॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण–२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २२ एप्रिल २०२६ रोजी संपन्न झालेल्या मा.विद्यापरिषद बैठकीतील विषय क्र.०८/६४–२०२६ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसार पदवी तृतीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्यास मा.विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी.एस्सी. तृतीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२६–२७ पासून लागू करण्यात येत आहे.

01	B.Sc. III Year Botany	10	B.Sc. III Year Biochemistry
02	B.Sc. III Year Chemistry	11	B.Sc. III Year Agriculture Microbiology
03	B.Sc. III Year Mathematics	12	B.Sc. III Year Electronics
04	B.Sc. III Year Zoology	13	B.Sc. III Year Seed Technology
05	B.Sc. III Year Microbiology	14	B.Sc. III Year Horticulture
06	B.Sc. III Year Geology	15	B.Sc. III Year Analytical Chemistry
07	B.Sc. III Year Enviornment & Earth Science	16	B.Sc. III Year Agrochemical & Fertilizers
08	B.Sc. III Year Statistics	17	B.Sc. III Year Industrial Chemistry
09	B.Sc. III Year Dairy Science	18	B.Sc. III Year Industrial Microbiology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या www.srtmun.ac.in या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/परिपत्रक/पदवी/बीएस्सी/२०२६–२७/60
दिनांक : १९.०६.२०२६

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळे) विभाग

प्रत माहिती व पुढील कार्यवाहीस्तव :–
१) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. प्र.कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ
३) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परिक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबंधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED - 431 606 (MS)

(Credit Framework and Structure of Four Year UG Program with Multiple Entry and Exit Option as per NEP-2020)

UNDERGRADUATE PROGRAMME OF SCIENCE & TECHNOLOGY

SUB - ZOOLOGY

Major in **DSC** and Minor in **DSM** (Subject)

Syllabus
B. Sc. Third Year

Under the Faculty of Science & Technology

Effective from the June - 2026
(As per NEP-2020)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

Details of the Board of Studies Members in the subject **Zoology** under the Faculty of Science & Technology of S.R.T.M. University, Nanded

Sr. No.	Name of the Member	Designation	Address	Contact No.
1	Dr. Hanumant Shahaji Jagtap	Chairman	Shri Shivaji College, Parbhani	9423717670 9834345722 hsjagtap1704@gmail.com
2	Dr. Shivaji Prabhakar Chavan	Member	School of Life Sciences, SRTMUN	9421046372 dr_spchavan@rediffmail.com
3	Dr. Dhanraj Balbhim Bhure	Member	Yeshwant Mahavidyalaya, Nanded	8149407814, 8329013983 drajbhure82@gmail.com
4	Dr. Anil M. Mane	Member	Arts, Science & Commerce College, Shankarnagar, Dist. Nanded	9422874110, 9404464462 anilmane531@gmail.com
5	Dr. Prashant P. Joshi	Member	Adarsh Education Society's ACS College, Hingoli	9595648535 7588081822 drprashantjo@gmail.com
6	Dr. Ratna V. Kirtane	Member	Dayanand Science College, Latur	9422185834, 8308886686 ratnakirtane@gmail.com
7	Dr. Sanjay Shamrao Nanware	Member	Yeshwant Mahavidyalaya, Nanded, Tq. & Dist. Nanded	9423401227, 8329199589 snanware@rediffmail.com
8	Dr. Sanjay Sadashivrao Kale	Member	Kumarswami Mahavidyalaya, Ausa, Tq. Ausa, Dist. Latur	9423348758 sanjaykale.sks@gmail.com
9	Dr. Deepak Pandurang Katore	Member	Nagnath Arts, Commerce & Science College, Aundha Nagnath, Dist. Hingoli	9765737373, 9134737373 katoredeepak@gmail.com
10	Dr. Ramrao Janardhanrao Chavan	Member	Dr. Babasaheb Ambedkar Marathwada University, Aurangabad	chavanrj@gmail.com 9423030859
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12	Dr. Karmveer Nagnathrao Kadam	Member	Shri Kumarswami Mahavidyalaya, Ausa Dist. Latur.	karmbeernk@gmail.com 9970129919
13	Dr. Shivesh Pratap Singh	Member	Government PG College, Santa – 485001 (MP)	drshiveshsingh2004@yahoo.com 07987155634

14	Dr. Chandrashekhar Devidasrao Basarkar	Member	Director, Nimbkar Seeds Pvt. Ltd. Phaltan, Dist. Satara	basarkarcd@gmail.com 9822652659
15	Pandhrpure Laxmi Gurunath (UG Merit Student, Zoology)	Invitee Member	C/o. Maharashtra Mahavidyalaya Nilanga	9529251388
16	Dusnale Prashant Baliram (PG Merit Student, Zoology)	Invitee Member	C/o. Yeshwant Mahavidyalaya Nanded	9834642631

B.Sc. Third Year Zoology Semester V *(Level 5.5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major (Theory)	SZOOCT1301	Ecology and Zoogeography	03	--	**03**	**03**	--
	SZOOCT1302	Medical and Economic Zoology	03	--	**03**	**03**	--
	SZOOIK1303	Indian Knowledge System in Zoology	02	--	**02**	**02**	--
Major (Practical)	SZOOCP1301	Ecology and Zoogeography (based on SZOOCT1301)	--	**02**	**02**	--	**04**
	SZOOCP1302	Medical and Economic Zoology (based on SZOOCT1302)	--	**02**	**02**	--	**04**
Elective (Theory) **(Select any one paper from A/B/C/D)**	SZOOET1301	(A)- Applied Parasitology – I	**02**	--	**02**	**02**	--
	SZOOET1301	(B)- Aquaculture –I	02	--	02	02	--
	SZOOET1301	(C)- Entomology- I	02	--	02	02	--
	SZOOET1301	(D)- Environmental Biology – I	02	--	02	02	--
Elective (Practical) **(practical based on theory papers)**	SZOOEP1301	(A)- Applied Parasitology – I	--	**02**	**02**	--	**04**
	SZOOEP1301	(B)- Aquaculture –I	--	02	02	--	04
	SZOOEP1301	(C)- Entomology- I	--	02	02	--	04
	SZOOEP1301	(D)- Environmental Biology – I	--	02	02	--	04
Vocational Course	SZOOVC1301	Apiculture Or Pest Management	--	**02**	**02**	--	**04**
Field Project	SZOOFP1301	Concerned with subject	--	**04**	**04**	--	**08**
Total			**10**	**12**	**22**	**10**	**24**

B.Sc. Third Year Zoology Semester V *(Level 5.5)*

Examination Scheme

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major (Theory)	SZOOCT1301	Ecology and Zoogeography	30	30	30	45	--	--	75
	SZOOCT1302	Medical and Economic Zoology	30	30	30	45	--	--	75
	SZOOIK1303	Indian Knowledge System in Zoology	20	20	20	30	--	--	50
Major (Practical)	SZOOCP1301	Ecology and Zoogeography (based on SZOOCT1301)	--	--	--	--	20	30	50
	SZOOCP1302	Medical and Economic Zoology (based on SZOOCT1302)	--	--	--	--	20	30	50
Elective (Theory) (Select any one paper from A/B/C/D)	SZOOET1301	(A)- Applied Parasitology – I	20	20	**20**	**30**	--	--	**50**
	SZOOET1301	(B)- Aquaculture –I	20	20	20	30	--	--	50
	SZOOET1301	(C)- Entomology- I	20	20	20	30	--	--	50
	SZOOET1301	(D)- Environmental Biology – I	20	20	20	30	--	--	50
Elective (Practical) (practical based on theory papers)	SZOOEP1301	(A)- Applied Parasitology – I					**20**	**30**	**50**
	SZOOEP1301	(B)- Aquaculture –I					20	30	50
	SZOOEP1301	(C)- Entomology- I					20	30	50
	SZOOEP1301	(D)- Environmental Biology – I					20	30	50
Vocational Course	SZOOVC1301	Apiculture **Or** Pest Management					**20**	**30**	**50**
Field Project	SZOOFP1301	Concerned with subject					**40**	**60**	**100**
									550

B.Sc. Third Year Zoology Semester VI *(Level 5.5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major (Theory)	SZOOCT1351	Ethology, Biometry and Bioinformatics	03	--	**03**	**03**	--
	SZOOCT1352	Reproductive Biology, Embryology, and Animal Development	03	--	**03**	**03**	--
	SZOOCT1353	Animal Biotechnology	02	--	**02**	**02**	--
Major (Practical)	SZOOCP1351	Ethology, Biometry and Bioinformatics (based on SZOOCT1351)	--	02	**02**	--	04
	SZOOCP1352	Reproductive Biology, Embryology, and Animal Development and Animal Biotechnology (based on SZOOCT1352 & SZOOCT1353)	--	02	**02**	--	04
Elective (Theory) **(Select any one paper from A/B/C/D)**	SZOOET1351	(A)- Applied Parasitology – II	**02**	**--**	**02**	**02**	--
	SZOOET1351	(B)- Aquaculture –II	02	--	02	02	--
	SZOOET1351	(C)- Entomology- II	02	--	02	02	--
	SZOOET1351	(D)- Environmental Biology – II	02	--	02	02	--
Elective (Practical) **(practical based on theory papers)**	SZOOEP1351	(A)- Applied Parasitology – II	--	**02**	**02**	**--**	**04**
	SZOOEP1351	(B)- Aquaculture –II	--	02	02	--	04
	SZOOEP1351	(C)- Entomology- II	--	02	02	--	04
	SZOOEP1351	(D)- Environmental Biology – II	--	02	02	--	04
Vocational Course	SZOOVC1351	Sericulture Or Poultry Farming	--	**02**	**02**	**--**	**04**
On Job Training	SZOOOJ1351	Concerned with subject	--	**04**	**04**	**--**	**08**
Total			**10**	**12**	**22**	**10**	**24**

B.Sc. Third Year Zoology Semester VI *(Level 5.5)*

Examination Scheme

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Avg of (T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major (Theory)	SZOOCT1351	Ethology, Biometry and Bioinformatics	30	30	30	45	--	--	75
	SZOOCT1352	Reproductive Biology, Embryology, and Animal Development	30	30	30	45	--	--	75
	SZOOCT1353	Animal Biotechnology	20	20	20	30	--	--	50
Major (Practical)	SZOOCP1351	Ethology, Biometry and Bioinformatics (based on SZOOCT1351)	--	--	--	--	20	30	50
	SZOOCP1352	Reproductive Biology, Embryology, and Animal Development and Animal Biotechnology (based on SZOOCT1352 & SZOOCT1353)	--	--	--	--	20	30	50
Elective (Theory) (Select any one paper from A/B/C/D)	SZOOET1351	(A)- Applied Parasitology – II	20	20	**20**	**30**	--	--	**50**
	SZOOET1351	(B)- Aquaculture –II	20	20	20	30	--	--	50
	SZOOET1351	(C)- Entomology- II	20	20	20	30	--	--	50
	SZOOET1351	(D)- Environmental Biology – II	20	20	20	30	--	--	50
Elective (Practical) (practical based on theory papers)	SZOOEP1351	(A)- Applied Parasitology – II					**20**	**30**	**50**
	SZOOEP1351	(B)- Aquaculture –II					20	30	50
	SZOOEP1351	(C)- Entomology- II					20	30	50
	SZOOEP1351	(D)- Environmental Biology – II					20	30	50
Vocational Course	SZOOVC1351	Sericulture **Or** Poultry Farming					**20**	**30**	**50**
On Job Training	SZOOOJ1351	Concerned with subject					**40**	**60**	**100**
									550

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester-V

SZOOCT1301 : Ecology and Zoogeography

Periods : 45 **No. of Credits: 03 (Marks: 75)**

Course objectives:

1. To understand the basic concepts of Ecology: Study the relationships between organisms and their environment.
2. To study ecosystem structure and function: Understand components of ecosystems such as producers, consumers, decomposers, energy flow, and nutrient cycles.
3. To understand biodiversity and conservation: Study the importance of biodiversity and methods for conservation of species and habitats.
4. To learn the principles of Zoogeography: Understand the geographical distribution of animals across the world.
5. To study zoogeographical regions of the world: Learn about major faunal regions and their characteristic animals.
6. To understand factors affecting animal distribution: Study climatic, geological, ecological, and evolutionary factors influencing species distribution.
7. To develop knowledge of animal migration and dispersal:Understand how animals move and spread across different regions.
8. To apply ecological knowledge to environmental issues: Learn how ecological principles help solve problems like habitat loss, pollution, and climate change.
9. To develop scientific observation and analytical skills: Encourage field studies, data interpretation, and ecological research.

Course outcomes:

After successful completion of this course, students will be able to:

1. Understand ecological concepts. Explain the basic principles, scope, and importance of ecology and environmental interactions.
2. Describe ecosystem structure and function. Identify components of ecosystems and explain energy flow, food chains, food webs, and ecological pyramids.
3. Interpret population growth patterns, ecological relationships, and community structure.
4. Explain biodiversity and conservation strategies. Understand the importance of biodiversity and methods for conservation of wildlife and natural resources.
5. Understand principles of animal distribution. Describe factors influencing the geographical distribution of animals.
6. Recognize the characteristics and fauna of the world's major zoogeographical regions.
7. Explain processes affecting animal distribution.
8. Analyze environmental problems such as habitat destruction, pollution, and climate change.
9. Develop responsibility towards sustainable use and protection of biological resources.

SZOOCT1301 : Ecology and Zoogeography : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	**Ecology**-Introduction and Scope of Ecology. Abiotic & Biotic Components of an ecosystem.	
	1.2	Types of Ecosystem- **Aquatic**- Pond ecosystem. **Terrestrial**- Desert ecosystem Food Chain, Food Web, Ecological Pyramids. Energy Flow in an Ecosystem	
	1.3	**Bio-geochemical Cycles**- Oxygen Cycle, Sulphur Cycle	
	1.4	Spheres of Earth. Ecological Succession-, Trends, Basic Types, Hydrarch and Xerarch	
2.0			**11**
	2.1	**Population Ecology –** Characteristics of Population Natality, Mortality, Population Dispersal, Population density, Age distribution	
	2.2	Population Growth Form. Population Equilibrium and Fluctuation.	
	2.3	**Biotic interactions** Positive interactions – Commensalism, Mutualism	
	2.4	Negative interactions – Competition, Predation, Parasitism	
3.0			**11**
	3.1	**Pollution – Sources, Effects and Control** Air Pollution, Noise Pollution	
	3.2	Water Pollution, Soil Pollution	
	3.3	**Energy Resources** Conventional energy resources and limitations Fossil Fuels, Nuclear Power, Hydel Power	
	3.4	Non-conventional energy resources – Advantages, Limitations & Latest developments Solar Energy, Wind Energy, Tidal Energy	
4.0			**11**
	4.1	**Adaptations** Aquatic, Desert and Volant Adaptations	
	4.2	**Wildlife Conservation and Endangered Species** Wild life and Endangered species of India Measures to protect endangered species in India Sanctuaries and National parks in India	
	4.3	**Zoogeographical Realms –** Physical features and fauna of following Realms in Brief. Oriental Realm, Australian Realm	
	4.4	Importance of zoogeography in evolution & conservation	
		Total	**45**

Text Books and Reference Books

1)Animal Ecology - R. K. Gupta and B.S. Malik, Pragati Prakashan, Meerut
2) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology- P.S. Verma and V.K.agrawal, S. Chand and Co. Ltd. New Delhi Publication
3) Animal Behaviour- M.P. Arora, Himalaya publication.
4) Animal Behaviour- Vinod Kumar, Himalaya publication.
5) Principles of Ecology-Odum, Sunder Publication.
6) Textbook of Animal Ecology, Toxicology and Environmental Pollution-Prashantkumar Joshi and Pushyamitra Joshi, Shashwat Publication, Bilaspur
7) Introduction to Bioinformatics- S. SundaraRajan, R. Balaji, Himalaya Publication.
8) Biostatistics- S.P. Gupta
9) Economic Zoology, Biostatistics and Animal Behaviour- Shukla, Mathur, Prasad, Upadhyay.
10) Animal Behaviour, Concept, Process and Method (Wadsworth)-Drickamer & Vessey.
11) Biology of Animal Behaviour- Grier
12) Introduction to Ethology (Plenum Press)-Immelmann
13) The Foundation of Ethology – Lorenz
14) An Introduction to Animal Behaviour- Manning
15) Animal Behaviour in Laboratory and Fields- Prince and Stoker
16) Ecology, Individuals, Populations and Communities-Begonm, J. L. (Black Well Science, Oxford, UK)
17) Ecological Concept- Cherrett J. M. (BlackWell Science, Oxford, UK)
18) Fundamental of Ecological modeling-Jorgensen S.E. (Elsevier, New York)
19) Animal Behaviour- A synthesis of ethology and comparative Psychology- Hinde R.A. (Mcgraw-Hill New York)
20) Bioinformation- A Biologist Guide to Biocomputing & Internet- Brown, S.M. Eaton Publication New York
21) Fundamental Concept of Bioinformation- Krane & Raymer, Persons Education, 2003
22) Introduction to Bioinformation – Attwood & Parry- Smith, Persons Education, 2003
23) Zoogeography- Darlington
24) Practical Methods in Ecology- Peter Henderson

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester-V

SZOOCT1302 : Medical and Economic Zoology

Periods : 45 **No. of Credits: 03 (Marks: 75)**

Course pre-requisite

Basic knowledge of Zoology, including biology, animal morphology, physiology, parasitology, and life cycles of parasites, arthropods, and economic animals.

Course objectives:

1. To study medically important protozoan and helminth parasites, their morphology, life cycles, pathogenicity, and control measures.
2. To identify arthropods of medical and forensic importance and understand their role as disease vectors.
3. To learn about economically important animals and insects (honey bees, silk moths, freshwater fish, poultry) and their management practices.
4. To understand techniques in aquaculture, pearl culture, vermiculture, and related economic applications.
5. To develop practical skills in specimen handling, observation, identification, and scientific reporting.

Course outcomes:

1. Ability to identify protozoan and helminth parasites and describe their morphology, life cycles, pathogenicity, and preventive measures.
2. Skill in recognizing medically and forensically important arthropods and explaining their role in disease transmission and forensic studies.
3. Knowledge of economic zoology, including honey bee organization, silkworm rearing, freshwater fish culture, and poultry management.
4. Ability to apply practical techniques in aquaculture, pearl culture, and vermiculture, understanding their economic significance.
5. Competence in practical laboratory skills, field observations, species identification, data recording, and preparation of detailed scientific reports.

SZOOCT1302 : Medical and Economic Zoology : Course Contents

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Protozoan Parasites Pathogenic to man- Entamoeba histolytica, Trypanosoma gambiense- Binomics, prevention & control.	
	1.2	Zooparasitic Helminths – Structure, Life cycle, Pathogenicity and control. Trematoda – *Schistosoma haematobium*.	
	1.3	Cestoda – *Taenia solium* and *Taenia saginata.*	
	1.4	Nematodes – *Wuchereria bancrofti,*	
2.0			**11**
	2.1	Systematic Position, Geographical Distribution, Morphology, Life Cycle, diseases and Control Measures of- Ticks & Mites	
	2.2	Mosquitoes as vector of Human diseases with special reference to - Malaria, Dengue, Filaria, Chickengunya and control of Mosquitoes.	
	2.3	Introduction to Arthropods of Forensic importance.	
	2.4	Viral respiratory diseases (brief overview)- COVID-19; influenza, SARS, MERS	
3.0			**11**
	3.1	Apiculture – Social Organization of Honey Bees, Life Cycle, Bee keeping and Economic Importance.	
	3.2	Sericulture - Types of Silk moth, Life cycle and rearing of Silk moth.	
	3.3	Fresh Water Fish Culture – Indian major Carps. Management of fish farm. Breeding Pond, Hatching Pit,	
	3.4	Nursery and Stocking Pond.	
4.0			**11**
	4.1	Pearl Culture Pearl producing molluscs. Pearl formation and pearl industries.	
	4.2	Vermiculture and Vermicomposting. Vermiculture techniques-Bedding, Essential parameters for Vermiculture and Management.	
	4.3	Methods of Harvesting (Manual & Mechanical). Economic Importance of Vermiculture	
	4.4	Poultry: Breeds, biology of fowl, methods of rearing and maintenance, diseases of poultry and their control measures.	
		Total	**45**

Text Book

1. **A Textbook of Zoology (Invertebrates)** – R.L. Kotpal, Rastogi Publications, 14th Edition, 2020.
2. **Parasitology for Medical Students** – K.D. Chatterjee, CBS Publishers & Distributors, 5th Edition, 2018.
3. **Medical Parasitology** – C.K. Jayaram Paniker, Jaypee Brothers Medical Publishers, 7th Edition, 2017.
4. **Economic Zoology** – P.S. Verma, S. Chand & Company, 2nd Edition, 2016.
5. **Practical Zoology** – R.L. Kotpal, Rastogi Publications, 11th Edition, 2019.

Reference Books

1. **Textbook of Arthropods of Medical Importance** – C.K. Jayaram Paniker, Jaypee Brothers Medical Publishers, 6th Edition, 2016.
2. **Modern Parasitology** – K.D. Chatterjee, New Age International Publishers, 3rd Edition, 2015.
3. **Invertebrate Zoology** – E.L. Jordan & P.S. Verma, S. Chand & Company, 8th Edition, 2017.
4. **Applied Economic Zoology** – S.C. Asthana & A. Asthana, S. Chand & Company, 2nd Edition, 2018.
5. **Fundamentals of Fish Culture and Aquaculture** – P. Keshavan, Scientific Publishers, 1st Edition, 2016.
6. **Beekeeping in India** – N.S. Rathore, ICAR Publications, 2nd Edition, 2015.
7. **Silkworm Rearing and Sericulture** – N. Krishnaswamy, ICAR Publications, 3rd Edition, 2014.
8. **Vermiculture and Vermicomposting** – Edwards & Arancon, CRC Press, 1st Edition, 2012.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester-V

SZOOIK1303 : Indian Knowledge System in Zoology

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. To introduce students to traditional Indian knowledge related to animals and biological systems.
2. To understand ancient Indian texts and practices related to zoology.
3. To connect indigenous knowledge with modern zoological science.
4. To promote sustainable and ethical approaches to animal use and biodiversity conservation.

Course outcomes:

After completing this course, students will be able to:

1. Understand the foundations of Indian Knowledge Systems related to zoology.
2. Identify and explain traditional classifications and uses of animals.
3. Analyze the role of ethnozoological knowledge in modern science.
4. Apply traditional knowledge to biodiversity conservation and sustainability.
5. Develop awareness of ethical treatment of animals based on Indian philosophy.

SZOOIK1303 : Indian Knowledge System in Zoology : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			
	1.1	Introduction to Indian Knowledge Systems (IKS) Concept and scope of IKS	**7**
	1.2	Historical development of biological knowledge in India	
	1.3	Overview of ancient texts related to zoology (e.g., Vedas, Puranas, classical literature)	
	1.4	Basic principles of life sciences in Indian tradition	
2.0			
	2.1	Animal Knowledge in Ancient Indian Texts Classification of animals in ancient India	**8**
	2.2	Study of animals in texts like Arthashastra and Ayurveda	
	2.3	Domestication and utility of animals	
	2.4	Role of animals in ancient times	
3.0			
	3.1	Ethnozoology and Traditional Practices Concept of Ethnozoology	**7**
	3.2	Indigenous knowledge of animal behavior and ecology Use of animals in traditional medicine and culture	
	3.3	Ancient Treatment Methods for Various Diseases	
	3.4	Human-animal relationships in tribal and rural India Integration with Modern Science	
4.0			
	4.1	Conservation and Ethical Perspectives Traditional conservation practices (sacred groves, animal worship)	**8**
	4.2	Biodiversity conservation in Indian traditions	
	4.3	Animal ethics and welfare in Indian philosophy (Ahimsa concept)	
	4.4	Relevance of IKS in modern conservation biology	
		Total	**30**

Text Books & Reference Books

1. Indian Philosophy : A Very Short Introduction - Sue Hamilton
2. A History of Indian Philosophy- Surendranath s Dasgupta
3. Indian Philosophy: A Critical Survey by Chandradhar Sharma
4. India : A History" by John Keay
5. The Wonder That Was India - A.L. Basham
6. Ancient India - R.S. Sharma
7. The Oxford History of India" edited by Percival Spear.
8. A History of Indian Literature (multiple volumes) by Sisir Kumar Das
9. Indian English Literature by M. K. Naik

10. The Norton Anthology of World Literature: India, Pakistan, and Bangladesh" edited by Sarah Lawall
11. Indian Art" by Partha Mitter
12. The Art and Architecture of the Indian Subcontinent" by J.C. Harle
13. Indian Architecture: Buddhist and Hindu Period" by Percy Brown
14. The Crest of the Peacock: Non-European Roots of Mathematics" by George Gheverghese Joseph
15. Indian Science and Technology in the Eighteenth Century" by Dharampal
16. Raga Mala: The Autobiography of Ravi Shankar" by Ravi Shankar
17. The Ragas of North India" by Walter Kaufmann
18. The Complete Book of Ayurvedic Home Remedies" by Vasant Lad
19. Ayurveda: The Science of Self-Healing" by Vasant Lad
20. The Heart of Yoga: Developing a Personal Practice" by T.K.V. Desikachar
21. The Yoga Sutras of Patanjali" translated by Swami Satchidananda
22. India's Contribution to World Culture – Sudheer Birodkar
23. Ancient India – R. C. Majumdar
24. Krishi Parashara – Agriculture by Parashara – Asian Agri-History Foundation
25. Animal Husbandry in Ancient Indian Literature- Aruna Tomar Kumar, Rajbir Singh, Vir
26. Singh, LAP Lambert Academic Publishing (2013)
27. Panchatantra- Vishnu Sharma.
28. Hitopadesha- Narayana Pandit.

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Faculty of Science and Technology,

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B. Sc. Third Year, Semester-V

SZOOCP1301 : Ecology and Zoogeography (Based on Paper No. SZOOCT1301)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. To develop understanding of basic ecological concepts and ecosystem components through practical observations and field studies.
2. To study the distribution of animals in different zoogeographical regions and understand factors affecting their distribution.
3. To learn and apply ecological techniques and methods such as identification of organisms, and analysis of ecological data.
4. To interpret ecological relationships such as food chains, food webs, and ecological pyramids in natural ecosystems.

Course Outcomes:

1. Students will be able to identify ecological components and analyze ecosystem structure and function.
2. Students will understand the zoogeographical distribution of animals and major biogeographical regions of the world.
3. Students will gain practical skills in ecological sampling methods, data collection, and interpretation.
4. Students will be able to construct and interpret food chains, food webs, and ecological pyramids and explain energy flow in ecosystems.

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1. Estimation of Dissolved O2 from Water Sample.

2. Estimation of Dissolved CO2 from Water Sample.

3. Estimation of Population Density from Water Sample/ Terrestrial area.

4.Estimation of Chlorides, Salinity, Hardness from given water sample.

5.Determination and study of Atmospheric Humidity.

6.Identification and construction of food chains and food webs in terrestrial or aquatic ecosystems.

7.Study of positive and negative interactions (biotic interaction) in animals.

8.Ecological Adaptations (Any two examples from each to be studied)

a) Volant Adaptations.

b) Aquatic Animals (from fresh water and marine environment).

c) Desert Animals.

9.Preparation and Interpretation of Ecological Pyramids

10.Museum study of Vertebrate Endangered Species or Threatened Wild Animals on the Basis of charts/ models/ photographs (Any Five).

11.Study of Zoogeographical Regions of India

12.Identification of representative animals from different Zoogeographical region using charts or specimens

13.Identification of Zoogeographical Realms from the Map and Identify Specific Fauna of Respective Regions.

14.Study of Endemic Animals of Different Regions

15.Marking and labelling the six major faunal regions on a world map.

16.Report on a Field Visit to Zoo Park/National Park/Biodiversity Park/Wild Life Sanctuary to study management, behavior and enumeration of wild animals.

(Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

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B. Sc. Third Year, Semester-V

SZOOCP1302 : Medical and Economic Zoology (Based on Paper No. SZOOCT1302)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. Identify and study medically important protozoan and helminth parasites and their life stages.
2. Recognize arthropods of medical and forensic importance and understand their roles.
3. Study economically important animals and insects, their life cycles, and economic significance.
4. Observe and analyze developmental stages linking structure to function and importance.
5. Develop practical skills in specimen handling, observation, identification, and reporting.

Course Outcomes:

1. Ability to identify parasites and describe their morphology, life cycles, and diagnostic features.
2. Ability to recognize arthropods, describe distinguishing traits, and explain their medical or forensic significance.
3. Knowledge of economic animals and insects, their life cycles, organization, and management.
4. Skill in documenting life stages and linking morphology to biological, ecological, or economic roles.
5. Competence in practical observation, species identification, field study, and preparing detailed reports.

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1. Study of *Entamoeba histolytica* by using slides or charts to observe trophozoite and cyst stages.
2. Study of *Trypanosoma gambiense* by using slides or charts to observe its morphology and identify the parasite.
3. Study of *Schistosoma haematobium* by using slides or charts to study its structure and identify characteristic features.
4. Study of Tapeworms (*Taenia solium* and *Taenia saginata*) by using specimens or slides to observe scolex and proglottids.
5. Study of *Wuchereria bancrofti* by using slides or charts to identify microfilaria and study its morphological features.
6. Study of Ticks (*Ixodes scapularis; Argas persicus)* using preserved specimens/Charts to identify morphological characters and the diseases transmitted.
7. Study of Mites (*Sarcoptes scabiei*) using prepared slides or charts to observe their structure and associated diseases.
8. Study of Mosquito Vectors using specimens or charts to identify distinguishing characters of *Anopheles, Culex,* and *Aedes* mosquitoes and the diseases transmitted by them.
9. Study of Mosquito Life Cycle by observing the egg, larval, pupal, and adult stages using specimens, slides, or charts.
10. Study of Arthropods of Forensic Importance by identifying common forensic insects such as blowflies and beetles using specimens or charts.
11. Study of Social Organization in Honey Bee using specimens or charts to identify castes in *Apis indica* (queen, worker, drone).
12. Study of Bee hive Structure by observing the honey comb and different parts of the bee hive using specimens or charts.
13. Study of Silkworm using charts or specimens to observe and understand the life cycle of *Bombyx mori*.

14. Study of Types of Silk using samples to identify different silk varieties: Mulberry, Tasar, Eri, and Muga.
15. Identification of Indian Major Carps using specimens to study *Catla catla*, *Labeo rohita*, and *Cirrhinus mrigala.*
16. Study of Pearl Culture using charts or specimens to observe pearl formation in *Lamellidens* sp., *Pinctada sp.*
17. Study of Vermiculture by observing earthworm species used in vermicomposting (e.g., *Eisenia fetida*) and studying the vermicomposting setup.
18. Study of Poultry Breeds using specimens or charts to identify common breeds such as White Leghorn and Rhode Island Red, and to study their economic importance and management.
19. Field Visit / Study Tour- Observe medically and economically important animals in their natural or applied habitats.

Note: Record observations, identify species, note morphology, life cycle, and economic or medical significance, and prepare a detailed field report.

(Note : Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

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B. Sc. Third Year, Semester – V

SZOOET1301: (A) Applied Parasitology-I

Periods : 30 **No. of Credits: 02 (Marks:50)**

Course Objectives:

1. To introduce students to the basic concepts of Applied parasitology.
2. To expose students to the knowledge of host-parasite relationship and life cycle of parasites.
3. To give students a broad perspective of epidemiology, transmission, control and treatment of parasitic diseases caused by Protozoans and Platyhelminthes.
4. To familiarize students with morphologic criteria for differentiating between the most common protozoan and helminth parasites.
5. To study endemic and national parasitic problems.
6. To understand the bionomics of common animal and human parasites.

Course Outcomes:

1. Demonstrate understanding of basics Applied parasitology; host-parasite relationships and life cycle of parasites.
2. An understanding of epidemiology, disease transmission and control & treatment of parasitic diseases caused by Protozoans and Platyhelminthes.
3. An ability to identify and describe common protozoan and helminth parasites.
4. Knowledge of locally occurring human parasites and national parasitic diseases.
5. An understanding of economic cost of animal and human parasitic diseases.

SZOOET1301: (A) Applied Parasitology-I : Course Contents

Iodule No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0			**8**
	1.1	1. **Introduction to Parasitology** : 1.1 Brief introduction of Parasitology, Parasitism, Parasite, Host, Vector, Host parasite relationship. 1.2 Scope and Branches of Parasitology.	
	1.2	1. **Parasitic Protozoa:** Classification and general organization of parasitic Protozoa	
	1.3	1. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of 1. *Entamoeba histolytica*	
	1.4	2. *Giardia intestinalis,* 3. *Trichomonas vaginalis*	
2.0			**7**
	2.1	Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of 1. *Trypanosoma gambiense*	
	2.2	2. *Balantidium coli*	
	2.3	3.*Sarcocystis cruzi* 4. *Plasmodium vivax*	
	2.4	5. *Eimeria tenella*	
3.0			**8**
	3.1	**Parasitic Platyhelminthes: Trematodes** Introduction, Classification, General organization of Trematodes.	
	3.2	Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- 1. *Schistosoma haematobium.*	
	3.3	2. *Paragonimus westermani.* 3. *Gastrodiscoides hominis.*	
	3.4	Parasitic adaptations in Trematodes. Larval forms in Trematodes.	
4.0			**7**
	4.1	**Parasitic Platyhelminthes: Cestodes** Introduction, Classification, General organization of Cestodes.	
	4.2	Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- 1. *Taenia saginata.*	
	4.3	2.*Taenia solium* 3. *Echinococcus granulosus.*	
	4.4	Parasitic adaptations in Cestodes Larval forms in Cestodes	
		Total	**30**

List of Text Books and Reference Books

1. Introduction to Parasitology- Chandler and Reid.
2. Parasitology – K. D. Chatterjee.
3. Essentials of Parasitology- Gerald D. Schmidt, 4th Edition, Universal Book Stall,
4. New Delhi, 1990, Reprint.
5. An Introduction to Parasitology- Bernard E. Mathews, Cambridge University, Press, 1998.
6. Textbook of Parasitology- Kochhar S. K., Dominant Publishers and Distributors,
7. New Delhi, 2004
8. Animal Nematodes from Indian Mammals- H. S. Nama, G. B. Shinde and B. V. Jadhav
9. Applied Parasitology- A Practical Manual – C. J. Hiware, B. V. Jadhav, A. D. Mohekar, Mangaldeep Publication, Jaipur.
10. Parasitis Insects-B. D. Patnaik, Dominant Publishers and Distributors, New Delhi, 2001
11. Handbook of Entomology-T.V. R. Ayyar
12. Useful and Destructive Insects- Metacalf and Flint
13. Protozoology- Kudo
14. Biology of Protozoa- Sleials
15. Clinical Parasitology- Faust
16. Medical Helminthology- Watson
17. Indian Insect Life- Lefrey
18. General Parasitology- Cheng
19. Bench Aids for the diagnosis of Malaria- WHO, 1985.
20. Human Parasitology- Burton J. Bogistch, Clint E. Carter, Thomas N. Oeltmann. 2005. Third Edition, Elsevier Academic press.
21. Malaria: Principles and Practice of Malariology. Vol. I and II,- Warnsdorfer W.H. and Sri. Mc Gregor, I. 1998. Churchill Livingstone, New York.
22. Parasitology (Medical Zoology)- H.S.Singh and P.Rastogi. Rastogi Publications. Meerut
23. Medical Parasitology- N.C. Dey and T.K.Dey. Allied Agency, Kolkatta.
24. A Modern Text Book of Parasitology- Dr.A.N.Latey, Narendra Prakashan, Pune
25. Medical Zoology-R.C.Sobti,Shoban Lal Nagin Chand & Co., Jalandhar.

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Faculty of Science and Technology,

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B. Sc. Third Year, Semester – V

SZOOET1301: (B) Aquaculture - I

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives :

1. To study the techniques and methods involved in fish farm construction and pond management.
2. To understand different fish breeding techniques and fish seed production methods.
3. To study capture fisheries and fishery resources in India.
4. To acquire knowledge about different fishing crafts and gears used in Indian capture fisheries.
5. To understand the symptoms, treatment, and management of diseases in ornamental and food fishes.
6. To study fish preservation methods, processing techniques, and various fish by-products.

Course Outcomes :

1. Design and construct a fish farm and manage fish ponds effectively.
2. Describe and perform different methods of fish breeding and seed production.
3. Identify and explain major food fish species and their capture methods used in India.
4. Explain different fishing crafts and gears used in Indian capture fisheries.
5. Recognize fish diseases and apply appropriate treatment and management techniques.
6. Explain fish preservation and processing techniques and describe different fish by-products and their uses.

SZOOET1301: (B) Aquaculture-I : Course Contents

oduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**8**
	1.1	**Fish Farm Engineering–** Topography; Soil type; Water supply; Layout of fish farm.	
	1.2	**Fish Farm Management–** Preparation and management of nursery pond.	
	1.3	Preparation and management of rearing pond.	
	1.4	Preparation and management of stocking pond.	
2.0			**7**
	2.1	**Biology of Indigenous and Exotic Carps.**	
	2.2	**Fish seed resources –** **Natural resources-** Riverine resources **Artificial resources-** Induced breeding by Hypophysation a) Historical back ground b) Technique of Induced breeding c) Bundh breeding d) Chinese hatchery e) Striping method g) Synthetic hormones used for fish induce brreding **2.3 Transportation of fish seed and brooders**	
	2.3	**Capture Fishery** Introduction and capture fishery resources in India.	
	2.4	**Important Marine Capture Fisheries** 1. Sardine fishery 2. Mackerel fishery 3. Bombay Duck fishery	
3.0			**8**
	3.1	**Fishing Methods**– **Gears** – traps, gill nets, cast nets, drag nets; **Crafts** – Masula, Catamaran, Odum, Vanchi.	
	3.2	**Recent Advances in Fishing Methods** Electrical fishing, light fishing, and fish finder.	
	3.3	**Fish Diseases Caused by Pathogens and Parasites – Symptoms and Treatment** **A) Bacterial** – dropsy, furunculosis, tail rot or fin rot; **B) Fungal** – gill rot, dermatomycoses; **C) Protozoan**– costiasis, ichthyophthirius; **D) Helminth** – gyrodactylosis, dactylogyrosis;	
	3.4	**Non-Parasitic Fish Diseases** Environmental diseases – acidosis, alkalosis, gas bubble disease; Nutritional / dietary diseases.	
4.0			**7**
	4.1	**Fish Preservation and Processing** Causes of spoilage of fishes	
	4.2	**Methods of fish preservation** Chilling, Freezing, Freezing-drying, Smoking, Drying, Salting and Canning	
	4.3	**Fish By-products** Fish oil (fish liver oil and fish body oil), fish meal, fish manure, fish protein.	
	4.4	Isinglsss, Fish glue, fish leather, fish soap and fish insulin.	
		Total	**30**

Text Books and Reference Books

1. Fish and fisheries of India- V.G. Jhingran, Hindusthan Publishing Company.
2. Fish and Fisheries – K. Pandey and J.P.Shukla, Rastogi Publications, Meerut.
3. Fisheries and Aquaculture- Ravi Shankar Piska, Lahari Publications, Hyderabad.
4. Concepts of Aquaculture- Ravi Shankar Piska, Lahari Publications, Hyderabad.
5. Fresh water fish pond culture and management – Marilyn Chakroff. Pace crops scientificpublishers – Jodhapur.
6. World fish farming cultivation and Economics- E. E. Brown Pvt. Pub. Co. U. S. A. 1983.
7. Aquaculture – Bardach J. E. J. H. Ryther and W.O. Meharney Wiley – Ind. Sci., New York.
8. Aquaculture- R. J. Reay – Arnold- Heive Mann Publishers, India,
9. An Introduction to fishes – S. S. Khanna, Central Book Dept., Allahabad
10. Manual of fresh water aquaculture – R. Sonthanam, N. Sukumaran & P. Niligajan
11. A text book of Fishery Science and Indian fisheries –C. B. C. ShrivastavKitalb Mahal, Nagpur.
12. Fish Biology and Indian Fisheries- R. P. Parihar, Central Publishing House, Allahabad.
13. Encyclopedia of Fishes and Fisheries of India- Pandey A. K. and Sandhu.
14. Fisheries in India- Misra S.B.
15. Fisheries Global Perspective – Cherunilam.
16. Fish Processing and Preservation- Charls L. Cutting, Agro Botanical Publisheres (India)
17. Fish and fish products – Winton A. L.
18. Pond & Fish culture - Hall C. B.
19. Fishery Management – Agrawal.
20. Coastal Aquaculture in India- Santhanam R.
21. Marine Fisheries of India- VirbhadraRao and Bal.
22. Introduction to fish technology- Regenstein.
23. Fresh water fish culture- Wankhede and Deshmukh.
24. Aquaculture Development- Amitabh Patel, S. N. Pathak.
25. A Textbook of Aquaculture- Rao K. R. S. S., Reddy M.S., Discovery Publication, Delhi.
26. A Text Book of Pisciculture & Aquarium Keeping- H. S. Jagtap, S. N. Mukherjee & V. K.Garad., Daya Publishing House, New Delhi.
27. Practical Manual of Pisciculture and Aquarium Keeping- H. S. Jagtap, S. N. Mukherjee & S. S.Nanware, Daya Publishing House, New Delhi.
28. General and Applied Ichthyology (Fish and Fisheries)- S.K.Gupta and P.C.Gupta.S.Chand &Company Ltd., New Delhi.
29. A Text Book of Pisciculture – A.M. Mane and V.H. Thaware, ArunaPrakashan, Latur, M.S.
30. Manual of Experimental Ichthyology-Gahlawat, Gupta,Yadava, Jain, Sihag, Sabhlok, DayaPublishing House, Delhi

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Faculty of Science and Technology,

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B. Sc. Third Year, Semester – V

SZOOET1301: (C) Entomology-I

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. To define general entomology and classification of insects.
2. To acquaint students with the morphology and anatomy of selected insect species.
3. To introduce students to insect biology and insect ecology.
4. To acquire knowledge of methods of insect collection, preservation and curtain.

Course Outcomes:

1. Ability to describe general entomology and elaborate on taxonomy of insects.
2. Describe the morphology and anatomy of insects.
3. An understanding of biology and ecology of insects.
4. Knowledge and skill of insect collection, preservation and curation.

SZOOET1301: (C) Entomology-I: Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**8**
	1.1	**Introduction:** Importance and Scope of Entomology- (Agriculture, Forest, Medical, Forensic and Industrial)	
	1.2	General Characters of Phylum Arthropoda.	
	1.3	Salient features of Phylum class Insecta.	
	1.4	Methods of insect pest collection, preservation and study.	
2.0			**7**
	2.1	**Type study: Cockroach** Classification, External Morphology including sexual dimorphism.	
	2.2	i) Digestive system ii) Respiratory system	
	2.3	i)Nervous system and Sense organs.	
	2.4	i) Circulatory system ii) Reproductive system.	
3.0			**8**
	3.1	**Insect Taxonomy** Salient features with suitable examples of following orders: i) Thysanura ii) Orthoptera	
	3.2	i) Odonata ii) Diptera	
	3.3	i) Isoptera ii) Hymenoptera	
	3.4	i) Lepidopteraii) Coleoptera	
4.0			**7**
	4.1	**Insect Metamorphosis-** General idea about metamorphosis	
	4.2	Types of Metamorphosis i) Ametabola, ii) Hemimetabola, iii) Paurometabola, iv) Holometabola & v) Hypermetabola	
	4.3	Hormonal control of metamorphosis in insects.	
	4.4	Insect Ecology effect of light, temperature, humidity and food on insect life.	
		Total	**30**

Text Books and Reference Books

1. K. K. Nayar, TnantKirshnanand B.W. David- General and applied Entomology.
2. C. L. Metcalf and W. P. fling- Destructive and useful inset.
3. Hemsingpruthi: A Text Book of Agricultural Entomology.
4. ESSIG: College entomology.
5. M. S. Mani: A text book of General Entomology.
6. Government of Maharashtra: Crop pests and how to fight them.
7. D. B. Tembhare: Modern Entomology.
8. R. E. Fradt: Fundamentals of Applied Entomology.
9. K. C. V. Smith: Insects and other Arthropods of Medical.
10. D. N. Ray and A. W. A Brown: Entomology Medical and Veterinary.
11. Shrivastave K. P. Vol (I-III): A Text Book of Applied Entomology.

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B. Sc. Third Year, Semester-V

SZOOET1301 : (D) Environmental Biology-I

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. To study fundamental structure and function of earth ecosystem.
2. To develop knowledge base about attributes of different types of ecosystems.
3. To study Biodiversity, its classification and identify threats to Biodiversity.
4. To gain critical understanding of human influence on Biodiversity.
5. To equip students with contemporary tools and technique for ecosystem and wildlife conservation.

Course outcomes:

1. Knowledge of the structure and function of earth's ecosystem.
2. An understanding of different types of ecosystems and biodiversity
3. An ability to classify biodiversity and identify threats to biodiversity.
4. An understanding of human influence on biodiversity.
5. Knowledge of modern tools and technique for study and conservation of ecosystem and wildlife.

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SZOOET1301 : (D) Environmental Biology-I : Course Contents

ModuleNo.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0			**8**
	1.1	**Introduction and Scope of Environmental Biology** Atmosphere: Structure, Composition and Importance	
	1.2	Hydrosphere: Physical and Chemical properties of water	
	1.3	Lithosphere: Structure and Composition, Physical and chemical properties of soil. Soil profile and process of soil formation	
	1.4	Biogeochemical Cycles Hydrogen Cycle Nitrogen Cycle Carbon Cycle Sulphur Cycle	
2.0			**7**
	2.1	**Ecosystem** Concept and structural components of an Ecosystem	
	2.2	Energy flow in an ecosystem Ecological pyramids- Pyramid of Numbers, Pyramid of Biomass and Pyramid of Energy.	
	2.3	Food chains and Food web (a) Food Chains-Grazing, Parasitic, Saprophytic or Detritus food chain (b) Food web.	
	2.4	Marine Ecosystem- Zonation in- a) Marine habitat b) Intertidal habitat	
3.0			**8**
	3.1	**Biodiversity-** Concept and Characteristics of Biodiversity Role of Biodiversity	
	3.2	**Threats to Biodiversity-** Habitat degradation and its loss, Invasion of non-native species, Species interdependence, Soil Erosion, pollution, Over-Exploitation of Resources, Change in the Global Environment.	
	3.3	Biodiversity conservation i) In-Situ conservation ii) Ex-Situ conservation	
	3.4	Biodiversity of India	
4.0			**7**
	4.1	**Wild life and its conservation-** Aims and Necessity of Wild life Conservation	
	4.2	Causes for wild life depletion.	
	4.3	Management and Conservation of wild life	
	4.4	Sanctuaries and Zoological Parks in India	
		Total	**30**

Text Books and Reference Books

1. Odum – **'Ecology'**.
2. P.D. Sharma, **'Ecology and Environment'** Rastogi Publications, Meerut-250002, India.
3. Edward J. Kormondy, **'Concepts of Ecology'**, Himalaya Publications House, Mumbai.
4. Mohan P. Arora, '**Ecology'** Himalaya Publications House, Mumbai.
5. H. Loggen, **'Environmental Pollution'** 2nd Edition, Holt ReinhortWintson (1978).
6. APHA, **'Standard methods of Examinations of Water and Waste Water'** 20th Edition (2000).
7. J. H. Seinfield ,**'Air Pollution; Physical and Chemical Fundamentals'**, Mc Graw Hill, New York (1975).
8. T. N. Tiwari,V. P. Kudesia, **'Noise Pollution and it's Control'**, PragatiPrakashan, New Delhi (1990).
9. G. R. Chatwal, M. C. Mehra, **'Environmeatal Radiation, Thermal Pollution And Control'**Amol Publication, New Delhi (1989).
10. Trivedi P.K. and Goel P.K**. 'Chemical and Biological methods for Water Pollution Studies'**(Published by Environmental Publisher KARAD).
11. Trivedi P.K. and Raj Gurudeep**'Environmental Water and Soil Analysis'.**
12. Published by Akashdeep Publication House New Delhi.
13. P. S. Verma and V.K. Aggrawal :**Environmental Biology**
14. P.D. Sharma :**Environmental Biology**
15. P.D. Sharma :**Toxicology**
16. E. P. Odum :**Fundamentals of Ecology**
17. E. P. Odum :**Fundamentals of Ecology**
18. Ranganalla :**Water and Waste Water Engineering**
19. P. D. Sharma :**Microbiology**
20. P. D. Sharma :**Microbiology**
21. Kndosia :**Water Pollution**
22. M. N. Rao :**Air Pollution**
23. NEERI Nagpur :**Manual on Waste Water Analysis.**

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)

B. Sc. Third Year, Semester-V

SZOOEP1301: (A) Applied Parasitology-I (Based on theory paper- (A):SZOOET1301)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. Acquire knowledge and skill to identify, classify and describe different protozoan, helminth, nematode and arthropod parasites.
2. Study methods of preservation and mounting of protozoan, helminth, nematode and arthropod parasites.
3. Learn methods of collection and processing of soil and plant parasitic nematodes.

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Course Outcomes:

1. Demonstrate knowledge and skill of identifying, classifying and describing different protozoan, helminth, nematode and arthropod parasites.
2. Perform preservation and mounting of protozoan, helminth, nematode and arthropod parasites.
3. Carry out collection and processing of soil and plant parasitic nematodes.

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1. Identification, classification and description of Protozoan Parasites through permanent slides/photomicrographs-

   a) Entamoeba histolytica, b) Giardia intestinalis, c) Trichomonas vaginalis, d) Trypanosoma gambiense, e) Balantidium coli, f) Sarcocystis cruzi, g) Plasmodium sp., h) Eimeria tenella

2. Collection, staining, identification and description of Parasitic protozoa from Blood sample or rectal contents of suitable animals –

   a) Cilliates, b) Flagellates, c) Malarial parasites, d) Coccidian Parasites

3. Identification, classification and description of Parasitic platyhelminths through permanent slides/photomicrographs or specimens -

   a) Schistosoma haematobium, b) Fasciola hepatica, c) Paragonimus westermani, d) Gastrodiscoides hominis, e) Taenia saginata, f) Taenia solium, g) Echinococcus granulosus, g) Diphyllobothrium lattum

4. Collection, Preservation, Staining, Mounting, identification and description of Trematodes and Cestodes from locally available different hosts (Gills & intestines).

5. Submission of a brief report on parasites of vertebrates.

Note: All animal based practical's should be conducted with the help of Models, Charts and Computer Aided Techniques.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)
B. Sc. Third Year, Semester-V

SZOOEP1301:(B) Aquaculture-I (Based on theory paper-:SZOOET1301-(B) Aquaculture)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. To provide practical knowledge of the layout and management of fish farms, induced breeding techniques, and different developmental stages of fish seed used in pisciculture.
2. To impart understanding of the basic anatomy and feeding habits of fishes through dissection and stomach content analysis.
3. To enable students to identify, classify, and describe economically important indigenous and exotic freshwater fishes used in aquaculture as well as selected marine fishes of capture fisheries.
4. To familiarize students with fishing crafts and gears used in capture fisheries through preparation and identification of models.
5. To develop practical knowledge of fish diseases, preservation techniques, and preparation of fish by-products, along with field exposure through visits to fish breeding farms or fish industries.

Course Outcomes:

Upon completion of the course, students will be able to:

1. Demonstrate practical knowledge of fish farm layout, induced breeding techniques, and identification of different developmental stages of fish seed used in aquaculture practices.
2. Identify and classify economically important indigenous and exotic Carps and selected marine fishes relevant to aquaculture and capture fisheries.
3. Explain the basic anatomy and feeding habits of fishes through dissection and stomach content examination.
4. Recognize major fish diseases and understand methods of fish preservation and processing, including preparation of fish by-products.
5. Describe the structure and working principles of different fishing crafts and gears and understand practical aspects of fishery operations through field visits.

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1. Diagrammatic presentation or Layout Plan for a Typical Fish Farm.
2. Demonstration or dissection of the brain, pituitary gland, reproductive system, and digestive system of any locally available bony fish.
3. Demonstration of the induced breeding technique (hypophysation) in carps using charts or models.
4. Examination and Analysis of Stomach Content of Fishes (Carnivorous and Herbivorous).
5. Identification, Classification and description of culturable Indian Major Carps
6. Identification, Classification and description of culturable Exotic Carps.
7. To study the Habit and Habitat of some Indigenous and exotic culturable freshwater fishes.
8. To study spawn, fry, Semi-fingerlings, and fingerlings of Indian major carps.
9. To study spawn, fry, Semi-fingerlings, and fingerlings of exotic carps.
10. To study the Habit and Habitat of some Marine water fishes for the Capture Fishery (any five).
11. Preparation and identification of fishing Craft model (Using locally available material).
12. Preparation and identification of fishing Gear model (Using locally available material).
13. Study of Fish Diseases caused by Pathogens & Parasites(Bacterial,Fungal,Protozoan, Helminth, etc.).
14. Study of fish Preservation Methods (e.g., Salting, Drying, Pickling, Smoking, etc.).
15. Preparation and Study of fish by-product (Fish pickle, Fish chips, decorative/utility article using fish body parts or whole fish).
16. Visit to Fish Breeding Farm/ Fish Industry and Submission of report.

(Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)
B. Sc. Third Year, Semester-V

SZOOEP1301:(C) Entomology-I (Based on theory paper- (C):SZOOET1301)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1) Acquire knowledge and skill to identify, classify and describe anatomical parts, organ systems and morphology of insects.
2) Learn methods of collection, preservation and curating of insects specimens of taxonomic and medical importance.
3) Study methods of and equipment used in chemical and biological control of insect pests

Course Outcomes:

1) Describe morphology & anatomy of insects
2) Demonstrate awareness of, and skill to identify, classify and describe anatomical parts, organ systems and morphology of insects.
3) Explain the different methods of collection, preservation and curating of insects specimens.

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1. Collection, Preservation and Identification of Insects- Study different methods of insect collection (netting, trapping, hand picking), preservation techniques (dry and wet), and identification up to order level using keys.

2. Mounting and Study of Insect Mouthparts- Prepare permanent slides and study different types of mouthparts: Biting and chewing; Piercing and sucking; Siphoning; Sponging

3. External Morphology and Sexual Dimorphism of Cockroach- Study external features of cockroach including head, thorax, abdomen, appendages, and identify differences between male and female.

4. Demonstration/ Dissection of Cockroach – Digestive and Respiratory Systems: Demonstrate/ Dissect cockroach to study alimentary canal and tracheal system, including spiracles and tracheae.

5. Demonstration/ Dissection of Cockroach – Nervous and Reproductive Systems: Demonstrate/Dissect cockroach to observe nervous system (brain, nerve cord, ganglia) and reproductive organs of male and female.

6. Museum Study of Insect Orders: Study and identify at least two specimens each from: Thysanura; Orthoptera; Odonata

7. Museum Study of Insect Orders: Study and identify at least two specimens each from: Diptera; Lepidoptera; Coleoptera

8. Developmental Stages of Cockroach: Prepare permanent slides and study life stages (egg, nymph, adult) of cockroach.

9. Excursion/ Field Visit Report: Excursion/ Field Visit Report on visit to agricultural research institutes with photographic documentation related to entomology**.**

(Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)
B. Sc. Third Year, Semester-V

SZOOEP1301:(D) Environmental Biology-I (Based on theory paper - (D):SZOOET1301)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. Acquire practical skill of measuring different environmental parameters of water, air and soil.
2. Study techniques of identification of plant and animal biodiversity of an ecosystem.
3. Learn about quantification techniques of pollutants in abiotic and biotic components of an ecosystem.

Course Outcomes:

1. Ability to measure different environmental parameters of water, air and soil.
2. Skill of identification of plant and animal biodiversity of an ecosystem.
3. Perform quantification of pollutants in abiotic and biotic components of an ecosystem.

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1. Recording of Atmospheric Temperature
2. Recording of Relative Humidity by psychrometer.
3. Estimation of Dissolved Oxygen Content (DO), in Water sample.
4. Estimation of free Carbon dioxide (CO_2) in Water sample.
5. Qualitative and Quantitative Study of Phytoplankton in water sample.
6. Qualitative and Quantitative Study of Zooplankton in water sample.
7. Estimation of Chlorides from Water Sample to Assess the Water Quality.
8. Estimation of Salinity from Water Sample to Assess the Water Quality.
9. To estimate pH of Water sample by pH Meter.
10. To estimate pH of Soil Sample by pH Meter.
11. To study the physical characteristic (Texture, Colour and Temperature) of the soil
12. To Estimate Organic Matter in soil sample.
13. Detection of NPK in the soil sample.
14. Demonstration of basic equipment used in wildlife studies (Use, Care and Maintenance).
15. Identification of flora, insects and avian fauna.
16. Field visit to Biodiversity Park / Wildlife Sanctuary / Zoo / National Park to study wild animals.

Short excursion / study tour is compulsory

Submission

i) Practical record book duly signed by the teacher in charge/Head of the Department.

(Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester – V

Vocational Corse in Zoology

SZOOVC1301: (E) Apiculture

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course objectives :

1. To learn about life history and social structure of honey bee species.
2. To study bee rearing and farming methods and the equipment involved.
3. To learn about apiculture benefits and different byproducts & their economic scope.
4. To study the different bee diseases and predators and their control measures.

Course Outcomes

1. Ability to understand and describe the life stages and social organization of honey bee species.
2. Ability to correctly explain and perform bee rearing, farming and harvesting practices.
3. Appreciate the economic importance of derivative benefits and byproducts of apiculture.
4. To identify and take remedial measures against the different bee diseases and predators.

SZOOVC1301: (E) Apiculture : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	History of Honey bees.	
	1.2	Classification and Biology of Honey bees. Types of Honey bees	
	1.3	Social Organization of Honey bees.	
	1.4	**Practicals:** 1. Study of different species of locally available Honey bees.	
2.0			**15**
	2.1	Artificial Bee Rearing (Apiary), Bee hives- Newton and Langstroth, Bee Pasturage, Selection of Bee Species for apiculture,	
	2.2	Bee keeping equipment	
	2.3	Methods of extraction of honey (Indigenous and Modern).	
	2.4	**Practicals:** 1. Visit to the Apiculture centers, Submission of report about different equipment and procedures used in keeping of artificial bee hives.	
3.0			**15**
	3.1	Bee diseases	
	3.2	Bee enemies	
	3.3	Control and preventive measures of bee diseases & enemies	
	3.4	**Practicals:** Study of different parasites and predators of honey bees.	
4.0			**15**
	4.1	Economy Of Bees And Entrepreneurship	
	4.2	Products of Apiculture industry and its uses (Honey, Bee wax, Propolis, Pollen etc.).	
	4.3	Bee keeping industry- Recent efforts, Modern methods in employing artificial believes for Cross pollination in horticulture gardens.	
	4.4	**Practicals:** 1. Collection of natural bee hives, honey etc. 2. Extraction of bees wax from bee hive.	
		Total	**60**

Reference Books

Apiculture - Prost, P. J. (1962), Oxford and IBH, New Delhi.

2. Apiculture - Bisht D. S., ICAR Publications.

3. Bee Keeping in India - Indian Council of Agricultural Research, New Delhi.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester – V

Vocational Course in Zoology

SZOOVC1301 : (G) Pest Management

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. To learn about the role monitoring pest management.
2. To study and describe role of pest management.
3. To study the economic importance of insect pest management.
4. To provide students an adequate knowledge of various types of insecticides and problems associated with their use.

Course Outcomes:

1. The students will get an idea about what are common Insect & their control and management
2. Student will able to get entrepreneurship in Integrated Pest Management(IPM).
3. The students will get able to utilizing good agricultural practices.
4. To provide students with opportunities to understand insect pest management techniques such as cultural, physical, Biological, chemical, IPM etc.

SZOOVC1301: (G) Pest Management : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	General description and morphology of insects:-Head, Thorax and Abdomen – Generalized structure in brief of their appendages.	
	1.2	Definition of insect pests, General characters, Habitats, Damage.	
	1.3	Economic threshold level, Natural enemies, Parasites and Predators.	
	1.4	**Practicals:** 1. Identification of different types of damage. 2. To study different types of mouth parts in insects.	
2.0			**15**
	2.1	Classification of pests Based on damage, feeding habits, Taxonomy etc.	
	2.2	a) General life cycle patterns in insect pests, Grasshopper, Aphids, Jowar stem borer, Mango stem borer, White grubs	
	2.3	b) Red hairy caterpillar, Termites, Snails, Slug, Nematodes. c) Non insect animal pestas Deer, Pig, Monkey, Parrot & Rat	
	2.4	**Practicals:** 1. To study Identification, Classification & Comments on given insects. 2. To identify classify and comments on non insect animal pest.	
3.0			**15**
	3.1	Principles of Integrated Pest and Disease Management: Categories of insect pests and diseases	
	3.2	IPM: Introduction, history ,importance, concepts, principles and tools of IPM.	
	3.3	Economic importance of insect pests, diseases and pestrisk analysis.	
	3.4	**Practicals:** 1. Methods of detection and diagnosis of insect pest and diseases. 2. Study tour: To collect different types of crop pest in local area.	
4.0			**15**
	4.1	Methods of control: Host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control.	
	4.2	Introduction to conventional pesticides for the insect pests and disease management.	
	4.3	Implementation and impact of IPM for Insect pest and disease. Safe handling of pesticides.	
	4.4	**Practicals:** 1. Identification and nature of damage of important insect pests and diseases and their management. 2. Identification of biocontrol agents, different predators and natural enemies. 3. Demonstration of use of different equipments such as drills, sprayers, dusters for insect control.	
		Total	**60**

Text Books and Reference Books

1. A Text Book of Applied Entomology:Vol.II.K.P.Srivastava.

2. Elements of Entomology Rajendra Singh.

3. Agricultural Pests of South East Asia and India.A.S. Atwal.

4. Principles of Insect Morphology.R.E.Snodgrass.

5. Insect Structure and Function. R.F.Chapman.

6. Entomology. GillotC.

7. General Entomology. Mani M.S.Oxford IBHPub.

8. Modern Entomology.Tembhre D.B.Himalaya Pub.

10. Insect Physiology and Anatomy.Pant N.S.and GhaiS.L.

11. Nair,M.R.G.K.1975.InsectsandMitesofCropinIndia.ICAR,NewDelhi

12. Metcalf,R.L.andLuckman,W.H.1982.IntroductiontoInsectpestmanagement WileyInter Science Publishing, New York.

13. Butani,D.K.1984.InsectsandFruits.PeriodicalExpertBookAgency,Newdelhi

14. Reddy,P.P.,2010,PlantProtectioninHorticultureVol.1,2&3,ScientificPublishers,Jodhpur

15. Govt.Maharashtra,Croppestandhowtofightthem;B.D.Ratnaik,TextBookOfEntomology.

16. Dhalinal,.G.S.andRameshAroraIntegratedPestManagementConceptandApproaches.Kalyani Publishers, Ludhiana.

17. Text Book on Integrated Pest Management of Horticultural Crops Astral International Publishers, New Delhi.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester – V

Field Project in Zoology

SZOOFP1301: Field Project in Zoology

Periods : 120 **No. of Credits: 04 (Marks: 100)**

Course Objectives:

1. Objectives of research projects in zoology include analyzing animal anatomy, behavior, and ecology to understand species adaptations and population dynamics.
2. Key goals focus on biodiversity conservation, identifying new species, and exploring molecular genetics for evolutionary insights.
3. Projects often aim to solve environmental, agricultural, or veterinary problems through scientific investigation.
4. To provide opportunity to involve in research related to zoological aspects.
5. To gain the knowledge of referring research journals, writing research articles and submit the dissertation report.
6. To inculcate research culture.
7. To enhance the rational and innovative thinking capabilities.

Course Outcomes:

On completion of this course, the student should be able to:

1. Developing scientific, research, and analytical skills.
2. Producing actionable data for habitat management.
3. Developing new techniques in animal breeding and protection.
4. Identify research problem and carry out literature survey.
5. Analyze the research gap and formulate the problem.
6. Interpret the data and synthesize research findings.
7. Students apply their knowledge in a practical setting.
8. It helps students develop their critical thinking skills.
9. It gives students the opportunity to work independently.
10. It provides students with the opportunity to collaborate with others.
11. It helps students develop their research skills.
12. It gives students the opportunity to gain real-world experience.

SZOOFP1301: Field Project in Zoology : Course Contents

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0			
		Individual project can be taken up. Involve in literature survey in the chosen field. Use scientific principles to solve identified issues. Adopt relevant and well defined / innovative methodologies to fulfil the specified objective. There are **Seven** main sections the project these are **Introduction** The aims of the project and what you hope to achieve. **Review of Literature** Evaluating and reviewing existing knowledge of the topic. **Materials and Methods** The methods you will use for your primary research. **Results** Presenting the data from your primary research. **Discussion** Summarising and analyzing your research and what you have found out. **Conclusion** How the project went (successes and failures), areas for future study. **List of References** Correctly cited sources that have been used throughout the project.	**120**
		Total	**120**

Note:

1. Project work carried out in stipulated period.
2. External and Internal Examiners will examine this project jointly at the time of practical examination.
3. The students will have to give at least one seminar in their subject of specialization is compulsory.
4. Project work must be carried out only in specialized branch.
5. The project work carried out should be presented in power point presentation in presence of University Examiners.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – V) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOCP1301: Ecology and Zoogeography)

Based On

(Paper: SZOOCT1301: Ecology and Zoogeography)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1. Estimation of Dissolved O2 / CO2 from Water Sample. **OR** **10**
Estimation of Population Density from Water Sample/ Terrestrial area. **OR**
Determination and study of Atmospheric Humidity. **OR**
Identify and comment on Biotic Interactions of Animals. (Two examples of Positive interaction and Three examples of Negative interaction).

Q.2. Estimation of Chlorides& Salinity/ Hardness from given water sample. **OR** **05**
Identify and describe. (Any Two examples of endangered species and Two example from Ecological Adaptation). **OR**
Identification of food chains and food webs. **OR**
Identification of Zoogeographical Realms (Any Two) from the Map and Identify Specific Fauna of Respective Regions

Q.3. To study the Positive and Negative Phototropism with suitable examples**. OR** **05**
To study the Positive and Negative Chemotactic Response with suitable examples **OR**
Study of Colouration of animals with suitable examples **OR**
Study of Endemic Animals of Different Regions (Any Two) **OR**
Marking and labelling the six major faunal regions on a world map.

Q.4. Journal /Record Book **05**

Q.5. Marks to awarded proportionate to the number of practical's / activities done by the students during the semester **03**

Q.6. Viva-voce **02**

Note: Continuous Assessment (CA) for Practical Examination

Practical Internal Evaluation (Continuous Assessment – CA): 20 Marks
i) Excursion Report – 10 Marks; ii) Submission of Animal Album / Permanent Slides / Seminar – 10 Marks
Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – V) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOCP1302: Medical and Economic Zoology)

Based On

(Paper: SZOOCT1302: Medical and Economic Zoology)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1	Study and identification of medically important parasites, arthropods and vectors using slides/ charts/ specimens: Identify, classify, comment, and draw a well-labelled diagram. (05 Spot) (***Protozoa*** *(1 Spot)- Entamoeba histolytica/Trypanosoma gambiense;* ***Helminth*** *(1 Spot)- Schistosoma haematobium/Taenia solium/Taenia saginata/ Wuchereria bancrofti;* **Ticks/ Mites** *(1 Spot)-* (*Ixodes scapularis/Argas persicus*; *Sarcoptes scabiei)***;** **Mosquito vector** *(1 Spot)-* (*Anopheles/Culex/ Aedes*). **Forensic insect** *(1 Spot)-* (Blowflies/ Beetles) using specimens or charts) OR Study of Mosquito Life Cycle by observing the egg, larval, pupal, and adult stages using specimens, slides, or charts	**10**
Q.2	Study of social organization and hive structure in honey bees (*Apis indica*) **OR** Study of Beehive Structure by observing the honeycomb and different parts of the beehive using specimens or charts **OR** Study of Silkworm using charts or specimens to observe and understand the life cycle of *Bombyx mori* **OR** Study of Types of Silk using samples to identify different silk varieties: Mulberry, Tasar, Eri, and Muga	**05**
Q.3	Identification of Indian Major Carps. Identify, classify, comment, and draw a well-labelled diagram. **Any two** (*Catla catla, Labeo rohita, Cirrhinus mrigala.*) **OR** *Study of Pearl Culture using charts or specimens to observe pearl formation in Lamellidens* sp./ *Pinctada sp.* ***OR*** Study of Vermiculture by observing earthworm species used in vermicomposting (e.g., *Eisenia fetida*) and studying the vermicomposting setup. ***OR*** Study of Poultry Breeds using specimens or charts to identify common breeds such as White Leghorn and Rhode Island Red, and to study their economic importance and management.	**05**
Q.4	Journal /Record Book	**05**
Q.5	Marks to awarded proportionate to the number of practical's / activities done by the students during the semester	**03**
Q.6	Viva-voce	**02**

Note: Continuous Assessment (CA) for Practical Examination

Practical Internal Evaluation (Continuous Assessment – CA): 20 Marks

i) Excursion Report – 10 Marks; ii) Submission of Animal Album / Permanent Slides / Seminar – 10 Marks

Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – V) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOEP1301: (A) Applied Parasitology-I)

Based On

(Paper: SZOOET1301: (A) Applied Parasitology-I)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1. Collect, Prepare a permanent slide, identify and describe Ciliates/Flagellate/ Malarial Parasites / Coccidian parasites from Blood sample / rectal contents of suitable animals **10**

Q.2. Collect, Prepare a permanent slide, identify and describe Trematodes /Cestodes from locally available Host (Gill/ Intestine) **05**

Q. 3. Identify, classify and describe Parasitic Protozoa (One), Platyhelminths (One) Trematode or Cestode by using permanent slides / photomicrographs /or specimens. **05**

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks

i) Excursion Report – 10 Marks; ii) Submission of Animal Album / Permanent Slides / Seminar – 10 Marks

Demonstration of animal Dissections through models, charts, or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – V) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOEP1301: (B) Aquaculture-I)

Based On

(Paper: SZOOET1301: (B) Aquaculture-I)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1. Diagrammatic presentation or Layout Plan for a Typical Fish Farm. / Demonstration of the induced breeding technique (hypophysation) in carps using charts or models. / Examination and Analysis of Stomach Content of Fish (Carnivorous or Herbivorous). / Dissectout/Demonstrate Brain/ Pituitary Gland/ Digestive System/ Reproductive System of any locally available bony fish. **10**

Q.2. Identify, Classify and Describe Indigenous & exotic culturable freshwater fishes (Any Two) / spawn/ fry/fingerlings of Indian major carp or exotic carp (Any Two) and Marine water fishes for Capture Fishery (Any Two). / Identification and description of Fishing Crafts.(Any Two) / Identification and description of Fishing Gears model (Any Two) **05**

Q.3. Identify and describe Fish Diseases caused by Pathogens and Parasites (Bacterial, Fungal, Protozoan, Helminth, etc.) (Any Two) / Study of fish preservation methods (Salting, Drying, Pickling, Smoking, etc.) (Any Two) / Preparation and Study of fish by-product (Fish pickle/Fish chips/ decorative/ utility article using fish body parts or whole fish) (Any Two). **05**

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
Excursion Report – 10 Marks; ii) Submission of Animal Album / Permanent Slides / Seminar – 10 Marks
Demonstration of animal Dissections through models, charts, or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – V) as per NEP-2020 (w.e.f. June 2026)

Practical (SZOOEP1301: (C) Entomology-I)

Based On

(Paper: SZOOET1301: (C) Entomology-I)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1. Preservation and Identification of given provided/collected Insects ***OR*** **10**
Prepare a permanent slide of mouth parts of provided insect **OR**
Study the external morphology and Sexual Dimorphism of the Cockroach

Q.2. Dissect/Demonstrate Cockroach so as to expose its Digestive System/ Respiratory **05**
Systems/ Nervous System/ Reproductive Systems with well labeled diagram

Q.3. **Identify, classify and comment on Two museum specimen–** Thysanura; **05**
Orthoptera; Odonata, Diptera; Lepidoptera; Coleoptera **(One from Any two order) OR**
Identify with comment on any Two Developmental Stage of Cockroach (Egg/ Nymph/ Adult**)**

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
Excursion Report – 10 Marks; ii) Submission of Animal Album / Permanent Slides / Seminar – 10 Marks
Demonstration of animal Dissections through models, charts, or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – V) as per NEP-2020 (w.e.f. June 2026)

Practical (SZOOEP1301: (D) Environmental Biology-I)

Based On

(Paper: SZOOET1301: (D) Environmental Biology-I)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1. Recording of Atmospheric Temperature / Relative Humidity **10**

OR

To estimate the amount of Dissolved Oxygen Content (DO)/ free Carbon dioxide (CO_2)

Q.2. Qualitative/ Quantitative Study of Phytoplankton/ Zooplankton in water sample.

OR

To estimate pH of Water sample/Soil Sample by pH Meter. **05**

OR

To study the physical characteristic (Texture, Colour and Temperature) of the soil.

OR

Q.3. Estimation of Chlorides & Salinity from Water Sample to Assess the Water Quality. **05**

OR

To Estimate Organic Matter in soil sample/ Detection of NPK in the soil sample.

OR

Comments on Equipments (Two) needed in wildlife studies, Identification and Comment on insect (One) and avian fauna (One).

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks

Excursion Report – 10 Marks; ii) Submission of Animal Album / Permanent Slides / Seminar – 10 Marks

Demonstration of animal Dissections through models, charts, or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

B. Sc. Third Year Syllabus (NEP-2020; w.e.f. June, 2026)

VOCATIONAL COURSE IN ZOOLOGY (VCZ)

CONTINUOUS ASSESSMENT (CA)

Zoology

Semester- V

SZOOVC1301 - VCZ- III : (E) Apiculture

Or

VCZ- III : (F) Pest Management

Centre: **Date:**

Marks: 20

SEAT NUMBER :----------

Sr. No.	Continuous Assessment (CA)	Maximum Marks	Marks Obtained
1	Seminar Presentation	10	
2	Test	10	
	Total Marks	**20**	

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

B. Sc. Third Year Syllabus (NEP-2020; w.e.f. June, 2026)

VOCATIONAL COURSE IN ZOOLOGY (VCZ)

END SEMESTER ASSESSMENT (ESA)

Zoology

Semester- V

SZOOVC1301 - VCZ- III : (E) Apiculture

Or

VCZ- III : (F) Pest Management

Centre: **Date:**

Marks: 30

SEAT NUMBER :----------

Sr. No.	End Semester Assessment (ESA)	Maximum Marks	Marks Obtained
1	Vocational Course Report Submission	10	
2	Overall Course Judgment	10	
3	Course Work Presentation	10	
	Total Marks	**30**	

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

B. Sc. Third Year Syllabus (NEP-2020; w.e.f. June, 2026)

B.Sc. Practical Examination (Third Year, Semester - V) Winter ……/Summer…….

Field Project in Zoology

SZOOFP 1301: Field Project

End Semester Examination

Centre: **Batch :**

Date: **Duration: 04 Hrs**

Seat No.: **Credits: 04 (100 Marks; ESE 60 & CA 40)**

Sr. No.	Assessment Component	Maximum Marks	Marks Obtained
1	**Field Project work done (Problem definition, Objectives, Review of Literature, Research Methodology, Experimental work, Analysis/Interpretation, Results, Conclusion, references etc.)**	**40**	
2	**Field Project Work Presentation and Viva Voce**	**10**	
3	**Project Report**	**10**	
	TOTAL	**60**	

Note : (**Field Project** - **Continuous Assessment** (CA) 40 Marks – Marks distribution =
i) Synopsis Submission -10 Marks **ii**) Attendance / Involvement in project-20 Marks **iii**) Seminar-10 Marks).

Name & Signature
Examiner – 1

Name & Signature
Examiner – 1

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOCT1351 : Ethology, Biometry and Bioinformatics

Periods : 45 **No. of Credits: 03 (Marks: 75)**

Course objectives:

1. To understand the basic principles and concepts of animal behaviour.
2. To study different types of behaviour such as feeding, mating, parental care, and social behaviour in animals.
3. To explain the mechanisms of learning, communication, and orientation in animals.
4. To understand the evolutionary significance and adaptive value of behaviour.
5. To introduce students to statistical methods used in biological research.
6. To develop skills in collection, organization, and presentation of biological data.
7. To understand and apply basic statistical tools such as mean, median, mode, standard deviation, and correlation.
8. To enable interpretation of biological data using statistical analysis.
9. To introduce the concept and scope of bioinformatics in biological research.
10. To familiarize students with biological databases and sequence analysis tools.
11. To develop skills in retrieval, analysis, and interpretation of biological data.
12. To understand the applications of bioinformatics in genomics, proteomics, and molecular biology.

Course outcomes:

1. Students will be able to explain various types of animal behaviour and their biological significance.
2. Students will understand the mechanisms of communication, learning, and social interactions in animals.
3. Students will be able to analyse behavioural adaptations in relation to environment and survival.
4. Students will develop the ability to interpret behavioural patterns in different animal groups.
5. Students will be able to collect, organize, and present biological data effectively.
6. Students will apply basic statistical methods in biological studies.
7. Students will interpret statistical results and draw conclusions from biological data.
8. Students will develop the ability to use quantitative techniques in biological research.
9. Students will understand the role of bioinformatics in modern biological sciences.
10. Students will be able to use biological databases and bioinformatics tools.
11. Students will analyse DNA, RNA, and protein sequences using computational tools.
12. Students will interpret bioinformatics results for applications in genomics and biotechnology.

SZOOCT1351 : Ethology, Biometry and Bioinformatics : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	**Introduction to Ethology** Definition, scope, and history of ethology. Contributions of ethologists	
	1.2	Basic concepts: instinct, reflex, fixed action pattern (FAP), sign stimulus, and releaser Methods used in the study of animal behaviour	
	1.3	**Classification of Animal Behaviour-** 1.1. Inborn or stereotyped animal behaviour – Taxis and Instincts with examples.	
	1.4	Acquired animal behaviour – Imprinting, Conditioning, Habituation, Reasoning. Social Behaviour in Insects –Honeybee.	
2.0			**11**
	2.1	**Communication in animals** Auditory Communication Chemical Communication	
	2.2	Visual Communication; Tactile Communication	
	2.3	**Mimicry** Types of Mimicry- Protective and Aggressive	
	2.4	**Colouration** Types of Colouration- Protective, Aggressive and Warning	
3.0			**11**
	3.1	**Collection and Classification of Data** a) Methods of collection of data b) Types of classification of data - Geographical, Chronological, Quantitative, Qualitative, Continuous, Discontinuous	
	3.2	**Measures of Central Tendency** Arithmetic Mean, Median and Mode	
	3.3	**Graphic Representation of Data** Histogram, Pie Diagram, Polygon Frequency Curve	
	3.4	Basic concept of probability in biological studies Applications of biometry in biological and ecological research	
4.0			**11**
	4.1	Computer and their Applications in Biology Definition, scope, and importance of bioinformatics	
	4.2	Internet and its Uses World Wide Web, Search Engines	
	4.3	Introduction to Biological Database a) NCBI b) Pub Med An elementary idea about FASTA, UniProt or GenBank and Clustal Omega web tool	
	4.4	Bioinformatics in drug discovery and development. Applications in agriculture, medicine, and biotechnology	
		Total	**45**

Text Books and Reference Books

1)Animal Ecology- R.K.Gupta and B.S. Malik, Pragati Prakashan, Meerut
2) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology- P.S. Verma and V.K.agrawal, S. Chand and Co. Ltd. New Delhi Publication
3) Animal Behaviour- M.P. Arora, Himalaya publication.
4) Animal Behaviour- Vinod Kumar, Himalaya publication.
5) Principles of Ecology-Odum, Sunder Publication.
6) Textbook of Animal Ecology, Toxicology and Environmental Pollution-Prashant kumar Joshi and Pushyamitra Joshi, ShashwatPublication, Bilaspur
7) Introduction to Bioinformatics- S. SundaraRajan, R. Balaji, Himalaya Publication.
8) Biostatistics- S.P. Gupta
9) Economic Zoology, Biostatistics and Animal Behaviour- Shukla, Mathur, Prasad, Upadhyay.
10) Animal Behaviour, Concept, Process and Method (Wadsworth)-Drickamer&Vessey.
11) Biology of Animal Behaviour- Grier
12) Introduction to Ethology (Plenum Press)-Immelmann
13) The Foundation of Ethology – Lorenz
14) An Introduction to Animal Behaviour- Manning
15) Animal Behaviour in Laboratory and Fields- Prince and Stoker
16) Ecology, Individuals, Populations and Communities-Begonm, J. L. (BlackWell Science, Oxford, UK)
17) Ecological Concept- Cherrett J. M. (BlackWell Science, Oxford, UK)
18) Fundamental of Ecological modeling-Jorgensen S.E. (Elsevier, New York)
19) Animal Behaviour- A synthesis of ethology and comparative Psychology- Hinde R.A. (Mcgraw-Hill New York)
20) Bioinformation- A Biologist Guide to Biocomputing & Internet- Brown, S.M. Eaton Publication New York
21) Fundamental Concept of Bioinformation- Krane&Raymer, Persons Education, 2003
22) Introduction to Bioinformation – Attwood & Parry- Smith, Persons Education, 2003
23) Zoogeography- Darlington
24) Practical Methods in Ecology- Peter Henderson

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOCT1351 : Reproductive Biology, Embryology, and Animal Development

Periods : 45 **No. of Credits: 03 (Marks: 75)**

Course objectives:

1. To study gametogenesis, fertilization, cleavage, and gastrulation. stages in developing embryo.
2. To acquaint students with basic knowledge of experimental embryology.
3. To understand metamorphosis and regeneration in various animals.
4. To study modern techniques used in infertility treatment in humans.
5. To learn about different types of infertility in humans.

Course outcomes:

1. Understand and describe the different developmental processes.
2. Describe different techniques and methods used in experimental embryology.
3. Elaborate on metamorphosis and regeneration in various and relate these processes to abnormalities in animals.
4. Identify and evaluate application of different ART techniques to different infertility conditions.
5. Describe different types of infertility in humans.

SZOOCT1352 : Reproductive Biology, Embryology, and Animal Development : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	**Spermatogenesis:** Introduction to Spermatogenesis Structure of Mammalian Sperm Phases of Spermatogenesis Factors Controlling Spermatogenesis	
	1.2	**Oogenesis:** Introduction to Oogenesis Structure of Mature Ovum Phases of Oogenesis	
	1.3	**Fertilization:** Pre fertilization events Post fertilization events Biochemistry of fertilization	
	1.4	**Biochemistry of semen:** Semen composition and formation in human. Assessment of sperm function. Semen related disabilities.	
2.0			**11**
	2.1	**Ovarian follicular growth & differentiation:** Introduction to Ovarian Follicular Growth Morphology of Ovarian Follicles Endocrinology and Molecular Biology of Follicular Development Ovulation Ovum Transport in Mammals	
	2.2	**Multiple ovulation and Embryo transfer technology (MOET)-** Introduction to MOET Multiple Ovulation Embryo Recovery Embryo Transfer Cryopreservation of Embryos Applications of MOET Limitations and Challenges	
	2.3	**Assisted Reproductive Technology (ART)** Introduction to ART Superovulation In Vitro Oocyte Maturation (IVM) In Vitro Fertilization (IVF) Advanced ART Techniques- ICSI, GIFT, ZIFT, IUI Embryo Sexing and Cloning- Embryo sexing, Cloning by nuclear transfer (SCNT)	
	2.4	**Impotence / Sexual Dysfunction in Humans-**Introduction **Male Impotence (Erectile Dysfunction)-** Types, Causes, Diagnosis, Treatment and Management, Prevention and Awareness **Female Sexual Dysfunction-** Types, Causes, Diagnosis, Treatment, Prevention and Awareness	

		Contraception: Introduction Classification of Contraceptive Methods **Sexually Transmitted Diseases (STDs) in Humans** Common STDs, Diagnosis of STDs, Treatment and Management Complications and Public Health Impact, Prevention and Awareness	
3.0			**11**
	3.1	**Chick embryology:** Structure of egg of Hen	
	3.2	Fertilization, Cleavage,	
	3.3	Blastulation, Gastrulation,	
	3.4	Foetal Membranes in chick	
4.0			**11**
	4.1	**Metamorphosis** Metamorphosis in amphibians & its hormonal control Metamorphosis in insects & its hormonal control.	
	4.2	Significance of Metamorphosis	
	4.3	**Regeneration-** Introduction to Regeneration, Mechanism of regeneration	
	4.4	Regeneration in Invertebrate & Vertebrate animals.	
		Total	**45**

Text Books

1. Chordate Embryology-P. S. Verma and V. K. Agarwal, S. Chand & Company Ltd., New Delhi, 2006 (Originally published 1975), ISBN**:** 9788121902618
2. Introduction to Embryology- Boris Ivan Balinsky, 5th Edition, Saunders College Publishing, Philadelphia, 1981
3. Text Book of Developmental Biology, Jagtap H. S. (2019). Sadhana Publication, ISBN No. 978-93-81921-65-4.

Reference Books

1. Developmental Biology- Norman J. Berrill and Gerald Karp, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1980
2. Gene Activity in Early Development- Eric H. Davidson, Academic Press, New York, 1968
3. Developmental Biology-Scott F. Gilbert, Sinauer Associates Inc., Massachusetts, 1988
4. Animal Development: A Laboratory Guide- V. Muthukaruppan, MKV Publications, Madurai,1979
5. Foundations of Embryology-Bradley M. Patten, McGraw-Hill Book Company, New York,1968
6. Principles of Animal Developmental Biology-Suresh C. Goel, Himalaya Publishing House, Mumbai, 2003
7. Developmental Biology – A Modern Synthesis- Vasudeo Rao,Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2001

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOCT1353 : Animal Biotechnology

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. To understand the fundamentals, history, and scope of animal biotechnology.
2. To learn about molecular tools, cloning vectors, and gene manipulation techniques.
3. To gain knowledge of animal cell and tissue culture methods and their applications.
4. To study transgenic animals, gene editing technologies, and their roles in research and agriculture.
5. To explore molecular diagnostics, therapeutic applications, and ethical considerations in biotechnology.

Course outcomes:

After successful completion of this course, students will be able to:

1. Students will be able to explain the principles, tools, and techniques used in animal biotechnology.
2. Students will identify and describe different cloning vectors and transformation methods.
3. Students will understand the process of establishing and maintaining animal cell cultures.
4. Students will evaluate the applications of transgenic animals and gene editing in real-world scenarios.
5. Students will critically discuss molecular diagnostics, therapeutic biotechnological products, and the ethical issues associated with GMOs.

SZOOCT1353 : Animal Biotechnology : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Introduction to Biotechnology and Tools of Gene Manipulation**	**7**
	1.1	**Overview:** Definition, history, and scope of animal biotechnology. Applications in medicine, agriculture, and research. **Basic Tools**: Restriction enzymes (DNA scissors); DNA ligases and polymerases	
	1.2	**Cloning Vectors:** Plasmids, Cosmids, Phagemids Lambda Bacteriophage BAC (Bacterial Artificial Chromosomes) and YAC (Yeast Artificial Chromosomes) Expression vectors	
	1.3	**Transformation Techniques:** Calcium chloride method; Electroporation; **Biolistic method (gene gun);** Microinjection	
	1.4	**Library Construction:** Genomic library construction; cDNA library construction	
2.0		**Animal Cell and Tissue Culture**	**8**
	2.1	**Introduction:** History, advantages, and limitations of tissue culture **Laboratory Setup:** Equipment and infrastructure required Sterilization and aseptic techniques	
	2.2	**Culture Media:** Natural and synthetic media Constituents: serum, balanced salt solutions, growth factors Roles of each constituent	
	2.3	**Types of Culture:** Primary culture, cell lines, suspension culture Organ culture and tissue engineering	
	2.4	**Cell Characterization:** Maintenance and subculturing Cell synchronization **Cryopreservation:** Techniques for preserving cells, tissues, and stem cells	
3.0		**Transgenic Animals and Gene Editing**	**7**
	3.1	**Production Techniques:** Retroviral method, DNA microinjection, Nuclear transplantation (cloning)	
	3.2	**Applications:** Transgenic animals in livestock improvement Molecular farming (production of pharmaceuticals) Knockout mice in disease research	
	3.3	**Gene Editing Tools:**	

		Zinc Finger Nucleases (ZFNs)	
	3.4	TALENs CRISPR/Cas9 systems	
4.0		**Molecular Diagnostics and Applications in Human Health**	**8**
	4.1	**Molecular Techniques:** Polymerase Chain Reaction (PCR), RFLP (Restriction Fragment Length Polymorphism) , RAPD (Random Amplified Polymorphic DNA), DNA sequencing (Sanger method)	
	4.2	**Diagnostics:** Molecular diagnosis of genetic diseases (Cystic fibrosis, Sickle cell anemia) Detection of pathogens	
	4.3	**Therapeutics:** Recombinant vaccines, Gene therapy Production of insulin and human growth hormone **Roles of Artificial Intelligence (AI) in Zoology**	
	4.4	**Ethics:** Ethical, legal, and social issues regarding Genetically Modified Organisms (GMOs) and animals	
		Total	**30**

Text Books

1. Molecular Biotechnology: Principles and Applications of Recombinant DNA – Glick, B. R., Pasternak, J. J., & Patten, C. L., ASM Press.
2. Animal Biotechnology – V. Kumaresan.
3. Textbook of Animal Biotechnology – B. Singh & S. K. Gautam, Publisher: [Specify edition/publisher if available].
4. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications – R. I. Freshney, Wiley-Blackwell.
5. Animal Biotechnology: Models in Discovery and Translation – Verma, A. S. & Singh, A., Academic Press (Elsevier).
6. Textbook of Animal Biotechnology – Ramadass, P. P., TERI Press, New Delhi.
7. Animal Biotechnology – A. M. Mane, Agrotech Press, Jaipur.

Reference Books

8. Biotechnology: Expanding Horizons – Singh, B. D., Kalyani Publishers, New Delhi.
9. Biotechnology and Genomics – Gupta, P. K., Rastogi Publications, Meerut.
10. Gene Cloning and DNA Analysis: An Introduction – Brown, T. A., Wiley-Blackwell.
11. Recombinant DNA: Genes and Genomes – A Short Course – Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., & Losick, R., Pearson Education.
12. Principles of Gene Manipulation and Genomics – Primrose, S. B. & Twyman, R. M., Blackwell Publishing.
13. A Textbook of Biotechnology – R. C. Dubey, S. Chand and Company.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOCP1351 : Ethology, Biometry and Bioinformatics (Based on Paper No. SZOOCT1351)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. To study and observe various types of animal behaviour in different organisms.
2. To understand communication, orientation, and social behaviour in animals through practical examples.
3. To introduce students to statistical techniques used in biological experiments.
4. To develop the ability to collect, organize, and present biological data**.**
5. To apply basic statistical calculations such as mean, median and standard deviation,
6. To familiarize students with bioinformatics tools and biological databases**.**
7. To understand the application of bioinformatics in molecular biology and genomics**.**

Course Outcomes:

1. Students will be able to **identify and describe different types of animal behaviours**.
2. Students will understand **behavioural responses related to survival and reproduction**.
3. Students will be able to **organize and present biological data using tables and graphs**.
4. Students will apply **basic statistical tools for biological data analysis**.
5. Students will interpret **statistical results in biological studies**.
6. Students will be able to **access and retrieve biological data from databases** and perform **basic sequence analysis using bioinformatics tools**.
7. Students will understand the **applications of bioinformatics in biological research and biotechnology**.

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1. To study the Positive and Negative Phototropism with suitable examples.
2. To study the Positive and Negative Chemotactic Response with suitable examples.
3. Study of Colouration of animals with suitable examples.
4. Study of different types of animal behaviour – feeding behaviour, mating behaviour, and parental care in animals.
5. Study of social behaviour in insects – organization and division of labour in honey bees or ants.
6. Study of biological rhythms – circadian rhythm and seasonal behaviour in animals
7. Problems Based on Mean.
8. Problems Based on Mode.
9. Problems Based on Median
10. Classification of Data- a) Histogram, b) Pie-Diagram, c) Polygon Frequency Curve.
11. Simple probability calculations and their applications in biological studies
12. To perform online search on Biological information/Literature
13. How to access the biological data from NCBI and Pub Med
14. BLAST- Sequence Search & alignment.
15. Find information about a protein using UniProt.
16. Report on Field visit to observe and record animal behaviour such as feeding, communication, and social interactions in natural habitats.

(Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B.Sc. TY Semester-VI

SZOOCP1352: Reproductive Biology, Embryology, and Animal Development & Animal Biotechnology

Periods: 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives

1. Identify stages of gametogenesis and reproductive anatomy.
2. Perform and interpret semen analysis.
3. Observe ovarian and embryonic development in model organisms.
4. Understand ART, cloning, embryo manipulation, and transgenic animal production.
5. Study metamorphosis and regeneration in selected organisms.
6. To develop essential laboratory skills, including aseptic techniques and proper handling of instruments.
7. To learn and perform key molecular biology techniques, such as DNA isolation, PCR, gel electrophoresis, and restriction digestion.
8. To gain practical experience in animal cell culture, media preparation, cryopreservation, and microbial transformation

Course Outcomes

1. Recognize stages of gamete development and reproductive structures.
2. Analyze semen parameters and sperm function.
3. Identify ovarian follicles and embryonic stages (chick/frog).
4. Explain ART techniques, cloning, and transgenic animal production.
5. Relate metamorphosis and regeneration to developmental biology.
6. Students will competently handle laboratory instruments and maintain aseptic conditions.
7. Students will perform molecular techniques, including DNA extraction, PCR amplification, restriction digestion, and DNA visualization via gel electrophoresis.
8. Students will prepare culture media, establish and maintain cell cultures, perform cryopreservation, and understand basic microbial transformation and gene delivery methods

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Reproductive Biology, Embryology, and Animal Development

1. **Histological Study of Gametogenesis (Spermatogenesis and Oogenesis)-** To study the histological structure of testes and ovaries and identify different stages of **spermatogenesis** and **oogenesis** under the microscope.
2. **Physical, Chemical and Microscopic Examination of Semen-** To study the physical, chemical, and microscopic characteristics of semen, including sperm count, motility, morphology, and functional assessment.
3. **Demonstration of reproductive system of Leech/Rat**-by using Charts/models for male and female reproductive anatomy.
4. **Histological Study of Gonads and Ovarian Follicular Development**- To study the histological structure of gonads (testes and ovaries) and identify stages of spermatogenesis, oogenesis, and ovarian follicular development.

5. **Demonstration of Superovulation, MOET and In Vitro Fertilization Techniques-** To study and understand the procedures of superovulation, MOET (Multiple Ovulation and Embryo Transfer), and assisted reproductive technologies (ART) such as IVF, ICSI, ZIFT, and GIFT using charts/models.
6. **Study of Types of Eggs**-To study and compare different types of eggs based on yolk content, cleavage pattern, and structure, with special reference to meroblastic and holoblastic eggs.
7. **Estimation of calcium in eggshell (EDTA method)**
8. **Study of Permanent Whole Mount Slides of Chick Embryos**- To study permanent whole mount slides of chick embryos and identify different developmental stages, including head and heart regions.
9. **Histological Study of L.S./T.S. of Chick Embryo**- To study longitudinal (L.S.) and transverse (T.S.) sections of chick embryo under the microscope and identify critical developmental regions.
10. **Developmental Study of Frog Embryos**- To study the developmental stages of frog embryos, including cleavage, gastrulation, and early organogenesis.
11. **Study of Regeneration in Hydra/Planaria**- To study regeneration in Hydra and Planaria by observing blastema formation and development of new structures, and to compare regenerative capacity among different organisms.
12. **Study of Metamorphosis (Insects & Amphibians) –** To study metamorphic stages in insects (larva, pupa, adult) and amphibians (tadpole to adult frog), and relate these changes to hormonal control (ecdysone, juvenile hormone, thyroxine, prolactin).
13. Field Visit / Excursion – Observation of Reproductive Biology and ART Facilities Centre

Animal Biotechnology

1. **Laboratory Handling & Safety:** Familiarization with microscope, centrifuge, incubator, and PCR machine
2. **Preparation of Culture Media:** To prepare and sterilize synthetic culture media and study animal cell culture and sterilization techniques in animal biotechnology.
3. **DNA Isolation:** Extraction of genomic DNA from blood or animal tissue
4. **Agarose Gel Electrophoresis:** Separation and visualization of DNA fragments
5. **PCR Demonstration:** Amplification of specific DNA sequences
6. **Restriction Enzyme Digestion:** Cutting DNA with restriction enzymes and analysis by gel electrophoresis
7. **Transformation of Bacteria:** Calcium chloride method to introduce plasmid DNA into *E. coli*
8. **Primary Cell Culture:** Isolation of cells from tissue and establishment of primary culture
9. **Cryopreservation Techniques:** Freezing and revival of animal cells
10. **Transgenic Model Demonstration:** Virtual or simulated demonstration of DNA microinjection or CRISPR gene editing in model animals
11. Biosafety regulations in animal biotechnology and their principles, significance, and applications

[Note-Demonstration of Dissections by Charts / Models/ Audio Visual Aids].

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOET1351 : (A) Applied Parasitology -II

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. To provide a broad-based knowledge and understanding of Parasitology inrelation to Parasitic Nematodes and Arthropods.
2. To understand the morphology, basic biology of nematodes in relation to their taxonomy and pathogenicity in plants and animals.
3. To understand and apply the principles of controlling nematode parasites in plants and animals.
4. To describe the basics of arthropods of public health importance.
5. To study vector-host-pathogen relationships in arthropod-borne diseases.
6. To study surveillance techniques, diagnosis and control measures of vector-borne diseases.

Course outcomes:

After successful completion of this course, students will be able to:

1. Ununderstanding of Parasitology of Nematodes and Arthropods.
2. Knowledge of morphology,biology,taxonomy & pathogenicity of nematodes in plants and animals.
3. Knowledgeandskilltoimplementcontrolmeasuresagainstnematodeparasites.
4. Understanding and knowledge of arthropods of public health importance.
5. Knowledgeofvector-host-pathogenrelationshipsinarthropodtransmitted diseases.
6. An understanding of the different surveillance techniques and diagnosis methods used in control of and management of vector-borne diseases.

SZOOET1351 : (A) Applied Parasitology-II : Course Contents

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0			**8**
	1.1	**Parasitic Nematodes : Animal Nematodes** 1. Introduction, Classification, General organization of Animal Nematodes.	
	1.2	1. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- 1.Enterobiusvermicularis	
	1.3	2.Ancylostomaduodenale 3.Wuchereriabancrofti.	
	1.4	Larval forms in Animal Nematodes	
2.0			**7**
	2.1	**Parasitic Nematodes : Plant Nematodes** 1. Introduction, Classification, General organization of Plant Nematodes	
	2.2	1. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- Meloidogyne (Root knot nematode)	
	2.3	2.Heterodera (Cystnematode)	
	2.4	3.Tylenchulus (Citrusnematode)	
3.0			**8**
	3.1	**Parasitic Arthropodes** Systematic Position, Geographical Distribution, Morphology, Life Cycle, diseases and Control Measures of– a) Acarina-Ticks & Mites	
	3.2	b) Parasitic Hemiptera – Bed Bug (Cimexlecturalius)	
	3.3	Parasitic flies – Outline Classification, Morphology, role as Vectors of Human diseases and Control Measures of: House Fly (Muscadomestica)	
	3.4	Bot Fly (Dermatobiahominis)	
4.0			**7**
	4.1	1. Morphology, pathogenecity and Control Measures of– 1.Siphonaptera 2.Anopleura	
	4.2	3. Mallophaga 4. Hymenoptera	
	4.3	Mosquitoes as a vector in the transmission of Malaria, Dengue fever, Elephantiasis, Yellow Fever, Chikungunya and their control measures.	
	4.4	Chemical and Biological Control of Insects.	
		Total	**30**

Text Books and Reference Books

1. Introduction to Parasitology-Chandler and Reid.
2. Parasitology–K.D.Chatterjee.
3. Essentials of Parasitology-GeraldD.Schmidt,4thEdition,UniversalBookStall,
4. NewDelhi,1990,Reprint.

5. An Introduction to Parasitology-BernardE.Mathews,CambridgeUniversity,Press,1998.
6. Text book of Parasitology-KochharS.K.,DominantPublishersandDistributors,
7. NewDelhi,2004
8. Animal Nematodes from Indian Mammals-H.S.Nama,G.B.ShindeandB.V.Jadhav
9. AppliedParasitology-APracticalManual–C.J.Hiware,B.V.Jadhav,A.D.Mohekar, Mangaldeep Publication, Jaipur.
10. Parasitis Insects-B.D.Patnaik,DominantPublishersandDistributors,NewDelhi, 2001
11. Hand book of Entomology-T.V.R.Ayyar
12. Useful and Destructive Insects-MetacalfandFlint
13. Protozoology-Kudo
14. Biology of Protozoa-Sleials
15. Clinical Parasitology-Faust
16. Medical Helminthology-Watson
17. Indian Insect Life-Lefrey
18. General Parasitology-Cheng
19. Bench Aids for the diagnosis of Malaria-WHO, 1985.
20. HumanParasitology-BurtonJ.Bogistch,ClintE.Carter,ThomasN.Oeltmann.2005.Third Edition, Elsevier Academic press.
21. Malaria: Principles andPracticeofMalariology.Vol.IandII,-WarnsdorferW.H.andSri.McGregor, I. 1998. Churchill Livingstone, New York.
22. Parasitology (MedicalZoology)-H.S.SinghandP.Rastogi.RastogiPublications.Meerut
23. Medical Parasitology-N.C.DeyandT.K.Dey.AlliedAgency,Kolkatta.
24. AModernTextBookofParasitology-Dr.A.N.Latey,NarendraPrakashan,Pune
25. Medical Zoology-R.C.Sobti, ShobanLalNagin Chand & Co.,Jalandhar.

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Faculty of Science and Technology,

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B. Sc. Third Year, Semester-VI

SZOOET1351 : (B) Aquaculture-II

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. To introduce and popularize fisheries education among society.
2. To provide information regarding fisheries of different commercially important species.
3. To provide skills for water quality monitoring and management in aquaculture and fishing activities.
4. To impart knowledge and skills of culture of different commercially important aquatic species.
5. To provide detailed knowledge and skills required for aquarium keeping and ornamental fish activities.

Course outcomes:

After successful completion of this course, students will be able to:

1. Students will acquire knowledge about scope and importance of aquaculture and culture practices of commercially important species.
2. Students will acquire knowledge about water quality management in aquaculture.
3. Students will understand different types of aquaculture practices of commercially important fishes.
6. Students will gain knowledge as well as technical skills related to aquarium keeping, ornamental fish production and management.
7. After successful completion of the course, students will be able to start their own ornamental fish related business.

SZOOET1351 : (B) Aquaculture-II : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**8**
	1.1	**Principals of Aquaculture** • Definition, scope and importance • Concept of Blue Revolution • Present Status of Aquaculture at Global level	
	1.2	**Fish cultivation Methods** • Cage Culture • Pen Culture	
	1.3	• Raceway Culture • Monoculture	
	1.4	Polyculture	
2.0			**7**
	2.1	**Manmade Hazards and Water Pollution** Domestic sewage	
	2.2	Agricultural sewage	
	2.3	Industrial Effluents Effect of water pollution on Fish fauna	
	2.4	**Sewage Fed Fish Culture** Composition of sewage • Use of Sewage for fish culture Fish species suitable for sewage culture	
3.0			**8**
	3.1	**Integrated Fish Farming** • Paddy cum fish farming • Duck cum fish farming • Cattle cum fish farming	
	3.2	**Aquatic weeds and their control methods** • Types of Aquatic weeds • Advantages and Disadvantages • Weed Control—Manual and Mechanical • Chemical Biological	
	3.3	**Introduction to other commercial Aquaculture practices** **Crustacean shell fish culture** • Culture of Scylla serrata • Culture of fresh water prawn (Penaeus monodon)	
	3.4	**Molluscan shell fish culture** Pearl oyster culture Edible oyster culture	
4.0			**7**
	4.1	**Aquarium Keeping** Introduction Importance of Aquarium keeping • Aquarium setting • Aquarium maintenance • Aquarium accessories	

	4.2	• Aqurium fishes	
	4.3	**Breeding of Ornamental fishes** • Beta splendens • Guppy fish	
	4.4	Swardtail fish Angel fish	
		Total	**30**

Text Books and Reference Books

1. Fish and fisheries of India – V.G. Jhingran, Hindustan Publishing Company.

2. Fish and Fisheries – K. Pandey and J.P. Shukla, Rastogi Publications, Meerut.

3. Fisheries and Aquaculture – Ravi Shankar Piska, Lahari Publications, Hyderabad.

4. Concepts of Aquaculture – Ravi Shankar Piska, Lahari Publications, Hyderabad.

5. Fresh water fish pond culture and management – Marilyn Chakroff, Pace Crops Scientific Publishers, Jodhpur.

6. An Introduction to Fishes – S.S. Khanna, Central Book Depot, Allahabad.

7. A Manual of Freshwater Aquaculture – R. Sontanam, N. Sukumaran & P. Nilgajan.

8. A Text Book of Fishery Science and Indian Fisheries – C.B.C. Shrivastav, Kitab Mahal, Nagpur.

9. Hand book on Aquafarming of shrimps,Lobsters and Mud Crabs—Kathirvel,M (MPEDA Handbook)

10. Prawn and Prawn Fisheries of India – Kurian C.V. and Sebastian.

11. Fish Biology and Indian Fisheries – R.P. Parihar, Central Publishing House, Allahabad.

12. Mud Crab Aquaculture : A Pratical Manual—Shelley,C.and Lovatelli,A / Publisher: FAO

13. Aquaculture: Dr N.Arumugam (Saras Publication)

14. Mud Crab Aquaculture and Biology,---Keenan,C.P and Blackshaw,A ./Publisher: ACIAR

15. Pond & Fish Culture – Hall C.B.

16. Fishery Management – Agrawal.

17. Coastal Aquaculture in India – Santhanam R.

18. Marine Fisheries of India – Virbhadra Rao and Bal.

19. Fresh Water Fish Culture – Wankhede and Deshmukh.

20. Aquaculture Development – Amitabh Patel, S.N. Pathak.

21. A Text Book of Aquaculture – Rao K.R.S.S., Reddy M.S., Discovery Publication, Delhi.

22. A Text Book of Pisciculture & Aquarium Keeping – H.S. Jagtap, S.N. Mukherjee & V. Garad, Daya Publishing House, New Delhi.

23. Practical Manual of Pisciculture and Aquarium Keeping – H.S. Jagtap, S.N. Mukherjee & S.S. Nanware, Daya Publishing House, New Delhi.

24. General and Applied Ichthyology (Fish and Fisheries) – S.K. Gupta, P.C. Gupta, S. Chand & Company Ltd., New Delhi.

25. Manual of Experimental Ichthyology – Gahlawat, Gupta, Yadava, Jain, Sihag, Sahlok, Daya Publishing House, Delhi.

26. Modern Experimental Zoology – Gupta and Chaturvedi, Raj Publishing House, Jaipur.

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B. Sc. Third Year, Semester-VI

SZOOET1351 : (C) Entomology-II

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. To acquire knowledge of ecology and biology of insects of medical and agricultural importance.
2. To study the different beneficial and harmful insect species.
3. Understand insect pest management techniques like cultural, physical, Biological, chemical, IPM etc.
4. To study various types of insecticides and problems associated with their use.
5. To acquire knowledge and skill of application of insecticides & maintenance of pest control equipment.

Course outcomes:

After successful completion of this course, students will be able to:

1. Demonstrate awareness of, and skill to identify, classify, and describe anatomical parts, organ systems, and morphology of insects
2. Explain the different methods of collection, preservation, and curating of insect specimens
3. Ability to handle equipment and other tools used in chemical and biological control of insect pests
4. Understand the concept of Integrated Pest Management (IPM) and its application
5. Acquire knowledge and skill of application of insecticides and maintenance of pest control equipment

SZOOET1351 : (C) Entomology-II : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**8**
	1.1	Concept of Pest Introduction to the insect Pest.	
	1.2	Types of Pest: Agricultural, Veterinary, Medical (Human), and Domestic (Household) Pests.	
	1.3	Study of Agriculture Pests (Classification bionomics, control measures) of the following a) Cotton-Boll worm, red cotton bug. b) Jawar-stem borer,Earhead midge. c) Sugarcane- Early shoot Borer (*Chilloinfuscatellus*), Termite.	
	1.4	d) Oil seeds- Mustard Aphid, Ground nut White grub. e) Fruits- Lemon butter fly, Mango Stem borer. f) Stored grain pest- Rice weevil, Khapra Beetle.	
2.0			**7**
	2.1	Human insect pests (Structure, Binomics and control measures of the following)- a) Mosquito b) Bed bugc) Head louse d) Housefly a) Cockroach b) Cricketc) Rat flead) Termite	
	2.2	Household insect pests (Structure, Binomics and control measures of the following)- a) Cockroach b) Cricketc) Rat flead) Termite	
	2.3	Non-insect animal pests and their control- a) Rat and Rodentb) Boarc) Monkeyd) Birdse) Deerf) Nematodes	
	2.4	Insect vectors affecting human health Ticks, Lime disease, Scenic typhus	
3.0			**8**
	3.1	Study of Social Insect viz Ants (Black and White)	
	3.2	Apiculture (Honey Bee)	
	3.3	Sericulture (Silk moth)	
	3.4	Lac Culture (Lac Insect)	
4.0			**7**
	4.1	Concept of Integrated pest management (IPM)	
	4.2	Physical and Mechanical control of insect pests.	
	4.3	Chemical control and safe handling of pesticide	
	4.4	Biological and cultural control of insect pest	
		Total	**30**

Text Books and Reference Books

1. Hemsingpruthi: A Text Book of Agricultural Entomology
2. ESSIG: College entomology.
3. M. S. Mani: A text book of General Entomology.
4. Government of Maharashtra: Crop pests and how to fight them.

5. Oldoyd, N.: A collection, preserving and studying insects.
6. D. B. Tembhare: Modern Entomology
7. R. E. Fradt: Fundamentals of Applied Entomology.
8. D. N. Ray and A. W. A Brown: Entomology Medical and Veterinary
9. Apple J. L. and Smith R.F.: Integrated Pest Management.
10. Champman R. F.: Insects – Structure and Function.
11. O. W. Richards and R. G. Davies: Imms Text Book of Entomology
12. Shrivastave K. P. Vol (I-III): A Text Book of Applied Entomology
13. Srivastava K.P.: A Text Book of Applied Entomology – II
14. Alaka Prakash- Laboratory manual of entomology.
15. Shinde S. S., Fundamentals of Entomology, Oxford Book Company .

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B. Sc. Third Year, Semester-VI

SZOOET1351 : (D) Environmental Biology-II

Periods : 30 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1.To interpret pollution, its causes and effects on environment.

2.To learn about mechanisms for protection of the environment from adverse effects of pollution.

3.To develop an interdisciplinary approach in the analysis of environmental issues.

4.To develop an understanding legal framework for protection of environment.

5.To impart basic knowledge about the environment and its allied problems.

Course outcomes:

After successful completion of this course, students will be able to:

1. Ability to assimilate causes of pollution, and its effects on environment.

2.Awareness about environmental issues and problems at local, national and international level.

3.An understanding of the laws and agencies pertaining to protection of environment.

4.Knowledge about environment, pollution and related problems.

SZOOET1351 : (D) Environmental Biology-II : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0		**Introduction to Environmental Pollution**	**8**
	1.1	Origin of Pollution.	
	1.2	Pollutants: The Creators of pollution,	
	1.3	Types of pollutants- Biodegradable and Non- Biodegradable Pollutants. Kinds of pollution	
	1.4	**Water Pollution** Types of Water pollution, Kinds and sources of Water pollutants Sources and Effects of water pollution. a) Pollution by Sewage and Domestic Waste, Eutrophication and Algal blooms b) Pollution by Heavy Metals; Sources and Effects of Lead and Mercury Assessment and Monitoring of Water pollution. Control of Water pollution.	
2.0		**Air Pollution: Types, Sources and Effects of Air Pollutants**	**7**
	2.1	Thermal Power Plants, Industrial Chimney Waste, Automobile Exhausts	
	2.2	Sulphate compounds as Air pollutants: Sources and Effects	
	2.3	Oxides of Nitrogen as Air pollutants: Sources and Effects	
	2.4	Carbon dioxide and Carbon Monoxide as Pollutant: Sources and effects Acid rains Ozone as a Protector and Destroyer Chlorofluro Carbons (CFCs) Photochemical Smog Control of Air pollution.	
3.0		**Radioactive, Solid Wastes and Noise Pollution**	**8**
	3.1	**Radioactive Pollution:** Sources, Effects and Control of Radioactive pollution	
	3.2	**Pollution by Solid Wastes:** a) Types and source of Solid wastes b) Effects of solid waste pollution c) Methods of Solid wastes Disposal.	
	3.3	**Noise Pollution:** Sources, Effects and	
	3.4	Control of Noise pollution.	
4.0		**Renewable Energy Sources and Alternative fuels**	**7**
	4.1	Renewable sources and its classification.	
	4.2	Biofuels- definition, benefits and prospects. Biogas production using methanogenic bacteria.	
	4.3	Microbial hydrogen gas production. Ethanol production and its use as fuel.	
	4.4	Role of State Pollution Control Board in Pollution abatement. Role of Central Pollution Control Board in Pollution Control. NEERI (National Environmental Engineering Research Institute) in Pollution Control.	
		Total	**30**

Text Books and Reference Books

1. Odum – **'Ecology'**.
2. P.D. Sharma, **'Ecology and Environment'** Rastogi Publications, Meerut-250002, India.
3. Edward J. Kormondy, **'Concepts of Ecology'**, Himalaya Publications House, Mumbai.
4. Mohan P. Arora, '**Ecology'** Himalaya Publications House, Mumbai.
5. H. Loggen, **'Environmental Pollution'** 2nd Edition, Holt ReinhortWintson (1978).
6. APHA, **'Standard methods of Examinations of Water and Waste Water'** 20th Edition (2000).
7. J. H. Seinfield ,**'Air Pollution; Physical and Chemical Fundamentals'**, Mc Graw Hill, New York (1975).
8. T. N. Tiwari,V. P. Kudesia, **'Noise Pollution and it's Control'**, PragatiPrakashan, New Delhi (1990).
9. G. R. Chatwal, M. C. Mehra, **'Environmeatal Radiation, Thermal Pollution And Control'**Amol Publication, New Delhi (1989).
10. Trivedi P.K. and Goel P.K**. 'Chemical and Biological methods for Water Pollution Studies'**(Published by Environmental Publisher KARAD).
11. Trivedi P.K. and Raj Gurudeep**'Environmental Water and Soil Analysis'.**
12. Published by Akashdeep Publication House New Delhi.
13. P. S. Verma and V.K. Aggrawal :**Environmental Biology**
14. P.D. Sharma :**Environmental Biology**
15. P.D. Sharma :**Toxicology**
16. E. P. Odum :**Fundamentals of Ecology**
17. E. P. Odum :**Fundamentals of Ecology**
18. Ranganalla :**Water and Waste Water Engineering**
19. P. D. Sharma :**Microbiology**
20. P. D. Sharma :**Microbiology**
21. Kndosia :**Water Pollution**
22. M. N. Rao :**Air Pollution**
23. NEERI Nagpur :**Manual on Waste Water Analysis.**

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Faculty of Science and Technology,

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B. Sc. Third Year, Semester-VI

SZOOVC1351 : (G) Sericulture

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. Equip students with skills for silk production and management
2. Impart knowledge on mulberry cultivation and silkworm rearing
3. Train in silk processing and quality control
4. Develop entrepreneurship skills for sericulture-based industries
5. Promote sustainable and eco-friendly sericulture practices

Course outcomes:

After successful completion of this course, students will be able to:

1. Ability to identify major silkworm diseases like pebrine, flacherie, muscardine, and grasserie and implement integrated disinfection measures.
2. Skill to analyze the economic efficiency of mulberry cultivation by evaluating labor, irrigation, and fertilizer inputs against leaf yield.
3. Knowledge to evaluate the financial viability of cocoon production by calculating costs per kilogram and identifying market profitability variables.
4. Ability to assess global silk market trends, price fluctuations, and synthetic competition to formulate effective branding and marketing strategies.
5. Knowledge of government schemes, subsidies, and Central Silk Board technical support to optimize sericulture entrepreneurship and promote silk products.

SZOOVC1351 : (G) Sericulture : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	**Mulberry cultivation and management**-Climate: Thrives in temperate, subtropical regions	
	1.2	**Soil:** Prefers well-drained, fertile soil (pH 6.5-7.5)	
	1.3	**Propagation:** Cuttings, grafting, or seedlings- **Pruning:** Regular pruning for bushy growth, easy harvesting- **Irrigation:** Regular watering, especially during leaf growth- **Pest management:** Control aphids, scale, leaf spots	
	1.4	Practical 1: Identify and visit a local mulberry farm, observe climate and soil conditions -Practical . 2: Conduct soil testing and recommend fertilizers based on pH levels	
2.0			**15**
	2.1	**Types of silkworms, Silkworm rearing and breeding**- Egg incubation, maintaining optimal temperature and humidity	
	2.2	**Larval feeding**-Providing mulberry leave, maintaining hygiene	
	2.3	**Cocoon harvesting**-timing, handling for quality silk	
	2.4	Practical 1: Demonstrate egg incubation techniques, monitor temperature (25-27°C) and humidity (80-85%) Practical 2. - Identify mature cocoons for harvesting, Demonstrate proper cocoon handling and sorting techniques	
3.0			**15**
	3.1	**Silk production and processing**-Stunning and killing pupae, Hot water or steam treatment,	
	3.2	**Reeling**-unwinding silk filament from cocoons.	
	3.3	**Twisting, weaving and Dyeing–** creating Yarn , fabrics, removing sericin and coloring silk	
	3.4	Practical 1: Demonstrate pupae killing methods (hot water/steam treatment). Practical 2 - Demonstrate silk twisting and yarn formation	
4.0			**15**
	4.1	**Unit no. 4.1.Pest and disease management**- - **Pebrine:** Caused by Nosema bombycis, symptoms include black spots on larvae- **Flacherie**: Bacterial infection, - **Muscardine:** Fungal infection, - **Grasserie:** Viral infection.	
	4.2	**Sericulture economics**- Cost of mulberry cultivation: Land, labor, inputs - Cocoon production costs: Labor, disease management, rearing expenses	
	4.3	**Sericulture marketing**--Market trends: Global demand, price fluctuations, Government support: Subsidies, incentives for farmers	
	4.4	Practical1: Identify silkworm diseases (pebrine, flacherie, muscardine, grasserie) Practical 2: Visit a sericulture farm or silk production unit.	
		Total	**60**

Text Books and Reference Books

1. Sericulture and Silk Production by K. P. Srivastava
2. Silk Production and Processing by S. K. Majumdar
3. Sericulture: An Agro-based Industry by A. K. Srivastava
4. Silk: Biology, Production, and Processing by M. S. Jolly
5. Handbook of Sericulture by S. K. Das
6. Sericulture and Apiculture by N. S. Arora
7. Silk Technology: A Text Book by K. P. Srivastava
8. Sericulture and Silk Industry by R. K. Mishra

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B. Sc. Third Year, Semester-VI

SZOOVC1351 : (H) Poultry Farming

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course objectives:

1. To provide knowledge of poultry farming, its significance, types, and important breeds.
2. To introduce modern systems of rearing and breeding of broilers, and to develop students' interest in contemporary poultry farming practices.
3. To highlight the role of poultry farming in generating employment opportunities.

Course outcomes:

After successful completion of this course, students will be able to:

1. Understand and evaluate the current status, prospects, and opportunities in poultry science.
2. Understand the scientific principles and methods of poultry farming and management.
3. Differentiate between various poultry breeds and explain their importance.

SZOOVC1351 : (H) Poultry Farming : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	**Introduction to poultry farming in Maharashtra and India**	
	1.2	Poultry breeds and their varieties- Layers for egg production, Broiler for meat production	
	1.3	Indigenous poultry varieties- Aseel, Kadaknath, Giriraj, Kalinga brown, swarnandh	
	1.4	**Practical**: To study external body parts (morphology), Digestive system and reproductive system of poultry as a bird	
2.0			**15**
	2.1	**Housing system**- Types of layers, broilers, and Indian breeds	
	2.2	Food, water, and waste management of caged chicken and poultry. Dietary requirements, poultry food, and feeding methods	
	2.3	Temperature, light, humidity, and wind as environmental factors and their management in poultry houses. Disinfection methods for the poultry house	
	2.4	**Practical:** To study the major bacterial, viral, protozoan, and helminth diseases of poultry, along with nutritional deficiency disorders and vaccination practices.	
3.0			**15**
	3.1	Economics of layer, broiler, and Desi poultry production- Investment, profits, losses	
	3.2	Export and import of poultry and poultry products	
	3.3	Preparation of poultry projects. Investment, finance, loans, Government schemes for small-scale and large-scale poultry	
	3.4	**Practical:** To study poultry marketing systems and record-keeping practices.	
4.0			**15**
	4.1	Poultry eggs grading and principles of incubation. Types of hatching systems.	
	4.2	Fertility of eggs, Incubation and hatching of eggs, chick care	
	4.3	Fumigation, sanitation and hygiene of hatchery	
	4.4	**Practical:** To study hatchery records, labour requirements, and chick marketing in poultry farming.	
		Total	**60**

Text Books

1. A Text Book of Animal Husbandry, C.C. Banerjee, Oxford IBH, Publication, ISBN: 9788120412606.

2. Text Book of Poultry science, P.V. Sreenivasaiah, Write and Print publications, ISBN: 978819297059.

Reference Books

1. Principles of poultry science,1996, CAB publishers, ISBN: 9780851991221.

2. Poultry Science Practices, Nilothapal Ghosh, CBS Publication & Distribution. (2015)
3. Poultry Production in Hot Climatic Zones, H. C. Saxena and E. H. Ketelaars, Klyani Publishers.
4. Poultry Production, Sunil Kumar Das, CBS Publishers & Distributors, Delhi

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w.e.f. June -2026)

B. Sc. Third Year, Semester – VI

On Job Training

SZOOOJ1301: On Job Training

Periods : 120 **No. of Credits: 04 (Marks: 100)**

Course Objectives:

1. It aims to bridge the gap between theoretical knowledge and practical application while lowerin training costs and fostering a culture of continuous learning.
2. Objectives of research projects in zoology include analyzing animal anatomy, behavior, and ecology to understand species adaptations and population dynamics.
3. Key goals focus on biodiversity conservation, identifying new species, and exploring molecular genetics for evolutionary insights.
4. Projects often aim to solve environmental, agricultural, or veterinary problems through scientific investigation.
5. To provide opportunity to involve in research related to zoological aspects.
6. To gain the knowledge of referring research journals, writing research articles and submit the dissertation report.
7. To inculcate research culture.
8. To enhance the rational and innovative thinking capabilities.

Course Outcomes:

On completion of this course, the student should be able to:

1. Developing scientific, research, and analytical skills.
2. Producing actionable data for habitat management.
3. Developing new techniques in animal breeding and protection.
4. Identify research problem and carry out literature survey.
5. Analyze the research gap and formulate the problem.
6. Interpret the data and synthesize research findings.
7. Students apply their knowledge in a practical setting.
8. It helps students develop their critical thinking skills.
9. It gives students the opportunity to work independently.
10. It provides students with the opportunity to collaborate with others.
11. It helps students develop their research skills.
12. It gives students the opportunity to gain real-world experience.

SZOOOJ1301: On Job Training : Course Contents

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**120**
		Total	**120**

Note:

1. External and Internal Examiners will examine jointly at the time of practical examination.
2. The students will have to give at least one seminar in their subject of specialization is compulsory.
3. Work must be carried out only in specialized branch.
   OJT work carried out should be presented in power point presentation in presence of University Examiners.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOEP1351 : (A) Applied Parasitology-II (Based on Paper No. SZOOET1351-(A) Applied Parasitology-II)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. Acquireknowledgeandskilltoidentify,classifyanddescribedifferentprotozoan,helminth, nematode and arthropod parasites.
2. Studymethodsofpreservationandmountingofprotozoan,helminth,nematodeandarthropod parasites.
3. Learn methods of collection and processing of soil and plant parasitic nematodes.

Course Outcomes:

1. Demonstrate knowledge and skill of identifying, classifying and describing different protozoan, helminth, nematode and arthropod parasites.
2. Performpreservationandmountingofprotozoan,helminth,nematodeandarthropodparasites
3. Carry out collection and processing of soil and plant parasitic nematodes.

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1. Identification, classification and description of Parasitic Nematodes (Animals & Plants)

Through permanent slides/photomicrographs or specimens–

a) Enterobius vermicularis, b)Ancylostoma duodenale, c)Ascaris lumbricoides, d)Wuchereria bancrofti, e)Meloidogyne (Rootknot nematode),*f)Heterodera* (Cystnematode), *g)Tylenchulus* (Citrusnematode), *h)Anguina* (Seed Gall- nematode)

2. Collection,Preservation,Mounting,identificationanddescriptionofAnimalNematodes fromlocally available different hosts (intestines).

3. Collection,Preservation,Mounting,identificationanddescriptionofPlantNematodes fromsoil samples.

4. Study of following arthropods through permanent slides / photographs:
Aedes, Culex, Anopheles,Pediculus humanus, Xenopsyllacheopis,Cimexlectularius Phlebotomus argentipes, Muscadomestica.

5. Collection, preservation, Preparation of permanent slides and description of mouth-partsof-

i. Housefly ii. Mosquito iii. Bedbug iv. Headlouse

6. Submission of a brief report on parasites of vertebrates.

(Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOEP1351 : (B) Aquaculture-II (Based on Paper No. SZOOET1351-(B) Aquaculture-II)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. To develops hands on skill in aquaculture techniques farm management.
2. To train students in identification of commercially important fishes,shell fish and aquatic organisms.
3. To provide knowledge of water quality assessment and management in aquaculture system.
4. To introduce methods of fish breeding, seed production and hatchery management.
5. To teach techniques for disease diagnose, prevention and health management in aquaculture.
6. To impart knowledge about aquatic weeds and their control measures.
7. To Provide exposure to modern aquaculture system such as integrated farming, pen culture, cage culture.

Course Outcomes:

On completion of the course, students will be able to:

1. Identify important aquaculture species of freshwater, marine water, brackish water.
2. Identify different types of aquatic weeds and know their control measures.
3. To analyse water quality parameters(PH, Temp, DO, alkalinity, hardness).
4. Prepare aquarium and how to maintain it.
5. To operate basic aquaculture equipment .
6. They will gain knowledge as well as technical skills related to aquarium keeping, ornamental fish production.

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1. Identification,classificationanddescriptionoffishspeciesformonoculture,polyculture, integrated fish farming and sewage fed fish culture
2. Identification of phytoplankton and zooplanktons
3. Permenat mounting of zooplanktons/ phytoplanktons.
4. Identification of common aquatic weeds of fresh water fish pond.
5. Control of common aquatic weeds of freshwater.
6. Identificationofnon-fishorganisms/commerciallyimportantshellfishes.
7. Setting up of aquarium.
8. Identification of aquarium accessories.
9. Identification of aquarium fishes.
10. Estimation of pH, hardness (magnesium + calcium) / alkalinity in waters
11. Estimation of O2 content, NPK, Ca, Na in sewage water sample.
12. Visit to fish breeding farm / fish industry and submission of report.
13. A Fish Album"containingphotographs,cutoutswithappropriatewriteupaboutthedifferentfish species.[fresh water, Marine water, Brackish water fishes].

Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (NEP-20; w. e. f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOEP1351 : (C) Entomology-II (Based on Paper No. SZOOET1351-(C) Entomology-II)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. Acquire knowledge and skill to identify, classify and describe anatomical parts, organ systems and morphology of insects.
2. Learn methods of collection, preservation and curating of insects specimens of taxonomic and medical importance.
3. Study methods of equipment used in chemical and biological control of insect pests.

Course Outcomes:

1. Demonstrate awareness of, and skill to identify, classify and describe anatomical parts, organ systems and morphology of insects.
2. Explain the different methods of collection, preservation and curating of insects specimens.
3. Ability to handle equipment and other tools used in chemical and biological control of insect pests.

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1. Collection, Identification and preservation of agricultural insect pests from local area (Minimum 05).
2. Collection, Preservation and Study of House hold and medically important Pests: Rat flea, Housefly, Head louse, Mosquito, Crickets, Cockroach.
3. Study of non insect animal pests: a. Rat b. Birds c. Monkey d. Boar e. Deer f. Mites
4. Collection, Preservation and submission of major crop insect pests from local area (at least 05).
5. Preparation and identification of permanent slides and study the Life Cycle (developmental stages) of Honeybee, Silk moth, Lac insects.
6. To study Equipments used in Apiculture, Sericulture, Lac culture.
7. Study of vertebrates important for biological control against insect pests - Guppy fish, Frog, Gecko, Wood pecker, Bat and Scaly ant-eater.
8. Demonstration and use of different equipments such as drills, sprayers, dusters for insect control.
9. Methods that modify the growing environment to be less favorable for pest and disease.And more favorable for crop.
10. Monitoring, Identification, cultural, biological and physical control rather than relying solely on pesticide.
11. Study tour: At least one visits to the crop fields, Agricultural Research Institutes and submission of Study tour report along with photographic documentation of Entomology related issues.

Note: All animal based practical's should be conducted with the help of Models, Charts and Computer Aided Techniques.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology,

Four Year UG Program, Zoology (w. e. f. June -2026)

B. Sc. Third Year, Semester-VI

SZOOEP1351 : (D) Environmental Biology-II (Based on Paper No. SZOOET1351-(D) Environmental Biology-II)

Periods : 60 **No. of Credits: 02 (Marks: 50)**

Course Objectives:

1. Acquire practical skill of measuring different environmental parameters of water, air and soil.
2. Study techniques of identification of plant and animal biodiversity of an ecosystem.
3. Learn about quantification techniques of pollutants in abiotic and biotic components of an ecosystem.

Course Outcomes:

1. Ability to measure different environmental parameters of water, air and soil.
2. Skill of identification of plant and animal biodiversity of an ecosystem.
3. Perform quantification of pollutants in abiotic and biotic components of an ecosystem.

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1. Estimation of Total Dissolved Solids (TDS) in water sample.
2. Estimation of Suspended Solids in water sample.
3. Comparative analysis of air sampling from clean and polluted areas using key parameters.
4. Effect of Heavy Metals / Pesticides on Oxygen consumption of crab/fish or suitable animal.
5. Effect of Hydrogen sulphide gas pollutant on plant parts.
6. Effect of sulfur dioxide (SO_2) gas pollutant on plant parts.
7. Determination of Biological Oxygen Demand (BOD) of Water Sample.
8. Determination of Chemical Oxygen Demand (COD) of Water Sample.
9. Determination of Turbidity of Water Sample.
10. Determination of Total Hardness of Water by EDTA method.
11. Estimation of Nitrate and Phosphate Content in Water Sample.
12. Determination of Sulphate Content in Water Sample.
13. Measurement of Noise Pollution using dB Meter (or Mobile App Method).
14. Study of Methods of Wastewater Treatment (Primary, Secondary, and Tertiary Treatment) using Models/Charts.
15. Field visit to river / lake and or wastewater treatment plant.
16. Measurement of Light intensity by LUX meter.
17. Measurement of rain falls by rain meter.

Note: (Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines)

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Faculty of Science & Technology
NEP-2020 Pattern

Practical Examination Winter / Summer 20----
B. Sc. Third Year Zoology (Semester – VI) as per NEP-2020
(w.e.f. June 2026)

Practical (SZOOCP1351: Ethology, Biometry and Bioinformatics)

Based On
(Paper: SZOOCT1351: Ethology, Biometry and Bioinformatics)

Centre: Batch No.:
Date: Time: **4 Hrs**
Exam Seat Number: Marks: 30

Q.1. To study the Positive and Negative Phototropism with suitable examples **OR** **10**
To study the Positive and Negative Chemotactic Response with suitable examples **OR**
Study of Colouration of animals with suitable examples

Q.2. Study of any two types of animal behaviour **OR** **05**
Study of social behaviour in insects. **OR**
Study of biological rhythms

Q.3. Give the diagrammatic representation of data with Histogram or Pie-Diagram or Frequency Polygon Curve. **OR** **05**
Solve any two problems based on Mean, Mode, Median. **OR**
Simple probability calculations and their applications in biological studies
OR
To perform online search on Biological information/Literature. **OR**
Determine sequence of protein or DNA from the provided file. **OR**
BLAST- Sequence Search & alignment. **OR**
Find information about a protein using UniProt. **OR**
Any problem or activity based on bioinformatics.

Q.4. Journal / Record Book **05**

Q.5. Marks to awarded proportionate to the number of practical's / activities done by the students during the semester **03**

Q. 6. Viva-voce **02**

Note: Continuous Assessment (CA) for Practical Examination
Practical Internal Evaluation (Continuous Assessment – CA): 20 Marks
i) Excursion Report – 10 Marks; ii) Submission of Animal Album / Permanent Slides / Seminar – 10 Marks
Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – VI) as per NEP-2020 (w.e.f. June 2026)

Practical (SZOOCP1352: Reproductive Biology, Embryology, and Animal Development & Animal Biotechnology) Based On

(Paper: SZOOCT1352: Reproductive Biology, Embryology, and Animal Development & Paper: SZOOCT1353: Animal Biotechnology)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: **30**

Q.1	Study and identify the different stages of gametogenesis using histological sections ***OR*** Perform physical, chemical, and microscopic analysis of a semen sample, recording volume, motility, morphology, chemical composition, and other cellular characteristics ***OR*** Demonstrate Leech / Rat so as to expose its reproductive system and leave a well labeled diagram. **OR** Identify, describe, and draw a well-labelled diagram of Spotters- 1 to 5. (Histological study of gonads (Testis/Ovary) of Frog / Rat (01 spot), Chick embryos of different hours/ L.S/ T.S. of chick embryo through head and heart regions (02 spot)/Developmental stages of Frog (01 spot); Developmental stages of Insects (01 spot). ***OR*** On the basis of models or charts, demonstrate or explain the procedures of superovulation and MOET (Multiple Ovulation and Embryo Transfer), and describe any two assisted reproductive technologies (IVF, ICSI, ZIFT, GIFT) along with their applications in animal breeding or human infertility treatment. ***OR*** Identify, classify and comment the types of eggs based on structure, size, shape, yolk type, and shell characteristics ***OR*** Estimate the calcium content in an eggshell by EDTA titration method. And record the results **OR** To Study of Regeneration in Hydra/Planaria	**10**
Q.2	Study the given laboratory instruments (Microscope/ Centrifuge/Incubator/ PCR) and explain their working principles and applications ***OR*** To study animal cell culture and sterilization techniques in animal biotechnology. **OR** Extraction of Genomic DNA from Blood or Animal Tissue ***OR*** To separate and visualize DNA fragments using agarose gel electrophoresis **OR** To demonstrate the amplification of specific DNA sequences using Polymerase Chain Reaction (PCR)	**05**
Q.3	study DNA digestion with restriction enzymes and analyze fragments using gel electrophoresis and charts. ***OR*** introduce plasmid DNA into *E. coli* using the calcium chloride method and study bacterial transformation **OR** isolate cells from tissue and establish a primary cell culture for further study.**OR** preserve animal cells by freezing and study their revival using cryopreservation techniques **OR** demonstrate the creation of transgenic animals through DNA microinjection or CRISPR gene editing using virtual or simulated models **OR** ıdy the bioethical issues and biosafety regulations in animal biotechnology and explain their principles, significance, and applications.	**05**
Q.4	Journal /Record Book	**05**
Q.5	Marks to awarded proportionate to the number of practical's / activities done by the students during the semester	**03**
Q.6	Viva-voce	**02**

Note: Continuous Assessment (CA) for Practical Examination

Practical Internal Evaluation (Continuous Assessment – CA): 20 Marks

i) Excursion Report – 10 Marks

ii) Submission of Animal Album / Permanent Slides /Seminar – 10 Marks

Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – VI) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOEP1351: (A) Applied Parasitology-II)

Based On

(Paper: SZOOET1351: (A) Applied Parasitology-II)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: **30**

Q.1. Collect, Prepare a permanent slide, identify and describe Animal Nematodes from Locally available Host Intestine / Plant Nematodes from soil samples. **10**

Q.2. Prepare a permanent slides of mouth parts from the given specimen and identify by giving reasons. **05**

Q.3. Identify, classify and describe Parasitic Nematodes(One) Animal Nematode or Plant Nematode and one Arthropods by using permanent slides / photomicrographs / or specimens. **05**

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks

i) Excursion Report – 10 Marks

ii) Submission of Animal Album / Permanent Slides /Seminar – 10 Marks

Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – VI) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOEP1351: (B) Aquaculture-II)

Based On

(Paper: SZOOET1351: (B) Aquaculture-II)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks:30

Q.1. Estimation of O2 Content / NPK / Ca, Na in sewage water. **10**

OR

Identify and describe fish species of (Monoculture species, polyculture species, Integrated fish farming species and sewage fed fish culture species) (Any Four)

OR

Q.2. Identify, classify and describe Aquatic weeds (Any Two) **05**

OR

Prepare permanent stained micropreparation of material provided (Identify, Classify, and Comments) (Zooplanktons / Phytoplanktons)

OR

Identify, classify and describe Aquarium Fishes. (Any Two)

OR

Q.3. Estimation of PH / Hardness (Magnesium and Calcium) / alkanity in water sample. **05**

OR

Identify, Classify and describe Non fish organisms. (Any Two)

OR

Identify and describe Aquarium accessories (Any Two)

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks

i) Excursion Report – 10 Marks

ii) Submission of Animal Album / Permanent Slides /Seminar – 10 Marks

Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – VI) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOEP1351: (C) Entomology-II)

Based On

(Paper: SZOOET1351: (C) Entomology-II)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1. Identify and comment on its importance of agricultural insect pest (03), Human & household pest (02) **10**

OR

Preparation of permanent slides of agricultural insect pests/human pests/house hold pests from given material.

OR

Identify and comment on its importance of non-insect animal pest and their control viz. Rat, Bird, Monkey, Boar, Deer.

Q.2. To study the life cycle (developmental stages) of Honey bee/Silk moth / Lac insect by using Charts / models. **05**

OR

Comment on Equipments used in Apiculture / Sericulture / Lac culture.

OR

Identification, Classification, and description of Vertebrates important for biological control against insect pest any three viz. Gecko, Wood pecker, Bat and Scaly Ant-eater .

OR

Q.3. Comments on methods that modify the growing environment to be less favourable for pest and disease. And more favourable for crop. **05**

OR

Demonstrate and use of different equipment's such as drills, sprayers, Dusters for insect control.

OR

Comments on monitoring, Identification, Cultural / Biological /Physical control rather than relying solely on pesticide.

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks

i) Excursion Report – 10 Marks

ii) Submission of Animal Album / Permanent Slides /Seminar – 10 Marks

Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

NEP-2020 Pattern

Practical Examination Winter / Summer 20----

B. Sc. Third Year Zoology (Semester – VI) as per NEP-2020

(w.e.f. June 2026)

Practical (SZOOEP1351: (D) Environmental Biology-II)

Based On

(Paper: SZOOET1351: (D) Environmental Biology-II)

Centre: Batch No.:

Date: Time: **4 Hrs**

Exam Seat Number: Marks: 30

Q.1. Estimation of Total Dissolved Solids (TDS)/ Suspended Solids in water sample. **10**

OR

Effect of Heavy Metals / Pesticides on Oxygen consumption of crab/fish or suitable animal.

OR

Effect of Hydrogen sulphide/ Sulfur dioxide (SO2) gas pollutant on plant parts.

Q.2. Determination of Biological Oxygen Demand (BOD)/ Chemical Oxygen Demand of Water Sample. **05**

OR

Determination of Turbidity of Water Sample.

OR

Determination of Total Hardness of Water by EDTA method.

OR

Q.3. Estimation of Nitrate and Phosphate/ Sulphate Content in Water Sample. **05**

OR

Measurement of Noise Pollution using dB Meter (or Mobile App Method).

OR

Study of Methods of Wastewater Treatment (Primary, Secondary, and Tertiary Treatment) using Models/Charts. OR

Measurement of Light intensity by LUX meter/ Measurement of rain falls by rain meter.

Q.4. Journal / Record book **05**

Q.5. Marks to be awarded proportionate to the number of practicals / activities done by the students during the semester. **03**

Q.6. Viva-Voce **02**

Note: Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks

i) Excursion Report – 10 Marks

ii) Submission of Animal Album / Permanent Slides /Seminar – 10 Marks

Demonstration of Animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

Name & Signature
Examiner–1

Name & Signature
Examiner-2

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

B. Sc. Third Year Syllabus (NEP-2020; w.e.f. June, 2026)

VOCATIONAL COURSE IN ZOOLOGY (VCZ)

CONTINUOUS ASSESSMENT (CA)

Zoology

Semester- VI

SZOOVC1301 - VCZ- IV : (G) Sericulture

Or

VCZ- IV : (H) Poultry Farming

Centre: **Date:**

Marks: 20

SEAT NUMBER :----------

Sr. No.	Continuous Assessment (CA)	Maximum Marks	Marks Obtained
1	Seminar Presentation	10	
2	Test	10	
	Total Marks	**20**	

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science & Technology

B. Sc. Third Year Syllabus (NEP-2020; w.e.f. June, 2026)

VOCATIONAL COURSE IN ZOOLOGY (VCZ)

END SEMESTER ASSESSMENT (ESA)

Zoology

Semester- VI

SZOOVC1301 - VCZ- IV : (G) Sericulture

Or

VCZ- IV : (H) Poultry Farming

Centre: **Date:**

Marks: 30

SEAT NUMBER :----------

Sr. No.	End Semester Assessment (ESA)	Maximum Marks	Marks Obtained
1	Vocational Course Report Submission	10	
2	Overall Course Judgment	10	
3	Course Work Presentation	10	
	Total Marks	**30**	

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP - 2020 w.e.f. June 2026
B. Sc. Zoology Practical Examination, Summer – 20---

B. Sc. Third Year (Semester - VI)

End Semester Assessment (ESA)

SZOOOJ 1351 : On Job Training (OJT)

Centre: **Duration: 04 Hrs.**

Date: **Time:**

Batch No.:

Exam. Seat Number :

Credits: 4 (Hrs. 120; CA - 40M & ESE- 60 M)

ASSESSMENT OF OJT

Sr. No.	Content	Maximum Marks	Marks Obtained
1	Report Submission	30	
2	Over all Judgment	10	
3	Report Presentation and Viva-voce	20	
	Total	**60**	

Note : (**On Job Training / Case Study** - **Continuous Assessment** (CA) 40 Marks – Marks distribution = i) Synopsis Submission -10; ii) Attendance / Involvement in project -20; iii) Seminar-10.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2