological happenings</p> <p>CO2: Explain the tools and techniques in field work on wildlife and understand the behavioral pattern of wild animals</p> <p>CO3: Acquaint with the techniques to determine the hardness, TDS, TSS of samples</p> <p>CO4: Demonstrate the techniques for determination of alkalinity, chlorine content in water samples</p> <p>CO5: Estimate the principle and techniques in ecological sciences</p> <p>CO6: Correlate the impact of environment on the various components existing</p>	
8	Course Description	The course discusses hands on and virtual experience on some of the techniques like detection of chloride, pH, alkalinity, hardness etc. in water samples. The field knowledge required for carrying our wildlife research and for studying the behaviour of wildlife species has also been included in this practical course.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Ecology experiments</b>	
	A	<ul style="list-style-type: none"> <li><a href="https://biomanbio.com/index.html">https://biomanbio.com/index.html</a></li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Species interaction in ecology</li> <li><a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=272&amp;sim=1477&amp;cnt=1">https://vlab.amrita.edu/index.php?sub=3&amp;brch=272&amp;sim=1477&amp;cnt=1</a></li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>To estimate the bacterial population growth;</li> <li>Study of life tables and plotting of survivorship curves of different types from</li> </ul>	CO1,CO6





		the hypothetical/real data provided. <ul style="list-style-type: none"> <li>Study of population dynamics through numerical problems. Study of circadian functions in humans (daily eating, sleep and temperature patterns).</li> </ul>	
	<b>Unit 2</b>	<b>Wildlife related lab work</b>	
	A	<ul style="list-style-type: none"> <li>Demonstration of basic equipments needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Familiarization and study of animal evidences in the field; Identification of animals through pug marks, hoof marks, scats, pellet groups, nest, antlers etc.</li> <li>Demonstration of different field techniques for flora and fauna</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Report on a visit to National Park/Biodiversity Park/Wild life sanctuary</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Environmental Science related experiments-I</b>	
	A	To estimate the Biological Oxygen Demand (BOD) <ul style="list-style-type: none"> <li><a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=272">https://vlab.amrita.edu/index.php?sub=3&amp;brch=272</a></li> <li>To Determine the pH of water samples</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Determination of hardness of water</li> <li>Determination of Total Suspended Solids</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Determination of Total Dissolved Solids</li> <li>Determination of chloride content</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Environmental Science related experiments-II</b>	
	A	<ul style="list-style-type: none"> <li>To Determine Alkalinity of a Given Water Sample</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>To Estimate the dissolved oxygen in the sample</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>To calculate the Sludge index</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Virtual Lab</b>	
	A	<ul style="list-style-type: none"> <li><a href="https://www.vlab.co.in">https://www.vlab.co.in</a></li> <li><a href="https://zoologysan.blogspot.com">https://zoologysan.blogspot.com</a></li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li><a href="http://www.vlab.iitb.ac.in/vlab">www.vlab.iitb.ac.in/vlab</a></li> <li><a href="http://www.onlinelabs.in">www.onlinelabs.in</a></li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li><a href="http://www.powershow.com">www.powershow.com</a></li> <li><a href="https://vlab.amrita.edu">https://vlab.amrita.edu</a></li> <li><a href="https://sites.dartmouth.edu">https://sites.dartmouth.edu</a></li> </ul>	CO5, CO6
	Mode of examination	<u>Practical/Viva</u> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)	
		CA	ETE



Weightage Distribution	25%		75%	
Text book/s*	<ol style="list-style-type: none"> <li>1. <a href="https://www.dbit.ac.in/ce/syllabus/environmental-lab.pdf">https://www.dbit.ac.in/ce/syllabus/environmental-lab.pdf</a></li> <li>2. <a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=272">https://vlab.amrita.edu/index.php?sub=3&amp;brch=272</a></li> <li>3. <a href="https://www.learner.org/wp-content/interactive/envsci/ecology/ecology.html">https://www.learner.org/wp-content/interactive/envsci/ecology/ecology.html</a></li> <li>4. <a href="https://www.jnec.org/labmanuals/civil/te/sem1/EE%20%20lab%20manual%20CIVIL%202018-19-%20Modified.pdf">https://www.jnec.org/labmanuals/civil/te/sem1/EE%20%20lab%20manual%20CIVIL%202018-19-%20Modified.pdf</a></li> <li>5. Ecology: The Experimental Analysis of Distribution and Abundance. Charles J. Krebs, 2016, Pearson Education Inc.</li> <li>6. Fundamentals of Ecology. E.P. Odum &amp; Gray. W. Barrett, 1971, Saunders.</li> <li>7. Robert Leo Smith Ecology and field biology Harper and Row publisher</li> </ol>			
Other References	<ol style="list-style-type: none"> <li>16. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>17. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>18. Swayam Prabha - DTH Channel,</li> <li>19. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>20. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>21. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>22. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>			

### Course Articulation Matrix for BZO313 Lab on Environmental and Ecological sciences

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	3	2	3	-	1	1	2	2
CO2	3	2	2	1	1	3	2	3	-	1	1	2	2
CO3	3	2	2	1	1	3	3	2	-	1	1	2	2
CO4	3	2	2	1	1	3	2	2	-	1	1	2	2
CO5	3	2	2	1	1	2	3	3	-	1	1	2	2
CO6	3	2	2	1	1	3	2	3	-	1	1	2	2
Average	3.00	2.00	2.00	1.00	1.00	2.83	2.33	2.67	-	1.00	1.00	2.00	2.00

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



### BMB312 ADVANCED IMMUNOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VI</b>	
1	Course Code	<b>BMB312</b>	
2	Course Title	<b>Advanced Immunology</b>	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students an understanding of advanced levels in Immunology, the various techniques and tools and the recent advances in immunology	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p>CO1: Recall the various lines of defense; cells, tissues and molecules present in our system.            CO2: Demonstrate the various interaction in our systems depicting antigen-antibody reactions            CO3: Appraise with the site or tissues specific form of immune response            CO4: Explain the immune response to pathogens            CO5: Evaluate the advance techniques in Immunology            CO6: Derive a complete knowledge about various tissues specific interactions and the methodology used in immunodiagnostics.</p>	
8	Course Description	The course has a special focus towards aiming to students to understand immunology of an advance level. The important interactions being done by various components of immune systems whether it is at molecular level or at tissue level has also been summed here. The immunodiagnostics component will add to the skill development.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Participants in Defence mechanism</b>	
	A	Lines of defense and various barriers; Concept of Herd immunity	CO1, CO6
	B	Cells and organs of Immune system; T <sub>h</sub> cell subsets; Cytokines and its types	CO1,CO6
	C	APC's of Immune system; Antigen processing and presentation; MHC and it types	CO1,CO6
	<b>Unit 2</b>	<b>Antigen-antibody interactions</b>	



A	Antigens, Antibody (isotypes, idiotypes, allotypes), Epitopes, Haptens; Immunogens; Antibody diversity Inflammation – acute and chronic; Cellular and molecular mediators of inflammation	CO2, CO6
B	Tolerance & its mechanisms, Systemic & organ specific diseases, Autoimmunity mechanisms	CO2, CO6
C	Hypersensitivity reactions and its types, diseases caused & Immunodeficiency disorders (SCID, AIDS, etc)	CO2, CO6
<b>Unit 3</b>	<b>Site specific Immunity</b>	
A	Mucosal immune system and its components; Epithelial Cells, Mucosal microbiota; Inflammatory Bowel Disease, Crohn's Disease, Mucosal Allergies, Celiac diseases	CO3, CO6
B	Reproduction and Immune system, Maternal immune tolerance to the fetus, Antigen presentation at the placenta; Immune basis for male & female infertility; Miscarriage.	CO3, CO6
C	Transplant Immunology: Concept of self non self-discrimination, donor, graft and recipient. Major and Minor histocompatibility antigens, Mechanisms of graft rejection; Components of immune system involved in graft rejection	CO3, CO6
<b>Unit 4</b>	<b>Immunity to infections</b>	
A	Immunity to bacterial and viral diseases with examples	CO4, CO6
B	Immunity to fungal and parasitic diseases with examples	CO4, CO6
C	Cancer and Immunity; Nutrition and Immunity	CO4, CO6
<b>Unit 5</b>	<b>Techniques in Immunology</b>	
A	Antigen antibody interaction: principles Immunodiffusion (double and radial); Immunofluorescence; Western Blotting	CO5, CO6
B	RIA & ELISA; Immuno-electrophoresis; PRNT; Hemagglutination assays	CO5, CO6
C	Vaccines and Immunodiagnostics ; Hybridoma technology	CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
Weightage Distribution	CA	MTE & ETE
	25%	75%
Text book/s*	<ol style="list-style-type: none"> <li>1. Janeway's Immunobiology, K. Murphy, 8<sup>th</sup> edition, Garland Science</li> <li>2. Immunology, J. Kuby, 7<sup>th</sup> Edition, Fence Creek Publishing (Blackwell)</li> <li>3. Immunology, D Male, J. Brostoff, DB Roth, Ivan Roitt, 7<sup>th</sup> edition, Mosby-Elsevier</li> <li>4. Cellular and Molecular Immunology, AK Abbas, AH Lichtman, S. Pillai, 6<sup>th</sup> edition, Elsevier</li> <li>5. <a href="#">Transplantation Immunology</a>, <a href="#">Fritz H. Bach</a>, <a href="#">Hugh Auchincloss</a>, Wiley. (1995)</li> </ol>	



	6. Transplant Immunology Methods and Protocols, Springer. (2006) 7. Tumor Immunology: Molecularly Defined Antigens and Clinical Applications, Giorgio Parmiani & Michael T. Lotze, 2002, CRC Press. 8. Cancer Immunology, Immunotherapy, Graham Pawelec & Enrico Mihich (Editors in chief), Springer, 2014 9. Topley Wikson & Graham S., Principles of bacteriology, virology and immunity 5 volumes, Edward Arnolds, Hodder & Stoughton, London (1983) 10. Stephen A, Mims CA and Nash A, Mim's Pathogenesis of Infectious diseases 5 <sup>th</sup> ed Academic Press U.K. (2006)	
Other References	23. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnpitelhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnpitelhrd</a> 24. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 25. Swayam Prabha - DTH Channel, 26. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a> 27. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> 28. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> 29. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> edX, <a href="https://www.edx.org/">https://www.edx.org/</a>	

### Course Articulation Matrix for BSZ316 ADVANCED IMMUNOLOGY

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PSO 1	PSO 2	PSO3
CO1	1	3	1	1	1	3	2	3	-	1	1	3	2
CO2	1	3	2	1	1	3	2	3	-	1	1	3	2
CO3	1	3	2	2	2	3	3	2	-	1	1	3	2
CO4	1	3	2	1	1	3	2	2	-	1	1	3	2
CO5	1	3	2	1	2	2	3	3	-	1	1	3	2
CO6	1	1	1	2	2	3	2	3	-	1	1	3	2

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### RBL004 --RESEARCH BASED LEARNING 4

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VI</b>	
1	Course Code	<b>RBL004</b>	
2	Course Title	Research Based Learning-4	
3	Credits	2	
4	Contact Hours (L-T-P)	0-0-4	
5	Course status	Compulsory (Training/Survey/Project)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in project writing and oral presentation.</li> </ul>	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO1:</b> Tell the understanding of various research articles to identify research gap on a given topic</p> <p><b>CO2:</b> Extract line of approach to overcome the research gap</p> <p><b>CO3:</b> Conclude appropriate method/s suitable for a given problem</p> <p><b>CO4:</b> Identify characterization techniques/theoretical analysis for obtaining result</p> <p><b>CO5:</b> Explain graphs, diagrams, flow chart etc.</p> <p><b>CO6:</b> Report research findings in written and verbal forms</p>	
8	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
9	Outline syllabus		CO Mapping
	<b>Part 1</b>	<b>Introduction to various research problems</b>	<b>CO1</b>
	<b>Part 2</b>	<b>Identify a research question</b>	<b>CO2, CO3</b>
	<b>Part 3</b>	<b>Literature survey</b>	<b>CO4</b>



<b>Part 4</b>	<b>Report writing</b>	<b>CO5</b>
<b>Part 5</b>	<b>Presentation</b>	<b>CO6</b>
Mode of examination	7. Rubric assessment 8. Monthly Presentation to be audited by supervisor 9. Mid Term Presentation and End Term Presentation	
Text book/s*	10 Recent International Journal Articles of repute.	
Other references	NA	

### Course Articulation Matrix for RBL004 Research Based Learning-4 (RBL4)

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	3	2	3	1	2	3	3	3
CO2	3	1	1	3	2	3	2	3	1	2	3	3	3
CO3	3	1	1	3	2	3	3	2	1	2	3	3	3
CO4	3	1	1	3	2	3	2	2	1	2	3	3	3
CO5	3	1	1	3	2	2	3	3	1	2	3	3	3
CO6	3	1	1	3	2	3	2	3	1	2	3	3	3
Average	3.00	1.00	1.00	3.00	2.00	2.83	2.33	2.67	1.00	2.00	3.00	3.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### COMMUNITY CONNECT

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VI</b>	
1	Course Code		
2	Course Title	<b>Community connect</b>	
3	Credits	0	
4	Contact Hours (L-T-P)	0-0-4 Contact Hours: 30 Project/Field Work: 20 Assessment: 00 Guided Study: 10 Total hours: 60	
5	Course Type	Compulsory (Training/Survey/Project)	
6	Course Objective	<ol style="list-style-type: none"> <li><b>Contribute to the holistic development of students</b> by making them more aware of socially and economically disadvantaged communities and their specific issues</li> <li><b>Provide more richer context to classrooms</b>, so as to make them more effective laboratories of learning by aligning them to social realities beyond textbooks</li> <li><b>Provide scope to faculty members to align their teaching and research goals</b> by giving them ample opportunity to carry out community-oriented projects</li> <li><b>Ensure that the community connect programs provides benefits to communities</b> in tangible ways so that they may feel perceptibly better off post the interaction and involvement of the Sharda academic community</li> <li><b>Provide ample opportunity for Sharda University academic community to contribute</b> effectively to society and nation building</li> </ol>	
7	Course Outcomes	The student upon the completion of the course will be able to: <b>CO1:</b> Recall the living challenges of disadvantaged communities. <b>CO2:</b> Extend appreciation to societal realities beyond textbooks and classrooms <b>CO3:</b> Apply their knowledge via research, and training for community benefit <b>CO4:</b> Perceive work on socio-economic projects with teamwork and timely delivery <b>CO5:</b> Develop a learning with communities for meaningful contribution to society	
8	Course Description	Community connect is a survey based learning and skill enhancement of the students which helps them to interact with the various strata of people around and also demonstrate their theoretical learning into practical learning through small field tasks.	
11	<b>Theme</b>	<b>Major themes for research:</b>  <ol style="list-style-type: none"> <li><b>Survey and self-learning:</b> In this mode, students will make survey, analyze data and will extract results out of it to correlate with their theoretical knowledge. E.g.</li> </ol>	





		<p>Crops and animals, land holding, labour problems, medical problems of animals and humans, savage and sanitation situation, waste management etc.</p> <p>2. <b>Survey and solution providing:</b> In this mode, students will identify the common problems and will provide solution/ educate rural population. E.g. air and water pollution, need of after treatment, use of renewable (mainly solar) energy, electricity saving devices, inefficiencies in cropping system, animal husbandry, poultry, pest control, irrigation, machining in agriculture etc.</p> <p>3. <b>Survey and reporting:</b> In this mode students will educate villagers and survey the ground level status of various government schemes meant for rural development. The analyzed results will be reported to concerned agencies which will help them for taking necessary/corrective measures. E.g. Pradhan Mantri Jan Dhan Yojana, Pradhan Mantri MUDRA Yojana, Pradhan Mantri Jeevan Jyoti Bima Yojana, Atal pension Yojana, Pradhan Mantri Awas Yojana, Pradhan Mantri Fasal Bima Yojana, Swachh Bharat Abhiyan, Soil Health Card Scheme, Digital India, Skill India Program, Beti Bachao, Beti Padhao Yojana, Deen Dayal Upadhyaya Gram Jyoti Yojana, Shyama Prasad Mukherjee Rurban Mission, UJWAL Discom Assurance Yojana, PAHAL, Pradhan Mantri Awas Yojana-Gramin, Pradhan Mantri Yuva Yojana, Pradhan Mantri Jan Aushadhi Yojana, Pradhan Mantri Khanij Kshetra Kalyan Yojana, Pradhan Mantri Suraksha Bima Yojana, UDAN scheme, Deen Dayal Upadhyaya Grameen Kaushalya Yojana, Pradhan Mantri Sukanya Samridhi Yojana, Sansad Adarsh Gram Yojana, Pradhan Mantri Surakshit Matritva Abhiyan, Pradhan Mantri Rojgar Protsahan Yojana, Midday Meal Scheme, Pradhan Mantri Vaya Vandana Yojana, Pradhan Mantri Matritva Vandana Yojana, and Ayushman Bharat Yojana.</p>	
11.1	<p><b>Guidelines for Faculty Members</b></p>	<p>It will be a group assignment.</p> <p>There should be not more than 10 students in each group.</p> <p>The faculty guide will guide the students and approve the project title and help the student in preparing the questionnaire and final report.</p> <p>The questionnaire should be well design and it should carry at least 20 questions (Including demographic questions).</p> <p>The faculty will guide the student to prepare the PPT.</p> <p>The topic of the research should be related to social, economical or environmental issues concerning the common man.</p> <p>The report should contain 2,500 to 3,000 words and relevant charts, tables and photographs.</p> <p><b>Plagiarism check of the report must.</b></p> <p>ETE will conduct out of 100, divided in three parts (i) 30 Marks for report (ii) 30 Marks for presentation (iii) 40 Marks for knowledge.</p> <p>The student should <b>submit the report</b> to CCC-Coordinator signed by the faculty</p>	



		<p>guide by .....</p> <p>The students have to send the hard copy of the <b>report and PPT</b>, and then only they will be allowed for ETE.</p>	
11.2	<b>Role of CCC-Coordinator</b>	<p>The CCC Coordinator will supervise the whole process and assign students to faculty members.</p> <p>1. PG- M.Sc.-Semester II - the students will be allocated to faculty member (mentors/faculty member) in odd term.</p>	
11.3	<b>Layout of the Report</b>	<p>Abstract (250 words)</p> <ol style="list-style-type: none"> <li>a. Introduction</li> <li>b. Literature review(optional)</li> <li>c. Objective of the research</li> <li>d. Research Methodology</li> <li>e. Finding and discussion</li> <li>f. Conclusion and recommendation</li> <li>g. References</li> </ol> <p>Note: Research report should base on primary data.</p>	
11.4	<b>Layout of the Report</b>	<p>Abstract (250 words)</p> <ol style="list-style-type: none"> <li>h. Introduction</li> <li>i. Literature review(optional)</li> <li>j. Objective of the research</li> <li>k. Research Methodology</li> <li>l. Finding and discussion</li> <li>m. Conclusion and recommendation</li> <li>n. References</li> </ol> <p>Note: Research report should base on primary data.</p>	
11.5	<b>Guideline for Report Writing</b>	<p><b>Title Page: The following elements must be included:</b></p> <ul style="list-style-type: none"> <li>• Title of the article;</li> <li>• Name(s) and initial(s) of author(s), preferably with first names spelled out;</li> <li>• Affiliation(s) of author(s);</li> <li>• Name of the faculty guide and Co-guide</li> </ul> <p><b>Abstract:</b> Each article is to be preceded by a succinct abstract, of up to 250 words, that highlights the objectives, methods, results, and conclusions of the paper.</p> <p><b>Text: Manuscripts should be submitted in Word.</b></p> <ul style="list-style-type: none"> <li>• Use a normal, plain font (e.g., 12-point Times Roman) for text.</li> <li>• Use italics for emphasis.</li> <li>• <i>Use the automatic page numbering function to number the pages.</i></li> <li>• <i>Save your file in docx format (Word 2007 or higher) or doc format (older Word versions)</i></li> </ul> <p><b>Reference list:</b></p>	



		<p>The list of references should only include works that are cited in the text and that have been published or accepted for publication.</p> <p>The entries in the list should be in alphabetical order. Journal article</p>	

### Course Articulation Matrix for CCU108 Community Connect

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	1	2	1	3	2	3	-	1	1	1	1
CO2	1	1	1	2	1	3	2	3	-	1	1	1	1
CO3	1	1	1	2	1	2	3	2	-	1	1	1	1
CO4	1	1	1	2	1	3	2	2	-	1	1	1	1
CO5	1	1	1	2	1	2	3	3	-	1	1	1	1
CO6	1	1	1	2	1	3	2	3	-	1	1	1	1
Average	1.00	1.00	1.00	2.00	1.00	2.67	2.33	2.67	-	1.00	1.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



# SEMESTER VII

## **B.Sc. (Hons.) in Zoology**



### BSZ404 COGNITIVE SCIENCE

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BSZ404</b>	
2	Course Title	Cognitive Science	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To develop and gain knowledge about the various instinct of human and animal behaviour and how they have evolved.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Relate with studies in cognitive science</p> <p>CO2: Extend views on the anatomy and physiology of nervous system w.r.t the potential and chemistry</p> <p>CO3: Demonstrate the methods used to explore various fields of cognitive science</p> <p>CO4: Familiarize with the concept of animal instincts and behavior</p> <p>CO5: Explain parental behavior and social behavior among humans and animals</p> <p>CO6: Exemplify the concepts about how we perceive and gather information in chemical and structural sense.</p>	
8	Course Description	The course has been formulated with the intention to make students focus towards advanced field of neuroscience and human behaviour, how vision, hearing etc evolved, how communication and social behaviour evolved and the methods of testing these.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to cognitive science</b>	
	A	Cognitive Science; Interdisciplinary sciences involved, History	CO1, CO6
	B	Human mind and Attention; Knowledge and processing of language, Importance of Language	CO1,CO6
	C	Memory, Perception, Action	CO1,CO6
	<b>Unit 2</b>	<b>Neuroscience</b>	



A	Neuron Anatomy and Physiology, Resting potential, Action potential, Chemistry and Physiology of Synaptic transmission	CO2, CO6
B	Types of Memory, Chemical control of Brain, Emotion,	CO2, CO6
C	Sleep behaviour, Artificial Intelligence, Brain and vision olfaction and hearing	CO2, CO6
<b>Unit 3</b>	<b>Methods in Cognitive Science</b>	
A	Behavioural experiments	CO3, CO6
B	Brain Imaging: MRI, PET, EEG, MEG	CO3, CO6
C	Computational Imaging , CAT	CO3, CO6
<b>Unit 4</b>	<b>Species specific behavior</b>	
A	Ethology definition; Behavioral Ecology & the Evolution; Concepts and Patterns; Approach and Methods	CO4, CO6
B	Mammalian Nervous System and Behavior; Pheromones; Hormones and Drugs; Biological Clocks; Orientation;	CO4, CO6
C	Bird Migration and Navigation; Fish Migration; Communication; Feeding Strategies; Aggressive and Territorial Behavior	CO4, CO6
<b>Unit 5</b>	<b>Social behaviour</b>	
A	Social Organization; Reproductive Behavior in Animals : Courtship and Mating	CO5, CO6
B	Parental Behavior; Learning; Behavioral Genetics	CO5, CO6
C	Sociobiology	CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
Weightage Distribution	CA	MTE& ETE
	25%	75%
Text book/s*	<ol style="list-style-type: none"> <li>Bermúdez, J. (2020). <i>Cognitive Science: An Introduction to the Science of the Mind</i> (3rd ed.). Cambridge: Cambridge University Press. doi:10.1017/9781108339216</li> <li>Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. <i>Neuroscience: Exploring the Brain</i>, 3rd ed. Baltimore, MD: Lippincott Williams &amp; Wilkins, 2006. ISBN: 9780781760034</li> <li>Principles of Neural Science, Eric R. Kandel</li> <li>Neuroscience, Dale Purves</li> <li>Mathur R (2009) Animal Behavior. Rastogi Publications, Meerut, India</li> <li>Rubenstein D &amp; Alcock J (2019). Animal behavior. ISBN: 9781605358949</li> <li><a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=43">https://vlab.amrita.edu/index.php?sub=3&amp;brch=43</a></li> </ol>	
Other References	<ol style="list-style-type: none"> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> </ol>	



	<ol style="list-style-type: none"><li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li><li>3. Swayam Prabha - DTH Channel,</li><li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li><li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li><li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li><li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li><li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li></ol>	
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### Course Articulation Matrix for BSZ404 Cognitive Science

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	1	2	3	2	3	-	1	1	1	1
CO2	1	3	1	1	2	3	2	3	-	1	1	1	1
CO3	1	3	1	1	2	3	3	2	-	1	1	1	1
CO4	1	3	1	1	2	3	2	2	-	1	1	1	1
CO5	1	3	1	1	2	2	3	3	-	1	1	1	1
CO6	1	3	1	1	2	3	2	3	-	1	1	1	1
Average	1.00	3.00	1.00	1.00	2.00	2.83	2.33	2.67	-	1.00	1.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## BSZ402—EPIDEMIOLOGY & DISEASE SURVEILLANCE

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BSZ402</b>	
2	Course Title	Epidemiology & Disease Surveillance	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students the knowledge about how diseases exit, how they are forecasted, monitored and surveyed and step taken by various governments to keep them under control	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p>CO1: Tell the basic concept of the Epidemiology            CO2: Reflect on the disease monitoring, forecasting and surveillance strategies            CO3: Demonstrate the impact of environment on disease occurrence            CO4: Develop understanding of the steps involved in disease eradication            CO5: Discuss the early warning tools related to disease forecasting.            CO6: Analyze the efforts taken by the Government at National and International level in handling diseases.</p>	
8	Course Description	This course is a co-curricular course formulated to guide students about the major happenings of disease at community level. The need of forecasting, early warning, disease monitoring and surveillance and the major organization working worldwide to keep a check on this has all been framed in this syllabus.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Epidemiology</b>	
	A	<ul style="list-style-type: none"> <li>• History and concept of epidemiology</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>• Conceptual knowledge on Epidemics, Outbreaks, endemic, zoonosis, incidence, prevalence.</li> </ul>	CO1,CO6





	C	<ul style="list-style-type: none"> <li>Pandemics and its phases, DALY</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Epidemiology &amp; Health Ethics</b>	
	A	Study design in Epidemiology	CO2, CO6
	B	Outbreak Investigation, Pandemics Preparedness, Situational Analysis, planning, assessments	CO2, CO6
	C	Nuremberg Code, Declaration of Helsinki; Principle of essentiality; Clinical trail Ethics	CO2, CO6
	<b>Unit 3</b>	<b>Disease Surveillance strategies</b>	
	A	<ul style="list-style-type: none"> <li>Disease monitoring and its importance; Steps in disease surveillance; need and importance</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Disease forecasting, Disease control</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Environmental factors affecting the incidence of disease; Examples of diseases affected by climatic conditions</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Disease eradication</b>	
	A	<ul style="list-style-type: none"> <li>Identification of disease progression towards eradication; Major diseases eradicated from World and India</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Steps taken by Government at National and International Level towards eradication of disease.</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Nosocomial Infections/Hospital Associated Infections</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Early warning Tools</b>	
	A	<ul style="list-style-type: none"> <li>Early warning tools developed for disease surveillance.</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>Determinants and predictors of Disease</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>Organizations working on Epidemiology of diseases at National and International level; Major decision taking organizations &amp; Stakeholders</li> </ul>	CO5, CO6
	Mode of examination	<b>Theory</b> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA	MTE& ETE
		25%	75%
	Text book/s*	1. Epidemiology: An Introduction. 2 <sup>nd</sup> edn, 2012; Kenneth J. Rothman. Published by Oxford University Press 2. An introduction to Epidemiology. Thomas C. Timmreck. 2002. 3 <sup>rd</sup> Edition. Jones & Barlett Learning. 3. Kenrad E. Nelson & Carolyn Masters Williams. <i>Infectious Disease Epidemiology: Theory and Practice</i> . 2006. Second Edition. Jones and Bartlett Publishers. 4. Websites: MOHFW, India and World Health Organization, Centre for Disease Control	



Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>
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### Course Articulation Matrix for BSZ402 Epidemiology & Disease Surveillance

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	1	2	3	2	3	-	1	3	2	1
CO2	3	1	1	1	2	3	2	3	-	1	3	2	1
CO3	3	1	1	1	2	3	3	2	-	1	3	2	1
CO4	3	1	1	1	2	3	2	2	-	1	3	2	1
CO5	3	1	1	1	2	2	3	3	-	1	3	2	1
CO6	3	1	1	1	2	3	2	3	-	1	3	2	1
Average	3.00	1.00	1.00	1.00	2.00	2.83	2.33	2.67	-	1.00	3.00	2.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



### BBI401 BIOSTATISTICS, BIOETHICS AND IPR

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BBI401</b>	
2	Course Title	Biostatistics, Bioethics and IPR	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students, the knowledge about how to apply statistics in basic sciences and gain knowledge on the values and ethics in science.	
7	Course Outcomes	<p>The students at the completion of the course will be able to:</p> <p>CO1: Tell the basic concepts of Statistics</p> <p>CO2: Explain the concept of probability and its application</p> <p>CO3: Demonstrate the topics of Correlation and regression</p> <p>CO4: Explain and learn the concepts of IPR</p> <p>CO5: Demonstrate the bioethics in biology</p> <p>CO6: Evaluate the applicability of biostatistics in biological data</p>	
8	Course Description	This course has been designed in such a way that the students can learn statistics and ethics together. These are additions to basics science and are important during the conversion of theory to practical applicability	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Biostatics-I</b>	
	A	<ul style="list-style-type: none"> <li>Introduction to Biostatistics</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Frequency distribution: Measures of central tendency: Mean, Median, Mode, standard deviation.</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>Measures of dispersion: Skewness &amp; Kurtosis</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Biostatistics-II</b>	



	A	<ul style="list-style-type: none"> <li>Probability: definition of probability and binomial distribution (numerical)</li> </ul>	CO2, CO6
	B	<ul style="list-style-type: none"> <li>Sample, Population, large sample, small sample. Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, difference.</li> </ul>	CO2, CO6
	C	<ul style="list-style-type: none"> <li>Correlation: Definition, Karl Pearson's coefficient of correlation, Simple Regression</li> </ul>	CO2, CO6
	<b>Unit 3</b>	<b>Biostatistics-III</b>	
	A	<ul style="list-style-type: none"> <li>Concept of Test of Hypothesis. Applications of t-test statistics to biological problems/data</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Chi square, statistic applications in Biology</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Error-I type, Error-II type, Standard error of mean</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>IPR</b>	
	A	<ul style="list-style-type: none"> <li>The concept of intellectual property, Importance of IPR in biotechnology, Indian laws and treaties for IPR</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Patents-basic concepts, Infringement, compulsory licenses, Exploitation of the Patented Invention, Compulsory Licenses</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Copyright and related rights; piracy and infringement and their remedies Definitions, Signs which serve as trademarks</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Bioethics</b>	
	A	<ul style="list-style-type: none"> <li>Introduction to Biosafety, Need for Biosafety in present scenario</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>Classification and Description of Biosafety Levels, Design of Clean rooms, Design of Biosafety Labs Biosafety Regulations</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>Laws and Policies, Biosafety and Agriculture, Genetic Engineering and Health; Genetic Engineering and Food Safety, International Centre for Genetic Engineering and Biotechnology (ICGEB)</li> </ul>	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA	MTE& ETE
		25%	75%
	Text book/s*	1. Fundamental of Statistics by S.C. Gupta, Himalaya Publishing House. 2. Pharmaceutical Statistics- Practical and Clinical Applications by Sanford Bolton, Marcel Dekker Inc. New York. 3. Design and Analysis of Experiments by R. Pannerselvam, PHI Learning Private Limited.	



		4. Design and Analysis of Experiments by Douglas and C. Montgomery, Wiley Students Edition.	
Other References		<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	

### Course Articulation Matrix for BBI401 Biostatistics, Bioethics and IPR

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	1	2	3	2	2	3	1	3	2	1
CO2	3	1	1	1	2	3	2	2	3	1	3	2	1
CO3	3	1	1	1	2	3	3	2	3	1	3	2	1
CO4	3	1	1	1	2	3	2	2	3	1	3	2	1
CO5	3	1	1	1	2	2	3	2	3	1	3	2	1
CO6	3	1	1	1	2	3	2	2	3	1	3	2	1
Average	3.00	1.00	1.00	1.00	2.00	2.83	2.33	2.00	3.00	1.00	3.00	2.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## BZO401 OMICS IN BIOLOGICAL SCIENCES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BZO401</b>	
2	Course Title	<b>Omics in Biological sciences</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students, the conceptual understanding of various disciplines in Omics for research and development.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Recall the knowledge of Genomics and its application in biotechnology</p> <p>CO2: Explain the fundamental of Epigenetics and its methods and management</p> <p>CO3: Demonstrate thorough Knowledge of Proteomics, methods of proteomic assays and application.</p> <p>CO4: Conclude on metabolomics, techniques and softwares used.</p> <p>CO5: Explain the Fundamentals of transcription process, techniques and applications</p> <p>CO6: Develop complete knowledge attainment on Genomics and Proteomics</p>	
8	Course Description	The study has been designed with the intention to inculcate in the students the major field of Omics biology i.e. Genomics, Proteomics, Metagenomics, Metabolomics, Transcriptomics and the related softwares and database of how to extract and learn about their inter relationship.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Genomics</b>	
	A	Definition; Types of omics study; Applications of Omics in biotechnology; Concept of Genomics; Information flow in Biology	CO1, CO6
	B	Genome Structure -Regulatory Sequences and Non-coding sequences, repetitive sequences; Genome evolution; Genome complexity; Mitochondrial DNA and inheritance.	CO1,CO6
	C	DNA Sequencing technologies, Sanger sequencing; Maxim-Gilbert; Whole genome sequencing platforms; Genomics database, GWAS analysis; Human Genome Project	CO1,CO6



<b>Unit 2</b>	<b>Epigenetics &amp; Metagenomics</b>		
A	Concept of Epigenetics and Epigenomics; Epigenetic mechanisms of gene regulation; DNA methylation; Histone modification; Epigenetics databases; Methods in Epigenomics: Histone modification assays and DNA methylation assays.		CO2, CO6
B	Metagenomics; History and importance; Oral Microbiome, Skin microbiome, Gut microbiome		CO2, CO6
C	Methods in metagenomics; Markers for metagenomics, Microbial sequencing methods, 16sRNA sequencing, Applications of metagenomics		CO2, CO6
<b>Unit 3</b>	<b>Proteomics</b>		
A	Introduction to Proteomics – The Proteome; Analysis of proteomes: 2D electrophoresis, De novo sequencing using MS;		CO3, CO6
B	Post translational modifications; Methods for studying proteins; Protein microarrays,		CO3, CO6
C	Application of Proteomics		CO3, CO6
<b>Unit 4</b>	<b>Metabolomics</b>		
A	Concept of Metabolomics; Important Metabolites and metabolite profiling		CO4, CO6
B	Technique's used in metabolomics; relative softwares used in Metabolomics		CO4, CO6
C	Databases of Metabolomics, Applications of metabolomics		CO4, CO6
<b>Unit 5</b>	<b>Transcriptomics</b>		
A	Concept of Transcriptomics, Methods in RNA sequencing, SAGE/ CAGE, ESTs		CO5, CO6
B	Microarrays, softwares in transcriptomic, Transcriptomics Databases		CO5, CO6
C	Applications of Transcriptomics		CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
Weightage Distribution	CA		MTE& ETE
	25%		75%
Text book/s*	1. Introduction to Genomics Arthur M Lesk Oxford University Press 2007 2. Discovering Genomics, Proteomics & Bioinformatics A M Campbell & L J Heyer Pearson Education, 2007 3. Proteins and Proteomics Richard J Simpson IK International 2003 4. Baxevanis AD and BFF Ouellette, Wiley O. (ed) (2001) Bioinformatics – A practical guide to the analysis of genes and proteins. Interscience, New York 5. Sandy B. Primrose Richard M. Twyman (2005) Principles of Genome Analysis and Genomics, Blackwell Publishing, USA. 6. Computing for Comparative Microbial Genomics by Ussery, Wassenaar & Borini (Springer) 7. Genomes 2 By T.A. Brown (Oxford)		



		8. Metabolomics – A powerful Tool in Systems Biology, Edited by J.Nielsen and M.C. Jewett, Springer Publishers	
	Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	

### Course Articulation Matrix for BZO401 Omics in Biological sciences

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	1	2	3	3	2	3	-	1	3	1
CO2	1	3	1	1	2	3	3	2	3	-	1	3	1
CO3	1	3	1	1	2	3	3	2	3	-	1	3	1
CO4	1	3	1	1	2	3	3	2	2	-	1	3	1
CO5	1	3	1	1	2	3	2	2	3	-	1	3	1
CO6	1	3	1	1	2	3	3	2	3	-	1	3	1
Average	1.00	3.00	1.00	1.00	2.00	3.00	2.83	2.00	2.83	-	1.00	3.00	1.00

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





### BZO402 Omics in Biological Sciences Lab

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BZO402</b>	
2	Course Title	Omics in Biological sciences Lab	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To acquaint the students with the advanced tools in the field of genomics, proteomics and other omics biology field	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Define genomics tools and database CO2: Familiarize themselves with the tools and database in proteomics CO3: Exemplify the use of database related to Transcriptomics and metabolomics CO4: Construct phylogenetic tree CO5: Collate with bioinformatics tools in virtual mode. CO6: Develop expertise on tools and techniques in the field of Omics.	
8	Course Description	The course has been formulated so as to give the student in their fourth year a higher version of learning with tools and techniques in the field of Omics.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Genomics related experiments</b>	
	A	To study biological database with reference to Genomics	CO1, CO6
	B	To search any gene of human disease importance in database	CO1,CO6
	C	To study genomic sequence similarity search in database	CO1,CO6
	<b>Unit 2</b>	<b>Proteomics related experiments</b>	
	A	To study biological database with reference to Proteomics Expasy (Expert Protein analysis system)	CO2, CO6
	B	Tools for Protein sequence identification, Post translational modification	CO2, CO6



	C	Protein structure, Protein –protein interaction, Use of Modeller		CO2, CO6
	<b>Unit 3</b>	<b>Transcriptomics &amp; Metabolomics related experiments</b>		
	A	Microarray databases (GEO, Array express etc.)		CO3, CO6
	B	Transcriptome Project (Human, Mouse)		CO3, CO6
	C	Computational Methods to Interpret and Integrate Metabolomic Data		CO3, CO6
	<b>Unit 4</b>	<b>Phylogenetic tree construction</b>		
	A	The concept of evolutionary tree, Dendogram, Cladograms, & Phylograms		CO4, CO6
	B	Types of phylogenetic trees (rooted vs. unrooted trees), gene tree & Species tree		CO4, CO6
	C	Homologs, Orthologs, & Paralogs, Newick format of tree representation, True tree & Inferred tree		CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>		
	A	<a href="https://edu.omicslogic.com/genomics-in-the-virtual-lab">https://edu.omicslogic.com/genomics-in-the-virtual-lab</a> <a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=273">https://vlab.amrita.edu/index.php?sub=3&amp;brch=273</a>		CO5, CO6
	B	<a href="https://learn.genetics.utah.edu/content/labs/">https://learn.genetics.utah.edu/content/labs/</a> <a href="https://www.vlab.co.in/">https://www.vlab.co.in/</a>		CO5, CO6
	C	<a href="https://pe-iitb.vlabs.ac.in/">https://pe-iitb.vlabs.ac.in/</a> <a href="https://diytranscriptomics.com/">https://diytranscriptomics.com/</a>		CO5, CO6
	Mode of examination	Practical/Viva Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)		
	Weightage Distribution	CA		ETE
		25%		75%
	Text book/s*	1. Introduction to Genomics by Arthur M. Leask, Oxford University Press 2. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by Durbin et al., Cambridge University Press 3. Molecular Evolution and Phylogenetics Masatoshi Nei and Sudhir Kumar 4. Transcriptomics: Expression pattern analysis. by Gomase, Virendra. 5. Metabolomics, by Ute Roessner, ISBN 978-953-51-0046-1, Hard cover, 364 pages, Publisher: InTech, Published 6. Microarray Analysis, by Mark Schena, Publisher: Wiley-Liss		
	Other References	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a> 2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 3. Swayam Prabha - DTH Channel,		



### Course Articulation Matrix for BZO402 Omics in Biological Sciences Lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	2	3	3	2	3	-	1	1	1	3
CO2	1	3	1	2	3	3	2	3	-	1	1	1	3
CO3	1	3	1	2	3	3	3	3	-	1	1	1	3
CO4	1	3	1	2	3	3	2	2	-	1	1	1	3
CO5	1	3	1	2	3	3	2	3	-	1	1	1	3
CO6	1	3	1	2	3	3	2	3	-	1	1	1	3
Average	1.00	3.00	1.00	2.00	3.00	3.00	2.17	2.83	-	1.00	1.00	1.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



# SEMESTER VIII

## **B.Sc. (Hons.) in Zoology**



### BSZ407 POLLUTION AND DISEASES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VIII</b>	
1	Course Code	<b>BSZ407</b>	
2	Course Title	Pollution and Diseases	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To demonstrate the various causes of pollution and its impact on human health in terms of health hazards.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Relate with the health hazard of Air Pollution and its types.</p> <p>CO2: Exemplify the role of soil microbes and other causes of soil pollution and their impact on human health</p> <p>CO3: Attain knowledge on the causes of water pollution and their impact on human health</p> <p>CO4: Develop knowledge on Radioactivity and Noise pollution and their impact on human health</p> <p>CO5: Familiarize with the concept of Occupational Hazards and their impact on human health</p> <p>CO6: Demonstrate the effects of pollution and their related diseases</p>	
8	Course Description	The course focusses on engaging students towards generating awareness on the surroundings; i.e. how the things around us can lead to health hazards and impact our lives on a long run.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Air pollution &amp; Diseases</b>	
	A	Environmental pollution; Global disease burden; Types of pollution; Classification of pollutants; Solubility of pollutants (hydrophilic and lipophilic pollutants), Concept of biotransformation and bioaccumulation	CO1, CO6
	B	Microbes in the air; Sources and types of air pollutants (primary and secondary); Related diseases: COPD, Asthma, Lung Cancer, Ischemic heart disease etc.	CO1,CO6
	C	Air pollution control and monitoring strategies; Ambient air quality: monitoring and standards measures	CO1,CO6
	<b>Unit 2</b>	<b>Soil pollution &amp; Diseases</b>	



	A	Microbes in the soil; Causes of soil pollution	CO2, CO6
	B	Diseases/ Effects of soil pollution on human health: <b>Neuromuscular blockage, leukemia, Kidney and liver damage</b>	CO2, CO6
	C	Toxins & Diseases; Soil pollution control and monitoring	CO2, CO6
	<b>Unit 3</b>	<b>Water Pollution &amp; Diseases</b>	
	A	Microbes in water; Fresh water & Marine pollution; Sources of marine pollution; oil spill and its effects	CO3, CO6
	B	Water pollution and related diseases: Amoebiasis; Cholera; Leptospirosis; Rotavirus; Dracunculiasis etc.	CO3, CO6
	C	Diseases due to lack of WASH: Lymphatic Filariasis; Scabies etc; Water pollution control and monitoring	CO3, CO6
	<b>Unit 4</b>	<b>Radioactive pollution &amp; Noise pollution</b>	
	A	Radioactivity; Concept of radioactivity, radioactive decay and half-life of pollutants, organometallic compounds, acid mine drainage	CO4, CO6
	B	Effects of Radioactive elements of health	CO4, CO6
	C	Noise pollution; Effect of Noise pollution on health	CO4, CO6
	<b>Unit 5</b>	<b>Occupational Diseases</b>	
	A	Occupations diseases-definition; Impact of Occupational hazards on human health	CO5, CO6
	B	Occupational lung diseases	CO5, CO6
	C	Occupational skin diseases	CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
Weightage Distribution	CA		MTE & ETE
	25%		75%
Text book/s*	<ol style="list-style-type: none"> <li>1. Besselivere et al. The Treatment of Industrial Waters, McGraw Hill Kogakusha (1978).</li> <li>2. Bockris, J.O.M. Environmental Chemistry, Plenum Press New York, U.S.A. (1978)</li> <li>3. Mahida, U.N. Water Pollution and Disposal of Wastewater on LandTata McGraw Publishing Co. Ltd., New Delhi, 1981</li> <li>4. Nemerow, N.L. Industria Water Pollution: Origins, Characteristics and Treatment, Addison-Wesley Publishing Co., Inc. Philipines, 1971.</li> <li>5. Trivedy, R.K. and Goel, P.K. (ed.) Current Pollution Research in India Environmental Publications, 1985. Pp. 350.</li> <li>6. Pepper, I.L., Gerba, C.P. &amp; Brusseau, M.L. 2006. Environmental and Pollution Science. Elsevier Academic Press.</li> <li>7. Purohit, S.S. &amp; Ranjan, R. 2007. Ecology, Environment &amp; Pollution. Agrobios Publications.</li> </ol>		



Other References	<ol style="list-style-type: none"><li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnptelhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnptelhrd</a></li><li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li><li>3. Swayam Prabha - DTH Channel,</li><li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li><li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li><li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li><li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li><li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li></ol>	
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### Course Articulation Matrix for BSZ407 Pollution and Diseases

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1	2	1	3	2	3	-	1	1	1	2
CO2	3	2	1	2	1	3	2	3	-	1	1	1	2
CO3	3	2	1	2	1	3	3	2	-	1	1	1	2
CO4	3	2	1	2	1	3	2	2	-	1	1	1	2
CO5	3	2	1	2	1	2	3	3	-	1	1	1	2
CO6	3	2	1	2	1	3	3	2	-	1	1	1	2
Average	3.00	2.00	1.00	2.00	1.00	2.83	2.50	2.50	-	1.00	1.00	1.00	2.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## BSZ408 --DRUG DEVELOPMENT & VACCINOLOGY

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VIII</b>	
1	Course Code	<b>BSZ408</b>	
2	Course Title	Drug Development & Vaccinology	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To impart knowledge and generate expertise on preliminary and advances aspects of Drugs and Vaccines	
7	Course Outcomes	The student at the completion of the course will be able to: CO: Show expertise in action and working of drugs CO2: Demonstrate knowledge on the effect of drugs in individual systems CO3: Explain the effect of drugs on microbial diseases CO4: Familiarize with the concept of vaccine and its developmental strategies CO5: Exemplify the role of vaccines on specific diseases CO6: Develop an overall clarity on various concept of drugs and vaccines	
8	Course Description	The course focuses on two major areas in the interdisciplinary sciences of Zoology i.e. one on drugs and the other on Vaccines. The mode of action, their production, effect on various body systems have all been well summarized here as per the standards of UG	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to drugs, mode of action and administration</b>	
	A	Drug definition, History, Classification system of drugs (Anatomical Therapeutic Chemical Classification System, Systematized Nomenclature of Medicine); toxicology	CO1, CO6
	B	Different categories of drug classification; Mechanism of drug action; Routes of drug administration	CO1,CO6
	C	Metabolism of drugs; Generic drugs; Prodrugs; Drug discovery and development Side effects and adverse reaction of drugs	CO1,CO6
	<b>Unit 2</b>	<b>Effect of drugs on body systems</b>	





	A	Drugs action on Anterior Nervous system, Central Nervous System and Peripheral Nervous system	CO2, CO6
	B	Drugs action on cardiovascular system and endocrine system	CO2, CO6
	C	Drugs action on gastro-intestinal system and respiratory system.	CO2, CO6
	<b>Unit 3</b>	<b>Antimicrobial therapy</b>	
	A	Drugs in treatment of infectious disease and cancer; mode of action	CO3, CO6
	B	Antibacterial drugs; Anti-viral drugs; Anti-fungal drugs; Anti-helminthic drugs; Anti-parasitic drugs	CO3, CO6
	C	Drug targeting, Personalized medicine; Bench to Bedside concept	CO3, CO6
	<b>Unit 4</b>	<b>Introduction to Vaccines</b>	
	A	Vaccines- History and background; Stages of vaccine development; Chemicals/ingredients used in vaccine production; Side effects of vaccines	CO4, CO6
	B	Classification of vaccines, Targets of vaccine production; Immunization, booster doses, Immunization chart and national vaccine schedule	CO4, CO6
	C	Vaccination and pregnancy, Importance of vaccination to health care professionals, Vaccine delivery systems; Quarantine measures	CO4, CO6
	<b>Unit 5</b>	<b>Vaccine types and host response</b>	
	A	Basics of vaccine immunology, Vaccine adjuvants; Clinical Trials to Evaluate Vaccines; Herd Immunity; new molecular methods for developing vaccines	CO5, CO6
	B	Some examples of Vaccines and their working: SARS-COV2; Vaccines Against Diarrheal Diseases; Malaria Vaccines etc..	CO5, CO6
	C	Potential targets for cancer vaccines - Tumor-associated and tumor-specific vaccines; Current status and emerging trends for cancer vaccines	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA 25%	MTE& ETE 75%
	Text book/s*	1. Bhandari PR (2021). Textbook of Pharmacology. ISBN no. 9789390553150 2. P N Bennett (2003). Clinical Pharmacology, 9 <sup>th</sup> Edition 3. WilliM B. Pratt.1990. Principles of Drug Action: The Basis of Pharmacology, 3 <sup>rd</sup> Edition 4. Vaccines. 6th Edition, Stanley Plotkin Walter Orenstein Paul Offit. 5. Vaccine Development and Manufacturing. Emily P. Wen (Editor), Ronald Ellis (Editor), Narahari S. Pujar (Editor). 6. Vaccines & Vaccine Technologies. Jose Ronnie Vasconcelos. 7. Plotkin, Stanley A, Orenstein, Walter A, Offit, Paul A. Vaccines: Vaccine Immunology. Elsevier Saunders. 2012. Pages 14-32.	



Other References	<ol style="list-style-type: none"><li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li><li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li><li>3. Swayam Prabha - DTH Channel,</li><li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li><li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li><li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li><li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li><li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li></ol>	
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### Course Articulation Matrix for BSZ408 Drug Development & Vaccinology

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	1	2	3	3	2	3	-	1	1	3	1
CO2	1	1	1	2	3	3	3	3	-	1	1	3	1
CO3	1	1	1	2	3	3	3	2	-	1	1	3	1
CO4	1	1	1	2	3	3	2	2	-	1	1	3	1
CO5	1	1	1	2	3	2	3	3	-	1	1	3	1
CO6	1	1	1	2	3	3	2	3	-	1	1	3	1
Average	1.00	1.00	1.00	2.00	3.00	2.83	2.50	2.67	-	1.00	1.00	3.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



### BSZ409 GENETIC DISORDERS & CANCER

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VIII</b>	
1	Course Code	<b>BSZ409</b>	
2	Course Title	Genetic Disorders & Cancer	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To acquaint with the various genetic disorders affecting human including the genetic of cancer	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Define Autosomal dominant and recessive types of disorders and their effects</p> <p>CO2: Confer knowledge on Sex linked disorders and their effects</p> <p>CO3: Demonstrate knowledge on expertise on Cancer and its basics</p> <p>CO4: Simplify knowledge on Cancer related Genetic disorders and their effects</p> <p>CO5: Explain basic knowledge on role of the various viruses causing cancer</p> <p>CO6: Develop understanding on the genetic basis of disease happening and how they can affect the future generation</p>	
8	Course Description	The course has been designed keeping in mind the genetic basis of disease. Diseases of Autosomal and sex linked inheritance have been included here. Also a very important disease i.e. Cancer and the genetics of cancer have also been added to the course so as to make the student understand these disturbances/effect/mutations at gene level.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Genetic Disorders and their types</b>	
	A	Introduction to Genetic Disorders	CO1, CO6
	B	Autosomal dominant disorders: Familial hypercholesterolemia, Polycystic Kidney Disease, Huntington's Disease	CO1,CO6
	C	Autosomal recessive disorders: Sickle cell anaemia, Cystic fibrosis, Tay-Sachs disease, Phenylketonuria	CO1,CO6



	<b>Unit 2</b>	<b>Sex linked Genetic disorders</b>		
	A	X-linked dominant disorders: Rett syndrome, Klinefelter syndrome		CO2, CO6
	B	X-linked recessive hemophilia A, Duchenne muscular dystrophy, and Lesch–Nyhan syndrome, red–green color blindness, Turner’s syndrome		CO2, CO6
	C	Y-linked disorders; Mitochondrial disorders		CO2, CO6
	<b>Unit 3</b>	<b>Cancer</b>		
	A	Introduction to cancer; history Tumour cells & Metastasis		CO3, CO6
	B	Genetic basis of cancer; Proto-oncogenes, Oncogenes, Tumor Suppressor Genes		CO3, CO6
	C	Growth promoting proteins & Cancer; Signal Transduction proteins & Cancer		CO3, CO6
	<b>Unit 4</b>	<b>Carcinogens &amp; Cancer</b>		
	A	Apoptotic proteins & Cancer; Telomere expression in cancer		CO4, CO6
	B	Role of Carcinogens in Cancer		CO4, CO6
	C	Human Hereditary Diseases and Cancers: Xeroderma pigmentosum; Blooms’ Syndrome; Fanconi Anemia; Hereditary Breast Cancer; Treatment and Diagnosis of cancer		CO4, CO6
	<b>Unit 5</b>	<b>Cancer &amp; Viruses</b>		
	A	Virus infection and carcinogenesis		CO5, CO6
	B	Virus causing cancer – EBV, HBV, HCV, HPV, HTLV-1, KSHV, MCV		CO5, CO6
	C	Immune response in Cancer; Immunotherapy		CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
	Weightage Distribution	CA		MTE& ETE
		25%		75%
	Text book/s*	1. Puiu, M (ed.). 2013, Genetic Disorders, IntechOpen, London. 10.5772/46039 2. National Center for Biotechnology Information (US). Genes and Disease [Internet]. Bethesda (MD): National Center for Biotechnology Information (US); 1998-. Available from: <a href="https://www.ncbi.nlm.nih.gov/books/NBK22183/">https://www.ncbi.nlm.nih.gov/books/NBK22183/</a> 3. Douglas Hanahan and Robert A. Weinberg (2000) <i>The Hallmarks of Cancer</i> , Cell 100(1): 57-70 4. Douglas Hanahan and Robert A. Weinberg (2011) <i>Hallmarks of Cancer: The Next Generation</i> , Cell 144(5):646-674. 5. Lodish et al; 2007. Molecular Cell Biology, 6 <sup>th</sup> Edition		



Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnptelhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnptelhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	
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### Course Articulation Matrix for BSZ409 Genetic Disorders & Cancer

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	3	3	3	-	1	1	1	3
CO2	2	3	1	1	1	3	2	3	-	1	1	1	3
CO3	2	3	1	1	1	3	3	2	-	1	1	1	3
CO4	2	3	1	1	1	3	2	2	-	1	1	1	3
CO5	2	3	1	1	1	2	3	3	-	1	1	1	3
CO6	2	3	1	1	1	3	2	3	-	1	1	1	3
Average	2.00	3.00	1.00	1.00	1.00	2.83	2.50	2.67	-	1.00	1.00	1.00	3.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



### BZO411 Techniques in Bioprocessing & Enzyme Engineering

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VIII</b>	
1	Course Code	<b>BZO411</b>	
2	Course Title	Techniques in Bioprocessing & Enzyme Engineering	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To accelerate the interest of the students in the industrial aspects of Bioprocessing and Enzyme technologies.	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Recall the Basic media and fermenters required in Industrial set up CO2: Demonstrate the techniques required in Bioprocessing CO3: Evaluate the applications of fermentation in industries CO4: Explore the nature and characteristics of Enzymes CO5: Familiarize themselves with the techniques in Enzymology CO6: Upgrade their knowledge and skill in the industrial aspects of the subject	
8	Course Description	The course has been designed such that the students in their 4 <sup>th</sup> year get an exposure to the industrial application of interdisciplinary subject of zoology.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Industrial Media; Nutrition of Industrial Organisms &amp; Types of Fermentors</b>	
	A	The Basic Nutrient Requirements of Industrial Media, Criteria for the Choice of Raw Materials Used in Industrial Media, Some Raw Materials Used in Compounding Industrial Media; Growth Factors, Water	CO1, CO6
	B	Some Potential Sources of Components of Industrial Media , Carbohydrate sources, Protein sources; The Use of Plant Waste Materials in Industrial Microbiology Media: Starch; Cellulose, hemi-celluloses and lignin in plant materials.	CO1,CO6
	C	Definition of a Fermentor, Aerated Stirred Tank Batch Fermentor; Aeration and agitation in a fermentor; Temperature control in a fermentor; Foam production and	CO1,CO6



		control, Anerobic Batch Fermentors, Continuous fermentations; Fed-batch Cultivation; Air Lift Fermentors; Microbial Experimentation in the Fermentation Industry: Inoculum Preparation ; Surface or Solid State Fermentors.	
	<b>Unit 2</b>	<b>Techniques in Bioprocessing</b>	
	A	Solids (Insolubles) Removal : Filtration; Centrifugation; Coagulation and flocculation; Foam fractionation; Whole-broth treatment	CO2, CO6
	B	Product Isolation : Cell disruption; Liquid extraction; Dissociation extraction	CO2, CO6
	C	Ion-exchange adsorption; precipitation; Purification ,Chromatography, Carbon decolorization, Crystallization, Product Isolation; Crystalline processing; Drying.	CO2, CO6
	<b>Unit 3</b>	<b>Fermentation application in Industries</b>	
	A	Production of alcohols-industrial ethanol , Production of Beer, Production of Wines and Spirits; Production of acetone, butanol; Production of Vinegar, citric acid and lactic acid	CO3, CO6
	B	Production of virus vaccines; Production of bacterial toxoids; Production of killed bacterial vaccines ; Control of Vaccines ;Vaccine Production versus Other Aspects of Industrial Microbiology	CO3, CO6
	C	Nature and Use of Steroids and Sterols; Types of microbial transformations in steroids and sterols; Fermentation conditions used in steroid transformation	CO3, CO6
	<b>Unit 4</b>	<b>Enzyme Basics</b>	
	A	Enzymes as Catalysts: Overview--Proteins as catalysts (Historical background); Enzyme characteristics and properties; Factors affecting Enzyme Activity; Co-enzyme; Co-factors Enzyme nomenclature & classification; EC number of enzymes; Structure and function of various enzymes	CO4, CO6
	B	Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory; Thermodynamics and its laws; Catalysis, reaction rates and. Catalytic power and specificity of enzymes (concept of active site)	CO4, CO6
	C	Fischer's lock and key hypothesis, Koshland's induced fit hypothesis; Kinetics of single substrate reactions; Enzyme inhibition; Irreversible and reversible inhibition, Competitive; non-competitive and un-competitive inhibition	CO4, CO6
	<b>Unit 5</b>	<b>Enzyme Engineering</b>	
	A	Isolation and purification of enzymes; Localization of proteins in various organelles; Related Techniques and their principles; Enzyme Immobilization: Adsorption, Matrix entrapment, Encapsulation	CO5, CO6
	B	Cross linking, covalent binding and their examples; Advantages and disadvantages of different immobilization techniques	CO5, CO6
	C	Industrial and Clinical Applications of Enzymes: In beverage industry in leather industry, in food processing industry; in dairy industry, in pharmaceutical industry	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA	MTE &ETE
		25%	75%



Text book/s*	<ol style="list-style-type: none"> <li>Principles of fermentation technology, Stanbury P.F. et al, Butterworth-Heinemann Ltd,</li> <li>Oxford Industrial Microbiology by Casida</li> <li>Industrial Microbiology by Cruger</li> <li>Palmer T., Bonner P. L., <i>Enzymes: Biochemistry, Biotechnology, Clinical Chemistry</i>, Woodhead Publishing (2007)</li> <li>Lubert Stryer: Biochemistry, WH Freeman, USA (2002)</li> </ol>	
Other References	<ol style="list-style-type: none"> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>Swayam Prabha - DTH Channel</li> <li><a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	

### Course Articulation Matrix for BZO411 Techniques in Bioprocessing & Enzyme Engineering

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	2	2	3	2	3	-	1	1	1	1
CO2	1	3	1	2	2	3	2	3	-	1	1	1	1
CO3	1	3	1	2	2	3	3	2	-	1	1	1	1
CO4	1	3	1	2	2	3	2	2	-	1	1	1	1
CO5	1	3	1	2	2	2	3	3	-	1	1	1	1
CO6	1	3	1	2	2	3	2	3	-	1	1	1	1
Average	1.00	3.00	1.00	2.00	2.00	2.83	2.33	2.67	-	1.00	1.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**





### BZO412 Techniques in Bioprocessing & Enzyme Engineering lab

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VIII</b>	
1	Course Code	<b>BZO412</b>	
2	Course Title	Techniques in Bioprocessing & Enzyme Engineering lab	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To make the students aware of the industrial applicability in the interdisciplinary science of Zoology w.r.t. Bioprocessing and Engineering techniques and gain a hands on experience on these.	
7	Course Outcomes	The student at the completion of the course will be able to:	
8	Course Description	CO1: Tell about the techniques of Enzyme isolation and understand the principle and working of equipments related to bioprocessing CO2: Explain techniques related to fermentation CO3: Build knowledge on the techniques related to demonstration of enzyme activity CO4: Demonstrate the Enzyme immobilization techniques CO5: Inspect some of the fermentation techniques through virtual mode CO6: Predict the principle and basic technique involved in fermentation and enzyme engineering.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Bioprocessing related experiments-I</b>	
	A	Demonstration of working principles of various components of a batch bioreactor; biosafety cabinet; and autoclave; centrifuge and incubator.	CO1, CO6
	B	Isolation and screening of microorganism producing enzyme (proteases)	CO1,CO6
	C	Isolation and screening of microorganism producing acid (citric acid)	CO1,CO6
	<b>Unit 2</b>	<b>Bioprocessing related experiments-II</b>	
	A	Fermentative production of Amylase; Fermentative production of Beer	CO2, CO6
	B	Estimation of Protease activity	CO2, CO6



	C	Citric acid production by solid state fermentation		CO2, CO6
	<b>Unit 3</b>	<b>Bioprocessing related experiments-III</b>		
	A	Identification and isolation of the enzymes present in different biological samples		CO3, CO6
	B	Estimation of enzyme activity (Amylase)		CO3, CO6
	C	Microbial production of enzymes (Amylase)		CO3, CO6
	<b>Unit 4</b>	<b>Enzyme engineering related experiments</b>		
	A	Demonstration of Enzyme Activity (Starch Hydrolysis by amylase)		CO4, CO6
	B	Demonstration of Enzyme Activity (protein Hydrolysis by Protease) Demonstration of Enzyme Activity (Lipid Hydrolysis by Lipase)		CO4, CO6
	C	Enzyme Immobilization by Gel Entrapment Method		CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>		
	A	<a href="http://www.bch.cuhk.edu.hk/vlab2/animation/fermentation/index.html">http://www.bch.cuhk.edu.hk/vlab2/animation/fermentation/index.html</a>		CO5, CO6
	B	<a href="https://www.labster.com/simulations/fermentation/">https://www.labster.com/simulations/fermentation/</a>		CO5, CO6
	C	<a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=64">https://vlab.amrita.edu/index.php?sub=3&amp;brch=64</a> <a href="https://www.biologycorner.com/worksheets/enzyme-lab-virtual.html">https://www.biologycorner.com/worksheets/enzyme-lab-virtual.html</a>		CO5, CO6
	Mode of examination	<b>Practical/Viva</b> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)		
	Weightage Distribution	CA		ETE
		25%		75%
	Text book/s*	1. Michael L. Shuler and Fikret Kargi (2009, Second edition) Bioprocess Engineering-Basic concepts. Pearson Prentice Hall 2. Pauline M. Doran (2010) Bioprocess Engg. Principles. Elsevier, California. 3. P. F. Stanbury, S. J. Hall and A. Whitaker, Principles of Fermentation Technology, 2nd Edn., Elsevier, Science & Technology Books, 2005. 4. Elsevier, Science & Technology Books, 2005. 5. B. D. Singh (2009, Revised edition) Biotechnology- Expanding Horizons. Kalyani publishers, Ludhiana-141008 6. Practical Enzymology by Hans Bisswanger_Wiley VCH; 4 <sup>th</sup> edition. ISBN-10: 3527320768 7. A Practical Book for Enzyme Technology by Lin Ying. Chemical Industry Press, ISBN-10: 7122037010		
	Other References	1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a>		



	<ol style="list-style-type: none"> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	
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### Course Articulation Matrix for BZO412 Techniques in Bioprocessing & Enzyme Engineering lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	3	1	2	3	2	3	-	1	1	3	1
CO2	1	1	3	1	2	3	2	3	-	1	1	3	1
CO3	1	1	3	1	2	3	3	2	-	1	1	3	1
CO4	1	1	3	1	2	3	2	2	-	1	1	3	1
CO5	1	1	3	1	2	2	3	3	-	1	1	3	1
CO6	1	1	3	1	2	3	2	3	-	1	1	3	1
Average	1.00	1.00	3.00	1.00	2.00	2.83	2.33	2.67	-	1.00	1.00	3.00	1.00

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



# SEMESTER VII

## **B.Sc. (Hons. with research) in Zoology**



### BSZ404 COGNITIVE SCIENCE

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BSZ404</b>	
2	Course Title	Cognitive Science	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To develop and gain knowledge about the various instinct of human and animal behaviour and how they have evolved.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Relate with studies in cognitive science</p> <p>CO2: Extend views on the anatomy and physiology of nervous system w.r.t the potential and chemistry</p> <p>CO3: Demonstrate the methods used to explore various fields of cognitive science</p> <p>CO4: Familiarize with the concept of animal instincts and behavior</p> <p>CO5: Explain parental behavior and social behavior among humans and animals</p> <p>CO6: Exemplify the concepts about how we perceive and gather information in chemical and structural sense.</p>	
8	Course Description	The course has been formulated with the intention to make students focus towards advanced field of neuroscience and human behaviour, how vision, hearing etc evolved, how communication and social behaviour evolved and the methods of testing these.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to cognitive science</b>	
	A	Cognitive Science; Interdisciplinary sciences involved, History	CO1, CO6
	B	Human mind and Attention; Knowledge and processing of language, Importance of Language	CO1,CO6
	C	Memory, Perception, Action	CO1,CO6



<b>Unit 2</b>	<b>Neuroscience</b>		
A	Neuron Anatomy and Physiology, Resting potential, Action potential, Chemistry and Physiology of Synaptic transmission		CO2, CO6
B	Types of Memory, Chemical control of Brain, Emotion,		CO2, CO6
C	Sleep behaviour, Artificial Intelligence, Brain and vision olfaction and hearing		CO2, CO6
<b>Unit 3</b>	<b>Methods in Cognitive Science</b>		
A	Behavioural experiments		CO3, CO6
B	Brain Imaging: MRI, PET, EEG, MEG		CO3, CO6
C	Computational Imaging , CAT		CO3, CO6
<b>Unit 4</b>	<b>Species specific behavior</b>		
A	Ethology definition; Behavioral Ecology & the Evolution; Concepts and Patterns; Approach and Methods		CO4, CO6
B	Mammalian Nervous System and Behavior; Pheromones; Hormones and Drugs; Biological Clocks; Orientation;		CO4, CO6
C	Bird Migration and Navigation; Fish Migration; Communication; Feeding Strategies; Aggressive and Territorial Behavior		CO4, CO6
<b>Unit 5</b>	<b>Social behaviour</b>		
A	Social Organization; Reproductive Behavior in Animals : Courtship and Mating		CO5, CO6
B	Parental Behavior; Learning; Behavioral Genetics		CO5, CO6
C	Sociobiology		CO5, CO6
Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
Weightage Distribution	CA		MTE& ETE
	25%		75%
Text book/s*	8. Bermúdez, J. (2020). <i>Cognitive Science: An Introduction to the Science of the Mind</i> (3rd ed.). Cambridge: Cambridge University Press. doi:10.1017/9781108339216 9. Bear, Mark F., Barry W. Connors, and Michael A. Paradiso. <i>Neuroscience: Exploring the Brain</i> , 3rd ed. Baltimore, MD: Lippincott Williams & Wilkins, 2006. ISBN: 9780781760034 10. Principles of Neural Science, Eric R. Kandel 11. Neuroscience, Dale Purves 12. Mathur R (2009) Animal Behavior. Rastogi Publications, Meerut, India 13. Rubenstein D & Alcock J (2019). Animal behavior. ISBN: 9781605358949 14. <a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=43">https://vlab.amrita.edu/index.php?sub=3&amp;brch=43</a>		



Other References	<ol style="list-style-type: none"> <li>9. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>10. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>11. Swayam Prabha - DTH Channel,</li> <li>12. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>13. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>14. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://npTEL.ac.in/course.html">https://npTEL.ac.in/course.html</a></li> <li>15. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>16. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	
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### Course Articulation Matrix for BSZ404 Cognitive Science

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	1	2	3	2	3	-	1	1	1	1
CO2	1	3	1	1	2	3	2	3	-	1	1	1	1
CO3	1	3	1	1	2	3	3	2	-	1	1	1	1
CO4	1	3	1	1	2	3	2	2	-	1	1	1	1
CO5	1	3	1	1	2	2	3	3	-	1	1	1	1
CO6	1	3	1	1	2	3	2	3	-	1	1	1	1
Average	1.00	3.00	1.00	1.00	2.00	2.83	2.33	2.67	-	1.00	1.00	1.00	1.00

**1-Slight (Low)    2-Moderate (Medium)    3-Substantial (High)**



## BSZ402—EPIDEMIOLOGY & DISEASE SURVEILLANCE

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BSZ402</b>	
2	Course Title	Epidemiology & Disease Surveillance	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students the knowledge about how diseases exit, how they are forecasted, monitored and surveyed and step taken by various governments to keep them under control	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p>CO1: Tell the basic concept of the Epidemiology            CO2: Reflect on the disease monitoring, forecasting and surveillance strategies            CO3: Demonstrate the impact of environment on disease occurrence            CO4: Develop understanding of the steps involved in disease eradication            CO5: Discuss the early warning tools related to disease forecasting.            CO6: Analyze the efforts taken by the Government at National and International level in handling diseases.</p>	
8	Course Description	This course is a co-curricular course formulated to guide students about the major happenings of disease at community level. The need of forecasting, early warning, disease monitoring and surveillance and the major organization working worldwide to keep a check on this has all been framed in this syllabus.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction to Epidemiology</b>	





	A	<ul style="list-style-type: none"> <li>History and concept of epidemiology</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>Conceptual knowledge on Epidemics, Outbreaks, endemic, zoonosis, incidence, prevalence.</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>Pandemics and its phases, DALY</li> </ul>	CO1,CO6
	<b>Unit 2</b>	<b>Epidemiology &amp; Health Ethics</b>	
	A	Study design in Epidemiology	CO2, CO6
	B	Outbreak Investigation, Pandemics Preparedness, Situational Analysis, planning, assessments	CO2, CO6
	C	Nuremberg Code, Declaration of Helsinki; Principle of essentiality; Clinical trail Ethics	CO2, CO6
	<b>Unit 3</b>	<b>Disease Surveillance strategies</b>	
	A	<ul style="list-style-type: none"> <li>Disease monitoring and its importance; Steps in disease surveillance; need and importance</li> </ul>	CO3, CO6
	B	<ul style="list-style-type: none"> <li>Disease forecasting, Disease control</li> </ul>	CO3, CO6
	C	<ul style="list-style-type: none"> <li>Environmental factors affecting the incidence of disease; Examples of diseases affected by climatic conditions</li> </ul>	CO3, CO6
	<b>Unit 4</b>	<b>Disease eradication</b>	
	A	<ul style="list-style-type: none"> <li>Identification of disease progression towards eradication; Major diseases eradicated from World and India</li> </ul>	CO4, CO6
	B	<ul style="list-style-type: none"> <li>Steps taken by Government at National and International Level towards eradication of disease.</li> </ul>	CO4, CO6
	C	<ul style="list-style-type: none"> <li>Nosocomial Infections/Hospital Associated Infections</li> </ul>	CO4, CO6
	<b>Unit 5</b>	<b>Early warning Tools</b>	
	A	<ul style="list-style-type: none"> <li>Early warning tools developed for disease surveillance.</li> </ul>	CO5, CO6
	B	<ul style="list-style-type: none"> <li>Determinants and predictors of Disease</li> </ul>	CO5, CO6
	C	<ul style="list-style-type: none"> <li>Organizations working on Epidemiology of diseases at National and International level; Major decision taking organizations &amp; Stakeholders</li> </ul>	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA	MTE& ETE
25%		75%	
	Text book/s*	5. Epidemiology: An Introduction. 2 <sup>nd</sup> edn, 2012; Kenneth J. Rothman. Published by Oxford University Press 6. An introduction to Epidemiology. Thomas C. Timmreck. 2002. 3 <sup>rd</sup> Edition. Jones & Barlett Learning.	



		<p>7. Kenrad E. Nelson &amp; Carolyn Masters Williams. <i>Infectious Disease Epidemiology: Theory and Practice</i>. 2006. Second Edition. Jones and Bartlett Publishers.</p> <p>8. Websites: MOHFW, India and World Health Organization, Centre for Disease Control</p>	
Other References		<p>9. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></p> <p>10. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></p> <p>11. Swayam Prabha - DTH Channel,</p> <p>12. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></p> <p>13. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></p> <p>14. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></p> <p>15. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></p> <p>16. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></p>	

### Course Articulation Matrix for BSZ402 Epidemiology & Disease Surveillance

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	1	2	3	2	3	-	1	3	2	1
CO2	3	1	1	1	2	3	2	3	-	1	3	2	1
CO3	3	1	1	1	2	3	3	2	-	1	3	2	1
CO4	3	1	1	1	2	3	2	2	-	1	3	2	1
CO5	3	1	1	1	2	2	3	3	-	1	3	2	1
CO6	3	1	1	1	2	3	2	3	-	1	3	2	1
Average	3.00	1.00	1.00	1.00	2.00	2.83	2.33	2.67	-	1.00	3.00	2.00	1.00

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



### BBI401 BIOSTATISTICS, BIOETHICS AND IPR

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BBI401</b>	
2	Course Title	Biostatistics, Bioethics and IPR	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students, the knowledge about how to apply statistics in basic sciences and gain knowledge on the values and ethics in science.	
7	Course Outcomes	The students at the completion of the course will be able to: CO1: Tell the basic concepts of Statistics CO2: Explain the concept of probability and its application CO3: Demonstrate the topics of Correlation and regression CO4: Explain and learn the concepts of IPR CO5: Demonstrate the bioethics in biology CO6: Evaluate the applicability of biostatistics in biological data	
8	Course Description	This course has been designed in such a way that the students can learn statistics and ethics together. These are additions to basics science and are important during the conversion of theory to practical applicability	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Biostatics-I</b>	
	A	<ul style="list-style-type: none"> <li>• Introduction to Biostatistics</li> </ul>	CO1, CO6
	B	<ul style="list-style-type: none"> <li>• Frequency distribution: Measures of central tendency: Mean, Median, Mode, standard deviation.</li> </ul>	CO1,CO6
	C	<ul style="list-style-type: none"> <li>• Measures of dispersion: Skewness &amp; Kurtosis</li> </ul>	CO1,CO6



	<b>Unit 2</b>	<b>Biostatistics-II</b>		
	A	<ul style="list-style-type: none"> <li>Probability: definition of probability and binomial distribution (numerical)</li> </ul>		CO2, CO6
	B	<ul style="list-style-type: none"> <li>Sample, Population, large sample, small sample. Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, difference.</li> </ul>		CO2, CO6
	C	<ul style="list-style-type: none"> <li>Correlation: Definition, Karl Pearson's coefficient of correlation, Simple Regression</li> </ul>		CO2, CO6
	<b>Unit 3</b>	<b>Biostatistics-III</b>		
	A	<ul style="list-style-type: none"> <li>Concept of Test of Hypothesis. Applications of t-test statistics to biological problems/data</li> </ul>		CO3, CO6
	B	<ul style="list-style-type: none"> <li>Chi square, statistic applications in Biology</li> </ul>		CO3, CO6
	C	<ul style="list-style-type: none"> <li>Error-I type, Error-II type, Standard error of mean</li> </ul>		CO3, CO6
	<b>Unit 4</b>	<b>IPR</b>		
	A	<ul style="list-style-type: none"> <li>The concept of intellectual property, Importance of IPR in biotechnology, Indian laws and treaties for IPR</li> </ul>		CO4, CO6
	B	<ul style="list-style-type: none"> <li>Patents-basic concepts, Infringement, compulsory licenses, Exploitation of the Patented Invention, Compulsory Licenses</li> </ul>		CO4, CO6
	C	<ul style="list-style-type: none"> <li>Copyright and related rights; piracy and infringement and their remedies Definitions, Signs which serve as trademarks</li> </ul>		CO4, CO6
	<b>Unit 5</b>	<b>Bioethics</b>		
	A	<ul style="list-style-type: none"> <li>Introduction to Biosafety, Need for Biosafety in present scenario</li> </ul>		CO5, CO6
	B	<ul style="list-style-type: none"> <li>Classification and Description of Biosafety Levels, Design of Clean rooms, Design of Biosafety Labs Biosafety Regulations</li> </ul>		CO5, CO6
	C	<ul style="list-style-type: none"> <li>Laws and Policies, Biosafety and Agriculture, Genetic Engineering and Health; Genetic Engineering and Food Safety, International Centre for Genetic Engineering and Biotechnology (ICGEB)</li> </ul>		CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction		
	Weightage Distribution	CA		MTE& ETE
		25%		75%
	Text book/s*	5. Fundamental of Statistics by S.C. Gupta, Himalaya Publishing House. 6. Pharmaceutical Statistics- Practical and Clinical Applications by Sanford Bolton, Marcel Dekker Inc. New York. 7. Design and Analysis of Experiments by R. Pannerselvam, PHI		



		Learning Private Limited. 8. Design and Analysis of Experiments by Douglas and C. Montgomery, Wiley Students Edition.	
Other References		9. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnptelhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2Fnptelhrd</a> 10. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a> 11. Swayam Prabha - DTH Channel, 12. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a> 13. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a> 14. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a> 15. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a> 16. edX, <a href="https://www.edx.org/">https://www.edx.org/</a>	

### Course Articulation Matrix for BBI401 Biostatistics, Bioethics and IPR

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	1	2	3	2	2	3	1	3	2	1
CO2	3	1	1	1	2	3	2	2	3	1	3	2	1
CO3	3	1	1	1	2	3	3	2	3	1	3	2	1
CO4	3	1	1	1	2	3	2	2	3	1	3	2	1
CO5	3	1	1	1	2	2	3	2	3	1	3	2	1
CO6	3	1	1	1	2	3	2	2	3	1	3	2	1
Average	3.00	1.00	1.00	1.00	2.00	2.83	2.33	2.00	3.00	1.00	3.00	2.00	1.00

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



## BZO401 OMICS IN BIOLOGICAL SCIENCES

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BZO401</b>	
2	Course Title	<b>Omics in Biological sciences</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To inculcate in the students, the conceptual understanding of various disciplines in Omics for research and development.	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Recall the knowledge of Genomics and its application in biotechnology</p> <p>CO2: Explain the fundamental of Epigenetics and its methods and management</p> <p>CO3: Demonstrate thorough Knowledge of Proteomics, methods of proteomic assays and application.</p> <p>CO4: Conclude on metabolomics, techniques and softwares used.</p> <p>CO5: Explain the Fundamentals of transcription process, techniques and applications</p> <p>CO6: Develop complete knowledge attainment on Genomics and Proteomics</p>	
8	Course Description	The study has been designed with the intention to inculcate in the students the major field of Omics biology i.e. Genomics, Proteomics, Metagenomics, Metabolomics, Transcriptomics and the related softwares and database of how to extract and learn about their inter relationship.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Genomics</b>	
	A	Definition; Types of omics study; Applications of Omics in biotechnology; Concept of Genomics; Information flow in Biology	CO1, CO6
	B	Genome Structure -Regulatory Sequences and Non-coding sequences, repetitive sequences; Genome evolution; Genome complexity; Mitochondrial DNA and	CO1,CO6



		inheritance.	
C		DNA Sequencing technologies, Sanger sequencing; Maxim-Gilbert; Whole genome sequencing platforms; Genomics database, GWAS analysis; Human Genome Project	CO1,CO6
<b>Unit 2</b>		<b>Epigenetics &amp; Metagenomics</b>	
A		Concept of Epigenetics and Epigenomics; Epigenetic mechanisms of gene regulation; DNA methylation; Histone modification; Epigenetics databases; Methods in Epigenomics: Histone modification assays and DNA methylation assays.	CO2, CO6
B		Metagenomics; History and importance; Oral Microbiome, Skin microbiome, Gut microbiome	CO2, CO6
C		Methods in metagenomics; Markers for metagenomics, Microbial sequencing methods, 16sRNA sequencing, Applications of metagenomics	CO2, CO6
<b>Unit 3</b>		<b>Proteomics</b>	
A		Introduction to Proteomics – The Proteome; Analysis of proteomes: 2D electrophoresis, De novo sequencing using MS;	CO3, CO6
B		Post translational modifications; Methods for studying proteins; Protein microarrays,	CO3, CO6
C		Application of Proteomics	CO3, CO6
<b>Unit 4</b>		<b>Metabolomics</b>	
A		Concept of Metabolomics; Important Metabolites and metabolite profiling	CO4, CO6
B		Technique's used in metabolomics; relative softwares used in Metabolomics	CO4, CO6
C		Databases of Metabolomics, Applications of metabolomics	CO4, CO6
<b>Unit 5</b>		<b>Transcriptomics</b>	
A		Concept of Transcriptomics, Methods in RNA sequencing, SAGE/ CAGE, ESTs	CO5, CO6
B		Microarrays, softwares in transcriptomic, Transcriptomics Databases	CO5, CO6
C		Applications of Transcriptomics	CO5, CO6
Mode of examination		<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
Weightage Distribution	CA		MTE& ETE
	25%		75%
Text book/s*		9. Introduction to Genomics Arthur M Lesk Oxford University Press 2007 10. Discovering Genomics, Proteomics & Bioinformatics A M Campbell & L J Heyer Pearson Education, 2007 11. Proteins and Proteomics Richard J Simpson IK International 2003 12. Baxevanis AD and BFF Ouellette, Wiley O. (ed) (2001) Bioinformatics – A practical guide to the analysis of genes and proteins. Interscience, New York	



		<p>13. Sandy B. Primrose Richard M. Twyman (2005) Principles of Genome Analysis and Genomics, Blackwell Publishing, USA.</p> <p>14. Computing for Comparative Microbial Genomics by Ussery, Wassenaar &amp; Borini (Springer)</p> <p>15. Genomes 2 By T.A. Brown (Oxford)</p> <p>16. Metabolomics – A powerful Tool in Systems Biology, Edited by J.Nielsen and M.C. Jewett, Springer Publishers</p>	
Other References		<p>9. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></p> <p>10. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></p> <p>11. Swayam Prabha - DTH Channel,</p> <p>12. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></p> <p>13. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></p> <p>14. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></p> <p>15. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></p> <p>16. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></p>	

### Course Articulation Matrix for BZO401 Omics in Biological sciences

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	1	2	3	3	2	3	-	1	3	1
CO2	1	3	1	1	2	3	3	2	3	-	1	3	1
CO3	1	3	1	1	2	3	3	2	3	-	1	3	1
CO4	1	3	1	1	2	3	3	2	2	-	1	3	1
CO5	1	3	1	1	2	3	2	2	3	-	1	3	1
CO6	1	3	1	1	2	3	3	2	3	-	1	3	1
Average	1.00	3.00	1.00	1.00	2.00	3.00	2.83	2.00	2.83	-	1.00	3.00	1.00

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





### BZO402 Omics in Biological Sciences Lab

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>BZO402</b>	
2	Course Title	Omics in Biological sciences Lab	
3	Credits	1	
4	Contact Hours (L-T-P)	0-0-2	
5	Course status	Compulsory (CC)	
6	Course Objective	To acquaint the students with the advanced tools in the field of genomics, proteomics and other omics biology field	
7	Course Outcomes	The student at the completion of the course will be able to: CO1: Define genomics tools and database CO2: Familiarize themselves with the tools and database in proteomics CO3: Exemplify the use of database related to Transcriptomics and metabolomics CO4: Construct phylogenetic tree CO5: Collate with bioinformatics tools in virtual mode. CO6: Develop expertise on tools and techniques in the field of Omics.	
8	Course Description	The course has been formulated so as to give the student in their fourth year a higher version of learning with tools and techniques in the field of Omics.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Genomics related experiments</b>	
	A	To study biological database with reference to Genomics	CO1, CO6
	B	To search any gene of human disease importance in database	CO1,CO6
	C	To study genomic sequence similarity search in database	CO1,CO6
	<b>Unit 2</b>	<b>Proteomics related experiments</b>	



	A	To study biological database with reference to Proteomics Expasy (Expert Protein analysis system)	CO2, CO6
	B	Tools for Protein sequence identification, Post translational modification	CO2, CO6
	C	Protein structure, Protein –protein interaction, Use of Modeller	CO2, CO6
	<b>Unit 3</b>	<b>Transcriptomics &amp; Metabolomics related experiments</b>	
	A	Microarray databases (GEO, Array express etc.)	CO3, CO6
	B	Transcriptome Project (Human, Mouse)	CO3, CO6
	C	Computational Methods to Interpret and Integrate Metabolomic Data	CO3, CO6
	<b>Unit 4</b>	<b>Phylogenetic tree construction</b>	
	A	The concept of evolutionary tree, Dendogram, Cladograms, & Phylograms	CO4, CO6
	B	Types of phylogenetic trees (rooted vs. unrooted trees), gene tree & Species tree	CO4, CO6
	C	Homologs, Orthologs, & Paralogs, Newick format of tree representation, True tree & Inferred tree	CO4, CO6
	<b>Unit 5</b>	<b>Virtual Labs</b>	
	A	<a href="https://edu.omicslogic.com/genomics-in-the-virtual-lab">https://edu.omicslogic.com/genomics-in-the-virtual-lab</a> <a href="https://vlab.amrita.edu/index.php?sub=3&amp;brch=273">https://vlab.amrita.edu/index.php?sub=3&amp;brch=273</a>	CO5, CO6
	B	<a href="https://learn.genetics.utah.edu/content/labs/">https://learn.genetics.utah.edu/content/labs/</a> <a href="https://www.vlab.co.in/">https://www.vlab.co.in/</a>	CO5, CO6
	C	<a href="https://pe-iitb.vlabs.ac.in/">https://pe-iitb.vlabs.ac.in/</a> <a href="https://diytranscriptomics.com/">https://diytranscriptomics.com/</a>	CO5, CO6
	Mode of examination	<b>Practical/Viva</b> Continuous Assessment (CA): 25 Marks Viva-Voce (on the basis of weekly Viva performance): 25 Marks ETE: 50 marks (Quiz for 15 marks; Lab Work for 15 Marks; Viva for 10 Marks and Lab record for 10 marks)	
	Weightage Distribution	CA	ETE
		25%	75%
	Text book/s*	7. Introduction to Genomics by Arthur M. Leask, Oxford University Press 8. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by Durbin et al., Cambridge University Press 9. Molecular Evolution and Phylogenetics Masatoshi Nei and Sudhir Kumar 10. Transcriptomics: Expression pattern analysis. by Gomase, Virendra. 11. Metabolomics, by Ute Roessner, ISBN 978-953-51-0046-1, Hard cover, 364 pages, Publisher: InTech, Published 12. Microarray Analysis, by Mark Schena, Publisher: Wiley-Liss	
	Other References	4. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a>	



	<ol style="list-style-type: none"><li>5. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li><li>6. Swayam Prabha - DTH Channel,</li><li>7. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li><li>8. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li><li>9. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li><li>10. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li><li>11. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li></ol>	
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### Course Articulation Matrix for BZO402 Omics in Biological Sciences Lab

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	1	2	3	3	2	3	-	1	1	1	3
CO2	1	3	1	2	3	3	2	3	-	1	1	1	3
CO3	1	3	1	2	3	3	3	3	-	1	1	1	3
CO4	1	3	1	2	3	3	2	2	-	1	1	1	3
CO5	1	3	1	2	3	3	2	3	-	1	1	1	3
CO6	1	3	1	2	3	3	2	3	-	1	1	1	3
Average	1.00	3.00	1.00	2.00	3.00	3.00	2.17	2.83	-	1.00	1.00	1.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



### PJI401 PROJECT

<b>School: SBSR</b>		<b>Batch: 2022-2026</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2025-2026</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VII</b>	
1	Course Code	<b>PJI401</b>	
2	Course Title	<b>Project</b>	
3	Credits	3	
4	Contact Hours (L-T-P)	0-0-6	
5	Course status	Compulsory (Project)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in project writing and oral presentation.</li> </ul>	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO1:</b> Recall the understanding of various research articles to identify research gap on a given topic</p> <p><b>CO2:</b> Extract line of approach to overcome the research gap</p> <p><b>CO3:</b> Conclude appropriate method/s suitable for a given problem</p> <p><b>CO4:</b> Identify characterization techniques/theoretical analysis for obtaining result</p> <p><b>CO5:</b> Explain graphs, diagrams, flow chart etc.</p> <p><b>CO6:</b> Report research findings in written and verbal forms</p>	
8	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
9	Outline syllabus		CO Mapping
	<b>Part 1</b>	<b>Introduction to various research problems</b>	<b>CO1</b>
	<b>Part 2</b>	<b>Identify a research question</b>	<b>CO2, CO3</b>



	<b>Part 3</b>	<b>Literature survey</b>	<b>CO4</b>
	<b>Part 4</b>	<b>Report writing</b>	<b>CO5</b>
	<b>Part 5</b>	<b>Presentation</b>	<b>CO6</b>
Mode of examination		10. Rubric assessment 11. Monthly Presentation to be audited by supervisor 12. Mid Term Presentation and End Term Presentation	
Text book/s*		10 Recent International Journal Articles of repute.	
Suggestive Digital Platforms / Web Links		NA	
Suggested Equivalent Online Courses		NA	

### Course Articulation Matrix for PJI401 Project

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	3	2	3	-	2	3	3	3
CO2	3	1	1	3	2	3	2	3	-	2	3	3	3
CO3	3	1	1	3	2	3	3	3	-	2	3	3	3
CO4	3	1	1	3	2	3	2	2	-	2	3	3	3
CO5	3	1	1	3	2	3	2	3	-	2	3	3	3
CO6	3	1	1	3	2	3	2	3	-	2	3	3	3
Average	3.00	1.00	1.00	3.00	2.00	3.00	2.17	2.83	-	2.00	3.00	3.00	3.00

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



# SEMESTER VIII

## **B.Sc. (Hons. with research) in Zoology**



### BSZ409 GENETIC DISORDERS & CANCER

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VIII</b>	
1	Course Code	<b>BSZ409</b>	
2	Course Title	Genetic Disorders & Cancer	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
5	Course status	Compulsory (CC)	
6	Course Objective	To acquaint with the various genetic disorders affecting human including the genetic of cancer	
7	Course Outcomes	<p>The student at the completion of the course will be able to:</p> <p>CO1: Define Autosomal dominant and recessive types of disorders and their effects</p> <p>CO2: Confer knowledge on Sex linked disorders and their effects</p> <p>CO3: Demonstrate knowledge on expertise on Cancer and its basics</p> <p>CO4: Simplify knowledge on Cancer related Genetic disorders and their effects</p> <p>CO5: Explain basic knowledge on role of the various viruses causing cancer</p> <p>CO6: Develop understanding on the genetic basis of disease happening and how they can affect the future generation</p>	
8	Course Description	The course has been designed keeping in mind the genetic basis of disease. Diseases of Autosomal and sex linked inheritance have been included here. Also a very important disease i.e. Cancer and the genetics of cancer have also been added to the course so as to make the student understand these disturbances/effect/mutations at gene level.	
9	Outline syllabus		CO Mapping
	<b>Unit 1</b>	<b>Genetic Disorders and their types</b>	
	A	Introduction to Genetic Disorders	CO1, CO6



	B	Autosomal dominant disorders: Familial hypercholesterolemia, Polycystic Kidney Disease, Huntington's Disease	CO1,CO6
	C	Autosomal recessive disorders: Sickle cell anaemia, Cystic fibrosis, Tay-Sachs disease, Phenylketonuria	CO1,CO6
	<b>Unit 2</b>	<b>Sex linked Genetic disorders</b>	
	A	X-linked dominant disorders: Rett syndrome, Klinefelter syndrome	CO2, CO6
	B	X-linked recessive hemophilia A, Duchenne muscular dystrophy, and Lesch-Nyhan syndrome, red-green color blindness, Turner's syndrome	CO2, CO6
	C	Y-linked disorders; Mitochondrial disorders	CO2, CO6
	<b>Unit 3</b>	<b>Cancer</b>	
	A	Introduction to cancer; history Tumour cells & Metastasis	CO3, CO6
	B	Genetic basis of cancer; Proto-oncogenes, Oncogenes, Tumor Suppressor Genes	CO3, CO6
	C	Growth promoting proteins & Cancer; Signal Transduction proteins & Cancer	CO3, CO6
	<b>Unit 4</b>	<b>Carcinogens &amp; Cancer</b>	
	A	Apoptotic proteins & Cancer; Telomere expression in cancer	CO4, CO6
	B	Role of Carcinogens in Cancer	CO4, CO6
	C	Human Hereditary Diseases and Cancers: Xeroderma pigmentosum; Blooms' Syndrome; Fanconi Anemia; Hereditary Breast Cancer; Treatment and Diagnosis of cancer	CO4, CO6
	<b>Unit 5</b>	<b>Cancer &amp; Viruses</b>	
	A	Virus infection and carcinogenesis	CO5, CO6
	B	Virus causing cancer – EBV, HBV, HCV, HPV, HTLV-1, KSHV, MCV	CO5, CO6
	C	Immune response in Cancer; Immunotherapy	CO5, CO6
	Mode of examination	<u>Theory</u> 20 marks for Test / Quiz / Assignment / Seminar. 05 marks for Class Interaction	
	Weightage Distribution	CA 25%	MTE& ETE 75%
	Text book/s*	6. Puiu, M (ed.). 2013, Genetic Disorders, IntechOpen, London. 10.5772/46039 7. National Center for Biotechnology Information (US). Genes and Disease [Internet]. Bethesda (MD): National Center for Biotechnology Information (US); 1998-. Available from: <a href="https://www.ncbi.nlm.nih.gov/books/NBK22183/">https://www.ncbi.nlm.nih.gov/books/NBK22183/</a> 8. Douglas Hanahan and Robert A. Weinberg (2000) <i>The Hallmarks of Cancer</i> , Cell 100(1): 57-70	





		<p>9. Douglas Hanahan and Robert A. Weinberg (2011) <i>Hallmarks of Cancer: The Next Generation</i>, Cell 144(5):646-674.</p> <p>10. Lodish et al; 2007. <i>Molecular Cell Biology</i>, 6<sup>th</sup> Edition</p>	
	Other References	<ol style="list-style-type: none"> <li>1. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd">https://www.youtube.com/results?search_query=cell+https%3A%2F%2Fwww.youtube.com%2Fuser%2FnpTELhrd</a></li> <li>2. Uttar Pradesh Higher Education Digital Library, <a href="http://heecontent.upsdc.gov.in/SearchContent.aspx">http://heecontent.upsdc.gov.in/SearchContent.aspx</a></li> <li>3. Swayam Prabha - DTH Channel,</li> <li>4. <a href="https://www.swayamprabha.gov.in/index.php/home">https://www.swayamprabha.gov.in/index.php/home</a></li> <li>5. Swayam - Government of India, <a href="https://swayam.gov.in/">https://swayam.gov.in/</a></li> <li>6. National Programme on Technology Enhanced Learning (NPTEL), <a href="https://nptel.ac.in/course.html">https://nptel.ac.in/course.html</a></li> <li>7. Coursera, <a href="https://www.coursera.org/in">https://www.coursera.org/in</a></li> <li>8. edX, <a href="https://www.edx.org/">https://www.edx.org/</a></li> </ol>	

### Course Articulation Matrix for BSZ409 Genetic Disorders & Cancer

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	3	3	3	-	1	1	1	3
CO2	2	3	1	1	1	3	2	3	-	1	1	1	3
CO3	2	3	1	1	1	3	3	2	-	1	1	1	3
CO4	2	3	1	1	1	3	2	2	-	1	1	1	3
CO5	2	3	1	1	1	2	3	3	-	1	1	1	3
CO6	2	3	1	1	1	3	2	3	-	1	1	1	3
Average	2.00	3.00	1.00	1.00	1.00	2.83	2.50	2.67	-	1.00	1.00	1.00	3.00

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



### PHR401-Nanogenerators

<b>School: SBSR</b>		<b>Batch:2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year</b>	
<b>Branch: Zoology</b>		<b>Semester: VIII</b>	
1	Course Code	PHR401	
2	Course Title	<b>Nanogenerators</b>	
3	Credits	4	
4	Contact Hours (L-T-P)	4-0-0	
	Course Status	Compulsory	
5	Course Objective	<p>1. With a focus on the synthesis, characterization, and applications of nanomaterials in Energy harvesting, this course will introduce students to the topic of nanotechnology and nanogenerators.</p> <p>1. The fundamental ideas, such as the nanoscale effect, the relationship between process, structure, and property, the characterization of the properties of nano- and micro-structures, multifunctional materials, and the fabrication of nanodevices and their applications for energy harvesting, water infiltrations, and environmental sensing, will be covered.</p>	
6	Course Outcomes	<p>After the completion of this course, the student will be able to</p> <p><b>CO1:</b> describe the terminology and basic concepts of thermoelectricity and piezoelectricity.</p> <p><b>CO2:</b> identify suitable methods for various nanodevice synthesis and processing method.</p> <p><b>CO3:</b> understand different characterization techniques of PENG and TENG.</p> <p><b>CO4:</b> explain the fundamental mechanism of unique properties of piezoelectric materials and thermoelectric materials.</p> <p><b>CO5:</b> describe the application of nanogenerators for energy harvesting and sensing.</p> <p><b>CO6:</b> appreciate the potential applications of Nanomaterials in different fields.</p>	
7	Course description	<p>With a focus on the synthesis, characterization, and applications of nanomaterials in Energy harvesting, this course will introduce students to the topic of nanotechnology and nanogenerators. Adapting mechanical properties, durability, energy harvesting, and other multi-functionality are only a few of the specialized uses. The fundamental ideas, such as the nanoscale effect, the relationship between process, structure, and property, the characterization of the properties of nano- and micro-structures, multifunctional materials, and the fabrication of nanodevices and their applications for energy harvesting, water infiltrations, and environmental sensing, will be covered. Students taking the course will have access to a lab where they can practice their nano- and micro-structure characterization techniques.</p>	
8	Outline Syllabus		CO Mapping
	<b>Unit 1</b>	<b>Introduction &amp; Piezoelectric Nanogenerators</b>	
	A	Introduction to nanogenerators, Types of Nanogenerators,	CO1
	B	Triboelectric Nanogenerators (TENG), Piezoelectric Nanogenerators (PENG)	CO1



	C	Pyroelectric Nanogenerators, Thermoelectric Nanogenerators & Electromagnetic generators.	CO1
	<b>Unit 2</b>	<b>Nanomaterials Synthesis and Fabrication of PENG and TENG</b>	
	A	Nanomaterials synthesis, Ball milling, Sol-Gel	CO2
	B	Hydrothermal, Sono-chemical method	CO2
	C	Fabrication of TENG and PENG by electrospinning and solution-cast method	CO2
	<b>Unit 3</b>	<b>Characterization of PENG and TENG</b>	
	A	X-ray Diffraction (XRD)	CO3
	B	Scanning Electron Microscopy (SEM)	CO3
	C	Electrical characterizations of TENG and PENG	CO3
	<b>Unit 4</b>	<b>Materials Properties for Energy Harvesting (TENG and PENG)</b>	
	A	Band Theory, Violation of Octet Rule, Hardness of Materials, Grain Boundary & Creep Fracture, Flexoelectricity	CO4
	B	Static Electricity, Pros & Cons of Static Electricity, EMG VS TENG (or PENG)	CO4
	C	Working Mechanism – Contact, Working Mechanism – Rotation, Efficiency of TENG and PENG	CO4
	<b>Unit 5</b>	<b>Energy Harvesting (TENG and PENG) and Applications</b>	
	A	Surface Charge Density, Impedance, other applications with TENG and PENG	CO5
	B	Bio application of TENG and PENG	CO5
	C	Antibacterial, Acoustic Sensor (pressure sensor) using TENG and PENG.	CO5, CO6
	Mode of Examination	Theory	
	Weightage Distribution	CA	MSE
		15%	10%
		ESE	75%
	Text books	1. Triboelectric Nanogenerators, Zhong Lin Wang, Long Lin, Jun Chen, Simiao Niu, Yunlong Zi, Springer 2016, <a href="https://doi.org/10.1007/978-3-319-40039-6">https://doi.org/10.1007/978-3-319-40039-6</a> 2. Jae Kim, Sang, Arunkumar Chandrasekhar, and Nagamalleswara Rao Alluri, eds. 2020. Nanogenerators. IntechOpen. doi:10.5772/intechopen.78915.	
	Other References	1. Review Article: Dongwhi Choi, et. al. "Recent Advances in Triboelectric Nanogenerators: From Technological Progress to Commercial Applications", ACS Nano, 2023, <a href="https://doi.org/10.1021/acsnano.2c12458">https://doi.org/10.1021/acsnano.2c12458</a> 2. Review Article: Briscoe, Joe, and Steve Dunn. "Piezoelectric nanogenerators—a review of nanostructured piezoelectric energy harvesters." Nano Energy 14 (2015): 15-29.	



**Course Articulation Matrix for PHR401-Nanogenerators**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	1	2	2	1	1	1	1	1	1	-	-
CO2	1	2	1	2	2	1	1	1	1	1	1	-	-
CO3	1	2	1	1	2	1	1	1	1	1	1	-	-
CO4	1	2	1	1	1	1	1	1	1	1	1	-	-
CO5	1	2	1	2	2	1	1	1	1	1	1	-	-
CO6	1	2	1	1	1	1	1	1	1	1	1	-	-
Average													

**1-Slight (Low) 2-Moderate (Medium) 3-Substantial (High)**



## PROJECT

<b>School: SBSR</b>		<b>Batch: 2023-2027</b>	
<b>Program: BSc (Hon with Research)</b>		<b>Current Academic Year: 2026-2027</b>	
<b>Branch: Zoology</b>		<b>SEMESTER: VIII</b>	
1	Course Code		
2	Course Title	Project	
3	Credits	9	
4	Contact Hours (L-T-P)	0-0-18	
5	Course status	Compulsory (Project)	
6	Course Objective	<ul style="list-style-type: none"> <li>• Develop knowledge of a specific area of specialization.</li> <li>• Develop research skills especially in project writing and oral presentation.</li> </ul>	
7	Course Outcomes	<p>The student upon the completion of the course will be able to:</p> <p><b>CO1:</b> Recall the understanding of various research articles to identify research gap on a given topic</p> <p><b>CO2:</b> Extract line of approach to overcome the research gap</p> <p><b>CO3:</b> Conclude appropriate method/s suitable for a given problem</p> <p><b>CO4:</b> Identify characterization techniques/theoretical analysis for obtaining result</p> <p><b>CO5:</b> Explain graphs, diagrams, flow chart etc.</p> <p><b>CO6:</b> Report research findings in written and verbal forms</p>	
8	Course Description	Reading in a field of special interest under the supervision of a faculty member. Intended for students interested in studying topics not offered in regularly available courses. Format and grading are determined by the supervising faculty member and the audit members then approved by the Head of Department.	
9	Outline syllabus		CO Mapping
	<b>Part 1</b>	<b>Introduction to various research problems</b>	<b>CO1</b>



	<b>Part 2</b>	<b>Identify a research question</b>	<b>CO2, CO3</b>
	<b>Part 3</b>	<b>Literature survey</b>	<b>CO4</b>
	<b>Part 4</b>	<b>Report writing</b>	<b>CO5</b>
	<b>Part 5</b>	<b>Presentation</b>	<b>CO6</b>
Mode of examination		13. Rubric assessment 14. Monthly Presentation to be audited by supervisor 15. Mid Term Presentation and End Term Presentation	
Text book/s*		10 Recent International Journal Articles of repute.	
Suggestive Digital Platforms / Web Links		NA	
Suggested Equivalent Online Courses		NA	

### Course Articulation Matrix for Project

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	3	3	3	-	1	3	3	3
CO2	3	1	1	3	2	3	2	3	-	1	3	3	3
CO3	3	1	1	3	2	3	3	2	-	1	3	3	3
CO4	3	1	1	3	2	3	2	2	-	1	3	3	3
CO5	3	1	1	3	2	2	3	3	-	1	3	3	3
CO6	3	1	1	3	2	3	2	3	-	1	3	3	3
Average	3.00	1.00	1.00	3.00	2.00	2.83	2.50	2.67	-	1.00	3.00	3.00	3.00

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