



**Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur 440033**

**Scheme and Syllabus
Bachelor of Science (Zoology)**

**Submitted by
Board of Studies,
Bachelor of Science (Zoology)**

FYUGP-Scheme I-VIII Semester
Bachelor of Science (Honors/Research)
(Zoology- Major)
Four Year (Eight Semester Degree Course)
Teaching and Examination Scheme
B.Sc. Sem.-I (Zoology- Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	T U	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Mi n.	SEE	CIE	Mi n.
1	DSC	Life and Diversity of Animals-Nonchordates (Protozoa to Annelida)	BZO1T01	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Life and Diversity of Animals-Nonchordates (Protozoa to Annelida)	BZO1P01	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Environmental Biology	BZO1T02	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Environmental Biology	BZO1T02	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO1T01	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO1T02	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Vermicomposting	BVS1P01	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS1P02	-	-	4	2	-	-	-	-	50	50	50
9	AEC	English Compulsory	BAE1T01	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Environmental Sci.	BVE1T01	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Vedic Mathematics	BIK1T01	2	-	-	2	3	80	20	40	-	-	-
12	CC	Refer CC Basket	BCC1P01	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	22		530	170		150	250	

B.Sc. Sem-II (Zoology- Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	T U	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Mi n.	SEE	CIE	Mi n.
1	DSC	Life and Diversity of Animals-Nonchordates (Arthropoda to Hemichordata)	BZO2T03	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Life and Diversity of Animals-Nonchordates (Arthropoda to Hemichordata)	BZO2P03	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Cell Biology	BZO2T04	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Cell Biology	BZO2P04	-	-	2	1	-	-	-	-	-	50	25
5	GE/OE	Refer GE/OE Basket	BGO2T03	2	-	-	2	3	80	20	40	-	-	-
6	GE/OE	Refer GE/OE Basket	BGO2T04	2	-	-	2	3	80	20	40	-	-	-
7	VSC	Culture of Indian major Carps	BVS2P03	-	-	4	2	-	-	-	-	50	50	50
8	SEC	Refer SEC Basket	BVS2P04	-	-	4	2	-	-	-	-	50	50	50
9	AEC	Second Language	BAE2T02	2	-	-	2	3	50	50	40	-	-	-
10	VEC	Constitution of India	BVE2T02	2	-	-	2	3	80	20	40	-	-	-
11	IKS	Indian Astronomy	BIK2T02	2	-	-	2	3	-	-	-	50	50	50
12	CC	Refer CC Basket	BCC2P02	-	-	4	2	-	-	-	-	-	100	50
Total				14	-	16	22		530	170		150	250	

**Exit option: Award of UG Certificate in Major with 40-44 credits and an additional 4 credits core NSQF course/ Internship OR
Continue with Major and Minor**

B.Sc. Sem.-III (Zoology- Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exa m Hrs.	SE E	CI E	M in.	SEE	CIE	Mi n.
1	DSC	Life and Diversity of Animals- Chordates (Protochordata to Amphibia)	BZO3T05	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Life and Diversity of Animals- Chordates (Protochordata to Amphibia)	BZO3P05	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Genetics	BZO3T06	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Genetics	BZO3P06	-	-	2	1	-	-	-	-	-	50	25
5	Minor	Minor 1 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 1 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
7	Minor	Minor 2 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
8	Minor	Minor 2 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO3T05	2	-	-	2	3	80	20	40	-	-	-
10	VSC	Refer VSC Basket	BVS3P05	-	-	4	2	-	-	-	-	50	50	50
11	AEC	Second Language	BAE3T03	2	-	-	2	3	50	50	40	-	-	-
12	FP	Field Project	BFP3P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC3P03	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	22		450	150		200	300	

B.Sc. Sem.-IV (Zoology- Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exa m Hrs.	SE E	CI E	M in.	SEE	CIE	Mi n.
1	DSC	Life and Diversity of Animals- Chordates (Reptilia to Mammalia)	BZO4T07	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Life and Diversity of Animals- Chordates (Reptilia to Mammalia)	BZO4P07			2	1	-	-	-	-	25	25	25
3	DSC	Developmental Biology	BZO4T08	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Developmental Biology	BZO4P08			2	1	-	-	-	-	-	50	25
5	Minor	Minor 3 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
6	Minor	Minor 3 (Refer Minor Basket)				2	1	-	-	-	-	25	25	25
7	Minor	Minor 4 (Refer Minor Basket)		2	-		2	3	80	20	40	-	-	-
8	Minor	Minor 4 (Refer Minor Basket)				2	1	-	-	-	-	-	50	25
9	GE/OE	Refer GE/OE Basket	BGO4T06	2	-	-	2	3	80	20	40	-	-	-
10	SEC	Refer SEC Basket	BVS4T06	-	-	4	2	-	-	-	-	50	50	50
11	AEC	English Compulsory	BAE4T03	2	-	-	2	3	50	50	40	-	-	-
12	CEP	Community Service	BCM4P01	-	-	4	2	-	-	-	-	50	50	50
13	CC	Refer CC Basket	BCC4P04	-	-	4	2	-	-	-	-	-	100	50
Total				12	-	20	22		450	150		200	300	

**Exit option; Award of UG Diploma in Major and Minor with 80-88 credits and an additional 4 credits core NSQF course/ Internship
ORContinue with Major and Minor**

B.Sc. Sem.-V (Zoology- Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credi t	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SE E	CIE	Min	SEE	CIE	Min .
1	DSC	General Mammalian Physiology I	BZO5T09	2	-	-	2	3	80	20	40	-	-	-
2	DSC	General Mammalian Physiology I	BZO5P09	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Applied Zoology	BZO5T10	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Applied Zoology	BZO5P10	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Evolutionary Biology	BZO5T11	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Evolutionary Biology	BZO5P11	-	-	2	1	-	-	-	-	25	25	25
7	DSE	• Systematic Entomology • Systematic Ichthyology • Male Mammalian Reproductive Physiology • Endocrinology	BZO5T12	3	-	-	3	3	120	30	60	-	-	-
8	DSE	• Systematic Entomology • Systematic Ichthyology • Male Mammalian Reproductive Physiology • Endocrinology	BZO5P12	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 5 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 5 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	Minor	Minor 6 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
12	Minor	Minor 6 (Refer Minor Basket)		-	-	2	1	-	-	-	-	-	50	25
13	VSC	Refer VSC Basket		-	-	4	2	-	-	-	-	50	50	50
14	CEP	Community Service		-	-	2	1	-	-	-	-	25	25	25
Total				13	-	18	22	-	520	130	--	225	225	-

B.Sc. Sem.-VI (Zoology- Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credi t	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exa m Hrs.	SE E	CI E	Mi n.	SE E	CIE	Min.
1	DSC	General Mammalian Physiology II	BZO6T13	2	-	-	2	3	80	20	40	-	-	-
2	DSC	General Mammalian Physiology II	BZO6P13	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Parasitology	BZO6T14	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Parasitology	BZO6P14	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Molecular Biology	BZO6T15	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Molecular Biology	BZO6P15	-	-	2	1	-	-	-	-	25	25	25
7	DSE	• Insect morphology and Physiology • Fish Physiology/ • Female Mammalian Reproductive Physiology • Biochemistry	BZO6T16	3	-	-	3	3	120	30	60	-	-	-
8	DSE	• Insect morphology and Physiology • Fish Physiology/ • Female Mammalian Reproductive Physiology • Biochemistry	BZO6P16	-	-	2	1	-	-	-	-	-	50	25
9	Minor	Minor 7 (Refer Minor Basket)		2	-	-	2	3	80	20	40	-	-	-
10	Minor	Minor 7 (Refer Minor Basket)		-	-	2	1	-	-	-	-	25	25	25
11	VSC	Refer VSC Basket	BVS6P08	-	-	4	2	-	-	-	-	50	50	50
12	OJT	Internship (Related to DSC)	BOJ6P01	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	22	22		440	110		275	275	

Exit option: Award of UG Degree in Major with 120-132 credits OR Continue with Major and Minor

B.Sc. Sem.-VII (Honors) (Zoology- Major)

S N	Course Category	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Credit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min.	SEE	CIE	Min.
1	DSC	Systematic Zoology	BZO7T17	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Systematic Zoology	BZO7P17	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Biotechnology	BZO7T18	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Biotechnology	BZO7P18	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Biostatistics and Bioinformatics	BZO7T19	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Biostatistics and Bioinformatics	BZO7P19	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Microtechniques	BZO7T20	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Microtechniques	BZO7P20	-	-	2	1	-	-	-	-	-	50	25
9	DSE	• Insect pests • Applied Fisheries • Reproductive Endocrinology and Toxicology • Nerve Physiology	BZO7T21	3	-	-	3	3	120	30	60	-	-	-
10	DSE	• Insect pests • Applied Fisheries • Reproductive Endocrinology and Toxicology • Nerve Physiology	BZO7P21	-	-	2	1	-	-	-	-	25	25	25
11	RM	Research Methodology	BZO7T22	2	-	-	2	3	80	20	40	-	-	-
12	RM	Research Methodology	BZO7P22	-	-	4	2	-	-	-	-	50	50	50
Total				13	-	14	20		520	130		175	175	

B.Sc. Sem.-VIII (Honors) (Zoology- Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Tota l Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SE E	CI E	M in.	SEE	CI E	Min .
1	DSC	Biotechniques	BZO8T23	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Biotechniques	BZO8P23	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Ethology	BZO8T24	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Ethology	BZO8P24	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Molecular Biology	BZO8T25	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Molecular Biology	BZO8P25	-	-	2	1	-	-	-	-	25	25	25
7	DSC	Immunology	BZO8T26	2	-	-	2	3	80	20	40	-	-	-
8	DSC	Immunology	BZO8P26	-	-	2	1	-	-	-	-	-	50	25
9	DSE	• Industrial Entomology • Fishery technology and fish pathology • Avian Biology • Hydrobiology	BZO8T27	3	-	-	3	3	120	30	60	-	-	-
10	DSE	• Industrial Entomology • Fishery technology and fish pathology • Avian Biology • Hydrobiology	BZO8P27	-	-	2	1	-	-	-	-	25	25	25
11	OJT	Apprenticeship (Related to DSC)	BOJ8P02	-	-	8	4	-	-	-	-	100	100	100
Total				11	-	18	20		440	110		225	225	

Four Year UG Honours Degree in Major and Minor with 160-176 credits

B.Sc. Sem.-VII (Research) (Zoology- Major)

S N	Cours e Cate gory	Name of Course	Course Code	Teaching Scheme (hrs.)			Total Cred it	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SE E	CI E	M in.	SEE	CIE	Mi n.
1	DSC	Systematic Zoology	BZO7T17R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Systematic Zoology	BZO7P17R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Techniques in Life Sciences	BZO7T18R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Techniques in Life Sciences	BZO7P18R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Biostatistics and Bioinformatics	BZO7T19R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Biostatistics and Bioinformatics	BZO7P19R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	• Insect pests • Applied Fisheries • Reproductive Endocrinology and Toxicology • Nerve Physiology	BZO7T20R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	• Insect pests • Applied Fisheries • Reproductive Endocrinology and Toxicology • Nerve Physiology	BZO7P20R	-	-	2	1	-	-	-	-	-	50	25
9	RM	Research Methodology	BZO7T21R	2	-	-	2	3	80	20	40	-	-	-
10	RM	Research Methodology	BZO7P21R	-	-	4	2	-	-	-	-	50	50	50
11	RP	Research Project/ Dissertation (Core)	BRP7P01	-	-	6	3	-	-	-	-	75	75	75
Total				11	-	18	20		440	110		225	225	

‘R’ in the subject code indicates ‘Research’.

B.Sc. Sem.-VIII (Research) (Zoology- Major)

S N	Course Categor y	Name of Course	Course Code	Teaching Scheme (hrs.)			Tota l Cre dit	Examination Scheme						
				(Th)	TU	P		Theory				Practical		
								Exam Hrs.	SEE	CIE	Min	SEE	CIE	Min
1	DSC	Biotechniques	BZO8T22R	2	-	-	2	3	80	20	40	-	-	-
2	DSC	Biotechniques	BZO8P22R	-	-	2	1	-	-	-	-	25	25	25
3	DSC	Ethology	BZO8T23R	2	-	-	2	3	80	20	40	-	-	-
4	DSC	Ethology	BZO8P23R	-	-	2	1	-	-	-	-	-	50	25
5	DSC	Molecular Biology And Immunology	BZO8T24R	2	-	-	2	3	80	20	40	-	-	-
6	DSC	Molecular Biology And Immunology	BZO8P24R	-	-	2	1	-	-	-	-	25	25	25
7	DSE	• Industrial Entomology • Fishery technology and fish pathology • Avian Biology •Hydrobiology	BZO8T25R	3	-	-	3	3	120	30	60	-	-	-
8	DSE	• Industrial Entomology • Fishery technology and fish pathology • Avian Biology •Hydrobiology	BZO8P25R	-	-	2	1	-	-	-	-	-	50	25
9	RP	Research Project / Dissertation (Core)	BRP8P02	-	-	14	7 (4+2 +1)	-	-	-	-	175	175	175
Total				09	-	22	20		360	90		275	275	

‘R’ in the subject code indicates ‘Research’.

Four Year UG Honours with Research Degree in Major and Minor with 160-176 credits

Total Credits:

1. Three Year UG Degree Program: 132
2. Four Year UG Degree Program: 172

Abbreviations: Generic/Open Electives: OE, Vocational Skills & Skill Enhancement Courses: VSEC, Vocational Skill Courses: VSC, Skill Enhancement Courses: SEC, Ability Enhancement Courses: AEC, Indian Knowledge Systems: IKS, Value Education Courses: VEC, On Job Training (Internship/Apprenticeship): OJT, Field Project: FP, Community Engagement & Service: CEP, Co-curricular Courses: CC, Research Methodology: RM, Research Project: RP

VSC Basket (Zoology)

Semester	Course Category	Name of Course	BoS	Course Code
I	VSC	Vermicomposting	Zoology	BVS1P01
II	VSC	Culture of Indian major Carps	Zoology	BVS2P03
III	VSC	Aquarium preparation and maintenance	Zoology	BVS3P05
V	VSC	Silkworm culture	Zoology	BVS5P07
VI	VSC	Prawn culture	Zoology	BVS6P08

Basket for ELECTIVE (DSE) Category Courses (B.Sc. Zoology)

Semester	Course Category	Name of Course	Course Code
V	Elective 1	A. Systematic Entomology	BZO5T12
		B. Systematic Ichthyology	
		C. Male Mammalian Reproductive Physiology	
		D. Endocrinology	
VI	Elective 2	A. Insect Morphology and Physiology	BZO6T16
		B. Fish Physiology	
		C. Female Mammalian Reproductive Physiology	
		D. Biochemistry	
VII (Honors)	Elective 3	A. Insect pests	BZO7T21
		B. Applied Fisheries	
		C. Reproductive Endocrinology and Toxicology	
		D. Nerve Physiology	
VIII (Honors)	Elective 4	A. Industrial Entomology	BZO8T27
		B. Fishery technology and fish pathology	
		C. Avian Biology	
		D. Hydrobiology	
VII (Research)	Elective 3	A. Insect pests	BZO7T20R
		B. Applied Fisheries	
		C. Reproductive Endocrinology and Toxicology	
		D. Nerve Physiology	
VIII (Research)	Elective 4	A. Industrial Entomology	BZO7T25R
		B. Fishery technology and fish pathology	
		C. Avian Biology	
		D. Hydrobiology	

‘R’ in the subject code indicates ‘Research’.

FYUGP ZOOLOGY

Programme Specific Outcomes (PSOs) of Four Year Undergraduate Programme for Zoology:

- Students will be able to describe, identified, classified and differentiate the animals of different taxonomic ranks. They could differentiate morphological, anatomical, and histological features of different organs and organ-systems of different animal groups. They could understand and analyze the different evolutionary trends among different animal groups.
- Students could describe different component of environment and ecosystems and could understand and explain the significance of consequences of deterioration of ecosystem and biodiversity. They could estimate and evaluate the different physic-chemical parameters of waters like DO, dissolved CO₂, pH, hardness etc. to deduce its status.
- Students could able to describe, sketch and differentiate different cell organelles of animal cell and could examine normal and abnormal cellular physiology. Students could demonstrate cells organelles and acellular components in tissues as well as able to estimate protein, lipid and carbohydrates in tissues.
- They could able to describe, interpret inheritance pattern in animals. They could differentiate varied mechanisms controlling inheritance in animals.
- They could describe, analyze the different aspect of Applied Zoology. They could understand the practices of apiculture, sericulture, fisheries etc. and acquainted themselves with economic benefit of these practices as well as explain it to others.
- Students understand, analyze, interpret the innate and learned behaviour of different animal groups.
- Students will be able to perform different experiments which could help them to prove their hypotheses. They could able to analyze the data with help of different statistical tools. Students will develop capabilities which help them to design and investigate the scientific research work. They could able to draft a scientific write up and could argue, defend his findings based on standard practices of research in Life Science

B.Sc. Sem. I . DSC: BZO1T01

Life and Diversity of Animals - Nonchordates (Protozoa to Annelida)

Theory- 2 Credits + Practical - 1 Credit

Course Outcomes (COs):

- Students will be able to understand about early phyla viz., Protozoa, Porifera, Coelenterata, Platyhelminthes, Aschelminthes and Annelida.
- Students could be able to identify, classify and analyze different animals belonging to phylum Protozoa to Annelida on the basis of levels or grades of organization, symmetry, coelom etc. upto class.
- Students will learn, analyze, describe a representative animal belonging to phylum Protozoa to Annelida
- Students could elucidate and explain uniqueness of phylum Protozoa to Annelida and they could be able to demonstrate peculiar tissues, organs of animals belonging to these phyla.

Unit:I

7 Hrs.

- 1.1 **Kingdom Protista, Phylum - Protozoa:** General characters of Protozoa.
- 1.2 **Paramecium:** Structure, locomotion and reproduction.
- 1.3 **Plasmodium:** Structure and life cycle.
- 1.4 **Parasitic Protozoans of Man :** *Entamoeba, Trypanosoma, Giardia and Leishmania* - Mode of infection, Damage and control.

Unit: II

7 Hrs.

- 2.1 **Kingdom- Animalia:** Major phyla of Animalia, general characters and classification upto classes of Phylum Porifera.
- 2.2: **Sycon:** Structure, reproduction and development, Canal system in sponges.
- 2.3 **Coelenterata :** General characters and classification up to classes.
- 2.4 **Obelia :** Structure and life cycle, corals and coral reef formation.

Unit III

8 Hrs.

- 3.1 **Platyhelminthes:** General characters and classification up to class.
- 3.2 **Taenia solium:** Structure and life cycle, parasitic adaptations in *Taenia solium*.
- 3.3 **Aschelminthes:** General characters and classification up to classes.

3.4 *Ascaris* : External morphology, reproductive system and life cycle.

Unit – IV

8 Hrs.

4.1 **Annelida**: General characters and classification up to classes.

4.2 **Leech**: Morphology, digestive and urinogenital system.

4.3 **Annelidan larvae**: Trochophore larva and its significance.

4.4 Economic importance of Annelids: Harmful Annelids, Beneficial Annelids, Therapeutic value of Annelids.

Practical : BZO1P01

1. Study of museum specimens (Classification of animals up to orders)

I. Protozoa (Slides) : *Paramoecium*, *Euglena*, *Plasmodium vivax*

II. Porifera: *Sycon*, *Leucosolenia*, *Hyalonema*, *Euplectella*, *Spongilla*

III. Coelenterata : *Obelia*, *Aurelia*, *Tubipora*, *Fungia*, *Adamsia*

IV. Platyhelminthes : *Planaria*, *Fasciola*, *Taenia*

V. Aschelminthes : *Ascaris*, *Drancunculus*, *Ancylostoma*, *Wuchereria*

VI. Annelida : *Aphrodite*, *Nereis*, *Chaetopteurs*, *Tubifix*, *Hirudinaria*

2. Study of permanent slides

Enatmoeba, *Giardia*, Sponge gemmules, Sponge spicules, V.S. *Sycon*, T.S. *Sycon*,

Obelia medusa, Miracidium, Redia and Cercaria larvae of *Fasciola*, T.S. male and

female *Ascaris*, Scolex of *Taenia*, Mature and gravid proglottids of *Taenia solium*,

T. S. of Leech through crop pockets, Trochophore larva

3. Anatomical observation (Demonstration only through You tube video and other ICT tools, models, and charts)

Digestive, nervous and reproductive system of Earthworm

4. Mounting

Spicules and gemmules of Sponge, *Obelia* colony, *Nereis* parapodia, Jaws of Leech,

Nephridia of Leech.

Practical Examination Scheme

Distribution of Marks –

Total Marks: 25

i. Identification and Comment on Spots (4 Museum specimens + 2 slides)	06
ii. Anatomical observation or Examination of pond water to identify invertebrates.	08
iii. Permanent stained preparation	04
iv. Submission of certified practical record	03
v. Submission of Slides	02
vi. Viva voce	02

List of Recommended Books:

1. Barnes R.D.(1980) – **Invertebrate Zoology. Halt-Saunders international**, 4th Edition, Philadelphia, USA, pp. 1089.
2. Borradaile L.A.and Potts F.A. (1935). **The Invertebrata; a manual for the use of students, 2nd Edition.** McMilan Publisher, New York, USA, pp. 746.
3. Nigam H. C. (2013). **Biology of Nonchordates.** Shoban Lal Nagin Chand, India, pp. 871.
4. Kotpal, Agrawal and Khetrapal (2012). **Modern Text Book of Zoology – Invertebrates.** Rastogi Publication, Meerut, India, pp.
5. Puranik P.G.and Thakur R.S. – **Invertebrate Zoology**
6. Majupuria T.C. – **Invertebrate Zoology**
7. Dhami and Dhami – **Invertebrate Zoology**
8. Parker and Hashwell, **Textbook of Zoology Vol. I (Invertebrates)** A.Z.T.B.S. Publishers and Distributors, New Delhi
9. Dr. S.S. Lal **Practical Zoology Invertebrates 9th edition**, Rastogi Publication Meerut
10. EJW Barrington– **Invertebrate Structure and Function** ELBS III Edition8
11. R.L. Kotpal – **Phylum Protozoa to Echinodermata (series)**, Rastogi and Publication, Meerut
12. Parker J. and Haswell W. – **Text Book of Zoology**, ELBS Edition
13. Vidyarthi – **Text Book of Zoology**, Agrasia Publishers, Agra
14. Jordan E.L. and Verma P.S. – **Chordate Zoology**, S. Chand and Co., New Delhi
15. Ayer E. – **Manual of Zoology**
16. M.D. Bhatia – **The Indian Zoological Memories – Leech**
17. Beni Prasad – **The Indian Zoological Memories – Pila**
18. P. K. Gupta – **Vermicomposting for Sustainable Agriculture**, Agrobios India Ltd
19. A manual of Practical Zoology Invertebrates – P. S. Verma

DSC: BZO1T02

Environmental Biology

Theory- 2 Credits + Practical - 1 Credit

Course Outcomes (COs):

- Students will be able to describe and explain atmosphere, hydrosphere, lithosphere and energy resources.
- Students could describe, elucidate different types and components of ecosystems. They could identify, describe and explain different biotic components and could explain and analyze their role in ecosystem.
- Students will describe, explain and be aware about the significance and need of biodiversity conservation. They also understand, describe and explain legislations passed to conserve the biodiversity and acquainted themselves to nearby National Parks and Wildlife Sanctuaries.
- They will elucidate and differentiate causes of different types and hazards of pollution.
- Students will estimate the different physico-chemical parameters of water to analyze.

Unit-I

7 Hrs.

- 1.1 Atmosphere:** Major zones, importance, composition of air.
- 1.2 Hydrosphere:** Global distribution of water, Physico-chemical characteristics of water.
- 1.3 Lithosphere:** formation of soil, Causes of soil erosion.
- 1.4 Renewable and non-renewable energy sources.**

Unit-II

7 Hrs.

- 2.1 Ecosystem-Definition and Types-** Forest, Grassland, Desert, Pond.
- 2.2 Food chain, food web.**
- 2.3 Ecological pyramids-** Definitions, pyramids in pond, forest and parasitic food chain.
- 2.4 Energy flow in an ecosystem, Single channel, Y-shape and Universal model.**

Unit-III

8 Hrs.

- 3.1 Biodiversity and its conservation, Biological Diversity Act, 2002.**
- 3.2 Causes of reduction of biodiversity.**
- 3.3 Salient features of Wildlife Protection Act, 1972, Zoological Survey of India: formation and role in animal conservation.**
- 3.4 Hot spots of biodiversity in India, Introductory study of national parks and sanctuaries – Tadoba, Nagzira, Kanha.**

- 4.1 Air Pollution:** Sources, effect and control measures of air pollution, Acid rain, green house effect, ozone depletion and global warming.
- 4.2 Water Pollution:** Sources, effect and control measures of water pollution, effect of mercury.
- 4.3 Noise pollution:** Sources effect and control measures of noise pollution.
- 4.4 Biomagnification and Bioaccumulation.**

Practical: BZO1P02

1. Major Experiment:

- i. Estimation of dissolved oxygen (DO) of water.
- ii. Estimation of soil organic carbon by Walkley and Black (Rapid Titration) method.
- iii. Estimation of total hardness of water.

2. Minor experiment

- i. To demonstrate the functioning of Simple and Compound Microscope (Minor)
- ii. Estimation of pH of water sample.
- ii. Estimation of noise frequency by using dB meter.
- iii. Quantitative analysis of plankton by Sedwick Rafter method.
- iv. Estimation of free CO₂ of water .

3. Preparation of permanent stained preparation of zooplanktons

4. Collection of photographs and identification of producers, primary consumers, secondary consumers, tertiary consumers, decomposers.
5. Preparation of permanent stained preparation of zooplanktons.
6. Study and collection of different types of zooplanktons.
7. Study tour at nearby forest and to record faunal biodiversity of nearby forest.

Practical Examination Scheme

Distribution of Marks –

Total Marks: 25

i Major experiment	06
ii Minor experiment	04
iii. Identification of consumers and planktons (Any four)	04
iv. Preparation of permanent slide of plankton	03
v. Submission of certified practical record	02
vi. Submission of photographic cards of consumers, zooplanktons	02
vii. Submission of tour diary	02
viii. Viva voce	02

List of recommended Books:

1. Ashthana D.K.(2001). **Environmental Problem and Solution**, S. Chand Publication, pp. 434.
2. Agrawal K.C.(1987). **Environmental Biology**. Agrobios Publishers, pp. 439.
3. Agrawal K.C. (1996). **Biodiversity**. Agrobios Publishers, pp. 144.
4. Mukharjee B. (1980). **Environmental Biology**. Mcgraw Hill, pp. 640.
5. Arora S. (2008). **Fundamentals of Environmental Biology**. Kalyani Publisher, pp. 294.
6. Sharma P.D.(2012). **Ecology and Environmental Biology**. Rastogi Publication, pp. 640.
7. Verma P.S. and Agrawal V.K. (2000). **Environmental Biology**, S. Chand Publication, pp. 434.
8. Trivedi & Rao – **Air Pollution**
9. Chapman J.L. and Reiss M.J. (1998). **Ecology-Principles and Applications**, 2nd ed., Cambridge University Press, pp. 336.
10. Chatterjee B (2003). **Environmental Laws-Implementation Problems and Perspectives**. Deep and Deep Publications,India, pp. 304
11. Sharma P.D. (1997). **Environmental Biology**, Rastogi Publication, Meerut, pp. 416.
12. Trivedi R.K. (19976). **Handbook of Environmental Laws, Acts, Rules, Guidelines, Compliances and Standards**. Enviro Media
13. Odum E.P. and Barret G,W, (2005). **Fundamentals of Ecology**, 5th edition. Thomson Brooks/ Cole , pp.598.
14. Smith R.L. (1996). **Ecology and Field Biology**, Harper Collins
15. Saxena D.N. – **Environmental Biology**, Studium Press (India)
16. Davis – **Behavioral Ecology**
17. Kumar U. and Asija M.J. (2000). **Biodiversity – Principle and Conservation**. Agrobios Publishers, pp. 302.
18. Rao M. and Rao H.V.N. (2017). **Air Pollution**, Mcgraw Hill, pp. 339.
19. Satyanarayan S., S. B. Zade S.B., S.R. Sitre S.R.and Meshram P.U. – **A Text Book of Environmental Studies**, Allied publisher (India)
20. Smitz R.J. (1996). **Introduction to Water Pollution**. Asian Books Private Limited, pp. 320
21. Subrahmanyam N.S. and. Sambamurthy A V.S.S (2000). **Ecology**. Narosa Publishing House, pp. 616.

B.Sc. Sem. I
VSC course : Vermicomposting BVS1P01
Credit: 2

Course outcomes: After completion of this course, student will –

- Get acquainted with hand on training of vermicomposting.
- Get acquainted with hand on training of vermiwash.
- Able to understand and learn about the vermicompost marketing.
- Able to do internship in any commercial vermicompost or vermiwash unit.

Practical:

1. Collection of Biodegradable wastes (Solid waste) and their segregation and processing
2. Bed Preparation for Pit/Windrow method
3. Pit Regulation, its maintenance and precautions
4. Earthworm collection and application on bed
5. Inspection of bed, watering and top up
6. Vermicompost collection, earthworm separation (Harvesting), air drying of vermicompost, sieving and storage of compost
7. Vermiwash: methods collection and processing
8. Cocoon formation, breeding methods of worms
9. Standardize technique with categorized biodegradable wastes
10. Analysis of vermicompost and vermiwash; soil testing
11. Applications/ packaging and marketing of byproducts
12. Visit to vermiculture farm/setup

Suggested reading:

Lekshmy MS and Santhi R. Vermitechnology. Saras Publication, pp. 416.

Singh K (2014). Textbook of vermicompost: vermiwash and biopesticides. Astral International, pp. 97.

Davies P. (2014). Vermicomposting and vermiculture, pp. 49.

Das M. (2013). Tools for vermitechnology. IK International Publishing House Pvt. Ltd., 1st ed., pp. 196

B.Sc. SEMESTER – I

BVE1T01: ENVIRONMENTAL SCIENCE

COURSE OUTCOMES:

At the end of the course, students shall be able to:

- Explain the basics of Environmental Science and Atmospheric Science along-with the components of Environment
- Explicate the importance of Environmental Education.
- Elucidate the fundamentals of atmospheric science including formation, depletion and effects of ozone layer and acid rain on environment.
- Describe the various physical and chemical characteristics and properties of Water and Soil
- Understand the Ecology and its allied branches
- Comprehend about Population and Community Ecology
- Study the changes in Population by understanding the concept of Population ecology

Unit-I: Basics of Environmental Science (7.5 Hrs)

- A. Introduction of Environmental Science: Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.
- B. Environmental Education: Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness.
- C. Components of Environment: Atmosphere (Structure and composition), hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

Unit-II: Basics of Atmospheric Science (7.5 Hrs)

- A. Atmospheric Chemistry: Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.
- B. Green House Effect: Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. Ozone depletion: chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.
- C. Acid Rain: Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. Precipitation – Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

Unit-III: Basics of Ecology (7.5 Hrs)

- A. Ecology: Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.
- B. Abiotic Factors: Temperature: effect of temperature on plants and animals, Adaptation to meet extreme temperature. Light: Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.
- C. Biotic Factor: Inter specific relationship Positive: Mutualism (symbiosis), commensalism, proto-cooperation Negative: Parasitism, predation, competition, Antibiosis, Neutralism.

Unit-IV: Ecosystems and food chain (7.5 Hrs)

- A. Ecosystem: Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)
- B. Food chain: Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological pyramids (number biomass and energy), energy flow in ecosystem (Y-shaped). Energy flow and the law of thermodynamics.
- C. Biogeochemical Cycles: Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

Reference Books:

1. Text Book of Environment: K M Agrawal, P.K. Sikdar, and S.C. Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C. Dash and P.C. Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C. Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K. Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S. Dara, S.Chand Publication ,New Delhi.
6. Environmental Chemistry: A.K. Dey, New Age International Publishers,2001.
7. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr

P.U. Meshram, Allied Publishers, New Delhi.

8. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi,1996.
9. Animal Ecology and Distribution of Animals: Veer Bala Rastogi , Rastogi Publication, Meerut (U.P).
10. Ecology and Environment: P.D.Sharma, Rastogi Publication ,Meerut (U.P).
11. Fundamentals of Environmental Biology: S. Arora, Kalyani Publishers.
12. Environmental Biology: P.K.G. Nair, Himalaya Publication.
13. Environmental Biology: K.C. Agrawal, Agro Botanical Publisher ,Bikaner,1994

Indian Knowledge System (IKS)
SEM1: VEDIC MATHEMATICS (BIK1T01)

Course Outcomes: This course will enable the students to

1. Improve speed and accuracy in numerical calculations
2. Acquire IQ skills and high-end technical knowledge
3. gain test taking skills & creativity of calculations

UNITS	TOPICS	HOURS
Unit 1	(i) Addition - Subtraction - Combined operations - Beejank (ii) Multiplication methods: Urdhwatiryagbhayam, Nikhilam, Ekanyunen, Ekadhiken, Antyayordashakepi. (iii) Vinculum - Operations. (iv) Awareness of 1 to 5 Vedic sutras as per Shankaracharya Bharthikrishan Teerthji Swamiji's book.	8
Unit 2	(i) Division methods : Nikhilam, Paravartya Yojayet, Dhvajank (ii) GCD and LCM (iii) Expression of GCD in terms of two numbers.	8
Unit 3	(i) Divisibility tests, Osculation & Reverse osculation. (ii) Division Algorithm, Quotient & Remainder. (iii) Duplex method.	7
Unit 4	i) Squares & Square-roots for 6 digit number. (ii) Cubes & Cube-roots for 6 digit number, Contribution of Indian Mathematicians in Arithmetic.	7
	TOTAL	30 HRS

Reference Books:

1. Tirthaji B.K. (1965) Vedic Mathematics, Motilal Banarsidass
2. Bidder G.P. (1856) On Mental Calculation. Minutes of Proceedings, Institution of Civil Engineers (1855-56), 15, 251-280
3. Scripture E.W. (1891) American Journal of Psychology. Vol. IV 1-59
4. Mitchell F.D. (1907) American Journal of Psychology. Vol. XVIII 61-143
5. Aitken A.C. (1954) The Art of Mental Calculation: With Demonstrations. Transactions of the Society of Engineers. 45, 295-309
6. Dow A. (1991) A Unified Approach to Developing Intuition in Mathematics, Scientific Research on the Transcendental Meditation and TM-Sidhi Program Vol 5, 3386-3398
7. Williams K.R. (1984) Discover Vedic Mathematics. Vedic Mathematics Research Group
8. Nicholas, Williams, Pickles (1984) Vertically and Crosswise. Inspiration Books

B.Sc. Sem. II

DSC: BZO1T03

Life and Diversity of Animals – Non-Chordates: Life and Diversity of Animals (Arthropoda to Hemichordata)

Theory- 2 Credits + Practical - 1 Credit

Course Outcomes (COs):

1. Students will learn, identify, explain and analyze the taxonomic position of animals belonging to phylum Arthropoda to Hemichordata
2. They could describe, explain and analyze phylogeny to understand the course of evolution in animals from phylum Arthropoda to Hemichordata
3. They will be able to describe, explain and differentiate various morphological, anatomical structures and functions of animals of phyla from Arthropoda to Hemichordata.
4. Students will be able to understand, describe, explain and differentiate the larval forms and development of the invertebrates from phylum Arthropoda to Hemichordata
5. Students will be able to describe, explain and analyze the ecological and economic importance of invertebrates.
6. Students will understand, be able to describe, explain and analyze the ecological role of invertebrates in the biodiversity.

UNIT: I

7 Hrs

1.1. Arthropoda: General characters of the phylum and classification up to classes with suitable examples

1.2. Cockroach: Digestive system, Male and Female reproductive system

1.3. Insects as Vectors : Mosquito, Housefly, Tse-Tse fly

1.4. Study of crustacean larvae: Nauplius, Zoea and Megalopa

UNIT: II

7 Hrs

2.1 Mollusca: General characters and classification up to classes

2.2 Pila: Respiratory system and Mechanism of Aquatic and Pulmonary respiration.

2.3 Economic importance of Mollusca: Edible oyster farming, pearl forming mollusc, types of pearl culture

2.4 Molluscan larva: Glochidium and Veliger

UNIT: III

8 Hrs

3.1 Echinodermata: General characters and classification up to classes

3.2 Asterias: External morphology, Straight and Crossed type of Pedicellariae.

3.3 Water vascular system and locomotion in *Asterias*

3.4 Echinoderm larva: Bipinnaria and Auricularia

UNIT: IV

8 Hrs

4.1 Hemichordata: General characters and Phylogeny

4.2 Balanoglossus: External features and digestive system

4.3 Pre-Larval Development in Balanoglossus, Tornaria larva

4.4 Affinities of Balanoglossus with Annelida, Echinodermata and Chordata

Practical - BZO1P03

1. Study of museum specimens (Classification of animals up to orders)

I. Arthropoda : Crab, Prawn, Scolopendra, Julus, Dragonfly, Moth, Limulus

II. Mollusca : Chiton, Dentalium, Pila, Mytilus, Sepia, Octopus

III. Echinodermata : Asterias, Ophiothrix, Holothuria, Antedon, Echinus

IV. Hemichordata : Balanoglossus, Saccoglossus

2. Study of permanent slides- Nauplius, Zoea and Megalopa larva of Arthropoda, Glochidium larva, Bipinnaria larva, T.S. Balanoglossus through branchiogenital region, Tornaria larva

3. Anatomical observation (Demonstration Only -Through You Tube Video and other ICT tools, Models, Charts) –

I. Digestive system of Cockroach

II. Male and Female Reproductive system of Cockroach

III. Water vascular system in *Asterias*.

4. Mounting (Any two) - I. Crustacean larvae and planktons

II. Mouth Parts of Insects – Cockroach/Mosquitoes

III. Gill lamella of Pila

5. Collection of photograph of insect vectors.

6. Examination of pond water to identify aquatic Arthropods and Molluscs.

Practical Examination Scheme

Distribution of Marks –

Total Marks: 25

i Identification and Comment on Spots (4 Museum specimens + 2 slides)	06
ii Anatomical observation or Examination of pond water to identify invertebrates.	08
iii Permanent stained preparation	04
iv Submission of certified practical record	03
v. Submission of Slides	02
vi. Viva voce	02

List of recommended books:

1. Barnes – **Invertebrate Zoology (Halt-Saunders international)** Philadelphia, USA
2. Barradaile L.A. and Potts F.A. – **The Invertebrate**
3. Nigam – **Biology of Nonchordates**
4. Kotpal, Agrawal & Khetrapal – **Modern Text Book of Zoology - Invertebrates**,
Rastogi Publication, Meerut
5. Puranik P.G. and Thakur R.S. – **Invertebrate Zoology**
6. Majupuria T.C. – **Invertebrate Zoology**
7. Dhami and Dhami – **Invertebrate Zoology**
8. Parker and Hashwell, **Textbook of Zoology Vol. I (Invertebrates)** A.Z.T.B.S. Publishers and
Distributors, New Delhi
9. Dr. S.S. Lal **Practical Zoology Invertebrates**. 9th edition, Rastogi Publication Meerut
10. EJW Barrington– **Invertebrate Structure and Function**. 8th Edition, ELBS III
11. R.L. Kotpal – **Phylum Protozoa to Echinodermata (series)**, Rastogi and Publication,
Meerut
12. Parker J. and Haswell W. – **Text Book of Zoology**, ELBS Edition
13. Vidyarthi – **Text Book of Zoology**, Agrasia Publishers, Agra
14. Jordan E.L. and Verma P.S. – **Chordate Zoology**, S. Chand and Co., New Delhi
15. Ayer E. – **Manual of Zoology**
16. M.D. Bhatia – **The Indian Zoological Memories – Leech**
17. Beni Prasad – **The Indian Zoological Memories – Pila**
18. P. K. Gupta – **Vermicomposting for Sustainable Agriculture**, Agrobios India Ltd
19. A manual of Practical Zoology Invertebrates – P. S. Verma

DSC: BZO1T04

Cell Biology

Theory- 2 Credits + Practical - 1 Credit

Course Outcomes (COs):

- Students will be able to describe, sketch, analyze, and explain the structure and function of the cell organelles.
- Students could describe, sketch, analyze, and explain the structure and function of nucleus and chromatin structure, its location.
- Students will be able to describe, sketch, analyze, and explain the basic principle of life. They could also demonstrate and explain how a cell divides leading to the growth of an organism.
- Students could describe, sketch, analyze, and explain how a cell communicates with its neighbouring cells.
- Students will be able to describe, sketch, analyze, and explain the abnormality in structural and functional aspects of cells.
- Students will be able to handle and use microscopes and oculometer to elucidate and measure and explain the minor details of tissues.
- Students will be able to demonstrate osmosis. They could also demonstrate and explain mitochondria, salivary gland chromosome and Barr body in cells.

UNIT: I

7 Hrs.

1.1 Ultra-structure of Plasma membrane and its chemical composition

1.2 Endomembrane system: Protein sorting, transport, exocytosis, endocytosis

1.3 Cell-cell interaction: Cell adhesion molecules, cellular junction

1.4 Golgi Complex: Structure and functions.

UNIT 2

7 Hrs.

2.1 Cytoskeleton: Microtubules, Microfilaments, intermediate filaments.

2.2 Mitochondria: Structure and Oxidative phosphorylation, ETS.

2.3 Peroxisome: Structure and functions.

2.4 Ribosome: Structure, types, Lake's model and functions.

UNIT 3

8 Hrs.

3.1 Lysosome: Structure, polymorphism and functions

3.2 Structure and function of Nucleus and Nuclear membrane

3.3 Chemical Composition and base composition of DNA and RNA

3.4 Chromatin Modelling: Supercoiling, Chromatin organization, structure of chromosome

UNIT 4

8 Hrs.

4.1 Cell cycle and its regulation, Apoptosis

4.2 Cell Division: Mitosis and Meiosis

4.3 Signal transduction: Intracellular signalling, cell surface receptors, G-protein coupled receptors

4.4 Cellular aging and cell death

Practical: BZO1P04

1. Major Experiment

- Study of Osmosis in human RBCs (Hypertonic, hypotonic and isotonic).
- Demonstration of Mitotic cell division in *Allium cepa*.
- Demonstration of Salivary gland chromosome in Mosquito/ *Chironomous* larvae.
- Demonstration of Barr body in blood smear.

2. Minor Experiment

- Use of Ocular micrometer and measurement of Micro objects.
- Demonstration of Meiotic cell division in *Tradescantia* buds or Grasshopper Testis (Virtual/Pictorial).
- Demonstration of mitochondria in buccal epithelium by Janus green B method.

3. **Reading/Preparation/Presentation a report** on Indian Scientist who contributed in the field of Cell biology/Molecular Biology (Dr. Hargovind Khurana, Dr. Lalji Singh, Dr/ Shantiswaroop Bhatnagar, Dr. Arunkumar Yadav etc.)

4. **Preparation of photographic cards on various cell organelles.**

Practical Examination scheme

Distribution of Marks –	Total Marks: 25
1. Major Cytology Experiment	06
2. Minor Cytology Experiment	04
3. Report (Indian Scientists)	02
4. Submission of Laboratory report/slides/photographs	03
5. Submission of certified Practical Record	05
6. Viva voce	05

List of recommended Books:

- Powar C.B. (1991). **Cell Biology**. Himalaya Publication, New Delhi, pp. 782.
- Dr. S.P. Singh, Dr. B.S. Tomar (2007). **Cell Biology**. 9th revised edition, Rastogi Publication, Meerut
- Gupta P.K. (2018). **Cell and Molecular Biology**. Rastogi Publication, Meerut, pp. 942.
- Veer Bala Rastogi. **Introduction to Cell Biology**, Rastogi Publication, Meerut

5. Gerald Karp (2007). **Cell and Molecular Biology-Concepts and Experiments**, John Wiley and Sons, pp. 843.
6. De Robertis, E. D. P., Nowinski, W. W., Saez, F. A. (1965). **Cell Biology**, Saunders, pp. 446.
7. Verma P.S. and Agrawal V.K. **Concepts of Cell Biology**
8. Dowben R.M. (1971). **Cell Biology**. Harper and Row Limited, pp. 570.
9. Witt – **Biology of Cell**
10. Ambrose E.J. and Easty D.M. (1970). **Cell Biology**. Thomas Nelson and Sons Ltd, pp.500.

B.Sc. Sem. II
VSC course: Culture of Indian Major Carps BVS1P03
Credit: 2

Course outcomes: After completion of this course, student will–

- Able to sketch, describe, Identify and classify the Indian major carps.
- Design the layout of the various types of ponds for the rearing of various stages of IMC.
- Get acquainted with hands on training of various breeding techniques.
- Get acquainted with hands on training of rearing of fry to fingerlings.
- Able to understand the different types of crafts and gears used in fish harvesting (Catching).
- Get hands on training of handling of various gear, crafts used in fish harvesting (Catching).
- Able to do internship and work in any commercial breeding centre .

Practical:

- Identification and classification of Indian major carps and other cultivable carps along with IMC (*Labeo*, *Catla* and *Mrigal*, *L. calbasu*, Grass carp, Silver carp, *Cyprinus*)
- Study of preparation of nursery, rearing and stocking pond by visiting Fish farm or with the help of ICT tools/ models/ charts/ photographs etc.
- Study of food and feeding habits of Indian major carps with the help of already available Food/ ICT tools/ models/ charts/ photographs etc.
- Study of carp seed rearing by visiting breeding centers or with the help of ICT tools/ models/ charts/ photographs etc.
- Study of rearing of fry to fingerlings by visiting breeding centers or help of ICT tools/ models/ charts/ photographs etc.
- Study of harvesting tools. (Crafts and Gears) with the help of already available crafts and gears / ICT tools/ models/ charts/ photographs etc.
- Study of fertilizers with the help of already available Fertilizers/ ICT tools/ models/ charts/ photographs etc..
- Study of stocking density to various ponds by visiting Fish farm or with the help of ICT tools/ models/ charts/ photographs etc.
- Study of preservation techniques with the help of ICT tools/ models/ charts/ photographs etc.
- Visit to breeding centers.
- Market survey.

Suggested reading:

- **Datta Munshi, JS and Shrivastva, M P (1988).** Natural history of fishes and systematic of fresh water fishes. Narendra Publishing House, pp. 381.
- **Jayaram KC (1981).** The freshwater fishes of India, Pakistan, Bangladesh, Burma and Shri Lanka Handbook: Zoological Survey of India, pp.475.
- **Mishra K. S. (2003).** An aid to the identification of common commercial fishes of India and Pakistan. Narendra Publishing House, pp. 320.
- **Bardach, J.E. (1974).** Aquaculture: The farming and husbandry of freshwater and marine organism. John Wiley and Sons, pp. 882.
- **Chonder S L(1970).** Handbook of breeding of Indian Major Carps by pituitary hormone injection. Satish Book Enterprises, pp. 100.
- **Jhingran V G (1991).** Fish and fisheries of India: Hindustan Publication Corporation, pp. 727.
- **Sinha VRP (1993).** A compendium of aquaculture technologies:. Oxford and JBH Publication Co. New Delhi.
- **Pandey K and J.P. Shukla JP (2018).** A Textbook of fish and fisheries Rastogi Publication, Meerut, pp. 588.
- **Khanna SS and Singh HR (2014).** A text book of fish biology and fisheries. 3rd edition, Narendra Publishing House.

SEM 2 : CONSTITUTION OF INDIA (BVE2T02)

Syllabus

UNIT – I:

- Historical Background to the Framing of the Indian Constitution: General Idea about the Constituent Assembly of India.

UNIT – II

- Preamble – Nature and key concepts/Constitutional values, Socialism, Secularism, Democracy, Justice, Liberty, Equality and Fraternity
- Salient Features of the Constitution of India

UNIT – III

- General study about the kinds, nature and importance of; Fundamental Rights, Directive Principles of State Policy and Fundamental Duties.

UNIT –IV

Introduction of the Constitutional Institutions and Authorities;

- Central Legislature and Executive (Parliament of India, President of India and Council of Ministers)
- State Legislature and Executive (State legislative Assemblies, Governors and Council of Ministers)
- Higher Judiciary (Supreme Court of India and High Courts)

Indian Knowledge System (IKS)

SEM2: INDIAN ASTRONOMY (BIK2T02)

Course Outcomes: This course will enable the students to understand that

- 1.** It is possible to create a map of the intellectual growth of a culture using astronomy as a probe.
- 2.** The growth of Indian astronomy occurs in distinct stages analogous to phase transitions of the evolution of cultures
- 3.** Indian Astronomy therefore provides an excellent window to the past dramatic transitions.

UNITS	TOPICS	HOURS
Unit 1	Astronomy in Prehistoric Era, Astronomy in Vedic Era, Vedang Jyotish, Astronomical References In Religious Scriptures, Astronomies of the West	8
Unit 2	Arya Bhatta, Panch Siddhantika of Varahamihira, Surya Siddhanta Varahamihira to Bhaskar Acharya-II, Siddhant Shiromani of Bhaskar Acharya-II, Bhaskar Acharya-II to Jai Singh, Jai Singh and his Observatories.	8
Unit 3	After Jai Singh, Interaction with the Astronomies of the World, Modern Era Astronomy , Our Universe, Cosmology	7
Unit 4	Panchang Horoscope and Astrology , Siddhantas, Karnas and Koshtakas, Observational Instruments of Indian Astronomy	7
	TOTAL	30 HRS

Reference Books:

1. The Story Of Astronomy In India, Chander Mohan, Pothi.com
2. Indian Astronomy: An Introduction. Front Cover · S. Balachandra Rao. Universities Press, 2000
3. Astronomy in India: A Historical Perspective, Thanu Padmanabhan, Springer Science & Business Media
4. Hindu Astronomy, W. Brennand, Alpha Editions
5. Origin and Growth of Astronomy in India,
<https://www.tifr.res.in/~archaeo/FOP/FOP%20pdf%20of%20ppt/Vahia%20Origin%20of%20Astronomy.pdf>