ACADEMIC CURRICULUM

UNDERGRADUATE DEGREE PROGRAMME

BACHELOR OF SCIENCES IN ZOOLOGY (HONOURS/RESEARCH)

B.Sc. ZOOLOGY. (Hons/Research)

Four Years (Full-Time)
(Multiple Entry and Exit)

Learning Outcome Based Curriculum Framework

As Per NEP-2020

Academic Year- 2023-2024

DEPARTMENT OF ZOOLOGY
SCHOOL OF BASIC SCIENCES

SRM UNIVERSITY SIKKIM
TADONG, GANGTOK - 737102

DEPARTMENT OF ZOOLOGY
SCHOOL OF BASIC SCIENCE

1. **Department Vision Statement**	
Stmt. - 1	To create a world-class centre of advanced learning for research and skill development in the realm of Zoology.
Stmt. - 2	To provide a learner-centric, outcome-based model of higher education in Zoology and allied biological sciences in the North-East and other region of India.
Stmt. - 3	To make learning Zoology globally relevant in the ever-changing social, industrial, research and application scenario.

2. **Department Mission Statement**	
Stmt. - 1	To prepare young learners to explore the concepts and ideas of origin, evolution, mechanism of life-processes, and interaction between living and non-living factors in biology.
Stmt. - 2	To cultivate skill-based learning in students enabling them to apply the acquired knowledge in analysing and evaluating problems and innovating scientific solutions.
Stmt. - 3	To develop skilled human resources by empowering learners to be globally relevant, technologically competent and creative.
Stmt. - 4	Create a niched knowledge base for sustenance of the unique North Eastern Himalayan biodiversity.
Stmt. - 5	To cultivate scientific temperament along with sense of social responsibility, morality and unwavering ethics.

3.Program Education Objectives (PEO) **B.Sc. Zoology (Honours/Research) program offers a wide variety of courses after which the graduates will be able to:**	
PEO - 1	To provide a flexible learning platform to foster a discipline specific along with a multidisciplinary approach and better understanding of Zoology within a broader scientific context.
PEO - 2	To integrate modern technologies and tools into the curriculum and to accomplish a high degree of academic excellence in the areas like Classical Zoology, Immunology, Genetics, Cell and Molecular Biology.
PEO - 3	To cultivate a sense of ethical conduct, social responsibility, and environmental stewardship among students, and to actively contribute to the conservation and sustainable management of biodiversity of the North East Himalayan Region.
PEO - 4	To nurture entrepreneurial skills and enhance employability through continuous learning, hands-on laboratory experiments, fieldwork, and original research projects, vital for academic and real-world success.

1. Consistency of PEO's with Mission of the Department

	Mission Stmt. - 1	**Mission Stmt. - 2**	**Mission Stmt. - 3**	**Mission Stmt. - 4**	**Mission Stmt. - 5**
PEO - 1	**H**	**H**	**H**	**M**	**M**
PEO - 2	**H**	**H**	**H**	**M**	**H**
PEO - 3	**H**	**H**	**M**	**H**	**H**
PEO - 4	**H**	**H**	**H**	**H**	**H**

H – High Correlation, M – Medium Correlation, L – Low Correlation

2. Consistency of PO's with Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)										
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10	11
	Domain Specific Knowledge	Critical Thinking and Problem Solving	Inter and Multi-disciplinary	Lifelong learning	Research Aptitude	Creativity	Communication Skills	Innovation and Entrepreneurship	Vocational and Industry Exposure	Environmental awareness and sustainability	Ethics
PO - 1	H	H	H	H	H	M	M	H	M	H	H
PO - 2	H	H	H	H	H	M	M	M	M	H	H
PO - 3	H	H	H	H	H	M	M	H	M	H	H
PO - 4	H	H	H	H	H	H	M	H	H	M	H

Programme Structure (Total Credit: 160)

Discipline Specific Core Courses – (CO)						
S.No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	**T**	**P**	
1	ZOL23CO11	Biology of Non-Chordates	2	0	2	3
2	ZOL23CO12	Ecology	2	0	2	3
3	ZOL23CO21	Biology of Chordates	2	0	2	3
4	ZOL23CO22	Cell Biology	2	0	2	3
5	ZOL23CO31	Physiology of Life Processes	3	0	2	4
6	ZOL23CO32	Principles of Biochemistry	3	0	2	4
7	ZOL23CO41	Evolution	3	0	2	4
8	ZOL23CO42	Parasitology	3	0	2	4
9	ZOL23CO43	Biochemistry: Metabolic Processes	3	0	2	4
10	ZOL23CO51	Molecular Biology	3	0	2	4
11	ZOL23CO52	Applied Genetics	3	0	2	4
12	ZOL23CO53	Immunology	3	0	2	4
13	ZOL23CO54	Reproductive and developmental biology	3	0	2	4
14	ZOL23CO61	Applied Biotechnology	3	0	2	4
15	ZOL23CO62	Wildlife conservation and Management	3	0	2	4
16	ZOL23CO63	Fish and Fisheries	3	0	2	4
17	UNI23RP71	Research Methodology	2	0	4	4
18	UNI23RP72	Data Analytics & Statistical Application	2	0	4	4
19	UNI23RP73	Scientific Writing & Publication Ethics	3	0	2	4
20	ZOL23RP71	Domain specific research paper I	3	0	2	4
21	ZOL23RP72	Domain specific research paper II	3	0	2	4
		Total Credits				**80**

Minor – (MI)						
S.No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	**T**	**P**	
1	ZOL23MI01	Diversity of Non-Chordates	2	0	2	3
2	ZOL23MI02	Diversity of Chordates	2	0	2	3
3	ZOL23MI03	Animal Behaviour	3	0	2	4
4	ZOL23MI04	Human Reproductive Biology	2	0	2	3
5	ZOL23MI05	Biodiversity & Conservation Biology	2	0	2	3
6	ZOL23MI06	Applied Zoology	3	0	2	4
7	ZOL23MI07	Biology of Human Diseases	3	0	2	4
		Total Credits				**24**

Ability Enhancement Courses– (AE)						
S.No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	**T**	**P**	
1	UNI23AE02	Computer Skills: Fundamentals of Computer	1	0	2	2
2	UNI23AE01	Communicative English: Listening and Speaking Skills	1	0	2	2
3	UNI23AE04	Computer Skill: Internet & Information Communication Technologies	1	0	2	2
4	UNI23AE03	Communicative English: Reading and Writing Skills	1	0	2	2
		Total Credits				**08**

Skill Enhancement Courses– (SE)						
S.No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	**T**	**P**	
1	ZOL23SE13	Medical Laboratory Techniques	1	0	4	3
2	ZOL23SE23	Food Microbiology	1	0	4	3
3	ZOL23SE33	Sericulture	1	0	4	3
		Total Credits				**09**

Internship – (IN)						
S.No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
1	ZOL23IN64	Project & Internship	0	0	8	4
		Total Credits				**04**

Dissertation						
S.No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
1	UNI23RP81	Research Project (Research Proposal, Tools and Methods, Field work, Research Progress)	3	3	6	12
2	UNI23RP83	Research Paper and Dissertation	0	0	0	4
3	UNI23RP82	Presentation and Viva-voce	1	2	4	4
		Total Credits				**20**

Value Added Courses– (VA) (Students will select one course in the first semester and second course out of remaining four courses in the second semester)						
S.No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	**T**	**P**	
1	UN123VA01	Yoga Practices	1	1	2	3
2	UNI23VA02	Environmental science	2	0	2	3
3	UNI23VA03	Universal Human Values	1	1	2	3
4	UNI23VA04	Understanding India	2	0	2	3
5	UNI23VA05	National Service Scheme	2	0	2	3
		Total Credits				**06**

Multidisciplinary Courses– (MD) **(Multidisciplinary Courses to be offered by ZOOLOGY Department to other Department)**						
S. No	**Course Code**	**Course Name**	**Hours/Week**			**Credits**
			L	**T**	**P**	
1	ZOL23MD01	Medical Laboratory Technology-I (Basic techniques in medical laboratory)	2	0	2	3
2	ZOL23MD02	Medical Laboratory Technology-II (Skills in microbiology and immunology)	2	0	2	3
3	ZOL23MD03	Medical Laboratory Technology-III (Essentials of general and clinical pathology)	2	0	2	3
		Total Credits				**09**

Total Credit: 160

3. Course Structure - Distribution of different Courses in each semester with their credits for B.Sc ZOOLOGY (Honours / Research)

SEMESTER	Discipline Specific Core Courses (CO) (Total no. of Papers 21)	Minor Courses (MI) (Total no. of Papers 9)	Multi-Disciplinary Courses (MDC) (Total no. of Papers 3)	Ability Enhancement Courses (Total no. of Papers 4)	Skill Enhancement Course (SEC)) (Total no. of Papers 3)	Value Added Courses (Total no. of Papers 2)	Internship (Total no. of papers 1)	Dissertation (Total no. of papers 1)	Total Credits (Total Papers 44)
Sem I	2	1	1	1	1	**1**	-	-	20
Sem II	2	1	1	1	1	1	-	-	20
Sem III	2	1	1	1	1	-	-	-	20
Sem IV	3	2	-	1	-	-	-	-	20
Sem V	4	1	-	-	-	-	-	-	20
Sem VI	3	1	-	-	-	-	1	-	20
Sem VII	5	-	-	-	-	-	-	-	20
Sem VIII	-	-	-	-	-	-	-	(12+4+4) Credits)	20
Total Credits	**80**	**24**	**09**	**08**	**09**	**06**	**04**	**20**	**160**

1. Program Articulation Matrix

	Program Articulation Matrix	PLO- 1	PLO- 2	PLO- 3	PLO- 4	PLO- 5	PLO- 6	PLO-7	PLO-8	PLO-9		
Course Code	**Course Name**	Domain Specific Knowledge	Critical Thinking and Problem Solving	Inter and Multi-disciplinary Skills	Lifelong learning	Research Aptitude	Creativity	Communication Skills	Innovation and Entrepreneurship	Vocational and Industry Exposure	Environmental awareness and sustainability	Ethics
ZOL23CO11	Biology of Non-Chordates	H			H	H					H	
ZOL23CO12	Ecology	H	H	H	H	H		H			H	M
ZOL23MI01	Diversity of Non-Chordates	H			H	H					M	
UNI23AE01	Communicative English: listening and speaking skills	H		H	H		H	H				
ZOL23SE13	Medical Laboratory Techniques	H	M	H	M					H	M	H
ZOL23CO21	Biology of Chordates	H			H	H					H	
ZOL23CO22	Cell Biology	H	H	M		H						
ZOL23MI02	Diversity of Chordates	H			H	H					M	
UNI23AE02	Computer skills: fundamentals of computer	H	H	H		H		H	H			
ZOL23SE23	Food Microbiology	H				H			H	H	H	
ZOL23CO31	Physiology of Life Processes	H	H		H	H						M
ZOL23CO32	Principles of Biochemistry	H	H	M	H	H						M
ZOL23MI03	Animal Behaviour	H	H		H	H					H	
UNI23AE03	Communicative English: reading and writing skills	H	H	H	H		H	H				
ZOL23SE33	Sericulture	H		H		H			H	H		
ZOL23CO41	Evolution	H	H	H	H	H					H	
ZOL23CO42	Parasitology	H	H	H		H					H	
ZOL23CO43	Biochemistry: Metabolic Processes	H	H	H	H	H						
ZOL23MI04	Human Reproductive Biology	H	H		H	H						H
ZOL23MI05	Biodiversity & Conservation Biology	H	H	H	H	H					H	H
UNI23AE04	Internet & information communication technologies	H	H	H			H	H	M			
ZOL23CO51	Molecular Biology	H	H	H	H	H						
ZOL23CO52	Applied Genetics	H	H	H	H	H						
ZOL23CO53	Immunology	H	H	H	H	H						M
ZOL23CO54	Reproductive and developmental biology	H	H	H	H				M			M
ZOL23MI06	Applied Zoology	H		H	H	H			H	H	H	H
ZOL23CO61	Applied Biotechnology	H	H	H		M	M		H	H		
ZOL23CO62	Wildlife conservation and Management	H		H	H	H					H	H
ZOL23CO63	Fish and Fisheries	H		H		H			H	H	H	
ZOL23MI07	Biology of Human Diseases	H	H	H	H	H						
ZOL23IN64	Project	H	H	H	H	H	H	H	H	H	H	H
Value Added Courses												
UN123VA01	Yoga Practices	M	H	M	H	H	L	H	H	H		M
UNI23VA02	Environmental science	M	H	M	H	H	L	H	H	H		M

UNI23VA03	Universal Human Values	M	H	M	H	H	L	H	H	H		M
UNI23VA04	Understanding India	M	H	M	H	H	L	H	H	H		M
UNI23VA05	National Service Scheme	M	H	M	H	H	L	H	H	H		M

BSc. Zoology Curriculum

SEMESTER-I

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
Core	ZOL23CO11	Biology of Non-Chordates	2	0	2	3
Core	ZOL23CO12	Ecology	2	0	2	3
Minor	M1	Minor Course 1	2	0	2	3
Multi	MDC1	Multidisciplinary Course 1	2	0	2	3
AEC	UNI23AE01	Communicative English: listening and speaking skills	2	0	0	2
Skill	ZOL23SE13	Medical Laboratory Techniques	1	0	4	3
VAC	Students will select any one course in the first semester out following five					
	UN123VA01	Yoga Practices	1	1	2	3
	UNI23VA02	Environmental science	2	0	2	3
	UNI23VA03	Universal Human Values	1	1	2	3
	UNI23VA04	Understanding India	2	0	2	3
	UNI23VA05	National Service Scheme	2	0	2	3
		Sub Total				**20**

SEMESTER-II

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
Core	ZOL23CO21	Biology of Chordates	2	0	2	3
Core	ZOL23CO22	Cell Biology	2	0	2	3
Minor	M2	Minor Course 2	2	0	2	3
Multi	MDC2	Multidisciplinary Course 2	2	0	2	3
AEC	UNI23AE02	Computer skills: fundamentals of computer	2	0	0	2
Skill	ZOL23SE23	Food Microbiology	1	0	4	3
VAC	Students will select any one course in the second semester which was not opted in the first semester.					
	UN123VA01	Yoga Practices	1	1	2	3
	UNI23VA02	Environmental science	2	0	2	3
	UNI23VA03	Universal Human Values	1	1	2	3
	UNI23VA04	Understanding India	2	0	2	3
	UNI23VA05	National Service Scheme	2	0	2	3
		Sub Total				**20**

SEMESTER-III

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
Core	ZOL23CO31	Physiology of Life Processes	3	0	2	4
Core	ZOL23CO32	Principles of Biochemistry	3	0	2	4
Minor	M3	Minor Course 3	3	0	2	4
Multi	MDC3	Multidisciplinary Course 3	2	0	2	3
AEC	UNI23AE03	Communicative English: reading and writing skills	2	0	0	2
Skill	ZOL23SE33	Sericulture	1	0	4	3
		Sub Total				**20**

SEMESTER-IV

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
Core	ZOL23CO41	Evolution	3	0	2	4
Core	ZOL23CO42	Parasitology	3	0	2	4
Core	ZOL23CO43	Biochemistry: Metabolic Processes	3	0	2	4
Minor	M4	Minor Course 4	2	0	2	3
Minor	M5	Minor Course 5	2	0	2	3
AEC	UNI23AE04	Internet & information communication technologies	2	0	0	2
		Sub Total				**20**

SEMESTER-V

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
Core	ZOL23CO51	Molecular Biology	3	0	2	4
Core	ZOL23CO52	Principles of Applied Genetics	3	0	2	4
Core	ZOL23CO53	Immunology	3	0	2	4
Core	ZOL23CO54	Reproductive and developmental biology	3	0	2	4
Minor	M6	Minor 6	3	0	2	4
		Sub Total				**20**

SEMESTER-VI

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
Core	ZOL23CO61	Applied Biotechnology	3	0	2	4
Core	ZOL23CO62	Wildlife conservation and Management	3	0	2	4
Core	ZOL23CO63	Fish and Fisheries	3	0	2	4
Minor	M7	Minor 7	3	0	2	4
Skill	ZOL23IN64	Project	0	0	8	4
		Sub Total				**20**

SEMESTER-VII

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
RM1	UNIV23RP71	Research Methodology	2	0	4	**4**
RM2	UNIV23RP72	Data Analytics & Statistical Application	2	0	4	**4**
RM3	UNIV23RP73	Scientific Writing & Publication Ethics	3	0	2	**4**
RM4	ZOL23RP74	Domain specific research paper I	3	0	2	**4**
RM5	ZOL23RP75	Domain specific research paper II	3	0	2	**4**
		Sub Total				**20**

SEMESTER-VIII

Course Category	Course Code	Course Name	Hours/Week			Credits
			L	T	P	
RM6	UNI23RP81	Research Project (Research Proposal, Tools and Methods, Field work, Research Progress)	3	3	12	**12**
RM7	UNI23RP82	Presentation and Viva-voce	1	1	4	**4**
RM8	UNI23RP83	Research Paper and Dissertation	1	1	4	**4**
		Sub Total				**20**

Total Credits: 160

SEMESTER I

Course Code	ZOL23CO11	Course Name	Biology of Non-Chordates	Course Category	C		L	T	P	C
							2	0	2	3
Pre-Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Explain the general characteristic features of Protista and Porifera with special reference to locomotion and reproduction.	**1**	**H**			**H**	**H**					**H**	
CLO-2	Describe the basic structure, classification and functions of cnidaria and Ctenophora along with evolutionary significance.	**2**	**H**			**H**	**H**					**H**	
CLO-3	Elaborate the characteristic features of helminths, and describe parasitic adaptations and life cycle with preventive methods.	**3**	**H**			**H**	**H**					**H**	
CLO-4	Compare the characteristic features of phylum Annelida and Arthropoda.	**3**	**H**			**H**	**H**					**H**	
CLO-5	Summarize the characters and biological aspects of phylum Mollusca and Echinodermata	**4**	**H**			**H**						**H**	
			H			**H**	**H**					**H**	

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Taxonomy, Protista, Porifera Introduction to Binomial nomenclature, classification of the animal kingdom; General characteristics and Classification up to classes (C. Linnaeus). Study of Euglena, Amoeba and Paramecium; Locomotion in Amoeba; Reproduction in Paramecium; Spicules in sponges; Canal system in sponges. • Identification of whole mount of Euglena, Amoeba and Paramecium. • Identification of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla	9	1
2	UNIT II: Cnidaria, Ctenophora General characteristics and Classification up to classes (C. Linnaeus). Metagenesis in Obelia, Polymorphism in Cnidaria, Corals and coral reef; Economic importance of corals. • Identification of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Madrepora	9	2
3	UNIT III: Platyhelminthes, Nemathelminthes General characteristics and Classification up to classes (C. Linnaeus). Life cycle and pathogenicity of Fasciola hepatica, Taenia solium, Ascaris lumbricoides and Wuchereria bancrofti • Identification of adult Fasciola hepatica, Taenia solium • Identification of adult Ascaris lumbricoides	9	3
4	UNIT IV: Annelida, Arthropoda General characteristics and Classification up to classes (C. Linnaeus). Excretion in Annelida; Metamerism in annelids; parasitic adaptation of leech; Vision and Respiration in Arthropoda, Mouth parts of insects; Metamorphosis in insects – Butterfly; Peripatus and its affinities. • Identification of body setae- Earthworm • Identification of insect mouth parts- housefly/mosquito/honeybee/cockroach • Identification and dissection of digestive system and nervous system of Periplaneta americana	9	4
5	UNIT V: Mollusca and Echinodermata General characteristics and Classification up to classes (C. Linnaeus). Torsion and detorsion in Gastropoda, Economic importance of Mollusca- pearl formation in bivalves; Water-vascular system in star fish (Asteriodea); Larval forms in echinoderms and their significance. • Identification of Molluscs-Pila, Echinodermata-Star fish	9	5

Learning Resources	
Text Books	• Kotpal, R. L. (2012). Modern text book of Zoology: Invertebrates. Rastogi Publications. • Verma, P. S. (2001). Invertebrate Zoology (Multicolour Edition). S. Chand Publishing.
Ref. Books	• Barnes, R.S.K., Calow, P., Olive, P.I.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science • Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII edition. Holt Saunders International Edition.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50 %**	**50%**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50 %**	**50%**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
Dr. Jagdeep Singh, Consultant Scientist, MoIQ Laboratory Haryana jagdeeprajwndra@gmail.com	Dr. Surjya Kumar Saikia Associate Professor, Dept. of Zoology, Visva Bharati. surjyasurjya@gmail.com Dr. Sujay Ghosh Associate Professor, Dept. of Zoology, University of Calcutta. g.sujoy@gmail.com	Dr. Sudarshana Nandi, Assistant Prof. Department of Zoology sudarshana.s@srmus.edu.in Dr. Bijoy Chhetri, Assistant Prof. Department of Zoology bijoychhetri.b@srmus.edu.in Dr. Mandar Sengupta, Assistant Prof. Department of Zoology mandar.s@srmus.edu.in Dr. S. Thangapandiyan, Assistant Prof. Department of Zoology thangapandiyan.s@srmus.edu.in Dr. Harish Assistant Prof. Department of Zoology harish.k@srmus.edu.in Dr. Subhro Banerjee, Assistant Prof. Department of Zoology subhro.b@srmus.edu.in

Course Code	ZOL23CO12	Course Name	Ecology	Course Category	C		L	T	P	C
							2	0	2	3
Pre-Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define the history of ecology and levels of organization, analyse the role of limiting factors and define the different physical factors in ecosystem.	1	H			H	M					M	
CLO-2	Explain the principles of population dynamics and express the characters of populations.	2	H	H		H						M	M
CLO-3	Interpret community characters in ecology, describe succession and evaluate biodiversity in communities.	3	H	H		H			H			H	M
CLO-4	Analyze different types of food chains and food webs, energy flow and nutrient cycles in ecosystems.	3	H			H	H						
CLO-5	Implement ecology in wildlife conservation and plan wildlife management strategies.	4	H	H	H	H			H			H	M
			H	H	H	H	H		H			H	M

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Introduction to Ecology History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors- Liebig's Law of the minimum, Blackman's Law of limiting factors, Shelford Law of tolerance, Study of physical factors. • Determination of Dissolved Oxygen content (Winkler's method) • Chemical Oxygen Demand and free CO_2	9	1
2	UNIT II: Population Unitary and Modular populations Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion, exponential and logistic growth, equation and patterns, r and K strategies Population regulation - density-dependent and independent factors, Niche concept, Population interactions, Gause's Principle, Lotka-Volterra equation. • Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided	9	2
3	UNIT III: Community Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one example. • Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community	9	3
4	UNIT IV: Ecosystem Types of ecosystems with one example in detail, Food chain: Detritus and grazing food chains, Linear and Y-shaped food chains, Food web, Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Nitrogen cycle. • Study of an aquatic ecosystem: Phytoplankton and zooplankton	9	4
5	UNIT V: Wildlife Conservation Ecology in Wildlife Conservation and Management, In-situ and Ex – situ conservation (Biosphere Reserves, National Park, Wildlife Sanctuary, Reserve Forest, Sacred grooves, Gene Bank, Seed Bank), Ecosystem services, Biodiversity Hotspots, Geographical Information System (GIS). • Report on a visit to National Park/Biodiversity Park/Wild life sanctuary	9	5

Learning Resources	
Text Books	• Odum. E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole • Sharma P D. (2017) Ecology and Environment. Rastogi Publications ISBN 9789350781227, 9350781220Edition: ed. 3,
Ref. Books	• Robert Leo Smith . Ecology and Field biology. Harper and Row publisher • Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Pres

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50%**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50%**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
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Course Code	UNI23AE01	Course Name	COMMUNICATIVE SKILLS: LISTENING AND SPEAKING SKILLS	Course Category	AE	Ability Enhancement Course	L	T	P	C
							1	0	2	2
Pre-requisite			Nil	Co-requisite		Nil				

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Identify strategies to become appreciative and empathetic listeners.	2	H		H	H		H	H				
CLO-2	Demonstrate an understanding of essential grammar rules and its usage.	3	H		H	H		H	H				
CLO-3	Interpret accurately a range of non-verbal signals	6	H		H	H		H	H				
CLO-4	Analyze the basic features of business communication	4	H		H	H		H	H				
CLO-5	Communicate effectively in spoken English with fluency and accuracy	4	H		H	H		H	H				
	Average		**H**		**H**	**H**		**H**	**H**				
(Level of correlation: **3-High, 2-Medium, 1-Low** can be used)													

Summary of Course Content			
Sr. No	**Course Content**	**Hour**	**Alignment to CLO**
Unit I	**Listening Skills** Introduction to Listening Active and Passive Listening Types of Listening – Appreciative, Emphatic, Critical, Comprehensive, Superficial Traits of a good Listener Techniques of effective listening Barriers to listening Art of Questioning- Purpose of questioning, Characteristics of questioning, Techniques of questioning **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level) Classroom Activity: Listening to the news and making notes, listening to announcements, listening to speeches, listening to instructions and summarizing them, Asking questions leading to discussion, Participation in conversation through questioning.	9	CLO 1
Unit II	**Grammar Practice** Types and forms of verbs, Tense Forms and Subject Verb Agreement, Determiners, Prepositions of Time and Place, Active and Passive Voice **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level) Activity from Worksheet	9	CLO 2
Unit III	**Non-Verbal Communication** Definition, Significance of Non-verbal Signals Types of Nonverbal communication- Kinesics- Paralinguistic- Proxemics and Chronemics Do's and Don'ts, Learning from experts	9	CLO3
Unit IV	**Verbal Communication** Communication- Formal and Informal Effective communication- ABC and 7Cs of Communication Methods of Communication- Internal and External communication Networks of communication Vertical- horizontal- diagonal	9	CLO 4
Unit V	**Speaking Skills** Purposes of Speaking- Interpersonal, Formal and Semi Formal, Task Oriented, Persuasive Errors of Speech Conversation, Presentation, Interviews, Group Discussion, Public Speaking (Theory and Practice) **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level) Classroom Activity: Peer Introduction, Just a Minute, Role play, Product description (Adzap), Debate	9	CLO 5

Learning Resources	
Text Books	• Raman Meenakshi, Sangeeta Sharma, "Technical Communication Principles and Practice". Ed Second. Oxford University Press, Delhi, 2013. • Raman, Meenakshi, Prakash Singh, "Business Communication". Press, 2013 Edition. Oxford University.
Ref. Books	• Green,David. "Contemporary English Grammar Structures and Composition." Macmilllian Publisher India Ltd, Delhi, 2000. • Taylor, Shirley, V. Chandra. "Communicaton for Business. 4 2011 Ed. Dorling Kindersly India Pvt. Ltd.

Bloom's Level of Thinking		Continuous Internal Assessment (100% weightage)									
		CIA- 1 (25%) Unit Test- I		CIA- 2 (25%) Unit Test- II		CLA – 3 (25%) Unit Test - III		CLA – 4 (25%) Unit Test - IV		Final Examination	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember	15%	15%		20%	20%		30%		-	-
2	Understand	15%	15%		20%	20%	10%	20%		-	-
3	Apply		10%		30%		20%	20%	10%	-	-
4	Analyse	15%	15%		20%	20%	10%	10%	10%	-	-
5	Evaluate	-			10%	-				-	-
6	Create	-		-						-	-
	Total	100%		100%		100%		100%			

CIA – Each Unit Test will be conducted for 25 Marks. Best 4 of 5 tests will be considered.

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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Course Code	ZOL23SE13	Course Name	Medical Laboratory Techniques	Course Category	Skill Enhancement Course		L	T	P	C
							1	0	4	3
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define basic laboratory principles and hazards	1	H	M		M					H	M	
CLO-2	Elaborate common laboratory equipment	3	H	M	H						H		
CLO-3	Explain about Sample collection and processing	3	H	M							H	M	H
CLO-4	Analyze preparation of Buffers	4	H	M	H						H		
CLO-5	Implement of Biomedical waste management	5	H	M	H						H	M	H
			H	M	H	M					H	M	H

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Introduction to basic laboratory principles and hazards Basic Laboratory Principles - Code of Conduct of Medical Laboratory Personnel. Organization and Functioning of Clinical Laboratory, Regulatory agencies in clinical research Safety Measures – Safety Equipment's, Safety Symbols, Hazards in the Laboratory (Chemical Hazards, Clinical Hazards, Electrical Hazards, Biological Hazards. Waste Disposal. • Identification of hazard symbols • Identification of safety equipment	9	1
2	UNIT II: Common laboratory equipment Introduction of Common Laboratory Equipment's: Hot Air Oven, Incubator, Autoclave, Water Bath and Centrifuges; Microscope - Fundamentals of Microscopy, Resolution and Magnification, Light Microscopy, Electron Microscopy, PCR Machine (Thermal Cycler), Electrophoresis Unit and UV Trans Illuminator Etc. • Identification of different components of microscope • Demonstration of operation procedure of autoclave • Demonstration of operation procedure of hot air oven • Demonstration of operation procedure of incubator • Demonstration of operation procedure of water bath • Demonstration of operation procedure of centrifuge	9	2
3	UNIT III: Sample collection and processing Specimen Collection, Processing and Preservation of Blood, Urine, Stool, Sputum, Pus, Body Fluids and Swab techniques, Sources of Biological Variations and Pre-Analytical Variables. • Demonstration of basic cold chain management during sample collection • Preparation and staining of Blood Smears	9	3
4	UNIT IV: Buffers Preparation of Reagents: Buffers and pH, Normal, Percent and Molar Solution, Normal Saline -Methods of Measuring Liquids. Clinical Laboratory Records - Modern Laboratory Set Up - Quality Control: Accuracy, Precision, and Reference Values. • Preparation of buffers	9	4
5	UNIT V: Biomedical waste management Disposal of Biomedical Waste Laboratory Safety Protocols and Guidelines	9	5

Learning Resources	
Text Books	• Godkar, P. B., & Godkar, D. P. (2003). Textbook of medical laboratory technology. Bhalani. • Godkar, P. B., & Godkar, D. P. (2003). Textbook of medical laboratory technology. Bhalani.
Ref. Books	• Puneet Munjal. MCQ in Medical Laboratory Technology: Puneet Munjal • Ramnik Sood. Modern Medical Laboratory: Methods and interpretation.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (100% weightage)**								**Final Examination (0% weightage)**	
		CLA – 1 (25%)		**CLA – 2 (25%)**		**CLA – 3 (25%)**		**CLA – 4 (25%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50%**	**50%**	**30%**	**30%**	**30%**	**30%**	-	-
	Understand									-	-
Level 2	Apply	**50%**	**50%**	**50%**	**50%**	**40%**	**40%**	**40%**	**40%**	-	-
	Analyze									-	-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	-	-
	Create	-	-	-	-					-	-
		100%		**100%**		**100%**		**100%**		-	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
Dr. Jagdeep Singh, Consultant Scientist, MoIQ Laboratory Haryana jagdeeprajwndra@gmail.com	Dr. Surjya Kumar Saikia Associate Professor, Dept. of Zoology, Visva Bharati. surjyasurjya@gmail.com Dr. Sujay Ghosh Associate Professor, Dept. of Zoology, University of Calcutta. g.sujoy@gmail.com	Dr. Sudarshana Nandi, Assistant Prof. Department of Zoology sudarshana.s@srmus.edu.in Dr. Bijoy Chhetri, Assistant Prof. Department of Zoology bijoychhetri.b@srmus.edu.in Dr. Mandar Sengupta, Assistant Prof. Department of Zoology mandar.s@srmus.edu.in Dr. S. Thangapandiyan, Assistant Prof. Department of Zoology thangapandiyan.s@srmus.edu.in Dr. Harish Assistant Prof. Department of Zoology harish.k@srmus.edu.in Dr. Subhro Banerjee, Assistant Prof. Department of Zoology subhro.b@srmus.edu.in

SEMESTER II

Course Code	ZOL23CO21	Course Name	Biology of Chordates	Course Category	C	Core	L	T	P	C
							2	0	2	3
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define the concepts of chordates origin, theories, general characteristic features, classification and advanced features of vertebrates.	**1**	**H**			**H**						**H**	
CLO-2	Interpret the characteristics features, classification of Pisces	**2**	**H**			**H**						**H**	
CLO-3	Explain the characteristics features and classification of amphibia	**3**	**H**			**H**	**H**					**H**	
CLO-4	Elaborate the characteristics features and classification of Reptilia and Aves	**4**	**H**			**H**	**M**					**H**	
CLO-5	Summarize characteristics features and classification of mammals	**4**	**H**			**H**						**H**	
			H			**H**	**H**					**H**	

Summary of Course Content			
S. No	**Course Content**	**Hour**	**Alignment to CLO**
1.	UNIT I : Introduction to Chordates General characteristics and outline classification of Chordates upto class. General characteristics of Hemichordata, Urochordata Cephalochordata and its affinities; Retrogressive metamorphosis in Urochordata; • Protochordata and Agnatha • Specimen Identification - Balanoglossus, Herdmania, Branchiostoma,Petromyzon, Myxine; Sections of Amphioxus through pharyngeal, intestinal and caudal regions.	9	1, 2
2.	UNIT II: Pisces General characteristics of Chondrichthyes and Osteichthyes, Types of Scales, Migration in fish, Study of Scoliodon- Digestive and Reproductive system, Parental care in fishes, Economic importance of fishes; • Specimen Identification -Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas. Types of fish scales.	9	2
3.	UNIT III: Amphibia Origin of Tetrapoda (Evolution of terrestrial ectotherms), General characteristics and classification up to order, Parental care in Amphibians, Study of Rana tigrine- Digestive, Reproductive and Excretory system; • Specimen Identification - Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra.	9	2, 3
4.	UNIT IV: Reptilia and Aves General characteristics and classification up to order, Poison apparatus and Biting mechanism in snakes; Identification of poisonous and non-poisonous snakes; General characteristics and classification up to order, Archaeopteryx- a connecting link; Types of feathers, Flight adaptations and Migration in birds; • Specimen Identification - Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus • Study of six common birds from different orders. Types of beaks and claws of birds, pecten from Fowl head, Dissection of Fowl head (Dissections and mounts subject to permission)	9	2, 4
5.	Unit V: Mammals General characters and classification up to order; Affinities of Prototheria, Metatheria, Eutheria; Study of Rabbit-Digestive system; Placentation and dentition in Mammals; Flying and Aquatic mammals; • Study of six common Mammalia, Bat (Insectivorous and Frugivorous)	9	2, 4, 5

Learning Resources	
Text Books	• E.L. Jordan and P.S. Verma (2001). Chordate Zoology New edition Edition, S. Chand • Verma, P. S. (2010). Chordate zoology. S. Chand Publishing..
Ref. Books	• Kotpal, R. L. (2010). Modern text book of zoology: vertebrates. Rastogi Publications. • Young , J.Z. (2004). The Life of vertebrates. III Edition. Oxford university press

Learning Assessment												
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50 %**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50 %**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
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Course Code	ZOL23CO22	Course Name	Cell Biology	Course Category	C	Core	L	T	P	C
Pre Requisite			Nil	Co-requisite			2	0	2	3

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define the structure and function of Plasma Membrane with its various models.	**1**	**H**	**M**	**M**		**M**						
CLO-2	Explain about the Endomembrane System and its functions.	**2**	**H**		**M**								
CLO-3	Demonstrate the structure and functions of Mitochondria, Peroxisomes and Cytoskeleton.	**3**	**H**										
CLO-4	Evaluate the role of nucleus and structure of chromosome, its packaging and chromatin.	**3**	**H**		**M**								
CLO-5	Demonstrate the processes underlying cell cycle and its regulation and cell signalling.	**4**	**H**	**H**			**H**						
			H	**H**	**M**		**H**						

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Plasma Membrane Concept of plasma membrane structure, Fluid mosaic model, Transport across membranes: Active and Passive transport, facilitated transport, Cell junctions: Tight junctions, Desmosomes, Gap junctions, Endocytosis.	9	1
2	UNIT II: Endomembrane System Structure and Functions- Endoplasmic Reticulum; smooth endoplasmic reticulum and rough endoplasmic reticulum, Golgi Apparatus; protein sorting and secretion, Types and functions of Lysosomes.	9	2
3	UNIT III: Mitochondria, Peroxisomes and Cytoskeleton Mitochondria: Structure, Semi-autonomous nature, Endosymbiotic hypothesis Mitochondrial Respiratory Chain, Chemi-osmotic hypothesis, Peroxisomes, Structure and Functions of cytoskeleton; Microtubules, Microfilaments and Intermediate filaments.	9	3
4	UNIT IV: Nucleus Structure of Nucleus: Nuclear envelope, Nuclear pore complex and nuclear transport, Nucleolus, Chromatin: Euchromatin and Heterochromatin and packaging (nucleosome). • Preparation of permanent slide to show the presence of Barr body in human female blood cells/cheek cells.	9	4
5	UNIT V: Cell Division and Cell Signalling Mitosis, Meiosis, Cell cycle and its regulation, check points, signalling molecules and their receptors, G-Protein Coupled Receptor (GPCR), Role of secondary messenger (cAMP) and secretory pathway. • Preparation of temporary stained squash of onion root tip to study various stages of mitosis • Study of various stages of meiosis from grasshopper testes. • Cell viability study using dye exclusion method.	9	5

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50 %**	**50 %**	**50%**	**30 %**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50 %**	**50 %**	**50%**	**40 %**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30 %**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Learning Resources	
Text Books	• Halder, S, Dipak Kumar K. (2011) Cell Biology Genetics Molecular Biology. New Central Book Agency • P.K.Gupta. (2016) Cell Biology And Genetics: A text Book For Undergraduate Students. Rastogi. • Powar C. B. (2010) Cell Biology. Himalaya Publishing House
Ref. Books	• Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc.,New York and London. • Cooper, G.M. and Hausman, R.E. (2009). The cell: A Molecular Approach. V Edition. ASM Press and Sunderland, Wasington, D.C.; Sinauer Associates, MA • Karp, G.(2010). Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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Course Code	UNI23 AE02	Course Name	FUNDAMENTALS OF COMPUTER	Course Category	AEC	Ability Enhancement Course	L	T	P	C
							1	0	2	2
Pre-requisite				Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Introduce the concept computer fundamentals and digital media	1	H		M		M			H			
CLO-2	Demonstrate the use of office package and tools	3	H		M								
CLO-3	Apply the statistical tools on data sheets.	3	H		H		M			H			
CLO-4	Analyse the data through charts and graphs	3	H	H	H		H		H	H			
CLO-5	Create and design good presentation	6	H	H	H		H		H	H			
			H	**H**	**H**		**H**		**H**	**H**			

(Level of corre1ation: **3-High, 2-Medium, 1-Low** can be used)

Summary of Course Content			
S. No	**Course Content**	**Hour**	**Alignment to CLO**
1.	**Computer and its Applications:** **Introduction-** Practical application of computers in various fields e.g. business, banking, education, research, engineering etc. **Software & its types**- System software, Application Software, Free and Open Source Software; **Operating System**s- User Interface (CLI, GUI, Touch, Voice, Gesture based Interface), Functions of OS. Batch OS, Multiprogramming System, Multi-Processing System Time Sharing System, Online & Real-time OS; **Networking**- Importance of Networking, Topologies, LAN, WAN, Models (OSI & TCP/IP), Protocols.	9	CLO-1, 2
2.	**MS-Word**: **Introduction to MS Word:** overview of MS Word, getting started with word interface, creating, opening and saving documents, spell and grammar check, printing documents, using templates; **Page setting** – Document setup and layout, page orientation (portrait & landscape), page margins and size, page breaks, adding and editing headers and footers, page numbering; **Page Design and formatting** – text formatting(usage of different font styles, colors, size etc), paragraph formatting, styles and themes, text boxes , shapes, images and graphics, charts and symbols, page borders and shading, tables, watermarks; **Review-** Spelling & Grammar, Define, Thesaurus, word count, translate, language, comments.	9	CLO-3, 4
3.	**MS- Excel:** **Introduction to Microsoft Excel:** Overview of the Excel interface, Workbook, worksheets, and cells, Data entry and editing, using autofill, creating and saving workbooks, opening existing workbooks. **Formulas and Functions:** Basic arithmetic functions (SUM, AVERAGE, COUNT, MAX, MIN), logical functions (TRUE, FALSE, IF, AND, OR, and NOT), Date and time(DATE, DATEVALUE, DAY, EDATE ETC), Lookup & Reference (ADDRESS, AREAS, HYPERLINK, HLOOKUP, VLOOKUP,INDEX, COLUMNS, ROWS etc.), Text functions (CONCATENATE,CHAR, REPLACE,LEN, LEFT, RIGHT, MID etc.), Cell references (relative, absolute, mixed); **Data Formatting and Conditional Formatting:** Formatting cells (font, borders, fill color) Number formatting (currency, percentage, date), Conditional formatting rules (highlighting, data bars, color scales)	9	CLO-5
4.	**Advance MS-Excel:** **Data Sorting and Filtering:** Sorting data in Excel, Filtering data using AutoFilter and advanced filter, using custom filter criteria, filtering by color and icon sets; **Statistical Functions and Analysis:** Descriptive statistics (AVERAGE, STDEV, MEDIAN), Histograms and frequency distributions, Data analysis tools; **Working with dashboard and Linking sheets in Excel**: Hyperlinks, cell references, create data links from multiple worksheets; **Data Visualization:** Creating charts (bar, line, pie, scatter, etc.), Formatting and customizing charts	9	CLO-5

	Data Import and Export: Importing data from external sources (CSV, text files), exporting data to different formats.		
5.	**MS- PowerPoint:** **Getting started with power Point**-Power Point Presentation Interface, Create Presentation, Working with Presentation Layouts, Formatting Slides, Templates, Inserting Slides; **Advance Text Editing**- Indenting, Adding images and Clip, Animations, Slide Transition, Sounds; **Tables and Charts**- Creating tables in PowerPoint, formatting and customizing table elements, inserting charts for Data Visualization, modifying and customizing chart types, Inserting charts from Excels; **View Slides**-Slide navigation, normal view, slide sorter view, reading view, slide show	9	CLO-5

Learning Resources	
Text Books	• Balagurusamy, E. (2008). Computing fundamentals and C Programming. McGraw-Hill Education. • Rajaraman, V., & Adabala, N. (2014). Fundamentals of computers. PHI Learning Pvt. Ltd..
Ref. Books	• Sinha, P. K., & Sinha, P. (2010). Computer fundamentals. BPB publications.

Bloom's Level of Thinking		**Continuous Learning Assessment (40% weightage)**				**Open Assessment (60% weightage)**		**Final Examination**
		CLA1 (10)	**CLA2 (10)**	**CLA3 (10)**	**CLA4 (10)**	**Assignment/ Presentation (20)**	**Practical/ Viva voce/Field Visit (40)**	
1	Remember	**50%**	**25%**	**20%**	**10%**	**20%**	**10%**	**-**
2	Understand	**50%**	**25%**	**20%**	**10%**	**20%**	**10%**	**-**
3	Apply	**0**	**20%**	**10%**	**20%**	**10%**	**20%**	**-**
4	Analyze	**0**	**30%**	**10%**	**20%**	**10%**	**20%**	**-**
5	Evaluate	**0**	**0**	**20%**	**20%**	**20%**	**20**	**-**
6	Create	**0**	**0**	**20%**	**20%**	**20%**	**20**	**-**
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	

Course Designers		
Experts from Industry: Name, Designation with official mail id	Experts from Higher Education Institutions: Name, Designation with official mail id	Internal Experts: Name, Designation with official id
Mr. Bishnu Prasad Misra, Software Architect, Ericsson India Pvt. Ltd.	**Dr. Rashmita Khilar Professor, Department of IT, Saveetha School of Engineering, SIMATS**	**Dr. Om Prakash Sharma, Assistant Professor, Dept-IT, SRMUS**

Course Code	ZOL23SE23	Course Name	Food Microbiology	Course Category	Skill Enhancement Course		L	T	P	C
							1	0	4	3
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Explain the role of Microbes in Food Fermentations	2	H				H			H	H	M	
CLO-2	Elaborate the Role of Microbes in Spoilage of Foods	3	H				H				H	H	
CLO-3	Assess Microbial Agents of Food Borne Illness	3	H								H		
CLO-4	Analyse the Control of Microbes in Foods	3	H								H	H	
CLO-5	Analyse About Microbial Examination methods from Foods	3	H				H			H	H		
			H				H			H	H	H	

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	Unit I: Microbes in food fermentations Microbes of importance in food fermentations, – homo & hetero-fermentative bacteria, yeasts & fungi; biochemistry of fermentations – pathways involved, lactic acid bacteria fermentation and starter cultures, alcoholic fermentations - fungal fermentations. microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats. • To perform simple staining of bacteria. • Preparation of different types of bacterial culture medium. • Isolation of bacteria from fermented foods.	9	1
2	Unit II: Role of microbes in spoilage of foods Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. • To perform Gram staining of bacteria. • Isolation of bacteria and fungi from spoiled fruits and vegetables.	9	2
3	Unit III: Microbial agents of food borne illness Food borne infections and food poisoning, microbial toxins, Gram Negative and Gram-positive food borne pathogens; toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa. • Microbiological examination of soft drinks.	9	3
4	Unit IV: Control of microbes in foods Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates / propionates naturally occurring antimicrobials; physical methods- low and high temperatures, drying, radiation and high pressure.	9	4
5	Unit V: Microbial examination of foods Detection & Enumeration of microbes in foods; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens • Standard plate count of milk. • Determination of quality of milk sample by methylene blue reduction test. • Quality testing of milk by resazurin test.	9	5

Learning Resources	
Text Books	• Frazier, W. C., Marth, E. H., & Deibel, R. H. (1968). Laboratory manual for food microbiology. • Matthews, K. R., Kniel, K. E., & Montville, T. J. (2017). Food microbiology: an introduction. John Wiley & Sons.
Ref. Books	• Aneja, K. R. (2018). Modern Food Microbiology. Medtech A division of scientific international.

	• Foster, W. D. (2014). A history of medical bacteriology and immunology. Butterworth-Heinemann.

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination (0% weightage)	
		CLA – 1 (25%)		CLA – 2 (25%)		CLA – 3 (25%)		CLA – 4 (25%)			
		Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical
Level 1	Remember	50%	50%	50 %	50%	30 %	30%	30%	30%	-	-
	Understand									-	-
Level 2	Apply	50%	50%	50 %	50%	40 %	40%	40%	40%	-	-
	Analyze									-	-
Level 3	Evaluate	-	-	-	-	30 %	30%	30%	30%	-	-
	Create	-	-	-	-					-	-
		100%		100%		100%		100%		-	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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SEMESTER III

Course Code	ZOL23CO31	Course Name	Physiology of Life Processes	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define different types of tissue and elaborate their structure and functions.	**1**	**H**				**M**						
CLO-2	Evaluate the different structure and function of bone, cartilage and muscles.	**2**	**H**				**H**						
CLO-3	Express the structure and function of nervous system.	**3**	**H**	**H**		**H**	**H**						**M**
CLO-4	Analyse the structure and physiology of the reproductive system.	**4**	**H**			**H**	**H**						**M**
CLO-5	Elaborate the components and function of endocrine system.	**4**	**H**	**H**		**H**	**H**						
			H	**H**		**H**	**H**						**M**

Summary of Course Content			
S. No	**Course Content**	**Hour**	**Alignment to CLO**
1	UNIT I: Digestive System Structure and functions of gastrointestinal tract and associated glands; Mechanical and chemical digestion of food; Absorptions of carbohydrates, lipids, proteins, Hormonal control of secretion of enzymes in Gastrointestinal tract. • Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum, liver, pancreas.	12	1
2	UNIT II: Respiratory System Structural organization of Respiratory pathway, Mechanism of respiration, Pulmonary ventilation; Respiratory volumes and capacities; Transport of oxygen and carbon dioxide in blood; Dissociation curves and the factors influencing it; Control of respiration • Examination of sections of mammalian oesophagus, stomach, duodenum, ileum, rectum liver.	12	2
3	UNIT III: Circulatory System Components of blood and their functions, Structure and functions of haemoglobin, Haemostasis: Blood clotting system, Haemopoiesis, Structure of mammalian heart, Coronary circulation; Cardiac cycle; Cardiac output and its regulation, Electrocardiogram, Blood pressure and its regulation • Examination of sections of mammalian bone, cartilage • Experiment of determination of ABO Blood group Enumeration of red blood cells and white blood cells using haemocytometer • Estimation of haemoglobin using Sahli's haemoglobinometer • Preparation of haemin and haemochromogen crystals • Recording of blood pressure using a sphygmomanometer	12	3
4	UNIT IV: Excretory System Structure of kidney and its functional unit; Mechanism of urine formation; Regulation of water balance; Regulation of acid-base balance, Micturition. • Examination of sections of mammalian skin, trachea, lung, kidney, nerve cell, etc.	12	4
5	UNIT V: Muscular and Nervous system Ultra structure of skeletal muscle, Molecular and chemical basis of muscle contraction, Structure of neuron, Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers, Types of synapses, Synaptic transmission and Neuromuscular junction. • Examination of sections of mammalian skin, nerve cell etc.	12	5

Learning Resources	
Text Books	• Chatterjee C.C.(2012). Human Physiology (Volume 1) CBS • Verma, P. S., Tyagi, B. S., & Agarwal, V. K. (2000). Animal physiology. S. Chand Publishing.
Ref. Books	• Chatterjee C.C.(2012). Human Physiology (Volume 2) CBS • Guyton, A. C. (2006). Text book of medical physiology. China. • Tortora, G. J., & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50 %**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50 %**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
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Course Code	ZOL23CO32	Course Name	Principles of Biochemistry	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define fundamental biochemistry of carbohydrates.	1	**H**				**H**						
CLO-2	Explain the biochemistry of lipids and its importance.	2	**H**				**H**						
CLO-3	Interpret the types and role of protein in biology.	3	**H**				**H**						
CLO-4	Analyze the structure and function of DNA and RNA.	4	**H**	**H**	**M**	**H**	**M**						**M**
CLO-5	Explain the classification and function of enzyme and its kinetics.	4	**H**	**H**			**H**						
			H	**H**	**M**	**H**	**H**						**M**

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I : Carbohydrates Structure and Biological importance: Monosaccharides, Disaccharides, Polysaccharides and Glycoconjugates • Qualitative tests of functional groups in carbohydrates,	12	1
2	UNIT II : Lipids Structure and Significance: Physiologically important saturated and unsaturated fatty acids, Tri-acylglycerols, Phospholipids, Glycolipids, Steroids • Qualitative tests of functional groups in lipids.	12	2
3	UNIT III: Proteins Amino acids: Structure, Classification and General properties of α-amino acids; Physiological importance of essential and non-essential α-amino acids Proteins: Bonds stabilizing protein structure; Levels of organization in proteins; Denaturation; Introduction to simple and conjugate proteins Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants • Qualitative tests of functional groups in proteins. • Paper chromatography of amino acids • Demonstration of proteins separation by SDS-PAGE.	12	3
4	UNIT IV Nucleic Acids Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids Cot Curves: Base pairing, Denaturation and Renaturation of DNA Types of DNA and RNA, Complementarity of DNA, Hpyo-Hyperchromaticity of DNA • DNA Extraction and agarose gel electrophoresis	12	4
5	UNIT V: Enzymes Nomenclature and classification; Cofactors; Specificity of enzyme action; Isozymes; Mechanism of enzyme action; Enzyme kinetics; Factors affecting rate of enzyme-catalyzed reactions; Derivation of Michaelis-Menten equation, Concept of Km and Vmax, Lineweaver-Burk plot; Multi-substrate reactions; Enzyme inhibition; Allosteric enzymes and their kinetics; Regulation of enzyme action • Action of salivary amylase under optimum conditions. • Effect of pH, temperature and inhibitors on the action of salivary amylase.	12	5

Learning Resources	
Text Books	• Jain, J. L. (2004). Fundamentals of biochemistry. S. Chand Publishing. • Satyanarayana, U., & Chakrapani, U. (2020). Biochemistry, (Updated and Revised Edition)-E-Book. Elsevier India.
Ref. Books	• Nelson, D. L., & Cox, M. M. (2013) Lehninger Principles of Biochemistry 6th Edition • Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition,W.H.Freeman and Co., New York. • Watson,. J.D., Baker, T.A., Bell, S.P., Gann A., Levine, M. and Losick, R. (2008)Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, PearsonPub.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50%**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50%**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
Dr. Jagdeep Singh, Consultant Scientist, MoIQ Laboratory Haryana jagdeeprajwndra@gmail.com	Dr. Surjya Kumar Saikia Associate Professor, Dept. of Zoology, Visva Bharati. surjyasurjya@gmail.com Dr. Sujay Ghosh Associate Professor, Dept. of Zoology, University of Calcutta. g.sujoy@gmail.com	Dr. Sudarshana Nandi, Assistant Prof. Department of Zoology sudarshana.s@srmus.edu.in Dr. Bijoy Chhetri, Assistant Prof. Department of Zoology bijoychhetri.b@srmus.edu.in Dr. Mandar Sengupta, Assistant Prof. Department of Zoology mandar.s@srmus.edu.in Dr. S. Thangapandiyan, Assistant Prof. Department of Zoology thangapandiyan.s@srmus.edu.in Dr. Harish Assistant Prof. Department of Zoology harish.k@srmus.edu.in Dr. Subhro Banerjee, Assistant Prof. Department of Zoology subhro.b@srmus.edu.in

Course Code	UN123AE03	Course Name	Communicative Skills: Reading and Writing Skills	Course Category	AE	Ability Enhancement Course	L	T	P	C
							1	0	2	2
Pre-requisite			Nil	**Co-requisite**		Nil				

H	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Acquire the ability to read for a variety of purposes	3	H	M	M	H			H				
CLO-2	Demonstrate improved reading skills by comprehending and analyzing various types of written texts	4	H	M	M	H			H				
CLO-3	Produce well-structured written documents, including letters and essays.	6	H	H	H	H			H				
CLO-4	Practice the unique qualities of professional writing style	6	H	H	H	H		H	H				
CLO-5	Demonstrate practical writing skills for online and digital platform	6	H	H	H	H		H	H				
			H	**H**	**H**	**H**		**H**	**H**				
	Average												
(Level of correlation: **3-High, 2-Medium, 1-Low** can be used)													

Summary of Course Content			
Sr. No	**Course Content**	**Hour**	**Alignment to CLO**
Unit I	**Reading Skills** Types of Reading- Intensive, Extensive, Skimming, Scanning Reading for note making and summarizing Techniques of effective reading **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level) **Classroom Activity**: Reading articles and short stories and verbally summarizing them, reading newspapers and magazines and highlighting information, reading novels/ novella, Fictions of all types	9	CLO 1
Unit II	**Techniques in Reading Comprehension** Gathering main ideas and supporting details information from a given text Making inferences and drawing conclusions Evaluating these ideas and information Interpret the text **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level) Classroom Activity: Reading comprehension passages, reading reviews, reading and interpreting the content, identifying topic sentences, themes, key points	9	CLO 2
Unit III	**Writing Skills: Letters and Essays** Introduction and Importance of Writing Letter writing- Thank you and follow-up letter, complaint letter, inquiry letter, invitation letter, letter to the editor Essays and Article Writing **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level) Classroom Activity: Writing different kinds of letters, Essays and Article Writing	9	CLO3
Unit IV	**Professional Writing** Writing memo, notice, agenda and minutes of the meeting Types of Reports- Informational and Analytical Poster Making for Campaigns, Events, Ads **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level) Classroom Activity: framing notices and memos and agendas, jotting down minutes of the meeting, Interpretation of data (flow charts, figures and pictures)	9	CLO 4
Unit V	**Writing through Digital Media** NETTIQUETTE Emails- Formulation of email address, Understanding email format, composition of emails Resume- Written and Digital, Cover Letters, resume in LinkedIn Social Media- WhatsApp, Facebook, X, Instagram Blogging, Podcast **Activity Based Learning** Exercises from Language Lab (Intermediate & Proficient Level)	9	CLO 5

	Classroom Activity: Writing Emails, Resume, blogging, Podcast, Using Social Media		

Learning Resources	
Text Books	• .Raman Meenakshi, Sangeeta Sharma, (2013) "Technical Communication Principles and Practice". Ed Second. Oxford University Press, Delhi. • 2. Raman, Meenakshi, Prakash Singh. (2013)"Business Communication". Press, Edition. Oxford University
Ref. Books	• Green,David. 2000. "Contemporary English Grammar Structures and Composition." Macmilllian Publisher India Ltd, Delhi, • Taylor, Shirley, V. Chandra. 2011. "Communicaton for Business. 4 Ed. Dorling KIndersly India Pvt. Ltd.

Bloom's Level of Thinking		**Continuous Internal Assessment (100% weightage)**									
		CIA- 1 (25%) Unit Test- I		**CIA- 2 (25%) Unit Test- II**		**CLA – 3 (25%) Unit Test - III**		**CLA – 4 (25%) Unit Test - IV**		**Final Examination**	
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
1	Remember	15%	15%	10%	10%		20%		20%	-	-
2	Understand	15%	15%	10%	10%	10%	10%	10%	10%	-	-
3	Apply	10%	10%	20%	20%		30%		30%	-	-
4	Analyse	10%	10%	10%	10%	-		-		-	-
5	Evaluate	-				-		-		-	-
6	Create	-		-			30%		30%	-	-
	Total	**100%**		**100%**		**100%**		**100%**			

CIA – Each Unit Test will be conducted for 25 Marks. Best 4 out of 5 tests will be considered.

Course Designers		
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Course Code	ZOL23SE33	Course Name	Sericulture	Course Category	SEC		L	T	P	C
							1	0	4	3
Pre Requisite			Nil	Co-requisite		Nil				

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define different types and distribution of silkworms.	1	H				H			H	H		
CLO-2	Describe the biology and life cycle of silk worms.	2	H							H	H		
CLO-3	Organize the setup of a silkworm rearing house.	3	H							H	H		
CLO-4	Analyse and implement prevention and control of pests and diseases in silkworm rearing.	4	H		H		M			H	H		
CLO-5	Design a Sericulture set-up for developing entrepreneurship.	6	H		H		H			H	H		
			H		H		H			H	H		

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I : Introduction Sericulture: Definition, history and present status; Silk route; Sericulture map of India and World; Types of silkworms, Distribution and Races; Exotic and indigenous races; Mulberry and non-mulberry Sericulture. • Identification of mulberry and non-mulberry leafs (Subject to availability)	9	1
2	UNIT II : Biology of Silkworm Silk producing species and their distribution; morphology of Male and Female Bombyxmori; Life cycle of Bombyxmori; Structure of silk gland and secretion of silk; • Identification of male and female Bombyx mori (Subject to availability/Picture demonstration)	9	2
3	UNIT III : Rearing of Silkworms Selection of mulberry variety and establishment of mulberry garden, Rearing house and rearing appliances Disinfectants: Formalin, bleaching powder, RKO Silkworm rearing technology: Early age and Late age rearing Types of mountages, Spinning, harvesting and storage of cocoons • Demonstration of different types of silks and its important (Subject to availability/picture demonstration)	9	3
4	UNIT IV: Pests and Disease control Pests of silkworm: Uzi fly, dermestid beetles and other vertebrates; Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacteria; Control and prevention of pests and diseases. • Identification of silk worm pest (Subject to availability /Picture demonstration)	9	4
5	UNIT V: Entrepreneurship in Sericulture Prospectus of Sericulture in India: Sericulture industry in different states, employment; Role of women in sericulture employment; Sericulture centres in India and abroad. • Visit mulberry garden /villages practicing the sericulture (Within Sikkim state) • Industrial visit (silk manufacturing company/industry) by the students for mini project work.	9	5

Learning Resources	
Text Books	• Patnaik, R. K. (2008). Sericulture Manual. Daya Books. • Rearing, S. Disease of Silkworm, 1956, Ptd. By Director of Ptg., Stn & Pub. Govt. Press, Bangalore. • Ullal, S. R., & Narasimhanna, M. N. (1981). Handbook of practical sericulture. Central Silk Board.
Ref. Books	• Handbook of Silkworm Rearing: Agriculture and Technical Manual-1, (1972) Fuzi Pub. Co.Ltd., Tokyo, Japan1972. • Rearing, S. (1988). Wupang—Chun and Chen Da-Chung, Pub. By FAO, Rome.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (100% weightage)**								**Final Examination (0% weightage)**	
		CLA – 1 (25%)		**CLA – 2 (25%)**		**CLA – 3 (25%)**		**CLA – 4 (25%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	-	-
	Understand									-	-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	-	-
	Analyze									-	-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	-	-
	Create	-	-	-	-					-	-
		100%		**100%**		**100%**		**100%**		-	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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SEMESTER IV

Course Code	ZOL23CO41	Course Name	Evolution	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Describe different concept and theories of origin of life on earth.	1	H			M						H	
CLO-2	Explain the various evolutionary forces acting on populations and role of natural selection on population.	2	H			M						H	
CLO-3	Evaluate different mode of formation of new species and extinction of species	2	H			H	H					H	
CLO-4	Discuss the origin and evolution of man	3	H	H	H	H	H					H	
CLO-5	Construct phylogenetic tree `of evolutionary relationship species using bio-informatics	4	H	H	H	H	H					H	

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Introduction, Lamarckism, Darwinism, Neo-Darwinism, Evidences of Evolution, Life's Beginnings: Chemogeny, RNA world, Evolution of eukaryotes, Lamarckism, Darwinism, Neo-Darwinism, Types of fossils, transitional forms, geological time scale, three domains of life, neutral theory of molecular evolution, molecular clock, example of globin gene family, Heritable variations and their role in evolution. • Study of fossils from models/ pictures	12	1
2	UNIT II: Population Genetics Hardy-Weinberg Law, Evolutionary forces upsetting H-W equilibrium. Natural selection (mechanism of working, types of selection), genetic load, heterozygous superiority, kin selection, adaptive resemblances, sexual selection. Genetic Drift- founder's effect and bottleneck phenomenon. • Study of homology and analogy from suitable specimens • Study and verification of Hardy-Weinberg Law by chi square analysis • Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies	12	2
3	UNIT III: Product of evolution, Extinctions Micro evolutionary changes (inter-population variations, clines, races), Species concept, Isolating mechanisms, modes of speciation, Adaptive radiation / macroevolution (exemplified by Galapagos finches), Background and mass extinctions (causes and effects), detailed example of K-T extinction.	12	3
4	UNIT IV: Origin and evolution of man, Origin and evolution of man, Unique hominin characteristics contrasted with primate characteristics, primate phylogeny from Dryopithecus leading to Homo sapiens, evolution of horse.	12	4
5	UNIT V: Phylogenetic trees Phylogenetic trees-types and construction method, Multiple sequence alignment- local and global, interpretation of trees.	12	5

Learning Resources	
Text Books	• Rajeev Tyagi (2011) Understanding Evolutionary Biology Published by Discovery Publishing House Pvt. Ltd. • Rastogi VB (2017) Organic EvolutionMedtech
Ref. Books	• Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates. • Campbell, N.A. and Reece J.B (2011). Biology. IX Edition. Pearson, Benjamin,Cummings.

	• Hall, B.K. and Hallgrimson, B (2008). Evolution IV Edition. Jones and Barlett Publishers. • Ridley, M (2004) Evolution III Edition Blackwell publishing

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (40% weightage)								Final Examination (60% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (10%)		CLA – 4 (10%)			
		Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical
Level 1	Remember	50%	50%	50 %	50%	30%	30%	30%	30%	30%	-
	Understand										-
Level 2	Apply	50%	50%	50 %	50%	40%	40%	40%	40%	40%	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	30%	30%	30%	30%	30%	-
	Create	-	-	-	-						-
		100%		100%		100%		100%		100%	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
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Course Code	ZOL23CO42	Course Name	Parasitology	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define parasitism, parasite, parasitoid and vectors and explain host parasite interaction.	**1**	**H**		**H**		**M**					**M**	
CLO-2	Explain the morphology, life cycle, epidemiology, diagnosis and treatment of parasitic protists.	**2**	**H**		**H**		**M**					**H**	
CLO-3	Demonstrate morphology, life cycle, epidemiology, diagnosis and treatment of parasitic helminths.	**3**	**H**	**H**	**H**							**H**	
CLO-4	Analyse the biology and control measures of Parasitic Arthropods	**4**	**H**	**H**	**H**		**H**					**H**	
CLO-5	Evaluate the biology of vertebrate parasites producing suitable examples.	**4**	**H**	**H**	**H**		**H**					**H**	

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	UNIT I: Introduction to Parasitology Brief introduction to Parasitism, types of symbiosis, Host-parasite interaction, Parasite, Parasitoid and Vectors (mechanical and biological vector).	12	1
2.	UNIT II: Parasitic Protists Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Entamoeba histolytica, Leishmania donovani, Plasmodium vivax • Study of life stages of Entamoeba histolytica, Giardia intestinalis, Leishmania donovaniand Plasmodium vivax through permanent slides/micro photographs	12	2
3.	UNIT III: Parasitic helminthes Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment of Taenia solium, Ascaris lumbricoides, Wuchereria bancrofti; Parasitic adaptation in Fasciola hepatica. • Study of life history of Fasciolopsis buski, Schistosoma haematobium, Taenia solium through permanent slides/micro photographs	12	3
4.	UNIT IV: Parasitic Arthropoda Biology, importance and control of ticks, mites, Pediculus humanus(head and body louse), Xenopsyllacheopisand Cimex lectularius, Infectious diseases caused by parasitic arthropods, myasis. • Identification of infective stage of endoparasites (through permanent slides) • Identification of adult ectoparasite (through permanent slides)	12	4
5.	UNIT V: Parasitic Vertebrates A brief account of parasitic vertebrates; Cookicutter Shark, Candiru, Hood Mockingbird and Vampire bat, Vertebrates hosts of infectious diseases and zoonotic infections. • Collection and identification of intestinal parasites from the gut content of Poultry bird [Intestine can be procured from poultry/market as a byproduct] or cockroach.	12	5

Learning Resources	
Text Books	• K. D. Chatterjee (2009). Parasitology: Protozoology and Helminthology. XIII Edition, CBS Publishers & Distributors (P) Ltd. • Arora, D. R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributors • Rattan Lal Ichhpujani and Rajesh Bhatia. Medical Parasitology, III Edition, Jaypee Brothers Medical • 4.Ahmed, N., Dawson, M., Smith, C. and Wood, Ed. (2007) Biology of Disease. Taylor and Francis Group Publishers (P) Ltd., New Delhi
Ref. Books	• E.R. Noble and G.A. Noble (1982) Parasitology: The biology of animal parasites. V Edition, Lea &Febiger • 2.Meyer, Olsen & Schmidt's Essentials of Parasitology, Murray, D. Dailey, W.C. Brown Publishers

	• 3.Thomas C. Cheng (1986). General Parasitology, II Edition, Academic Press Inc

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (40% weightage)								Final Examination (60% weightage)	
		CLA – 1 (10%)		CLA – 2 (10%)		CLA – 3 (10%)		CLA – 4 (10%)			
		Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical	Theory	Practical
Level 1	Remember	50%	50%	50%	50%	30%	30%	30%	30%	30%	-
	Understand										-
Level 2	Apply	50%	50%	50%	50%	40%	40%	40%	40%	40%	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	30%	30%	30%	30%	30%	-
	Create	-	-	-	-						-
		100%		100%		100%		100%		100%	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
Dr. Jagdeep Singh, Consultant Scientist, MoIQ Laboratory Haryana jagdeeprajwndra@gmail.com	Dr. Surjya Kumar Saikia Associate Professor, Dept. of Zoology, Visva Bharati. surjyasurjya@gmail.com Dr. Sujay Ghosh Associate Professor, Dept. of Zoology, University of Calcutta. g.sujoy@gmail.com	Dr. Sudarshana Nandi, Assistant Prof. Department of Zoology sudarshana.s@srmus.edu.in Dr. Bijoy Chhetri, Assistant Prof. Department of Zoology bijoychhetri.b@srmus.edu.in Dr. Mandar Sengupta, Assistant Prof. Department of Zoology mandar.s@srmus.edu.in Dr. S. Thangapandiyan, Assistant Prof. Department of Zoology thangapandiyan.s@srmus.edu.in Dr. Harish Assistant Prof. Department of Zoology harish.k@srmus.edu.in Dr. Subhro Banerjee, Assistant Prof. Department of Zoology subhro.b@srmus.edu.in

Course Code	ZOL23CO43	Course Name	Biochemistry: Metabolic Processes	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite		ZOL1847				

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define biochemical reactions within a living cell and organism.	**1**	**H**										
CLO-2	Explain the structure and classification of carbohydrates and their importance for sustaining life.	**2**	**H**										
CLO-3	Express the metabolism of lipids and its importance.	**2**	**H**			**H**	**H**						
CLO-4	Evaluate the biochemical reactions of proteins and their significances.	**3**	**H**	**H**	**H**	**H**	**H**						
CLO-5	Analyze the process of ATP production and its role in biological systems.	**4**	**H**	**H**	**H**	**H**	**H**						

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	UNIT I: Overview of Metabolism Catabolism vs Anabolism, Stages of catabolism, Compartmentalization of metabolic pathways, Shuttle systems and membrane transporters; ATP as "Energy Currency of cell"; coupled reactions; Use of reducing equivalents and cofactors; Intermediary metabolism and regulatory mechanisms	12	1
2.	UNIT II: Carbohydrate Metabolism Sequence of reactions and regulation of glycolysis, Citric acid cycle, Phosphate pentose pathway, Gluconeogenesis, Glycogenolysis and Glycogenesis	12	2
3.	UNIT III: Lipid Metabolism β-oxidation and omega -oxidation of saturated fatty acids with even and odd number of carbon atoms; Biosynthesis of palmitic acid; Ketogenesis • To study the enzymatic activity of Lipase.	12	3
4.	UNIT IV: Protein Metabolism Catabolism of amino acids: Transamination, Deamination, Urea cycle; Fate of C-skeleton of Glucogenic and Ketogenic amino acids • To study the enzymatic activity of Trypsin • Estimation of total protein in given solutions by Lowry's method. • Detection of SGOT and SGPT or GST and GSH in serum/ tissue	12	4
5.	UNIT V Oxidative Phosphorylation Redox systems; Review of mitochondrial respiratory chain, Inhibitors and un-couplers of Electron Transport System • To perform the Acid and Alkaline phosphatase assay from serum/ tissue. • Dry Lab: To trace the labelled C atoms of Acetyl-CoA till they evolve as CO2 in the TCA cycle.	12	5

Learning Resources	
Text Books	• Jain, J. L. (2004). Fundamentals of biochemistry. S. Chand Publishing. • Satyanarayana, U., & Chakrapani, U. (2020). Biochemistry, (Updated and Revised Edition)-E-Book. Elsevier India
Ref. Books	• Nelson, D. L., & Cox, M. M. (2013) Lehninger Principles of Biochemistry 6th Edition • Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). Biochemistry, VI Edition,W.H.Freeman and Co., New York. • Watson,. J.D., Baker, T.A., Bell, S.P., Gann A., Levine, M. and Losick, R. (2008). Molecular Biology of the Gene, VI Edition, Cold Spring Harbor Lab. Press, Pearson Pub.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50%**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50%**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
Dr. Jagdeep Singh, Consultant Scientist, MoIQ Laboratory Haryana jagdeeprajwndra@gmail.com	Dr. Surjya Kumar Saikia Associate Professor, Dept. of Zoology, Visva Bharati. surjyasurjya@gmail.com Dr. Sujay Ghosh Associate Professor, Dept. of Zoology, University of Calcutta. g.sujoy@gmail.com	Dr. Sudarshana Nandi, Assistant Prof. Department of Zoology sudarshana.s@srmus.edu.in Dr. Bijoy Chhetri, Assistant Prof. Department of Zoology bijoychhetri.b@srmus.edu.in Dr. Mandar Sengupta, Assistant Prof. Department of Zoology mandar.s@srmus.edu.in Dr. S. Thangapandiyan, Assistant Prof. Department of Zoology thangapandiyan.s@srmus.edu.in Dr. Harish Assistant Prof. Department of Zoology harish.k@srmus.edu.in Dr. Subhro Banerjee, Assistant Prof. Department of Zoology subhro.b@srmus.edu.in

Course Code	UNI23AE04	Course Name	Internet & Information Communication Technologies	Course Category	AEC	Ability Enhancement Course	L	T	P	C
							1	0	2	2
Pre-requisite				**Co-requisite**						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	**Bloom's Learning (BL) Level**	1. **Domain Specific Knowledge**	2. **Critical Thinking and Problem Solving**	3. **Inter and Multi-disciplinary Skills**	4. **Lifelong learning**	5. **Research Aptitude**	6. **Creativity**	7. **Communication Skills**	8. **Innovation and Entrepreneurship**	9. **Vocational and Industry Exposure**	10. **Environmental awareness and sustainability**	11. **Ethics**
CLO-1	Introduce the concept of Internet, its applications	1	H	M	H			H	H	M			
CLO-2	Express the various types of email communications	2	H	M	H			H	H				
CLO-3	Demonstrate the use of ERP & ICT tools	3	H		H			H	H				
CLO-4	Access the University LMS	4	H		H			H	H	M			
CLO-5	Apply the ethical skills in social communication and research activity	5	H	H	H			H	H	M			
			H	**H**	**H**			**H**	**H**	**M**			

(Level of corre1ation: **3-High, 2-Medium, 1-Low** can be used)

Summary of Course Content			
S. No	**Course Content**	**Hour**	**A1ignment to CLO**
1.	**Basics of Internet:** **Internet overview**- Applications of Internet, Domain Name System, URLs; **Internet Services**- ISP, Accessing the internet website & bookmark, Searching information using Search engine, University internet services (STPI, GIO); **WWW**- Importance, Maintaining University Website, Web accessibility and usability, Accessing e-journals, e-books, Library module; **Open AI**- Tools and Utility Accessing sites or information repository for curriculum and research. Eg – Courseera, Nptel, Swayam etc.	9	CLO-1
2.	**Basics of E-mail: Email overview**- Providers, services, basics of email communication and terminology; **Working with email-** mail-id creation**,** e-mail operation, organizing emails in folders; **Email Features-** understanding the purpose of "To", "CC", "BCC", sending and receiving email attachments, filters and rules for email organization, Voice based Content; **Email Etiquettes**- email etiquette and professionalism guidelines, handling confidential information in emails; **University Mail-ids-** familiarity with the university email policies, compliance with security and data protection guidelines, admin, faculty, and students mail accounts, email groups and lists for collaborative communication.	9	CLO-2
3.	**Enterprise Resource Planning & Information and Communication technology in Educational Institutions:** **Projectors and Board Cameras**: Understanding the functionality and setup of projectors. Interactive whiteboards and their use in classrooms. Utilizing board cameras for document sharing and live annotation. Practical exercises on using projectors and board cameras. Connecting the Wi-Fi, connecting the HDMI cable. **Overview of ERP**: Introduction to Enterprise Resource Planning (ERP) systems. Role of ERPs in educational institutions for management and administration. Features and benefits of ERP software in streamlining operations. Case studies and practical examples of ERP implementations in education.	9	CLO-3
4.	**University Learning Management System:** **Overview of LMS**- Learning management system and its role in education, working of the university LMS, navigation, user roles, content creation, and assessment tools within an LMS. **Google Classroom-** overview of Google Class room , benefits and features, creation of classroom, adding and managing students, navigating through Google classroom-interface tour(Stream, classwork, people, grades), creating assignment, quizzes and questions, adding resources(docs, slides, links),posting announcements , Projects, Posting materials, grading , using rubrics, providing feedback. **Video conferencing tools:** Google-meet, zoom, Microsoft teams etc.	9	CLO-4
5.	**Social media & Plagiarism:**	9	CLO-5

	Social media platforms: overview of major platforms (Twitter, Facebook, LinkedIn, Instagram etc.), importance of social media in communication and networking; **Using social media effectively:** Creating and optimizing profiles, content creation and posting strategies, advertising, building and engaging with an audience, social media analytics and performance measurement **Social media communication ethics:** importance of ethical communication in social media, understanding online privacy, data protection and content, ethical considerations while sharing data, addressing cyberbullying and online harassment; **Plagiarism check-** practical usage of plagiarism detection software (e.g. drillbot), and interpreting reports to maintain originality in academic work, plagiarism detection and citation assistance; **Grammarly** - features, grammar and writing style improvement, integrating grammarly into different writing platforms.		

Learning Resources	
Text Books	• Joseph B. Miller MD. Internet Technologies and Information Services. • Margaret Leving Young. The Complete Reference to Internet.
Ref. Books	• Mario Freire & Manuela Pereira Internet Technology and Applications

Bloom's Level of Thinking		**Continuous Learning Assessment (40% weightage)**				**Open Assessment (60% weightage)**		**Final Examination**
		CLA1 (10)	**CLA2 (10)**	**CLA3 (10)**	**CLA4 (10)**	**Assignment/ Presentation (20)**	**Practical/ Viva voce/Field Visit (40)**	
1	Remember	**50%**	**25%**	**20%**	**10%**	**20%**	**10%**	**-**
2	Understand	**50%**	**25%**	**20%**	**10%**	**20%**	**10%**	**-**
3	Apply	**0**	**20%**	**10%**	**20%**	**10%**	**20%**	**-**
4	Analyze	**0**	**30%**	**10%**	**20%**	**10%**	**20%**	**-**
5	Evaluate	**0**	**0**	**20%**	**20%**	**20%**	**20**	**-**
6	Create	**0**	**0**	**20%**	**20%**	**20%**	**20**	**-**
	Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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SEMESTER V

Course Code	ZOL23CO51	Course Name	Molecular Biology	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	**Bloom's Learning (BL) Level**	**Program Learning Outcomes (PLO)**										
			1. Domain Specific Knowledge	**2. Critical Thinking and Problem Solving**	**3. Inter and Multi-disciplinary Skills**	**4. Lifelong learning**	**5. Research Aptitude**	**6. Creativity**	**7. Communication Skills**	**8. Innovation and Entrepreneurship**	**9. Vocational and Industry Exposure**	**10. Environmental awareness and sustainability**	**11. Ethics**
CLO-1	Define the basic concept on nucleic acid and its biological importance.	**1**	**H**			**H**							
CLO-2	Explain central dogma and its role in living organism.	**3**	**H**			**H**							
CLO-3	Demonstrate the mechanism of modification of protein and its role.	**4**	**H**	**H**	**H**								
CLO-4	Express gene regulation and its importance for sustain of life.	**4**	**H**	**H**	**H**		**H**						
CLO-5	Analyzing mechanism of repair system of DNA and regulation of RNA	**5**	**H**	**H**	**H**		**H**						

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Nucleic Acids Salient features and structure of DNA and RNA, Composition and types of DNA and RNA, Chargaff's rule, Watson and Crick model of DNA, Central Dogma. • Genomic DNA extraction, spectrophotometric estimation of DNA quantity and quality, Agarose gel electrophoresis. • RNA extraction, spectrophotometric estimation of RNA quantity and quality, Agarose gel electrophoresis.	12	1
2	UNIT II: DNA Replication and repair DNA Replication in prokaryotes, Semi-conservative, bidirectional and semi-discontinuous replication, RNA priming, Different types of DNA repair Mechanisms. • Demonstration of Polymerase chain reaction (PCR). • Study and interpretation of electron micrographs/ photograph showing DNA replication	12	2
3	UNIT III: Transcription and post transcriptional Modifications RNA polymerase and transcription Unit, mechanism of transcription in prokaryotes and eukaryotes, synthesis of rRNA and mRNA, transcription factors, Split genes: concept of introns and exons, splicing mechanism, alternative splicing, exon shuffling, and RNA editing. • Study and interpretation of electron micrographs/ photograph showing transcription	12	3
4	UNIT IV: Translation Genetic code, Wobble Hypothesis, Process of protein synthesis in prokaryotes: Ribosome structure and assembly in prokaryotes, fidelity of protein synthesis, aminoacyl tRNA synthetases and charging of tRNA; Proteins in initiation, elongation and termination of polypeptide chain; Inhibitors of protein synthesis; Prokaryotic and eukaryotic translation.	12	4
5	UNIT V: Gene regulations Transcription regulation in prokaryotes: Principles of transcriptional regulation with examples from lac operon and trpoperon; Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements; Gene silencing. • Study and interpretation of electron micrographs/ photograph showing split genes	12	5

Learning Resources	
Text Books	• Lewin B. (2008). Gene XI, Jones and Bartlett • De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and MolecularBiology. • VIII Edition. Lippincott Williams and Wilkins, Philadelphia. • **3.** Powar C. B. (2010) Cell Biology. Himalaya Publishing House
Ref. Books	• Cooper, G.M. and Hausman, R.E. (2009). The cell: A Molecular Approach. V • Edition. ASM Press and Sunderland, Wasington, D.C.; Sinauer Associates, MA. • De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and MolecularBiology. • VIIIEdition. Lippincott Williams and Wilkins, Philadelphia. • Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI • Edition. John Wiley and Sons. Inc.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50 %**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50 %**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
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		harish.k@srmus.edu.in Dr. Subhro Banerjee, Assistant Prof. Department of Zoology subhro.b@srmus.edu.in

Course Code	ZOL23CO52	Course Name	Applied Genetics	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define the genetic pattern of inheritance based on principles of Mendelian Law.	1	H				H						
CLO-2	Explain the molecular mechanism of crossing over, linkage, recombination frequency and Chromosomal mapping.	2	H	H		M	H						
CLO-3	Illustrate the cause of genetic diseases due to various types of gene mutation and evaluate the sex determination in Drosophila and Human.	4	H	H	H	M	H						
CLO-4	Demonstrate the transmission of extra-chromosomal inheritance and polygenic inheritance.	4	H	H	H		H						
CLO-5	Summarize transposable elements in bacteria and virus.	4	H	M	H	H	H						

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	UNIT I : Mendelian Genetics and its Extension Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Inheritance of sex-linked, sex-influenced and sex-limited characters. • Analysis of data using Mendelian laws and gene interactions.	12	1
2.	UNIT II : Linkage, Crossing Over and Chromosomal Mapping Linkage and crossing over, Molecular mechanisms of crossing over including models of recombination, Recombination frequency as a measure of linkage intensity, Two factor and three factor crosses, Interference and coincidence. • Chi-square analyses using seeds/beads/Drosophila. • Study of Polytene chromosomes from Chironomous / Drosophila larvae	12	2
3.	UNIT III: Mutations and Sex Determination Types of gene mutations, Types of chromosomal aberrations, Molecular basis of mutations in relation to physical and chemical mutagens, Chromosomal mechanisms of sex determination in Drosophila and Man • Study of human karyotype (normal and abnormal).	12	3
4.	UNIT IV: Extra-chromosomal Inheritance and Polygenic Inheritance Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces, Infective heredity in Paramecium, Maternal effects and maternal inheritance, Polygenic inheritance with suitable examples. • Pedigree analysis of some human inherited traits.	12	4
5.	UNIT V: Recombination in Bacteria, Viruses and Transposable Elements Conjugation, Transformation, Transduction, Complementation test in Bacteriophage, Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, Transposons in humans	12	5

Learning Resources	
Text Books	• Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of • Genetics. VIII Edition. Wiley India • Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of • Genetics. X Edition • Gupta Pk (2013) Genetics Classical To Modern. Rastogi Publications
Ref. Books	• Russell, P. J. (2009). Genetics- A Molecular Approach.III Edition. Benjamin • Cummings • Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John • Wiley and Sons Inc

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50 %**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50 %**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	- -	- -	- -	- -	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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Course Code	ZOL23CO53	Course Name	Immunology	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define the general concepts of Immunology.	**1**	**H**										
CLO-2	Explain the various types of adaptive immunity and its role in immune system.	**2**	**H**										
CLO-3	Elaborate the structure and functions of different types of immunoglobulins.	**3**	**M**	**H**		**H**	**M**						
CLO-4	Demonstrate the major histocompatibility complex and pathways of complement system.	**4**	**M**	**H**	**H**	**H**	**H**						
CLO-5	Summarize different types of hypersensitivity and vaccine production.	**5**	**H**	**M**	**H**	**H**	**H**						**M**

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	UNIT I: Overview of Immune System Historical perspective of Immunology, Cells and organs of the Immune system, Innate immunity- Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity • Demonstration of lymphoid organs. • Histological study of spleen, thymus and lymph nodes through slides/ photographs	12	1
2.	UNIT II: Adaptive Immunity Adaptive immunity (Cell mediated and humoral), Passive: Artificial and natural Immunity, Active: Artificial and natural Immunity, Immune dysfunctions (brief account of autoimmunity with reference to Rheumatoid Arthritis and tolerance, AIDS).	12	2
3.	UNIT III: Antigens and Immunoglobulins Antigenicity and immunogenicity, Adjuvants and haptens, B and T-Cell epitopes, Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA and RIA), Monoclonal and Polyclonal antibodies, Hybridoma technology. • Preparation of stained blood film to study various types of blood cells. • Ouchterlony's double immuno-diffusion method. • Demonstration of ELISA/ Immunoelectrophoresis.	12	3
4.	UNIT IV: Major Histocompatibility Complex, Cytokines and Complement System Structure and functions of MHC molecules. Endogenous and exogenous pathways of antigen processing and presentation, Properties and functions of cytokines, Complement system and its activation pathways.	12	4
5.	UNIT V: Hypersensitivity and Vaccines Introduction to hypersensitivity, Gell and Coombs' classification of hypersensitivity. Vaccines- Different types of vaccines, development of vaccines and its application.	12	5

Learning Resources	
Text Books	• Chakravarty AK Immunology and Immunotechnology oxford publisher • Ramesh. (2016) Immunology Mcgraw Higher Ed
Ref. Books	• Kindt, T. J., Goldsby, R.A., Osborne, B. A. and Kuby, J (2006). Immunology, VI Edition. W.H. Freeman and Company. • Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology. V Edition. Saunders Publication.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50 %**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50 %**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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Course Code	ZOL23CO54	Course Name	Reproductive and Developmental Biology	Course Category	E		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define the structure and function of male and female reproductive system.	**1**	**H**										
CLO-2	Explain early embryonic developmental events including gametogenesis, fertilization, etc.	**3**	**H**	**H**	**H**								
CLO-3	Demonstrate the idea of late embryonic development and different types of placentae and uterus.	**4**		**H**	**H**								**M**
CLO-4	Evaluate the post embryonic developmental process including metamorphosis and regeneration.	**4**	**H**	**H**	**H**	**H**				**M**			**M**
CLO-5	Summarize the modern technique and their role in developmental biology.	**5**	**M**	**H**	**H**	**H**				**M**			**M**

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Introduction to reproductive system Structural and functional aspects of Male and female reproductive system, physiology of spermatogenesis and oogenesis, structures of gametes, reproductive cycles-estrous and menstrual cycles, hormonal regulation of male and female reproduction.	12	1
2	UNIT II: Early Embryonic Development Types of eggs, Fertilization (External and Internal), Blocks to polyspermy; Planes and patterns of cleavage; Types of Blastula; Fate maps, Early development of frog and chick up to gastrulation; Embryonic induction and organizers • Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula, neurula, tail-bud stage, tadpole (external and internal gill stages) • Identification of whole mounts of developmental stages of chick through permanent slides.	12	2
3	UNIT III: Late Embryonic Development Fate of Germ Layers; Extra-embryonic membranes in birds; Types of uterus, Implantation of embryo in humans, Placenta (Structure, types and functions of placenta) • Study of histological types of placenta (photomicropgraph/ slides)	12	3
4	UNIT IV: Post Embryonic Development Metamorphosis: Changes, hormonal regulations in amphibians and insects; Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each). • Study of the developmental stages and life cycle of Drosophila from stock culture	12	4
5	UNIT V: Developmental biology and its Implications Teratogenesis: Teratogenic agents and their effects on embryonic development; In vitro fertilization, Concepts of Stem cell, Amniocentesis.	12	5

Learning Resources	
Text Books	• Das N. Fundamental Concepts of Developmental Biology Affiliated East-West Press Pvt. Ltd.-New Delhi • Verma P.S., Agarwal V.K. (2010) C hordate Embryology Paperback . S.Chand.
Ref. Books	• Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press • Carlson, R. F. Patten's Foundations of Embryology

	• Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates,Inc., Publishers, Sunderland, Massachusetts, USA Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers • Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50%**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50%**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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SEMESTER VI

Course Code	ZOL23CO61	**Course Name**	Applied Biotechnology	**Course Category**	C		**L**	**T**	**P**	**C**
							3	**0**	**2**	**4**
Pre Requisite			Nil	**Co-requisite**						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	**Bloom's Learning (BL) Level**	**Program Learning Outcomes (PLO)**										
			1. Domain Specific Knowledge	**2. Critical Thinking and Problem Solving**	**3. Inter and Multi-disciplinary Skills**	**4. Lifelong learning**	**5. Research Aptitude**	**6. Creativity**	**7. Communication Skills**	**8. Innovation and Entrepreneurship**	**9. Vocational and Industry Exposure**	**10. Environmental awareness and sustainability**	**11. Ethics**
CLO-1	Define the fundamental concept and scope of biotechnology	**1**	**H**										
CLO-2	Explain basic principles and applications of genetic engineering	**2**	**H**				**M**						
CLO-3	Illustrate the basic techniques in biotechnology	**3**	**H**		**H**		**H**	**M**		**H**	**H**		
CLO-4	Demonstrate basic techniques of animal cell culture.	**4**	**H**	**H**	**H**		**H**	**H**		**H**	**H**		
CLO-5	Evaluate the applications of biotechnology in the field of medicine, agriculture and environment.	**4**	**H**	**H**	**H**		**H**	**H**		**H**	**H**		
			H	**H**	**H**		**M**	**M**		**H**	**H**		

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Introduction to Biotechnology Biotechnology-concepts, types, Scope and applications of Biotechnology in Medicine, Industry and Environment.	12	1
2	UNIT II: Biotechnology in genetic engineering Cloning vectors- Plasmids, cosmids, lambda phage, Phage vectors, BAC and HAC; Restriction enzymes, Polymerases, DNA ligases, Recombinant DNA technology, Site-directed mutagenesis, CRISPR-CAS9, Transgenic organisms, Ethical issues and biosafety regulations. • Plasmid extraction by mini prep method • Restriction digestion of plasmid and agarose gel electrophoresis • Preparation of chemically competent cell • Bacterial transformation using heat-shock method.	12	2
3	UNIT III: Gene library and basic techniques in biotechnology Genomic library, cDNA, Methods of construction of cDNA Genomic library. Elementary idea of PCR and its application. Agarose and Polyacrylamide Gel Electrophoresis, Southern, Northern and Western blotting, DNA sequencing: Sanger method, DNA Fingerprinting and DNA microarrays. • Demonstration of blue -white screening and colony PCR.	12	3
4	UNIT IV: Basics of animal cell culture Basic techniques in animal cell culture and organ culture, Primary Culture and Cell lines, Culture media- Natural and Synthetic, Stem cells, Cryopreservation of cultures, Hybridoma technology.	12	4
5	UNIT V: Industrial biotechnology Bioreactors and fermentation technology, biotechnology of vaccine production, Production of bio-fuels, genetically modified crops, genetically modified micro-organism in bio-remediation. • Selection of bacterial strains using antibiotic resistance.	12	5

Learning Resources	
Text Books	• Gupta P.K. (2003) Biotechnology and Genomics, Rastogi publishers. • Singh B.D. (1998) Biotechnology, Kalyani publishers, (Reprint 2001).
Ref. Books	• Darling, D. C., & Morgan, S. J. (1994). Animal cells: culture and media. John Wiley & Sons. • Griffiths, A. J. (2005). An introduction to genetic analysis. Macmillan. • Wu, W., Zhang, H. H., Welsh, M. J., & Kaufman, P. B. (2003). Gene biotechnology. CRC Press.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50 %**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50 %**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
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Course Code	ZOL23CO62	Course Name	Wildlife Conservation and Management	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite		ZOL1866				

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Explain the knowledge of wild life conservation ethics, importance of wildlife conservation	1	H			M						H	
CLO-2	Elaborate the different physical and biological parameters of wildlife.	2	H			H						H	
CLO-3	Assess wildlife threat status and management mechanism using various modern technologies.	3	H		H	H	M					H	H
CLO-4	Analyse, compile and compute data on different attributes of population.	4	H		H	H	H					M	M
CLO-5	Apply the in-depth knowledge of different national parks, tiger reserves and sanctuaries of India.	5	M		H	H	H					H	H

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1	UNIT I: Introduction to Wild Life Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies. • Identification of flora, mammalian fauna, avian fauna, herpeto-fauna	12	1
2	UNIT II: Evaluation and management of wild life Physical parameters: Topography, Soil and water; Biological Parameters: food, forage, cover estimation; Standard evaluation procedures: remote sensing and GIS. • Demonstration of basic equipment needed in wildlife studies use, care and maintenance (Compass, Binoculars, Spotting scope, Range Finders, Global Positioning System, Various types of Cameras and lenses)	12	2
3	UNIT III: UNIT III: Basic concept of wildlife biology Definition and importance of wildlife; Threatened wildlife and IUCN status - Concept of Extinct, Critically Endangered, Endangered, Vulnerable and rare species; Red data book	12	3
4	UNIT IV: Basic concept of wildlife conservation Aims & Objectives of wildlife conservation; in-situ and ex-situ conservation; Biosphere Reserves, Biodiversity hotspots. Wildlife conservation Indian perspective: Threats to wildlife conservation in India; Conservation status, habit & habitat, threats and conservation management of the following animals; Himalayan salamander/ / Great Indian bustard / Himalayan musk deer/Greater one-horned rhinoceros /Bengal Tiger/Red Panda/Snow leopard • Demonstration of different field techniques for flora and fauna • Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).	12	4
5	UNIT V: Legal framework of biodiversity and Wildlife in India: Indian Forest (Conservation) Act 1980, Wild Life Protection Act (1972) and amendments, Biodiversity Act 2002, Wild Life Crime Bureau India. Tiger conservation-Tiger reserve in India, management and challenges in Tiger reserve, eco-tourism/ wildlife tourism in forest.	12	5

Learning Resources	
Text Books	• Balakrishnan M. (2016) Wildlife Ecology and Conservation. Scientific Publishers • Biology and Wildlife Management: Exercises for Class, Field, and Laboratory. Blackwell Publishing. • Hunter M.L., Gibbs, J.B. and Sterling, E.J. (2008). Problem-Solving in Conservation
Ref. Books	• Caughley, G., and Sinclair, A.R.E. (1994). Wildlife Ecology and Management.Blackwell Science. • Sutherland, W.J. (2000). The Conservation Handbook: Research, Management and Policy. Blackwell Sciences.

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50%**	**50%**	**50 %**	**50%**	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50%**	**50%**	**50 %**	**50%**	**40%**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
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		Dr. Subhro Banerjee, Assistant Prof. Department of Zoology subhro.b@srmus.edu.in

Course Code	ZOL23CO63	Course Name	Fish and Fisheries	Course Category	C		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Explain general characteristic of fish and describe the classification.	1	H										
CLO-2	Write about the morphology of fish and explain the detailed physiological process.	2	H							M			
CLO-3	Evaluate the essential concept of different types of fisheries and recent modern applications in fisheries.	3	H	H						H	H		
CLO-4	Demonstrate and create the concept of different aquacultural practices and its management.	4	H				H			H	H		
CLO-5	Apply the overall ideas of fish research with the elaboration of transgenic fish.	5	H		H		H			H	H		
			H		H		H			H	H	H	

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
	UNIT I: Introduction and Classification: General description of fish; Account of systematic classification of fishes (upto classes); Classification based on feeding habit, habitat and manner of reproduction. • Study of Petromyzon, Myxine, Pristis, Chimaera, Exocoetus, Hippocampus, Gambusia, Labeo, Heteropneustes, Anabas	12	1
	UNIT II: Morphology and Physiology: Types of fins and their modifications, Types of Scales, Use of scales in Classification and determination of age of fish; Gills and gas exchange; Swim Bladder, Osmoregulation in Elasmobranchs; Electric organs; Bioluminiscience; Mechanoreceptors; Schooling; Parental care; Migration • Study of different types of scales (through permanent slides/ photographs).	12	2
	UNIT III: Fisheries Growth analysis of fish, length weight relationship, influence of environmental factors in fish growth, Fish stock maintenance and assessment, Inland Fisheries; Marine Fisheries; Fishing crafts and Gears; Application of remote sensing and GIS in fisheries; Fisheries law and regulations. • Growth analysis of Indian major carps, Geometric morphometry analysis of fish, Study of feeding ecology of fish. • Study of crafts and gears used in Fisheries.	12	3
	UNIT IV: Aquaculture Sustainable Aquaculture; Extensive, semi-intensive and intensive culture of fish; Pen and cage culture; Polyculture; Composite fish culture; Brood stock management; Induced breeding of fish; Finfish culture, Aquarium fishes of NE India; Preparation of compound diets for fish. • Determination of DO, Turbidity, Carbon di oxide, Hardness.	12	4
	UNIT V: Fish in research Transgenic fish, Zebrafish as a model organism in research, Fish diseases: Bacterial, viral and parasitic; Preservation and processing of harvested fish, Fishery by-products, Benefits of small fish species.	12	5

Learning Resources	
Text Books	• Srivastava, CBL. Fish Biology, (2001) Narendra Publishing House • Khanna S.S. and Singh H.R. (2002) A text book of Fish Biology and Fisheries, Narendra Publishing House.
Ref. Books	• Bone Q and Moore R, Biology of Fishes, Talyor and Francis Group, CRC Press, U.K. • Evans D.H. and Claiborne J.D. (2014) The Physiology of Fishes, Taylor and Francis Group, CRC Press, UK von der Emde, R.J. Mogdans and B.G. Kapoor

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50 %**	**50 %**	**50%**	**30 %**	**30%**	**30%**	**30%**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50 %**	**50 %**	**50%**	**40 %**	**40%**	**40%**	**40%**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30 %**	**30%**	**30%**	**30%**	**30%**	-
	Create	-	-	-	-						-
		100%		**100%**		**100%**		**100%**		**100%**	-

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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Syllabus for Minor Subjects offered by Department of Zoology

Course Code	**ZOL23MI01**	**Course Name**	**Diversity of Non-Chordates**	**Course Category**	MI		**L**	**T**	**P**	**C**
							2	**0**	**2**	**3**
Pre Requisite			Nil	**Co-requisite**						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	**Bloom's Learning (BL) Level**	**Program Learning Outcomes (PLO)**										
			1. Domain Specific Knowledge	**2. Critical Thinking and Problem Solving**	**3. Inter and Multi-disciplinary Skills**	**4. Lifelong learning**	**5. Research Aptitude**	**6. Creativity**	**7. Communication Skills**	**8. Innovation and Entrepreneurship**	**9. Vocational and Industry Exposure**	**10. Environmental awareness and sustainability**	**11. Ethics**
CLO-1	Explain the general characteristic features of Protista and Porifera with special reference to locomotion and reproduction.	**1**	**H**			**M**							
CLO-2	Describe the basic structure, classification and functions of cnidaria and Ctenophora along with evolutionary significance.	**2**	**H**			**M**						**M**	
CLO-3	Elaborate the characteristic features of helminths, and describe parasitic adaptations and life cycle with preventive methods.	**3**	**H**			**H**						**M**	
CLO-4	Compare the characteristic features of phylum Annelida and Arthropoda.	**4**	**H**			**H**	**H**						
CLO-5	Summarize the characters and biological aspects of phylum Mollusca and Echinodermata	**5**	**H**			**H**	**H**						

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	**UNIT I: Protista, Porifera** General characteristics features and Classification up to classes- Study of Amoeba, Euglena, and Paramecium; Locomotion in amoeba; Reproduction in paramecium; Canal system in sponges, Spicule in sponges. • Identification and whole mount of Euglena, Amoeba and Paramecium. • Identification of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla	9	1
2.	**UNIT II:, Cnidaria, Ctenophora** General characteristics and Classification up to classes Metagenesis in Obelia, Polymorphism in Cnidaria, Corals and coral reefs, Economic importance of corals. • Identification of Obelia, Physalia, Millepora, Aurelia, Tubipora, Corallium, Alcyonium, Gorgonia, Metridium, Pennatula, Fungia, Meandrina, Madrepora; One specimen/slide of any ctenophore	9	2
3.	**UNIT III: Platyhelminthes, Aschelminthes** General characteristics and Classification up to classes Life cycle and pathogenicity of Fasciola hepatica, Taenia solium, Ascaris lumbricoides and Wuchereria bancrofti. • Identification and whole mount of Fasciola hepatica/Taeniasolium/ Ascarislumbricoides	9	3
4.	**UNIT IV: Annelida, Arthropoda** General characteristics and Classification up to classes Digestion in Annalids-Earthworm; Metamorphism in annelids; Prawn appendages and respiration; Mouth parts of insects; Metamorphosis in Insects. • Identification and whole mount of body seta-Earth worm. • Mount of mouth parts and dissection of digestive system and nervous system of Periplaneta	9	4
5.	**UNIT V: Mollusca and Echinodermata** General characteristics and Classification up to classes; Torsion and detorsion in Gastropoda, Pearl formation in bivalves; Water-vascular system in Asteriodea; Echinoderm larvae and their significance. • Identification of Molluscs (Pila, Oyster, muscle), • Identification of echinoderms (Star fish,)	9	5

Learning Resources	
Text Books	• Verma, P. S. (2001). Invertebrate Zoology (Multicolour Edition). S. Chand Publishing. • 2. Kotpal, R. L. (2012). Modern text book of Zoology: Invertebrates. Rastogi Publications.
Ref. Books	• Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII edition. Holt Saunders • International Edition. • Barnes, R.S.K., Calow, P., Olive, P.I.W. and Spicer, J.I. (2002). The Invertebrates: A • New Synthesis, III Edition, Blackwell Science

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	

Course Designers		
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Course Code	ZOL23MI02	Course Name	Diversity of Chordates	Course Category	MI		L	T	P	C
							2	0	2	3
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			Domain Specific Knowledge	Critical Thinking and Problem Solving	Inter and Multi-disciplinary Skills	Lifelong learning	Research Aptitude	Creativity	Communication Skills	Innovation and Entrepreneurship	Vocational and Industry Exposure	Environmental awareness and sustainability	Ethics
CLO-1	Define the concepts of chordates origin, theories, general characteristic features, classification and advanced features of vertebrates.	1	H			M							
CLO-2	Interpret the characteristics features, classification of Pisces and Amphibia	2	H			M						M	
CLO-3	Explain the characteristics features and classification of Reptiles and Aves.	3	H			H						M	
CLO-4	Elaborate the characteristics features and classification of Mammals.	4	H			H	H						
CLO-5	Summarize zoogeographical realms.	5	H			H	H					M	

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	**UNIT I: Introduction to Chordates** General characteristics and outline classification of Chordates upto class; Origin of chordates; Prochordates: General Character and affinities of Hemichordata, Cephalochordata and Urochordata. • Protochordata and Agnatha: Identification with reason of the Specimen -Balanoglossus, Herdmania, Branchiostoma, Petromyzon, Myxine; Sections of Amphioxus through pharyngeal, intestinal and caudal regions.	9	1
2.	**UNIT II: Pisces** General characteristics of Chondrichthyes and Osteichthyes, Respiration in Gills-Shark, Types of Scales in fishes; Migration, Parental care in fishes. • Pisces: Specimen Identification - Scoliodon, Sphyrna, Pristis, Torpedo, Chimaera, Mystus, Heteropneustes, Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas. Types of fish scales.	9	2
3.	**UNIT III: Amphibia** Origin of Tetrapoda; General characteristics and classification up to order; Parental care in Amphibians; Reproduction in Amphibia-Life cycle of tadpole larva • Amphibia and Reptiles: Specimen Identification - Ichthyophis/Ureotyphlus, Necturus, Bufo, Hyla, Alytes, Salamandra.	9	3
4.	**UNIT IV: Reptiles** General characteristics and classification up to order; Affinities of Sphenodon; Poison apparatus and Biting mechanism in snakes; Identification of Poisonous and non-poisonous snake. • Reptiles: Specimen Identification - Chelone, Trionyx, Hemidactylus, Varanus, Uromastix, Chamaeleon, Ophiosaurus, Draco, Bungarus, Vipera, Naja, Hydrophis, Zamenis, Crocodylus	9	4
5.	**UNIT V: Aves and Mammals** General characteristics and classification up to order, Archaeopteryx- a connecting link; Types of feathers, Flight adaptations and Migration in birds; General characters and classification up to order; Affinities of Prototheria; Dentition in Mammals; Flying and aquatic mammals. • Identify and Study of six common birds from different orders; Types of beaks and claws of birds, • Dissection of Rats and display the digestive system, reproductive and excretory system (Dissections and mounts subject to permission); Study of six common Mammalia, Bat (Insectivorous and Frugivorous)	9	5

Learning Resources	
Text Books	• E.L. Jordan and P.S. Verma (2001). Chordate Zoology New edition Edition, S. Chand • Verma, P. S. (2010). Chordate zoology. S. Chand Publishing.
Ref. Books	• Kotpal, R. L. (2010). Modern text book of zoology: vertebrates. Rastogi Publications. • Young, J.Z. (2004). The Life of vertebrates. III Edition. Oxford university press

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
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		Department of Zoology subhro.b@srmus.edu.in

Course Code	ZOL23MI03	Course Name	Animal Behaviour	Course Category	MI		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. Critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Explain about general concept and mechanism of animal behaviour.	1	H			M	.					H	
CLO-2	Elaborate about patterns of behaviour.	2	H			M						H	
CLO-3	Evaluate social behaviour among different animals.	3	H			H						H	
CLO-4	Analyze different types of sexual behaviour with suitable example.	4	H	H		H	H					H	
CLO-5	Construct the function, structure and role of biological clock.	5	H	H		H	H						

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	**UNIT 1: INTRODUCTION AND MECHANISMS OF BEHAVIOUR** Origin and history of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behavior; Objective of behaviour, Behaviour as a basis of evolution; Behaviour as a discipline o science; Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Code breakers. • Demonstration of different types of behaviour in animals using audio-visual aids.	12	1
2.	**UNIT 2: PATTERNS OF BEHAVIOUR** Reflexes: Types of reflexes, reflex path, characteristics of reflexes (latency after discharge, summation, fatigue, inhibition) and its comparison with complex behaviour. Orientation: Primary and secondary orientation; kinesis taxis. Learning: Associative learning, classical and operant conditioning Habituation and Imprinting. • Behavioural studies in butterflies. • To study geotaxis/ phototaxis behaviour	12	2
3.	**UNIT 3: SOCIAL BEHAVIOUR** Insects' society; Honey bee: Society organization, polyethism, foraging, round dance, waggle dance, learning ability in honey bee, formation of new hive/queen; Reciprocal altruism, Hamilton's rule and inclusive fitness with suitable examples. • Study of social behaviour in insects	12	3
4.	**UNIT 4: SEXUAL BEHAVIOUR** Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (malerivalry), Inter-sexual selection (female choice), Infanticide Consequences of mate choice for female fitness, Sexual conflict for male versus female parental care, Courtship behaviour. • Study of mimicry and colouration through photographs. • Territorial behaviour in stray dogs.	12	4
5.	**UNIT 5: BIOLOGICAL CLOCKS** Circadian rhythm, Tidal rhythm, Lunar rhythm, Advantages of biological clocks, Jet lagand Entrainment. Development and genetic basis of behaviour Hormone-brain relationship. • Field visit and submission of reports on observed animal behaviour	12	5

Learning Resources	
Text Books	• Aubrey Manning; (2016) An Introduction to Animal Behaviour South Asia Edition 6th Ed Cambridge University Press India Private Limited • John Alcock, (2009) Animal Behaviour: An Evolutionary Approach, 9th Edition. Sinauer Associate Inc., USA.
Ref. Books	• Drickamer& Vessey (1986) Animal Behaviour –Concepts, Processes and Methods (2nd ed.), Wadsworth. • Dustin R. Rubenstein and John Alcock, Sinauer 2018. Animal Behaviour (11th Edition); Associate Inc., USA,

	• Gadagkar;(1998) Survival Strategies-Cooperation and Conflict in Animal Societies. Universities Press, • Goodenough (1993) Perspectives on Animal Behaviour, Wiley,

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
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Course Code	ZOL23MI04	Course Name	Human Reproductive Biology	Course Category	MI		L	T	P	C
							2	0	2	3
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			12. Domain Specific Knowledge	13. Critical Thinking and Problem Solving	14. Inter and Multi-disciplinary Skills	15. Lifelong learning	16. Research Aptitude	17. Creativity	18. Communication Skills	19. Innovation and Entrepreneurship	20. Vocational and Industry Exposure	21. Environmental awareness and sustainability	22. Ethics
CLO-1	Define the structure and function of male and female primary and secondary sexual organs	1	H			M	.						
CLO-2	Explain the process of zygote formation and various stages involved up to the birth of a young ones	2	H			M							
CLO-3	Implement the different methods of birth control and evaluate their implications	3	H			H							
CLO-4	Examine the reasons of male and female infertility and possible medical interventions	4	H	H		H	H						
CLO-5	Summarize the various factors responsible for sexual dysfunction and sexual	5	H	H		H	H						H
	diseases, and the role of environment in reproductive health		H	H		H	H						H
			H	H		H	H						H

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	**UNIT I: Introduction to Reproduction** Male reproductive system: Structural and Functional aspects of testis, Physiology of spermatogenesis, Role of male accessory sex organs, Female reproductive system: Overview of female reproductive organs, Ovarian follicular growth and oogenesis, Menstrual cycle and hormonal regulation, • Demonstration of male and female reproductive systems of mammals.	9	1
2.	**UNIT II: Fertilization, embryonic development and parturition** Fertilization and formation of zygote, cleavage and blastocyst formation, implantation, pregnancy and fetal development, parturition, lactation and hormonal regulation Study of permanent slides of mammalian reproductive tissues; • Processing of reproductive tissues for microanatomy.	9	2
3.	**UNIT III: Contraception and family planning** Male and female contraception, Natural method (Fertility awareness), Surgical, Physical/Barrier methods, Chemical methods, limitations of current contraceptives	9	3
4.	**UNIT IV: Infertility and assisted reproductive techniques (ARTs)** Male infertility: Azoospermia, Oligozoospermia, Asthenozoospermia, Varicocele, etc.; Female infertility: PCOS, endometriosis, endocrinal factors, etc. ARTs: IVF, IUI, ICSI, GIFT, ZIFT, Surrogacy, negative aspects and recent trends in ART; • Assessment of Sperm morphology, sperm count, and sperm motility.	9	4
5.	**UNIT V: Reproductive health and disorders** Endocrine disrupting chemicals, sexual dysfunctions, sexually transmitted infections (STIs), reproductive cancers and their prevention; • Effects of pesticides, drugs, and xenobiotics on testicular tissue in vitro.	9	5

Learning Resources	
Text Books	• Arumugam, N. (2018) Developmental Biology, Saras Publication • Jones, R. E., & Lopez, K. (2013). Human reproductive biology. Academic Press.
Ref. Books	• EDITION, F. (2015). KNOBIL AND NEILL'S PHYSIOLOGY OF REPRODUCTION. • Ramesh Mahadeo Gejage and ManishaRamesh Gejage, Human Reproductive Physiology by Walnut Publication • Tortora, G. J., & Derrickson, B. H. (2018). Principles of anatomy and physiology. John Wiley & Sons."

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	

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Course Code	ZOL23MI05	Course Name	Biodiversity and Wildlife Conservation	Course Category	MI		L	T	P	C
							2	0	2	3
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			Domain Specific Knowledge	Critical Thinking and Problem Solving	Inter and Multi-disciplinary Skills	Lifelong learning	Research Aptitude	Creativity	Communication Skills	Innovation and Entrepreneurship	Vocational and Industry Exposure	Environmental awareness and sustainability	Ethics
CLO-1	Define biodiversity and its importance in an ecosystem.	1	H			M	.					M	
CLO-2	Outline the threats to biodiversity and its mitigation.	2	H			M						M	
CLO-3	Interpret the basic concept of wildlife's status.	3	H			H						H	
CLO-4	Explain the different types of wildlife conservation and habitat management.	4	H	H	H	H	H					H	H
CLO-5	Discuss the concept of the protected area for biodiversity and its legal framework.	5	H	H	H	H	H					H	H
			H	H	H	H	H					H	H

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	**UNIT I: Biodiversity: patterns and processes** General concept of biodiversity; types and levels of biodiversity; patterns and process; local and regional biodiversity-niche assembly theories; hotspots of biodiversity; restricted range species and endemism, keystone species flagship species, indicator species, surrogate species; biodiversity with reference to Eastern Himalayas. • Identification of flora, mammalian fauna, avian fauna, herpeto-fauna	9	1
2	**UNIT II: Threats to biodiversity** Threats to species diversity: habitat loss, habitat fragmentation, risks to biodiversity extinction, human-animal conflict: type and nature of conflict causes of conflict, and measures of conflict mitigation; • Demonstration of different field techniques for flora and fauna.	9	2
1.	**UNIT III: Basic concept of wildlife biology** Definition and importance of wildlife; wildlife wealth of India; Threatened wildlife and IUCN status - concept of extinct, critically endangered, endangered, vulnerable and rare species; red data book; wildlife wealth of India; management of rare and endangered species; • Demonstration of basic equipment needed in wildlife studies use, care and maintenance (compass, binoculars, spotting scope, range finders, global positioning system, various types of cameras and lenses).	9	3
2.	**UNIT IV: Basic concept of wildlife conservation** Wildlife conservation Indian perspective: aims & objectives of wildlife conservation; in-situ and ex-situ conservation; threats to wildlife conservation in India; conservation status, habit & habitat, threats and conservation management of the following animals; Himalayan salamander/ Great Indian bustard / Himalayan musk deer/Greater one-horned rhinoceros /Bengal Tiger/Red panda/Snow leopard. • Trail / transect monitoring for abundance and diversity estimation of mammals and bird (direct and indirect evidences).	9	4
3.	**UNIT V: Protected areas concept and legal framework of biodiversity** In situ conservation- problems and prospects; sanctuaries, national parks community and conservation reserves; biosphere reserve, laws and policies for biodiversity conservation; biodiversity management committees and people's biodiversity register.	9	5

Learning Resources	
Text Books	• M. Kato. (2000). The Biology of Biodiversity. Springer. • 2. Kothari, A.S. &Chapgar. (2005) Treasure of Indian Wildlife, BNHS Mumbai.
Ref. Books	• • B. B. Hosetti. (2005) Concepts in Wildlife Management. 2nd Revised & Enlarged Ed, 2005. Daya Publishing House, Delhi. • Smith, R.L. and T.M. Smith (2002) Ecology and Field Biology. Addison - Wesley Educational Publishers Inc. • Hussain, M. (2013) Environment and Ecology: Biodiversity, Climate Change and Disaster Management. Access Publishing House.

	• Biodiversity: Convention on Biological Diversity, Abiotic Stress, Internationa Treaty on Plant Genetic Resources for Food and Agriculture Books LLC, Wik Series (2011).

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	

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Course Code	ZOL23MI06	Course Name	Applied Zoology	Course Category	MI		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			1. Domain Specific Knowledge	2. critical Thinking and Problem Solving	3. Inter and Multi-disciplinary Skills	4. Lifelong learning	5. Research Aptitude	6. Creativity	7. Communication Skills	8. Innovation and Entrepreneurship	9. Vocational and Industry Exposure	10. Environmental awareness and sustainability	11. Ethics
CLO-1	Define fish culture and its economic importance.	1	H			M	.			H	H	M	
CLO-2	Identify the different types of worms and insects commonly used in industries.	2	H			M				H	H	M	
CLO-3	Demonstrate the basic concept of dairy farming and its products. wildlife's status.	3	H			H				H	H	H	
CLO-4	Explain the different types of breeds and their products used in poultry farming.	4	H		H	H	H			H	H	H	H
CLO-5	Discuss the usage of livestock in industries and their management.	5	H		H	H	H			H	H	H	H

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	**UNIT - I Fish culture** Fish Culture- General Introduction to Pisciculture techniques of induced breeding, Commercial culture of Catla and Catfish; By-Products of fishes and its commercial values; preservation - processing and export techniques adopted in fish culture. • Identification with reason for 5 ornamental fish species • Identification and displaying of Catla/Rohu/Mirgala	12	1
2	**UNIT - II Worms and Insects culture** Vermiculture- Vermiculture and its types of composting; Apiculture - Species of Honeybees, honey composition, honey extraction, Sericulture–Types and secretion of silks; The life cycle of silkworms, Nature and economic importance of Sericulture in India. • Identification of Earthworm types (Collection/specimens/photographs) Megacolexmauritii; Drawidamodesta Pheretimaposthuma • Demonstration of Different stage of Silkworm life stages (Subjects to availability) • Demonstration and display of Honey bees mouth parts.	12	2
3.	**UNIT III: Dairy farming** General concepts of dairy farm and management; Milch breeds; Draught breeds, Dual-purpose breeds and New Crossbreeds of Cows and Buffaloes in India; Hybrid species of cattle; Sheep farming: Indigenous and Exotic breeds of Sheep; different types of dairy products. • Identification of different types of dairy products (Subjects to availability) • Dairy farm visit/Field visit and submission of a report.	12	3
4.	**UNIT IV Poultry farming** Introduction to poultry management; Morphology of different breeds of Chicken - Brooding and Rearing of Chicks-Processing of Egg, Meat and By-Products of Poultry; feeding habit and common diseases of poultry. • Identification of Morphology of different breeds of Chicken (Picture demonstration) • Identification and demonstration of common diseases of poultry (Picture demonstration) • Poultry farm visit/Field visit and submission of a report.	12	4
5.	**UNIT V Livestock management** Transgenic Animal Technology; tools and techniques for livestock management; Genetic Improvement for best breeds; types of leather and management, Wool types and its management; collection and management of fur from different animals. • Identification of fur from different animals and benefits (Picture demonstration) • Demonstration of tools and techniques for livestock management • Animal farm visit/Field visit and submission of a report	12	5

Learning Resources	
Text Books	• Sukla, G.S. and Upadhyay, V.B., 2000 Economic Zoology - ISBN - 81-7133-137-8 Rastogi Publications, Meerut, India. • JawaidAhsan and Subhas Prasad Sinha, 2000 A Handbook on Economic Zoology- ISBN-81-219-0876-O S. Chand & Co., Ltd., New Delhi.
Ref. Books	• Ashok Kumar and Premmohan Nigam, 1991 Economic and Applied Entomology; Emkay Publications, New Delhi. • Shammi, Q.J. and Bhatnagar, S., 2002 Applied Fisheries: ISBN-81-7754-114-5Agrobios (India), Jodhpur - India. • Major Hall, C.B. 2005 Ponds and Fish culture - ISBN-81-7754-146-3 Agrobios (India), Jodhpur - India. • Keith Wilson, N.D.P., 2005 A Handbook of Poultry Practice - ISBN-81-7754-O-69-65

Learning Assessment												
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	

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Course Code	ZOL23MI07	Course Name	Biology of Human Diseases	Course Category	MI		L	T	P	C
							3	0	2	4
Pre Requisite			Nil	Co-requisite						

Course Learning Outcomes (CLO)	At the end of this course, learners will be able to:	Bloom's Learning (BL) Level	Program Learning Outcomes (PLO)										
			Domain Specific Knowledge	critical Thinking and Problem Solving	Inter and Multi-disciplinary Skills	Lifelong learning	Research Aptitude	Creativity	Communication Skills	Innovation and Entrepreneurship	Vocational and Industry Exposure	Environmental awareness and sustainability	Ethics
CLO-1	Define human diseases and their epidemiology	**1**	**H**	**H**		**M**	.						
CLO-2	Interpret the immunology of diseases and its prevention	**2**	**H**	**H**		**M**							
CLO-3	Relate the factors related to non-communicable diseases	**3**	**H**	**H**		**H**							
CLO-4	Analyze the causative agents behind infectious diseases	**4**	**H**	**H**	**H**	**H**	**H**						
CLO-5	Evaluate the ways of Prevention and Intervention in human diseases	**5**	**H**	**H**	**H**	**H**	**H**						

Summary of Course Content			
S. No	Course Content	Hour	Alignment to CLO
1.	Unit I: Introduction to human diseases and epidemiology Definition of health and disease, Communicable and. non communicable diseases; Introduction to Infectious, deficiency, hereditary, physiological and psychological diseases; Basic concepts of epidemiology: Outbreak, Endemic, Epidemic and Pandemic; Prevalence and incidence; Morbidity and mortality.	12	1
2.	Unit II: Immunology of diseases Innate and adaptive immunity; Vaccination and herd immunity; Immune deficiency, five cardinal signs of Inflammation, autoimmune diseases and allergy;	12	2
3.	Unit III: Causative factors of non-communicable diseases Genetic, Immunological and environmental factors in disease; Effect of Alcohol, smoking, pollution, and radiation exposure; Nutritional factors: malnutrition and obesity; Introduction to Genetic disorders: Chromosomal abnormality (Down syndrome), Single gene disorder (Sickle cell anaemia), Basics of genetic mutation and cancer. • Measurement of BMI, Blood pressure, Blood Glucose • Estimation of haemoglobin by Sahil's haemoglobinometer	12	3
4.	Unit IV: Infectious Diseases Infectious agents: Virus, Bacteria, Protozoa, Fungi and Helminths; Role of Mosquitoes as vectors in disease transmission; Sexually transmitted diseases; Life cycle, pathogenesis and control of: Entamoeba histolytica; Taenia solium. • Identification of parasitic pathogens from slides/specimens/photographs: Giardia, Entamoeba, Taenia, Fasciola. • Identification of Vectors from specimens/photographs: Culex, Anopheles, Aedes	12	4
5.	Unit V: Prevention and Intervention of diseases Importance of Diet, exercise and hygiene; Modes of disease transmission and its control; Antimicrobial resistance; Detection methods for infectious agents: ELISA, RT-PCR. Basics of drug discovery; Pedigree analysis for inheritance patterns; Genetic counselling; • Pedigree analysis for inheritance patterns • Demonstration of PCR/RT-PCR/ELISA (Any one) as a diagnostic tool.	12	5

Learning Resources	
Text Books	• Barbara J. Cohen and Dena L. Wood. Study Guide to 9r.e (Memmler's Study Guide for the Human Body in Health and Disease. • Raman. M.K. 2021. Common Human Diseases - Biology Series VI Paperback – 5 • Tamparo and Marcia: A. Lewis. Diseases of the Human Body: Third Edition Carol D.
Ref. Books	• Lammert and MartinZeeb. Metabolism of Human Diseases: Organ Physiology and Pathophysiology; Eckhard • Leonard Crowley. An Introduction to Human Disease: Pathology and Pathophysiology Correlations:

Learning Assessment											
	Bloom's Level of Thinking	**Continuous Learning Assessment (40% weightage)**								**Final Examination (60% weightage)**	
		CLA – 1 (10%)		**CLA – 2 (10%)**		**CLA – 3 (10%)**		**CLA – 4 (10%)**			
		Theory	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**	**Theory**	**Practical**
Level 1	Remember	**50 %**	**50%**	**50%**	**50 %**	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Understand										-
Level 2	Apply	**50 %**	**50%**	**50%**	**50 %**	**40%**	**40 %**	**40%**	**40 %**	**40%**	-
	Analyze										-
Level 3	Evaluate	-	-	-	-	**30%**	**30 %**	**30%**	**30 %**	**30%**	-
	Create										-
		100%		**100%**		**100%**		**100%**		**100%**	

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Curriculum for 4th year BA/BSc/BCom (Hons) with Research

Course category	Course Code	Course Name	L	T	P	C
SEMESTER - VII						
Core	UNIV23RP71	Research Methodology	2	0	4	4
	UNIV23RP72	Data Analytics & Statistical Applications	2	0	4	4
	UNIV23RP73	Scientific Writing and Research Ethics	3	0	2	4
	UNIV23RP74	Domain Specific Research Paper I	3	0	2	4
	UNIV23RP75	Domain Specific Research Paper II	3	0	2	4
		Total				**20**
SEMESTER - VIII						
Research Project/Dissertation	UNI23RP81	Research Project (Research Proposal, Tools and Methods, Field work, Research Progress)	0	0	0	12
	UNI23RP82	Presentation and Viva-voce	0	0	0	4
	UNI23RP83	Research Paper and Dissertation	0	0	0	4
		Total				**20**

SEMESTER VII

Course Code	UNI23RP71	Course Name	Research Methodology	Course Category		CORE COURSE	L	T	P	C
							3	0	2	4
Pre-requisite				Co-requisite						

			Program Learning Outcomes (PLO)										
Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	**Blooms Learning (BL) Level**	**1. Domain Specific Knowledge**	**2. Critical Thinking and Problem Solving**	**3. Inter and Multi-disciplinary Skills**	**4. Lifelong learning**	**5. Research Aptitude**	**6. Creativity**	**7. Communication Skills**	**8. Innovation and Entrepreneurship**	**9. Vocational and Industry Exposure**	**10. Environmental awareness and sustainability**	**11. Ethics**
CLO-1	Understand the methods of research design	**2**	**H**	**M**	**H**		**H**						**M**
CLO-2	Apply Data collection and analysis tools in research	**3**	**H**	**H**	**M**		**H**	**M**					**H**
CLO-3	Analyze sample data	**4**	**H**	**H**	**M**		**H**						
CLO-4	Evaluate different methods and tools in qualitative research	**5**	**H**	**H**	**M**		**H**						
CLO-5	Create research-proposals, research-reports, presentations and manuscripts for publication.	**6**	**H**	**H**	**M**	**M**	**H**	**M**					**H**

Summary of Course Content			
Sr. No	**Course Content**	**Hour**	**Alignment to CLO**
Unit I	**Research Design** Objectives of research- type of research – understanding research and its goals, critical thinking, selecting topic for research, justification and rationale development, research designs, method of scientific enquiry, formulation of hypothesis, writing a research proposal - Ethics of research planning and preparation Practical: Topic selection through literature review, Proposal writing, Journal club	12	CLO 1
Unit II	**Data collection, analysis and inference** Questionnaire design, selection of samples, errors in data collection, data validation process, data entry formats, data entry software, data cleaning and management, basic statistical analysis, univariate and multivariate - interpretation and discussion of research findings- Ethics in Data collection Practical: Questionnaire design for a study, Data entry, cleaning and management using software	12	CLO 2
Unit III	**Sampling and Sampling Methods** Definition of sampling, principles of sampling, advantages and disadvantages of sampling, probability and non-probability sampling methods, simple random sampling, systematic random sampling, stratified random sampling, cluster sampling, multistage sampling methods, determination of sample size, sampling weights, choosing appropriate sampling methods for research - Ethical issues in sample selection Practical:Application of sampling methods and sample selection strategies	12	CLO3
Unit IV	**Qualitative Research Methods** Introduction to qualitative research, Ethnography, Phenomenology, Narrative Enquiry, Focus Group Discussions, In depth Interviews, Recording qualitative interviews, transcription, analysis paradigms, grounded theory methodology, content analysis, discourse analysis, Reflective analysis, Qualitative data analysis software, coding, thematic analysis, conceptual diagram Practical:Qualitative data analysis software, coding, thematic analysis, conceptual diagram	12	CLO 4

Unit V	**Academic writing and presentations** Proposal writing for obtaining funding, elements of writing style, writing research reports, manuscript preparation for publication, referencing styles, oral presentations, poster presentations, peer review process, thesis writing, Ethical issues in thesis writing- Sources of information, review of literature, online databases, search tools, effective use of pubmed and other online search engines Practical:Proposal writing, Application of online databases, search tools and online databases.	12	CLO 5

Learning Resources	
Text Books	• Sampling: Design and Analysis. -Sharon L Lohar. Second Edition. -Brooks / Cole Cengage Learning, 2010 • World Health Organization. Health Research Methodology A guide for training in research methods. -World Health Organization -World Health Organization, 2011
Ref. Books	• Designing Qualitative Research: An Interactive Approach. -Maxwell, J, Third Edition-Sage Publications, 2013 • Fundamentals of Research Methodology for Health Care Professionals. -Second Edition. Hilla Brink, Christa Van der Walt, Gisela Van Rensburg. -Juta and Company Ltd, 2006 • Participatory Rural Appraisal: Principles, Methods and Application. -N Narayanaswamy-Sage Publications Pvt. Ltd. 2009 • Qualitative Interviewing: The Art of Hearing Data -Rubin, H. and I. Rubin-Thousand Oaks, CA: Sage Publications. 2005 • Research Methods in Health: Investigating Health and Health Services-Second Edition. Ann Bowling. -Open University Press, Buckingham, 2002 • Writing Ethnographic Field notes. -Emerson, Robert M., Rachel I. Fretz, and Linda L. Shaw. -University of Chicago Press.1995

Bloom's Level of Thinking		**Continuous Internal Assessment (100% weightage)**									
		CIA- 1 Assignment- I		**CIA- 2 Assignment- II**		**CLA – 3 Assignment- III**		**CLA – 4 Assignment - IV**		**CLA – 5 Final Assignment - V**	
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
1	Remember		***30%***		***20%***		***20%***		***20%***		***20%***
2	Understand		***30%***		***20%***		***20%***		***20%***		***20%***
3	Apply		***10%***		***30%***		***30%***		***30%***		***20%***
4	Analyse		***30%***		***20%***	-					***20%***

5	Evaluate	-			*10%*	-					*10%*
6	Create	-		-			*30%*		*30%*		*10%*
	Total	**100%**		**100%**		**100%**		**100%**		**100%**	

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
NA		Mr. Dhirendra Kumar Shah and Assistant Professor, SRM University Sikkim, dhirendrakumarshah.d@srmus.edu.in Dr. HindolChakraborty, Assistant Professor, SRM University Sikkim, hindol.c@srmus.edu.in

Course Code	UNIV23RP72	Course Name	Data Analytics & Statistical Applications	Course Category		*Core*	L	T	P	C
							2	0	4	4
Pre-requisite				**Co-requisite**						

Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	**Bloom's Learning (BL) Level**	**Program Learning Outcomes (PLO)**										
			PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PLO 11**
			12. Domain Specific Knowledge	**13. Critical Thinking and Problem Solving**	**14. Inter and Multi-disciplinary Skills**	**15. Lifelong learning**	**16. Research Aptitude**	**17. Creativity**	**18. Communication Skills**	**19. Innovation and Entrepreneurship**	**20. Vocational and Industry Exposure**	**21. Environmental awareness and sustainability**	**22. Ethics**
CLO-1	Understand the data and importance of data in decision making	1	**H**	**H**	**M**			**M**					**H**
CLO-2	Express the knowledge on how to use measures of dispersion	2	**H**	**H**	**M**								
CLO-3	Apply the knowledge and use of correlation and regression analysis	3	**H**	**H**			**H**						
CLO-4	Understand about the probability and probability distribution	4	**H**	**H**			**H**						
CLO-5	Apply the inferential statistics for estimation.	4	**H**	**H**			**H**						

Summary of Course Content			
S. No	**Course Content**	**Hour**	**Alignment to CLO**
1	**Unit I: INTRODUCTION TO STATISTICAL DATA & SOFTWARE:** Data: Meaning and importance, Types of data in research, scale of measurement, continuity, origin, characteristics; Scope of data, Data Structure – Cross Sections, Time Series, and Panel Data; Data Size - High Frequency and Big Data Sets; Data Generating Process (DGP).	12	**CLO1**
2	**Unit II: DESCRIPTIVE STATISTICS-** Measures of central tendency- Mean, Median, Mode, combined mean, weighted average, Quartiles, Deciles and Percentiles Measures of variation -	12	**CLO2**

	Range, Quartile Deviation, Standard deviation, Coefficients, Variance and Coefficient of variation.		
3	**Unit III: INFERENTIAL STATISTICS (PARAMETRIC TEST)-** Parametric Test: Student T- test, Z- test (testing of single mean and testing of two population means), ANOVA TEST- One-way ANOVA, Two-way ANOVA, Correlation analysis – scatter diagram method.	12	**CLO3**
4	**Unit IV: INFERENTIAL STATISTICS (NON-PARAMETRIC TEST)-**Non-Parametric Tests- Meaning and importance, Chi-square test- Goodness of fit and Independence of attributes, U-test, H test and K-S test.	12	**CLO4**
5	**Unit V: MODEL ESTIMATION-** Estimation of Regression Model; Testing and Interpretation of Regression coefficients; Testing of Hypotheses and their interpretation; Functional Forms; Dummy Variables.,Multicollinearity, Heteroscedasticity, Autocorrelation; Simultaneous-Equations Models; Identification & Estimation**.**	12	**CLO5**

Learning Resources	
Text Books	• Levine, Stephan, Krehbiel and Berenson, "Statistics for Managers using Microsoft Excel", PHI Learning Private Limited, 2010. • S. P. Gupta, "Statistical Methods", Sultan Chand & Sons; 1ST edition, 2014.
Ref. Books	• Arora P.N., "Managerial Statistics", S.Chand Limited, 2009. • Dr. Deepak Chawla, Dr. NeenaSondhi, "Research Methodology Concepts and Cases", Vikas Publishing House Private Limited, 2011. • Dr. T.N. Srivastava, Statistics for Management, Tata McGraw Hill Publishing Company, 2008. • Gerald Keller, "Managerial Statistics", Cengage Learning, 2011. • N G Das, "Statistical Methods", Volume – 1 and Volume 2, McGraw Hill Education; 1st Edition, 2008. • VikramDayal, An Introduction to R for Quantitative Economics: Graphing, Simulating and Computing, Springer Briefs in Economics, Springer (India), 2015.

Bloom's Level of Thinking		**Continuous Internal Assessment (40% weightage)**										**Final Examination (60 % weightage)**	
		CIA- 1		**CIA- 2**		**CLA – 3**		**CLA – 4**		**CLA – 5**			
		Theory	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**	**Theory**	**Practice**
1	Remember	***30%***		***20%***		***20%***		***30%***		***10%***		***30%***	
2	Understand	***30%***		***20%***		***20%***		***30%***		***10%***		***20%***	
3	Apply	***10%***		***30%***		***30%***		***20%***		***20%***		***20%***	
4	Analyse	***30%***		***20%***		***20%***		***20%***		***20%***		***10%***	
5	Evaluate	-		***10%***		-				***20%***		***10%***	
6	Create	-		-		***30%***				***20%***		***10%***	
	Total	**100%**		**100%**		**100%**		**100%**				**100%**	

Course Designers		
Experts from Industry: **Name, Designation with official mail id**	**Experts from Higher Education Institutions:** **Name, Designation with official mail id**	**Internal Experts:** **Name, Designation with official id**
	Dr. KomalSingha Professor, Department of Economics Sikkim Central University, Sikkim Email id: ksingha@cus.ac.in	Dr. Praveen Rizal Associate Professor Department of Economics SRM University Sikkim praveen.r@srmus.edu.in

Course Code	UNIV23RP73	Course Name	Scientific Writing and Research Ethics	Course Category	*CORE COURSE*	L	T	P	C
						3	0	2	4
Pre-requisite				**Co-requisite**					

			Program Learning Outcomes (PLO)										
Course Learning Outcomes (CLO)	*At the end of this course, learners will be able to:*	**Blooms Learning (BL) Level**	**1. Specific Domain Knowledge**	**2. Critical Thinking and Problem Solving**	**3. Inter and Multi-disciplinary Skills**	**4. Lifelong learning**	**5. Research Aptitude**	**6. Creativity**	**7. Communication Skills**	**8. Innovation and Entrepreneurship**	**9. Vocational and Industry Exposure**	**10. Environmental awareness and sustainability**	**11. Ethics**
CLO-1	Demonstrate the skills for writing a Research Proposal	2	**H**	**H**	**M**		**H**						**H**
CLO-2	Estimate the budget requirements for a research fund application	2	**H**	**H**	**M**							**M**	**M**
CLO-3	Prepare a manuscript for publication following the guidelines.	3	**H**	**H**			**H**		**M**				**H**
CLO-4	Analyze and adopt an appropriate ethical stance towards writing and publication	4	**H**	**H**	**M**		**H**		**M**				**H**
CLO-5	Develop the skills required for writing a book	6	**H**	**M**			**H**	**M**					**M**
			H	**H**	**M**		**H**	**M**	**M**			**M**	**H**

Summary of Course Content			
Sr. No	**Course Content**	**Hour**	**Alignment to CLO**
Unit I	**Writing a Research Proposal:** Writing the Cover Page – Title Page, Abstract Writing the Introduction –Purpose/Relevance, Furnishing Research Question/Hypothesis, Aim and Objectives Writing Literature Review - Empirical Analyses, Theoretical Analyses, Research Gaps Writing the Methods and Design - Research Philosophy, Research Approach, Research Design, Data Collection Writing the Significance and Expected Results– Research Contribution, Potential Outcomes and Limitations Writing the Conclusion - Summarize key points and significance of research Writing the Appendices and References - Additional Data, Questionnaire, Interview Questions, citations Proofreading and Editing - Errors in Grammar and Punctuation, Revisions	12	CLO 1
Unit II	**Writing a Budget Proposal:** Research Cost – Personal Costs, Equipment and Supplies, Travel Expenses, Budget for Data Collection & Analyses, Participant Compensation, fees linked with Publication and Dissemination, Contingency Fund, Consultation Fees, Training and Development Justification on Cost Source of Expenditure Timeline and Payment Schedule Final Budget Summary	12	CLO 2
Unit III	**Manuscript Writing:** Understanding the Publication Process Selecting a Target Journal Writing according to the Authors Guidelines Title and Abstract Writing Introduction and Literature Review Writing the Methods and Results Presentation Writing the Discussion section and Conclusion– Interpret Findings, Implications, Limitations, and Future Research, Summarize key findings and their significance Citation and Referencing – Citing sources following a specific citation style Manuscript formatting – font, spacing and margin specifications Submission Process Preparing a Cover Letter – writing a letter to the Editor Peer Review Process Responding to Reviewers Comments	12	CLO3

Unit IV	**Publication Ethics** Role of ethical behavior in scholarly publishing Criteria for Authorship and Acknowledging Contributors Plagiarism and Self-Plagiarism – Data Fabrication and falsification, Redundant or Duplicate Publication, Salami Slicing, Image Manipulation, Publication Bias and its impact on Research Research Misconducts and Research Integrity Conflict of Interest Peer Review Ethics Ethical use of Human and Animal Subjects Ethical approval - Consent Letter, Code of Ethics Open Access and Copyright Predatory Journals and Conferences Journal Selection and Impact Factor	12	CLO 4
Unit V	**Introduction to Book Writing** Overview of the Book Writing Process Choosing a Compelling Book Topic – Researching market demand and competition Creating a structured book outline – outlining chapters and subtopics Research and Fact-Checking Setting Writing Goals Writing Style and Voice Drafting the manuscript Editing and Revising Title and Cover Design Considerations Publishing the Book - Conventional /Self-Publishing, Marketing and Promotion, Legal and Copyright Issues, Author Branding, Book Launch and Beyond	12	CLO 5

Learning Resources	
Text Books	• Chowdhary, Nimit, Hussain Sarah. *Handbook of Research and Publication Ethics*. Bharti Publication, 2021. • Hofmann, Angelika H. *Scientific Writing and Communication: Papers, Proposals, and Presentations*. Oxford UP, USA, 2017. • Katz, Michael J. *From Research to Manuscript: A Guide to Scientific Writing*. 2006, ci.nii.ac.jp/ncid/BB01221094. • Lalli, William R. *Handbook of Budgeting*. John Wiley and Sons, 2012.
Ref. Books	• Becker, Howard S. *Writing for Social Scientists: How to Start and Finish Your Thesis, Book, or Article*: Second Edition. University of Chicago Press, 2007. • Booth, Wayne C., et al. The Craft of Research. University of Chicago Press, 2016. • D, Andrea R. Gwosdow Ph. *The Complete Guide to Scientific Manuscript Writing*. Aviva Publishing, 2018. • Hayot, Eric. *The Elements of Academic Style: Writing for the Humanities*. Columbia UP, 2014. • Labaree RV. *Organizing Your Social Sciences Research Paper: Writing a Research Proposal*. Available from: http://www.libguides.usc.edu/writingguide. • Lerner, Betsy. *The Forest for the Trees (Revised and Updated): An Editor's Advice to Writers*. National Geographic Books, 2010. • McGranaghan M. Guidelines on Writing a Research Proposal. Available from: https://www.2.hawaii.edu/~matt/proposal.html

	• *The Writer's Options: Lessons in Style and Arrangement* (8th ed.) by Max Morenberg and Jeff Sommers.

Bloom's Level of Thinking		Continuous Internal Assessment (100% weightage)									
		CIA- 1 Assignment- I		CIA- 2 Assignment- II		CLA – 3 Assignment- III		CLA – 4 Assignment - IV		CLA – 5 Final Assignment - V	
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
1	Remember		*30%*		*20%*		*20%*		*20%*		*20%*
2	Understand		*30%*		*20%*		*20%*		*20%*		*20%*
3	Apply		*10%*		*30%*		*30%*		*30%*		*20%*
4	Analyse		*30%*		*20%*	-					*20%*
5	Evaluate	-			*10%*	-					*10%*
6	Create	-		-			*30%*		*30%*		*10%*
	Total	100%		100%		100%		100%		100%	

Assignments will be conducted for 10 marks each.
The final Assignment will be conducted for 60 marks, to be reviewed by experts.

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
		Mr. Dhirendra Kumar Shah and Assistant Professor, SRM University Sikkim, dhirendrakumarshah.d@srmus.edu.in Dr. HindolChakraborty, Assistant Professor, SRM University Sikkim, hindol.c@srmus.edu.in

Course category	Course Code	Course Name	L	T	P	C
SEMESTER - VII						
Core	UNIV23RP74	Domain Specific Research Paper I	3	0	2	4
	UNIV23RP74	Domain Specific Research Paper II	3	0	2	4
		Total				**8**

Course category	Course Code	Course Name	L	T	P	C
SEMESTER - VIII						
Research Project/Dissertation	UNI23RP81	Research Project (Research Proposal, Tools and Methods, Field work, Research Progress)	0	0	0	12
	UNI23RP82	Presentation and Viva-voce	0	0	0	4
	UNI23RP83	Research Paper and Dissertation	0	0	0	4
		Total				**20**

Course Designers		
Experts from Industry: Name, Designation with official mail id	**Experts from Higher Education Institutions: Name, Designation with official mail id**	**Internal Experts: Name, Designation with official id**
1. Dr. Ratnesh Kumar Tripathi, Application Scientist & Head, Diagnostics & Genomics Solutions Division and Center of Excellence, Aglient Technologies ratnesh.tripathi@agilent.com	1. Dr. Bomba Dam, Assistant Professor, Dept. of Botany, Visva-Bharati, Santiniketan bomba.dam@visva-bharati.ac.in 2. Dr. Bidhan Golay, Assistant Professor, Department of Political Sciences, Sikkim Central University, Sikkim. bgolay@cus.ac.in 3. Dr. Dilip Barad, Professor, Department of English, M. K. Bhavnagar University, Gujrat	1. Dr. Praveen Rizal, Associate Professor & Head, Dept. of Social Sciences, SRM University Sikkim. praveen.r@srmus.edu.in 2. Dr. Kinkar Mandal, Assistant Professor, School of Public Health, SRM University Sikkim. kinkarmandal.r@srmus.edu.in 3. Dr. Dhirendra Kumar Shah, Assistant Professor, Department of English, SRM University Sikkim. dhirendrakumarshah.d@srmus.edu.in 4. Dr. Biswajit Bose, Assistant Professor, Dept. of Botany, SRM University Sikkim. biswajitbose.k@srmus.edu.in 5. Dr. Govind Pratap Singh, Professor, Dept. of Chemistry, SRM University Sikkim. Govindpratapsingh.v@srmus.edu.in 6. Dr. Oindrila Biswas, Assistant Professor, Dept. of Botany, SRM University Sikkim. oindrilabiswas.m@srmus.edu.in