॥ 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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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 पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२४–२५ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, या विद्यापीठा अंतर्गत येणा–या सर्व संलग्नित महाविद्यालयामध्ये शैक्षणिक वर्ष २०२४–२५ पासून राष्ट्रीय शैक्षणिक धोरणानुसार पदव्यूत्तर द्वितीय वर्षाचे अभ्यासक्रम लागू करण्याच्या दृष्टीकोनातून विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत येणा–या अभ्यासमंडळांनी तयार केलेल्या पदव्यूत्तर द्वितीय वर्षाच्या अभ्यासक्रमांना मा. विद्यापरिषदेने दिनांक १५ मे २०२४ रोजी संपन्न झालेल्या बैठकीतील विषय क्रमांक १५/५९–२०२४ च्या ठरावाअन्वये मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील खालील एम. एस्सी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) लागू करण्यात येत आहेत.

1) M. Sc. II year - Analytical Chemistry (Affiliated College)
2) M. Sc. II year - Biochemistry (Affiliated College)
3) M. Sc. II year - Organic Chemistry (Affiliated College)
4) M. Sc. II year - Physical Chemistry (Affiliated College)
5) M. Sc. II year - Inorganic Chemistry (Affiliated College)
6) M. Sc. II year - Analytical Chemistry (Campus)
7) M. Sc. II year - Industrial Chemistry (Campus)
8) M. Sc. II year - Medicinal Chemistry (Campus)
9) M. Sc. II year - Organic Chemistry (Campus)
10) M. Sc. II year - Physical Chemistry (Campus)
11) M. Sc. II year - Polymer Chemistry (Campus)
12) M. Sc. II year - Computer Management (Affiliated College)
13) M. Sc. II year - Computer Sciene (Affiliated College)
14) M. Sc. II year - Software Engineering (Affiliated College)
15) M. Sc. II year - System Administration & Networking (Affiliated College)
16) M. Sc. II year - Computer Application (Campus)
17) M. Sc. II year - Computer Network (Campus)
18) M. Sc. II year - Computer Science (Campus)
19) M. Sc. II year - Zoology (Campus)
20) M. Sc. II year - Zoology (Affiliated College)
21) M. Sc. II year - Physics (Campus)
22) M. Sc. II year – Physics (Affiliated College)

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.

डॉ. सरिता लोसरवार
सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२४–२५/993
दिनांक १३.०६.२०२४

प्रत : १) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मुल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, सदर परिपत्रक संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH

MARATHWADA UNIVERSITY, NANDED - 431 606

(**Structure and Syllabus of Two Years PG Program in Zoology**)

TWO YEAR MASTERS PROGRAMME IN SCIENCE

Subject – **Zoology (M.Sc. SY)**

(Affiliated Colleges)

Under the Faculty of
Science and Technology

Effective from Academic year 2024 – 2025
(As per NEP-2020)

Forward by the Dean, Faculty of Science and Technology

From the Desk of the Dean:

To meet the challenge of ensuring excellence in basic science education, the issue of quality needsto be addressed, debated and taken forward in a systematic manner. Faculty of Science and Technology of SRTMU, Nanded has taken a lead in incorporating philosophy of outcome based education in the process of curriculum development.

Faculty of Science and Technology, SRTMU, Nanded is unanimously resolved that, each Board of Studies shall prepare some Program Educational Objectives (PEO's) and give freedom to affiliated colleges to add few (PEO's) and course objectives and course outcomes tobe clearly defined for each course, so that all faculty members in affiliated colleges understand the depth and approach of course to be taught, which will enhance learner's learning process. It was also resolved that, maximum senior faculty from colleges and experts from industry to be involved while preparing the curriculum. I am happy to state that, each Board of studies has adhered to the resolutions passed by Faculty of Science and Technology, and developed curriculum accordingly. In addition to outcome based education, semester based credit and grading system is also introduced to ensure quality of basic science education.

Semester based Credit and Grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhancethe quality of education. SRTMU Nanded has taken a lead in implementing the system through its affiliated colleges, Faculty of Science and Technology has devised a transparent credit assignment policy and adopted ten points scale to grade learner's performance. Credit assignment for courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 3-2 weeks to be utilized for revision, guestlectures, coverage of content beyond syllabus etc.

NEP-2020, Credit and grading based system was implemented for First Year of M.Sc. from the academic year 2023-2024. Subsequently this system will be carried forward for Second Year in the academic year 2024-2025.

Prof. Dr. M. K. Patil
Dean
Faculty of Science and Technology,
Swami Ramanand Teerth Marathwada University, Nanded

From Desk of Chairman, Board of Studies of the Subject Zoology

Preamble:

Education is fundamental for achieving full human potential, developing an equitable and just society, and promoting national development. NEP-2020, New Education Policy lays particular emphasis on the development of the creative potential of each individual. It is based on the principle that education must develop not only cognitive capacities - both the 'foundational capacities 'of literacy and numeracy and 'higher-order' cognitive capacities, such as critical thinking and problem solving – but also social, ethical, and emotional capacities and dispositions.

The basic science education in India in general is expanding in manifolds. Now, the challenge is to ensure its quality to the stakeholders along with the expansion. To meet this challenge, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Program outcomesare essentially a range of skills and knowledge that a student will have at the time of graduation from the program. The basic science program must ensure that its graduates understand the basic concepts of science, and use its methodologies of analyses and design, and have acquired skills for life- long learning.

An all Basic Science program must therefore have a mission statement which is in conformity with program objectives and program outcomes that are expected of the educational process. The outcomes of a program must be measureable and must be assessed regularly through proper feedback for improvement of the programme. The curriculum must be constantly refined and updated to ensure that the defined objectives and outcomes are achieved. Students must be encouraged to comment on the objectives and outcomes and the role played by the individual courses in achieving them.

I, as Chairman, Board of Studies in Zoology, SRTM University, Nanded happy to state here that, Program Educational Objectives were finalized by the help of BOS members Zoology. The Program Educational Objectives finalized for postgraduate program in Zoology are listed below;

- To provide students with a strong foundation in the basic science, scientific and fundamentals necessary to formulate, solve and analyze problems and to prepare them for postgraduate studies.
- To prepare students to demonstrate an ability to identify, formulate and solve basic science problems.
- To prepare students to demonstrate ability to design systems and conduct experiments, analyze and interpret data.

- To prepare students to demonstrate for successful career in industry to meet needs of Indian and multi-national companies.
- To develop the ability among students to synthesize data and technical concepts.
- To provide opportunity for students to work as part of teams on multidisciplinary projects.
- To promote awareness among students for the life-long learning and to introduce them toprofessional ethics and codes of professional practice.

In addition to Program Educational Objectives, for each course of postgraduate program, objectives and expected outcomes from learner's point of view are also included in the curriculum to support the philosophy of outcome based education. I believe strongly that small step taken inright direction will definitely help in providing quality education to the stake holders.

Program Outcomes

The student will be able to :

Acquire the knowledge with facts and figures related to Zoology.

Understand the basic concepts, fundamental principles and the scientific theories related to various scientific phenomenon and their relevancies in the day-to-day life.

Acquire the skills in handling scientific instruments, planning and performing in laboratory experiments.

Develop scientific outlook not only with respect to science subjects but also in all aspects related to life.

Program Specific Outcomes

Acquire basic knowledge of various disciplines of Zoology and General Biology.

Inculcate interest in nature and love of nature.

Understand the rich diversity of organisms and their ecological and evolutionary significance.

Create awareness on the internal harmony of different body systems and the need for maintaining good health through appropriate lifestyle.

Acquire basic knowledge and skills in certain applied branches for self employment.

Impart awareness of the conservation of the biosphere.

Prof. Dr. H. S. Jagtap
Chairman,
Board of Studies in Zoology
Faculty of Science and Technology
Swami Ramanand Teerth Marathwada University, Nanded (MS)
Mob: 9423717670/9834345722
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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. A. M. Mane	Member	Arts, Science & Commerce College, Shankarnagar, Dist. Nanded	9422874110, 9404464462 anilmane531@gmail.com
5	Dr. P. 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. S. S. 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

11	Dr. Ranjitsingh Krishnarao Nimbalkar	Member	Government Institute of Forensic Science, Aurangabad	rknimbalkar@gmail.com 9422345234
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 7987155634
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

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science & Technology

Credit Framework for Two Year PG Program

Subject: Zoology

Year & Level 1	Sem. 2	Major Subject (DSC) 3	 (DSE) 4	RM 5	OJT / FP 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
1	1	**SZOOCT401 (4 Cr)** **SZOOCT402 (4 Cr)** **SZOOCT403 (4 Cr)**	**SZOOET401** **(3 Cr)**	**SZOORM 401** *Research Methodology* **(3 Cr)**	--		**SZOOCP401 (1Cr)** **SZOOCP402 (1Cr)** **SZOOCP403 (1Cr)** **SZOOEP401(1Cr)**	**22**	**44**
	2	**SZOOCT451 (4 Cr)** **SZOOCT452 (4 Cr)** **SZOOCT453 (4 Cr)**	**SZOOET451** **(3 Cr)**	---	**SZOOOJ451 / SZOOFP451/ SZOOCS451** **(3 Cr)**	--	**SZOOCP451 (1Cr)** **SZOOCP452 (1Cr)** **SZOOCP453 (1Cr)** **SZOOEP451(1Cr)**	**22**	
Exit option: Exit Option with PG Diploma *(after 2024-25)*									
2	3	**SZOOCT501 (4 Cr)** **SZOOCT502 (4 Cr)** **SZOOCT503 (3 Cr)**	**SZOOET501 (3 Cr)** ***(From same Department / School)***	--		**Research Project** **SZOOR501 (4Cr)**	**SZOOCP501 (1 Cr)** **SZOOCP502 (1 Cr)** **SZOOCP503(1Cr)** **SZOOEP501(1Cr)**	**22**	**44**
	4	**SZOOCT551 (4 Cr)** **SZOOCT552 (4 Cr)**	**SZOOET551 (3 Cr)** ***(From same Department / School)***	**SZOOPE551** Publication Ethics **(2 Cr)**		**Research Project** **SZOOR551** **(6 Cr)**	**SZOOCP551 (1Cr)** **SZOOCP552 (1Cr)** **SZOOEP551(1Cr)**	**22**	
Total Credits		**43**	**12**	**05**	**03**	**10**	**15**	**88**	

M. Sc. Second Year Zoology Semester III *(Level 6.5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SZOOCT501**	Vertebrates: Structure and Function	04	--	**04**	04	--
	SZOOCT502	Molecular Cell Biology	04	--	**04**	04	--
	SZOOCT503	Applied Zoology (Microbes, Arthropods and Protozoans of Medical Importance)	03	--	**03**	03	--
Elective (DSE)	**SZOOET501 (A) Or SZOOET501 (B) Or SZOOET501 (C) Or SZOOET501 (D)**	Applied Parasitology – I (A) (Trematodes and Cestodes) **Or** Fishery Science – I (B) (Fish Morphology, Anatomy & Physiology) **Or** Entomology - I (C) – (Insect, Taxonomy, Development and Ecology) **Or** Animal Physiology- I (D)	03	--	**03**	03	--
Research Methodology	**SZOORP501**	Research Project	--	04	**04**		08
DSC Practical	**SZOOCP501**	LC (Based on theory paper SZOOCT501)	--	01	**01**	--	02
	SZOOCP502	LC (Based on theory paper SZOOCT502)	--	01	**01**	--	02
	SZOOCP503	LC (Based on theory paper SZOOCT503)	--	01	**01**	--	02
DSE Practical	**SZOOEP501A/B/C/D**	LC (Based on elective theory paper SZOOET501A/B/C/D)	--	01	**01**	--	02
Total Credits/Hours			**14**	**08**	**22**	**14**	**16**

M. Sc. Second Year Zoology Semester III *(Level 6.5)*

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	**SZOOCT501**	Vertebrates: Structure and Function	20	20	20	80	--	--	100
	SZOOCT502	Molecular Cell Biology	20	20	20	80	--	--	100
	SZOOCT503	Applied Zoology (Microbes, Arthropods and Protozoans of Medical Importance)	15	15	15	60	--	--	75
Elective (DSE)	**SZOOET501 (A) Or SZOOET501 (B) Or SZOOET501 (C) Or SZOOE501 (D)**	Applied Parasitology – I (A) (Trematodes and Cestodes) **Or** Fishery Science – I (B) (Fish Morphology, Anatomy & Physiology) **Or** Entomology - I (C)- (Insect, Taxonomy, Development and Ecology) **Or** Animal Physiology- I (D)	15	15	15	60	--	--	75
Research Methodology	**SZOORP501**	Research Project					20	80	100
DSC Practical	**SZOOCP501**	LC (Based on theory paper SZOOCT501)	--	--	--	--	05	20	25
	SZOOCP502	LC (Based on theory paper SZOOCT502)	--	--	--	--	05	20	25
	SZOOCP503	LC (Based on theory paper SZOOCT503)	--	--	--	--	05	20	25
DSE Practical	**SZOOEP501A/B/C/D**	LC (Based on elective theory paper SZOOET501A/B/C/D)	--	--	--	--	05	20	25

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

M. Sc. Second Year Zoology Semester IV *(Level 6.5)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SZOOCT551**	Mammalian Endocrinology	04	--	**04**	04	--
	SZOOCT552	Genetics and Genetic Engineering	04	--	**04**	04	--
Elective (DSE)	**SZOOET551 (A) Or SZOOET551 (B) Or SZOOET551 (C) Or SZOOET551 (D)**	Applied Parasitology – II (A) – (Animal Nematodes and Plant Nematodes) **Or** Fishery Science – II (B) (Fisheries and Fish Culture) **Or** Entomology - II (C)- (Economic, Agricultural Entomology and Pest Management) **Or** Animal Physiology- II (D)	03	--	**03**	03	--
	SZOOPE551	Publication Ethics	02	--	**02**	02	
Research project	**SZOORP551**	Research Project		06	**06**		12
DSC Practical	**SZOOCP551**	LC (Based on theory paper SZOOCT551)	--	01	**01**	--	02
	SZOOCP552	LC (Based on theory paper SZOOCT552)	--	01	**01**	--	02
DSE Practical	**SZOOEP551A/B/C/D**	LC (Based on elective theory paper SZOOET551A/B/C/D)	--	01	**01**	--	02
Total Credits			**13**	**09**	**22**	**13**	**18**

M. Sc. Second Year Zoology Semester IV *(Level 6.5)*

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	**SZOOCT551**	Mammalian Endocrinology	20	20	20	80	--	--	100
	SZOOCT552	Genetics and Genetic Engineering	20	20	20	80	--	--	100
Elective (DSE) (*Students should opt for same specialization, as chosen in Semester III*)	**SZOOET551 (A) Or SZOOET551 (B) Or SZOOET551 (C) Or SZOOET551 (D)**	Applied Parasitology – II (A) - (Animal Nematodes and Plant Nematodes) **Or** Fishery Science – II (B) (Fisheries and Fish Culture) **Or** Entomology - II (C)- (Economic, Agricultural Entomology and Pest Management) **Or** Animal Physiology- II (D)	15	15	15	60	--	--	75
	SZOOPE551	Publication Ethics	10	10	10	40	--	--	50
Research project	**SZOORP551**	Research Project					30	120	150
DSC Practical	**SZOOCP551**	LC (Based on theory paper SZOOCT551)	--	--	--	--	05	20	25
	SZOOCP552	LC (Based on theory paper SZOOCT552)	--	--	--	--	05	20	25
DSE Practical	**SZOOEP551A/B/C/D**	LC (Based on elective theory paper SZOOET551A/B/C/D)	--	--	--	--	05	20	25

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

M.Sc. SY (Semester-III)

SZOOCT501 : Vertebrates - Structure and Function

Periods : 60 **No. of Credits: 04 (Marks: 100)**

Course pre-requisite:

Require basic knowledge about vertebrate and species identification of vertebrates

Course objectives:

1. To study the broad taxonomy of vertebrates.
2. To study comparative anatomy of different vertebrate groups.
3. To learn about integumentary and skeletal systems of vertebrates.
4. To understand functional mechanisms of different systems of vertebrates.
5. To study about the structural and functional aspects of different systems of vertebrates.

Course outcomes:

1. Able to explain the broad classification of vertebrates based on features.
2. Describe relation between organ systems in different vertebrate groups.
3. Explain the significance of integument and skeletal systems of vertebrates.
4. Compare the structural and functional morphology of vertebrates.

SZOOCT501 : Vertebrates - Structure and Function

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	General introduction to Chordates- General Characters, origin and ancestry.	
	1.2	Protochordates- General characters and affinities of Protochordates. Vertebrates: General characters and origin of Vertebrata,	
	1.3	Theories of origin of vertebrates.	
	1.4	Classification of vertebrates upto Class level.	
2.0			**15**
	2.1	Vertebrate integument and its derivatives; Development, general structure and function of integument and its derivatives-	
	2.2	Glands, scales, horns, claws, nails, hooves, feathers and hairs	
	2.3	General plan of circulation in various Groups Blood- Composition and function Evolution of heart Comparative anatomy of heart.	
	2.4	Evolution of aortic arches Blood circulation in various vertebrate groups: Single circulation and Double Circulation.	
3.0			**15**
	3.1	Respiratory system:Types of respiratory organs Internal and external respiration	
	3.2	Comparative account of respiratory organs.	
	3.3	Skeletal system:Comparative account of jaw suspensorium, vertebral column and skull.	
	3.4	Comparative account of limbs and girdles.	
4.0			**15**
	4.1	Urinogential system: Evolution of kidney and gonads in vertebrates. Comparative anatomy of Vertebrate kidney and their ducts. Comparative anatomy of Vertebrate gonads and their ducts	
	4.2	Nervous system ;Comparative anatomy of the Brain and spinal cord, Central nervous system.	
	4.3	Peripheral and autonomic nervous system. Structure and function of sense organs Chemoreceptors- Olfactory organs.	
	4.4	Photoreceptors- Eyes. Phonoreceptors- Ears.	
		Total	**60**

Text Books

1. Sedgwick, A.A., students Text Book of Zoology, Vol.II
2. R. L. Kotpal, Modern text Book of Zoology vertebrates, Rastogi publications Meerut 10th revised edition.

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Boume, G.H., The Structure and functions of nervious tissue academic Press, New York.
3. Carter, G.S., Structure and habit in vertebrate evolution, Sedgwick and Jackson, London.
4. Eecles, J.C., The understanding of the brain, McGraw Hill CO., New York and London.
5. Kent, C.G., Comparative anatom of vertebrates.
6. Malcom Jollie, Chordata morphology, East-West press Ltd., New Delhi.
7. Milton Hilderbrand, Analysis of vertebratestructure-IV, Ed. Johan Wily and Sons Ine., New York.
8. Smith, H.S., Evolution of chordara structure, Hold Rinehart and Winstoin Inc, New York.
9. Torrey, T.W., Morphogenesis of erthates, John Wiley & Sons Inc., New York.
10. Walters, H.E. and Sayles, L.D., Ecology of vertebrates, Machillan and Co., New York.
11. Eolstenhoint, E.W. and Knight J. (Ed), Taste and smell in vertebrates, J & A, Churchill, London.
12. Romer, A.S., Vertebrate Body, IInd Edition, W.B. Saunders Co., Philadelphia.
13. Young, J.Z., Life of mammals, Oxford University press, London.
14. Colbert, E.H., Evolution of the vertebrates, Johan Wiley and Sons Inc., New York.

M.Sc. SY (Semester – III)

SZOOCT502 : Molecular Cell Biology

Periods : 60 **No. of Credits: 04 (Marks: 100)**

Course pre-requisite:

Needs knowledge about cell biology and molecular biology.

Course objectives:

1. To acquire contemporary knowledge and understanding of molecular biology.
2. To study distinctions between structure and functions of prokaryotes and eukaryotes.
3. To understand role of cell communication in their function and carcinogenesis.
4. To learn about latest in gene and genome structure, functions and organization.

Course outcomes:

1. Elaborate about contemporary developments in the field of molecular biology.
2. Explain the differences between prokaryotes and eukaryotes.
3. Describe the processes of cell communication and carcinogenesis.
4. Learn about latest in gene and genome structure, functions and organization.

SZOOCT502 : Molecular Cell Biology : Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	**Introduction to Molecular Biology** Structure of Prokaryotic and Eukaryotic cells, Plasma membrane (Prokaryote and Eukaryote)- Structure and composition, Fluid Mosaic Model, Functions of cell membrane- Active and Passive Transport.	
	1.2	Intracellular compartments, protein sorting- secretary and endocytic pathways. Cytoskeleton : Microtubule- structure and composition, Microtubule-associated proteins (MAPs),	
	1.3	Microtubule Organizing Centers (MTOCs), Functions of microtubules. Intermediate Filaments- Types and Functions, Microfilaments- Myosin, Actin.	
	1.4	Nucleus, structure and functions, structure and rganization of chromatin. Cell cycle- Phases, control of cell cycle.	
2.0			**15**
	2.1	**Structure of gene and nature of genome** Fine structure of gene- eukaryotic genome organization (coding and non-coding sequences, satellite DNA)	
	2.2	DNA damage and repair, DNA amplification.	
	2.3	Replication of DNA.	
	2.4	Regulation of gene expression in eukaryotes, Attenuation and anti-termination.	
3.0			**15**
	3.1	**Organization of transcriptional units** Mechanism of transcription in prokaryotes and eukaryotic	
	3.2	RNA processing- capping, polyadenylation, splicing, introns and exons.	
	3.3	Ribonucleoproteins, structure of mRNA in prokaryotes and eukaryotic. Genetic code & Protein synthesis	
	3.4	Operon concept; DNA modification- DNA methylation, Heterochromatization. Transposition-Mobile genetic elements.	
4.0			**15**
	4.1	**Biochemistry and molecular biology of cancer** Definition, Types, Characteristics of cancer; Mechanism of carcinogenesis. Oncogenes, chemical carcinogenesis, genetic disorders.	
	4.2	Hormonal imbalances; Drug metabolism and detoxification. Signal Transduction- Extra cellular messengers, coupled receptors. Second messengers and their role in signal transduction	
	4.3	Cyclic Adenosine Monophosphate (cAMP). Cyclic Adenosine Diphosphate (cGMP). Di-Acyl Glycerol (DAG); Inositol Triphosphate (IP3). Calcium (Ca2+)	
	4.4	Signaling by insulin receptor. Role of (Nitric Oxide) NO and Carbon Monoxide (CO) as cellular messengers. Apoptosis (Programmed cell death).	
		Total	**60**

Text Books

1. Text Book-Cell Biology.-Dr.S.S.Nanware, Dr.D.B.Bhure & M.U.Barshe 2015 Aruna Prakashan Latur, M.S. ISBN: 978-93-5240-012-6,Publication12th June, 2015

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Molecular Biology of the Cell - Bruce Alberts, Dennis Bray, Julian Lewis, Martin Raff, Keith Roberts and James D. Watson, Garland Publishing Inc.,New York, London, 4th Ed. 2002.
3. Molecular Biology of the Gene – James D. Watson, Lania A. Raker, Stephen P. Bell, Alexander Gann, Michael evine and Richard Logic, Pearson Education, 5th Ed. 2004.
4. Molecular Cell Biology – Harvey Lodish, Arnold Berk, Paul Mastudaria, Chris A. Kaiser, Monty Krieger, Mathew P. Scott, S. Lawrence Zipursky and James Darnell, W.H. Freeman & Company, New York, 5th Ed 2004.
5. Genes IX – Benjamin Lewin, Oxford University Press, 2008.
6. Cell Molecular Biology – Gerald Karp, 5th Ed., John Wiley and Sons Inc., 2008.
7. Cell and Molecular Biology – DeRobertes
8. Cell Biology – David E. Sadava, Jones and Bartlett Publishers, London, 1993.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)

M. Sc. SY (Semester-III)

SZOOCT503 : Applied Zoology –Microbes, Arthropods and Protozoans of Medical Importance

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

Course pre-requisite:

The students know about basic knowledge of uses of animals.

Course objectives:

1. To introduce students to the basic concepts of Applied Zoology.
2. To provide a broad-based knowledge and understanding of Parasitology with special emphasis on Microbes, Arthropods and Protozoans of medical importance.
3. To describe the basics of microbes, arthropods and Protozoans of public health importance.
4. To identify vector-host-pathogen relationships.
5. To understand the morphology, life cycle, pathogenicity and control measures of important microbes, arthropods and Protozoans.
6. To understand and apply the principles of controlling diseases caused by microbes, arthropods and Protozoans

Course outcomes:

1. Students are able to identify Microbes, Arthropods and Protozoans of medical importance.
2. Students can describe basics of microbes and arthropods of public health importance.
3. Students will be able to understand and apply the principles of controlling diseases caused by microbes, arthropods and Protozoans.
4. Students will be able to elucidate the Vector-Host-Parasites relationship.
5. Students will be able to understand the basic components of the immune system and its role to protect the host against pathogens.

SZOOCT503 : Applied Zoology – Microbes, Arthropods and Protozoans of Medical Importance

Curriculum Details:

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	**Microbes of Medical Importance** Brief Introduction to medically important parasitic microbes.	
	1.2	Study of pathogen microbes with reference to the following diseases: (Emphasis be given to causative organism, pathogenesis, symptoms, transmission, prevention and control)- Typhoid fever (Salmonella typhi), Dengue fever (Dengue virus), Plague, AIDS (HIV), Hepatitis (Hepatitis A & B viruses), Leprosy (Mycobacterium leprea), Cholera (Vibrio cholerae)	
	1.3	Viral respiratory diseases (brief overview)- COVID-19; influenza, SARS, MERS	
	1.4	Human defense mechanism, Antigen and Antibody reactions and its role in clinical parasitology Basic Principles of immunity in relation to stem cells, T and B cells	
2.0			**11**
	2.1	**Arthropods of Medical Importance** General Account of Arthropods of medical importance. Systematic Position, Geographical Distribution, Morphology, Life Cycle, diseases and Control Measures of- Acarina- Ticks & Mites Parasitic Hemiptera - Bed Bug *(Cimex lacturalis)*	
	2.2	Morphology, pathogenecity and Control Measures of- Siphonaptera; Anopleura' Mallophaga	
	2.3	Morphology, pathogenecity and Control Measures of- Siphonaptera; Anopleura;Mallophaga	
	2.4	Generalized account of Mosquitoes (Anopheline, Culex, Ades); Mosquito borne diseases- Their pathogenesis, diagnosis, treatment and control; Control of mosquitoes. 1. Chemical and Biological Control of Insects.	
3.0			**11**
	3.1	**Protozoans of Medical Importance-I** **Introduction to Parasitology**: Brief introduction to Parasitology, its scope and branches; Animal associations- Symbiosis, Commensalism, Phoresis and Parasitism; Host parasite relationship.; Types of Parasites; Types of hosts- Definitive and intermediate, primary secondary specific host, Paratenic, Carrier, Susceptible, Resistant, Accidental,	

		Vectors etc.	
	3.2	**Parasitic Protozoa:** Classification of protozoa as proposed by Levine et al, 1980.	
	3.3	Methods of feeding, digestion, nutritional requirements and culture of parasitic protozoa. Locomotion in Protozoa.	
	3.4	Growth and methods of multiplication in the protozoan parasites. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- Sarcodine amoeba *(Entamoeba histolytica*, *Entamoeba coli*) Opalinids *(Opalina* spp).	
4.0			**11**
	4.1	**Protozoans of Medical Importance-II** Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- Sporozoan *(Toxoplasma* spp, *Plasmodium vivax*, *Sarcocystis cruzei*)	
	4.2	Ciliates (*Balantidium coli*, *Nyctotherus* spp and *Ichthyopthirius* spp)	
	4.3	Haemoflagellates *(Trypanosoma gambiense; Trypanosoma cruzi* and *Leishmania donovanii*)	
	4.4	Intestinal Flagellates *(Giardia lamblia, Trichomonas vaginalis* and *Trichomonas foetus*)	
		Total	**45**

Text Books

1. K.P. Srivastava A Text Book of Applied Entomology Vol.1, Kalyani Publishers New Delhi.
2. Text book of medical parasitology by Sawitz

Reference Books

3. Online resources like academic, research databases etc are recommended.
4. R.K. Nayr, T.N. Ananthakrishnan; B.V. David General & Applied Entomology Tata McGraw Hill, Publishers.
5. Askew R.R. Parsitic insects Londan, Heinemam Education Book.
6. Pedigo Larry P. Entomology & Pest Management; America, Prentice Hall upper Saddle river, 1996.
7. An Introduction to Protozoology by Dogiel
8. Chemical Zoology Vol I by Florkin and Sheer
9. Protozoology by Grell
10. Protozoology by Hall
11. The Coccidia by Hammond and Long
12. Parasitic Protozoa Vol, I-II by Krier et al
13. Protozoology by Kudo
14. An Introduction to Prozoan Parasities of domestic animals and man by Levine

15. An Introduction to Protozoa by Manwell
16. Essential Parasitology by Scmidt
17. Biology of Protozoa by Sleigh
18. Parasitism by Cameron
19. Animal Parasitism by Read
20. Medical Parasitology N.C. Dey, T.K. Dey, ALLIED AGENCY 36, Dr. Sundari Mohan Avenue Calcutta-7000014.
21. Medial Parasitology by K.D. Chatterjee
22. Parasitology by G.D. Smith
23. Parasitoogy by Coble Raymand, Bombay Allied Pacific Pvt. Ltd.
24. Parasitology The Biology of Animal Parasites by Nofel E.R., Philadelophia, Lea & Febiger.
25. Parasitic protozoa by Baker J.R. London, Hutchinson U'ty, Library.
26. Parasites & Parasitism by Chameron Thanas W.A.M. Londan, the English Language Book Society.
27. Medical Parasitology by Markell, Voge and John 8th ed. W.B. Saunders Co.
28. Parasitology by Nobel and Nobel

M.Sc. SY (Semester-III)

SZOOET501 (A) : Applied Parasitology – I (A) (Trematodes and Cestodes)

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

Course pre-requisite:

A minimum background in parasites of human and other animals.

Course objectives:

1. To provide students with knowledge about biological, epidemiological and ecological aspects of parasites of veterinary and medical importance.
1. To enable students to understand the pathogenesis, symptoms and complications of Trematode and Cestode parasites.
2. To enable students to reach a diagnosis and know the general outline of treatment, prevention and control of helmith infections.
3. To understand and apply the principles of controlling diseases caused by Trematode and Cestodes.
4. To provide students with adequate knowledge about endemic parasites and national parasitic problems, as well as, reemerging parasitic infections.
5. To introduce basic concepts of immunity and understanding the role of immunity in animal and human well being.

Course outcomes:

1. Students will understand morphology, life cycle and pathogenesis of Trematode and Cestode infections.
1. Students will be able to identify clinical signs and suggest preventive measure in parasitic infections.
2. Students will understand structure and working of immunity system and appreciate its role in resistance to parasitic infections.
3. Students will have the knowledge of endemic and national parasitic problems.

SZOOET501 (A) : Applied Parasitology – I (A) (Trematodes and Cestodes):Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	General organization of Trematodes and its classification upto family level.	
	1.2	General organization of Monogenea, Aspidobothria and Digenea. Ultra structure and functions of Tegument.	
	1.3	Functional anatomy of Male and Female reproductive system in Digenea.	
	1.4	Biology of Egg, Egg Shell formation, Chemistry of egg shell formation, factors influencing embryonation and hatching in Trematodes. General metabolism of helminthes.	
2.0			**11**
	2.1	Parasitism and parasitic adaptations in helminths. Larval forms in Trematodes.	
	2.2	Immunology- Basic concept, Antigen Antibody reaction, Innate and Acquired immunity.	
	2.3	Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- *Fasciolopsis buski; Schistosoma japonicum* *Schistosoma mansoni*	
	2.4	*Clonorchis sinensis; Paragonimus wetermani.*	
3.0			**11**
	3.1	General organization of cestodes and its classification up to order level. Structural organization of cestodarians.	
	3.2	General important features of the following orders: Proteocephalidea; Tetraphyllidea	
	3.3	Davaineidea ; Hymenolepidea	
	3.4	Hold fast organs in Cestodes. Modification of uterus in Cestodes.	
4.0			**11**
	4.1	Larval forms in Cestodes. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- Taenia solium ; Taenia saginata Echinococcus granulosus	
	4.2	Diphyllobothrium latum ; Hymenolepis nana Dipylidium caninum	
	4.3	Factors influencing parasitism- influence of season and other phenological factors on parasitic population (prevalence, intensity of infection).	
	4.4	Helminthes of livestock with emphasis on *Fasciola hepatica* and *Moniezia* spp. General organization in Acanthocephala.	
		Total	**45**

Text Books

1. Handbook of Medical Parasitology- V. Zaman & L.H.Keong (K.C. Ang Publishing Pvt. Ltd., 1989).
2. T.B. Medical parasitology – P. Chakraborty (New Central Book Agency, 2004).
3. A.T.B. **of** Parasitology 2nd Ed.- S.S.Kelkar & R.S.Kelkar (Bombay Popular Prakshan, 1993).
4. T.B.Fish Diseases- (Tr.)- D.A. Convoy & R.L. Herman (Narendra Publg. House, 1997).

Reference Books

5. Online resources like academic, research databases etc are recommended.
6. Animal parasitology – J. D. Smyth (Cambridge Univ. Press., 1976).
7. Foundations of Parasitology 6th Ed.- L.S.Roberts & J.Janovy Jr (McGraw Hill Publ., 2000).
8. Parasitism- A. O. Bush, J.C. Fernandez & J. R. Seed (Cambridge Univ. Press, 2000).
9. Helminthology- Eds. N. Chaudhury & I. Tada (Narosa Publg. House, 1994).
10. Helminthes, Arthropods, & Protozoa of domesticated animals 6th Ed.- EJL Soulsby (ELBS,1976).
11. Introduction to parasitology- B.E. Matthews (Cambridge Univ. Press. 1998).
12. The physiology of Trematodes- JD. Smyth & D.W. Halton (Cambridge Univ. Press, 1983).
13. The physiology and Biochemistry of Cestodes – J.D. Smyth & D.P. MEmanus, (Cambridge Univ.Press, 1989).
14. Ecological Animal Parasitology – C. R. Kennedy (Black well Scientific Publ., 1975).
15. Infectious Diseases of fish – S. Egusa (Oxonian Pvt. Ltd., New Delhi, 1978).
16. An Introduction to Parasitology– By chandler
17. General Parasitology– By Cheng T. C.
18. Biology of Parasites– By Cheng
19. Systema Helminthum– By S. Yamaguti
20. Biology of Animal parasites– By Saunders.
21. Clinical Parasitology– By Faust
22. Medical Helminthology– By Watson
23. Parasitology – By K. D. Chatterjee
24. Medical Parasitology– By N. C. Dey, T. K. Dey.

M.Sc. SY (Semester-III)

SZOOET501(B) : Fishery Science – I (B) Fish Morphology, Anatomy and Physiology

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

Course pre-requisite:

Basic knowledge about fish classification, biology.

Course objectives:

1. To understand the structure of and relation between different groups of fish.
2. To acquire skill to identify and broadly classify fish.
3. To learn and understand the feeding and digestive mechanisms in fish.
4. To appreciate the respiratory mechanisms in different groups of fish.
5. To understand the significance of biological rhythms in fish growth.

Course outcomes:

1. Explain the inter-relation between different groups of fish.
2. Be able to identify and broadly classify fish.
3. Appreciate the relation between environment and feeding and digestion in fish.
4. Describe the respiratory mechanisms in different groups of fish.
5. Explain the significance of biological rhythms in fish growth and reproduction.

SZOOET501(B) : Fishery Science – I (B) Fish Morphology, Anatomy and Physiology : Curriculum Details:

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Scope and Significance of Fishery Science. Classification of fishes. General characters of Elasmobranchii,	
	1.2	Teleostomi- Actinopterygii, Crossopterygii.	
	1.3	Integument and Exoskeleton- Fish skin and functions, Exoskeleton- Types of scales. Colouration in fishes- Chromatophores, Biological Significance of colouration	
	1.4	Food, feeding habits and digestion- Feeding habit of Teleosts, Alimentary canal and its modification, Physiology of digestion.	
2.0			**11**
	2.1	Respiration- Organs of respiration in fishes, Types and structure of gills, Accessory respiratory organs.	
	2.2	Excretion and Osmoregulation - In freshwater fish, In marine fish.	
	2.3	Nervous System- Structure and function of Brain,	
	2.4	Lateral Line Canal System.	
3.0			**11**
	3.1	Reproduction- Organs of reproduction, Maturation and spawning, Seasonal changes in gonads, Fecundity & Spawning periodicity. Parental Care in Fishes.	
	3.2	Migration of Fishes- Types of migration, Patterns of migration, Causes of migration,	
	3.3	Advantages of migration, Factors influencing migration.	
	3.4	Age and growth in Fishes- Methods of determining age & growth- Tagging, marking, scale & otolith method, Factors influencing growth of fish.	
4.0			**11**
	4.1	Swim bladder and its modifications- Structure of the swim bladder, Structural modifications, Function of the swim bladder.	
	4.2	Endocrine glands- Pituitary gland : Structure and functions of Pituitary gland, role of pituitary gland in reporoduction.	
	4.3	Thyroid gland: Structure and functions	
	4.4	Adrenal gland: Structure and functions of Adrenal gland.	
		Total	**45**

Text Books

1. A Text Book of Fishery Science in India - C. B. L. Srivastava
2. Huet M. 1972 Text Book of Fish culture Breeding and cultivation of fish fishing New (Books) Ltd. Surrey England.
3. A Text Book of Fish Biology and Fisheries - by S.S. Khanna and H.R. Singh.

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Fish and fisheries of India - V. J. Jhingran.
3. A manual of freshwater fish culture - R. Santharmma N. Sakuran and Natrajan.
4. An Introduction to Indian Fisheries. - Sharma and Grover
5. Introduction of Fishes by - S. S. Khanna
6. Bal D.V. and Rao K.V. 1989 - Marine Fisheries
7. Hand Book Breeding of Indian Major carps by Chondar S.Z.
8. Jayaram K.C. 1978 Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Srilanka - Hand Book Zoological Survey of India Calcutta.
9. C.V. and Sebastian V.O. 1986 Prawns and Fisheries of India Hindustan Publishing Corp, Delhi.
10. Moyle P.B. and Cech. J.J. Jr 1988 - Fishes an Introduction to Ichthyology - Prentice all, Englewood cliffs N.J.
11. Norman J.R. 1975 A History of Fishes Third Edn by PH.
12. Balkrishnan N.N. and Thampy D.M. 1980 A Text Book of Marine Ecology, Macmillan India.
13. Anatomy and Physiology of Fishes - by Santosh Kumar and Manju Tembhre
14. Practical Manual on Fish Biology by Ashok Kumar, Jaiswal, S.K. Chakraverthy, CIFE Publication.
15. An Introduction to Fishes - by S.S. Khanna.
16. Ichthyology - by Lagler
17. Behaviour and Physiology of Fish- Sloman, K. A., Wilson, R. W., & Balshine, S. (2005). (1st Ed., Vol. 24). Academic Press.

M.Sc. SY (Semester-III)

SZOOET501(C) : Entomology – I (C)

Insect, Taxonomy, Development and Ecology

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

Course pre-requisite:

Basic knowledge about insect classification, biology etc.

Course objectives :

1. To understand anatomy and morphology of head and mouth parts of insects.
2. To learn about thorax and its parts in insects.
3. To explore the structure and functions of digestive, circulatory and excretory systems.
4. To study the structure and working of the respiratory, nervous and reproductive systems.
5. To learn techniques of collection & processing of insect specimens.

Course outcomes :

1. To describe the anatomy & morphology of head and mouth parts of insects.
2. To explain the structure of thorax & appendages and their functions in insects.
3. To represent the structure and functions of digestive, circulatory and excretory systems.
4. To elaborate about structure & working of respiratory, nervous & reproductive systems.
5. To explain the structure of thorax & appendages and their functions in insects.
6. Ability to collect & process insect specimens.
7. Explain the detailed classification of insects.
8. Describe types of development and its stages in insects.
9. Explain the ecology and social organization of insects.

ZOOET501(C):Entomology–I(C):Insect,Taxonomy,Development and Ecology : Curriculum Details:

IoduleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Insect: General morphology and exoskeleton in insect.	
	1.2	Collection, Preservation, curation and study of insects (Classification, taxonomic procedures, newer trends in insect taxonomy).	
	1.3	Classification of Apterygote insects : Thysanura	
	1.4	Pterygota : Exopterygota groups : (diagnostic characters and examples); Order : Odonata; Order : Isoptera Endopterygota groups : (diagnostic characters and examples); order : Lepiodeptera; Order : Coleoptera	
2.0			**11**
	2.1	The Head – Segmentation, exo and endoskeleton; Head appendages.	
	2.2	Different types of mouth parts : the Biting and Chewing – Cockroach, Piercing and Sucking mouth parts – Mosquito, Siphoning mouth parts- Butterfly . The thorax : structure, exo and endo skeleton	
	2.3	Wings : structure, modification, halters , wing venation and coupling apparatus.	
	2.4	The legs: general structure, types of legs, modification for locomotion on land and in water. Abdomen : structure, external genitalia of male and female insects.	
3.0			**11**
	3.1	The digestive system: the alimentary canal: its morphology, histology and modification; digestive glands and enzymes, microfauna, digestion of organic compounds, keratin and wax.	
	3.2	Nervous system and nerve co-ordination: Brain, ganglia, nerve cord and nervous integration.	
	3.3	Respiratory system and respiration: tracheal system; spiracles, trachea, tracheoles and air sacs; respiration in aquatic insects and endo-parasitic insects: mechanism of ventilation.	
	3.4	Excretory system and osmoregulation: structure of Malpighian tubules; nitrogenous excretion; water and ionic regulation. Reproductive system and reproduction: Reproductive organs of male and female in Honey bee.	
4.0			**11**
	4.1	Food as a limiting factor for distribution and abundance. Insect galls- formation structure and ecology.	
	4.2	Spermatogenesis and oogenesis; structure of insect eggs. Cleavage and early development.	
	4.3	Post embryonic development and metamorphosis, types of metamorphosis, significance of metamorphosis, endocrinal control of metamorphosis.	
	4.4	Insect Ecology- Effect of temperature and humidity on insect life; Diapause.	
		Total	**45**

Books

1. Hemsingh Pruthi : A Textbook of Agricultural Entomology.
2. M. S. Mani : A text book of General Entomology.
3. R.G.Davies; Imms : Text book of Entomology.
4. Shrivastave K.P.Vol (I-H) : A text book of applied Entomology.
5. Ross, H. A. : Text book of Entomology.

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. K. K. Nayar, T. Anant Krishnan and B.W. David : General and Applied Entomology.
3. G. L. Metcalf and W. P. Fling : Destructive and useful inset.
4. Wigglesworth : Principles of insect physiology.
5. ESSIG : College entomology.
6. Government of Maharashtra publ : Crop pests and how to fight them.
7. Oldroyd : Collection, Preserving and Studying insects.
8. Roger P. and Anderson : Forest and shade tree entomology.
9. D. B. Tembhare : Modem Entomology.
10. RE. Fradt : Fundamentals of applied entomology.
11. K.G.V. Smith : Insects and other Arthropods of Medical importance.
12. D.N. ray and A.W.A. Brown : Entomology medical& veterinary.
13. Chandler. A.C. and Read C.P. : Introduction to Parasitology.
14. R. Debatch : Biological control of natural Enemies.
15. Apple J.L. and Smith R.F. : Integrated pest management.
16. Cheny : General Parasitology.
17. Corbet J.R. : The biochemical mode of action Pesticides.
18. Champman RF : Insects-structure and function O.W. Richards .
19. BursellE : An introduction to insect physiology.
20. Rockstein M. Vol. (1-VI) : The physiology of Insects.
21. Johanson O. A. : Embryology of insects & Myriopods.
22. Roddick : Insect physiology.

M.Sc. SY (Semester-III)

SZOOET501(D) : Animal Physiology- I (D)

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

Course pre-requisite:

Basic knowledge about animal physiology.

Course objectives:

1. To understand significance and mechanism of homeostasis in animals.
2. To learn about neuron structure and function.
3. To study respiratory aspects of high altitude and diving.
4. To realize the importance of physiology of physical exercise and Yoga.

Course outcomes:

1) To describe the different mechanisms of homeostasis in animals.
2) To elaborate about and relate the structure and functions of neurons.
3) To explain respiratory functions under conditions of high altitude and under water.
4) To explain the relation between physiology of body with physical exercise and Yoga.
5) Ability to distinguish between prokaryotes and eukaryotes.
6) Trace relation between different aspects of metabolism.
7) Knowledge of different types of enzymes, their properties, functions and interactions.
8) An appreciation of energy pathways, intermediaries and dynamics in cells.

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SZOOET501(D) : Animal Physiology- I (D): Curriculum Details:

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	**Homeostasis; Thermo-regulation and Nerve Physiology:** 1. Definition, concept, Characteristics of homeostasis. 2. Physiology of homeostatic mechanism: Factors destabilizing homeostasis mechanism (Fever and Diabetes mellitus).	
	1.2	3. Temperature compensation in Poikilotherms & Homeotherms and their regulatory mechanism. 4. Types and structure of neurons; Glial cells; Functional properties of the nerve fiber.	
	1.3	5. Physiology of modulated and non modulated transmission of nerve impulse, Action potential. 6. Ultrastructure of synapse and synaptic transmission.	
	1.4	7. Biosynthesis, storage and release of neurotransmitter – Acetylcholine, Acetylcholinesterase. 8. The reflex action and the reflex arc.; Properties and types of reflexes.	
2.0			**11**
	2.1	**a) Physiology of High Altitude** 1. Effects of high altitude on humans; Acclimatization to high altitude. 2. Physiological disorders at high altitude- Dyspnoea and Asphyxia; Physiological polycythemia.	
	2.2	3. Underwater Physiology- Introduction, effects of gases on body 4. Underwater Respiration, SCUBA Diving.	
	2.3	**b) Work Physiology** 1. Types of exercise- Severe and Moderate Exercise 2. Circulatory and cardiovascular changes; Blood pressure during muscular exercise	
	2.4	3. Respiratory and Endocrine response to exercise; Muscle Fatigue. 4. Meditation, Yoga and their benefits.	
3.0			**11**
	3.1	**a) Nature of Prokaryotic and Eukaryotic cells** 1. Origin, structure, organization and composition of Prokaryotic cells and Eukaryotic cells.	
	3.2	2. Permeability of plasma membrane to water; Methods of studying permeability of cell membrane. 3. Osmosis, Osmotic pressure and solute requirements of living tissues.	
	3.3	**b) Metabolism** 1. Energy Metabolism. 2. Methods for determination of energy output. 3. Respiratory Quotient (R. Q.)	

	3.4	4. Basal Metabolism – Factors affecting B.M.R. 5. Mineral Metabolism – Calcium, Phosphorous and Sodium.	
4.0			**11**
	4.1	**a) Enzymology** 1. Units of enzyme activity; Co-enzymes and cofactors; energy of activation, enzyme specificity. 2. Enzyme kinetics: Michaelis-Menten Equation and Lineweaver-Burk equation. Factors affecting enzyme reaction.	
	4.2	3. Enzyme inhibition, enzyme isoforms – structural basis and functional significance, LDH, hexokinase. 4. Application of enzymes: Clinical, industrial, therapeutic, enzymes in recombinant DNA technology.	
	4.3	**b) Bioenergetics** 1. Redox potential, free energy and free energy change, high energy compounds. 2. Electron transport chain.	
	4.4	3. Oxidative phosphorylation: Sites, Energetics and Mechanism of Oxidative phosphorylation; Inhibitors of Oxidative phosphorylation. 4. Enzymes involved in Biological Oxidation.	
		Total	**45**

Text Books

1. Bell & Davidson, Text Book of Physiology and Biochemistry.
2. Mitchell P.H., Text Book of General Physiology.
3. Smith, Patterson, Text Book of Physiology (ELBS) Read & Scratched (1988) 11th Ed.

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Bolander F. F., Molecular Endocrinology.
3. Cole S.W., The Practical Physiological Chemistry.
4. Eckert, Marsall, Animal Physiology Mechanism and Adaptations.
5. Eckert & Ranadak, Animal Physiology (CBS), 2nd Ed. (1978).
6. Garden M.S., Animal Physiology, Principal and Adaptations.
7. Hill R.W., Comparative Physiology of Animals.
8. Hoar W.S., General and Comparative Physiology.
9. Houssay, Human Physiology, McGraw Hill Books Company.
10. Hunter & Bornford, Hutchinson's Clinical Methods.
11. Heil E. Joets N., Physiology, Oxford University Press (1982).
12. Chatterjee C.C., Human Physiology, Vol. 1 & 2.
13. Mill Peter J., Comparative Neurobiology (Ed. Hrbord London).
14. Norman A.W., Hormones.
15. Philips G., Environmental Physiology.
16. Prosser C.L., Comparative Animal Physiology.
17. West, Best & Taylor's, Physiological Basis of Medical Practice.
18. Wilson J.A., Principles of Animal Physiology.
19. Wod Dennus W., Principles of Animal Physiology (Ed. Arbod) London.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)
M.Sc. SY (Semester-III)
Research Project Course
Course Code - SZOORP501
Title of the Course : Research Project

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

Course objectives:

1. To provide opportunity to involve in research related to zoological aspects.

2. To gain the knowledge of referring research journals, writing research articles and submit the dissertation report.

3. To inculcate research culture.

4. To enhance the rational and innovative thinking capabilities.

Course outcomes:

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

1. Identify research problem and carry out literature survey.
2. Analyze the research gap and formulate the problem.
3. Interpret the data and synthesize research findings.
4. Students apply their knowledge in a practical setting.
5. It helps students develop their critical thinking skills.
6. It gives students the opportunity to work independently.
7. It provides students with the opportunity to collaborate with others.
8. It helps students develop their research skills.
9. It gives students the opportunity to gain real-world experience.

SZOORP501 : Research Project

Curriculum Details:

		Topic /Content	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 fulfill the specified objective. There are **Seven** main sections to a research project these are **Introduction** The aims of the project and what you hope to achieve. **Literature Review** Evaluating and reviewing existing knowledge of the topic. **Methodology** The methods you will use for your primary research. **Findings and 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 each semester in their subject of specialization is compulsory.
4. Project work must be carried out only in specialized branch.
5. The project work carried out during the year should be presented in power point presentation in presence of University Examiners.

M.Sc. SY (Semester-III)

SZOOCP501 : Vertebrates : Structure and Function (Based on theory paper SZOOCT501)

Curriculum Details

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Objectives

1. Learn about various vertebrate species, their affinities and their adaptive features.
2. Acquire skills of dissection/demonstration of organ systems in vertebrates.
3. Understand structure of bony parts of different groups of vertebrates.

Outcomes

1. Describe in detail the structure, affinities and adaptive features of vertebrates.
2. Able to dissect/demonstrate important organ systems in vertebrates.
3. Explain about structure of bony parts of different vertebrates.

Practicals

1. Demonstration / Dissection of heart, afferent and efferent arteries of Scoliodon.
2. Demonstration / Dissection of cranial nerves of Scoliodon
3. Demonstration / Dissection of brain and membranous labyrinth of Scoliodon.
4. Demonstration / Dissection of arterial system of Rat.
5. Demonstration / Dissection of venous system of Rat.
6. Demonstration / Dissection of neck nerves of Rat.
7. Demonstration / Dissection of urinogenital system of Rat.
8. Museum study of Protochordates- Balanoglossus, salpa, Doliolum, Herdmania, Amphioxus.
9. Museum study of Pisces- Zygaena, pristis, ophiocephalus, Mastacembalus, Catla-catla, Exocoetus, Hippocampus, Syngnathus, Diodon, Notopterus.
10. Museum study of Amphibia: Icthyophis, Rhacophorus, Rana, Necturus, Ambystoma.
11. Museum study of Reptilia- Chameleon, Phrynosoma, Varanus, Crocodilus, Cobra.
12. Museum study of Aves- Bubo, Duck, Vulture, Psittacula, Pigeon.
13. Museum study of Mammalia- Loris, Bat, Pangolin, Funambulus, Shrew.
14. Osteology of skull of fowl and dog/rabbit.
15. Osteology of vertebral column: Atlas vertebra, Axis vertebra, Trunk, Lumbar, Caudal.
16. Osteology of Pectoral girdle and Pelvic girdle.

Visit to Zoological Survey of India, Zoological park, Zoological museum, and submission of excursion report.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

2) Essential animal material should collected from slaughter house.

M.Sc. SY (Semester-III)

SZOOCP502 : Molecular Cell Biology (Based on theory paper SZOOCT502)

Curriculum Details

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Objectives

1. Learn the techniques of extraction of nucleic acids.
2. Learn the methods of micro-preparation of cell division stages and chromosomes.
3. Study methods of detection of biomolecules.
4. Learn the techniques of separation of biomolecules.

Outcomes

1. Perform extraction of DNA and RNA.
2. Perform micro-preparation of cell division stages and chromosomes.
3. Detect different types of biomolecules in sample.
4. Perform separation of biomolecules using different techniques.

Practicals

1) Extraction of DNA from suitable tissue.
2) Extraction of RNA from suitable tissue.
3) Estimation of DNA from sample.
4) Estimation of RNA from sample.
5) Study of different stages of mitosis.
6) Study of different stages of meiosis.
7) Preparation of slide for different mitotic stages in onion root tips.
8) Preparation of meiotic stages and study of meiosis using suitable material.
9) Detection of Proteins, Carbohydrates and lipids in animal tissues sections using histochemical staining techniques.
10) Micropreparation and observation of giant chromosomes from chironomous larvae.
11) Study of sex chromatin from mammalian buccal epithelial cells or hair root cells or lymphocytes.
12) Study of cancer cell histology (observation of slides of different cancer types).
13) Separation of DNA fragments by agarose gel electrophoresis.
14) Separation of cell proteins by electrophoresis.
15) Study of effect of pH on protein solubility in water.
16) Northern blotting, Western blotting (Demonstration only)

Visit to a biotechnology/molecular biology laboratory and submission of report.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. SY (Semester-III)

SZOOCP503 : Applied Zoology –Microbes, Arthropods and Protozoans of Medical Importance (Based on theory paper SZOOCT503)

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Course objectives:

1. To provide a practical knowledge of Microbes and Arthropods of medical importance.
2. To identify vector-host-pathogen relationships in arthropod-borne diseases.
3. To understand the morphology, life cycle, pathogenicity and control measures of important arthropods.
4. To understand and apply the principles of controlling diseases caused by microbes and arthropods.
5. To study protozoans of medical importance.
6. To learn techniques of micropreparation, microscopy and micrography of protozoans.
7. To develop skill of identification of pathogenic protozoans.
8. To learn techniques of isolation of pathogenic protozoans

Course outcomes:

1. Identify, classify and describe microbes and Arthropods of medical importance.
2. Explain about vector-host-pathogen relationships in arthropod-borne diseases.
3. Elaborate about arthropod vectors and their control measures.
4. Appreciate the principles of controlling microbial and arthropod caused diseases.
5. Describe protozoans of medical importance.
6. Perform micropreparation, microscopy and photo-micrography of protozoans.
7. Identify pathogenic protozoans
8. Isolate of pathogenic protozoans.

SZOOCP503 : Applied Zoology – Microbes, Arthropods and Protozoans of Medical Importance (Based on theory paper SZOOCT503)

Course Contents:

Practicals

1. Microbiological examination of water and foods.
2. Isolation and characterization and Staining techniques of microbes.
3. Mounting technique, potassium hydroxide method for clearing arthropods.
4. Study of following arthropods through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus humanus, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica, Glossina palpalis.*
5. Collection, preservation, Preparation of permanent slides and description of mouth-parts of – i. House fly ii. Mosquito iii. Bed bug iv. Head louse
6. Study of permanent mounts of arthropod parasites and pests
7. Study of permanent mounts of Insect vectors- Housefly, Mosquito, Lice, Bed-bug, Flea.
8. Study of Arthropod parasites and pests (Adult, Larvae and mouth parts).
9. Standardization of microscope; drawings of protozoans to scale, measurement of protozoans.
10. Study of different type of animal associationship; different types of parasites, vectors with a suitable example.
11. Identification, classification and description of Protozoan Parasites through permanent slides/photomicrographs-
    Sarcodine amoeba *(Entamoeba histolytica, Entamoeba coli*);

    Opalinids *(Opalina* spp)
    Sporozoan *(Toxoplasma* spp, *Plasmodium vivax and P. falciparum, Sarcocystis cruzei.;*
    Ciliates *Balantidium coli, Nyctotherus* spp and *Ichthyopthirius* spp)
    Haemoflagellates *(Trypanosoma gambiense; T. cruzi* and *Leishmania donovanii*);
    Intestinal Flagellates *(Giardia lamblia, Trichomonas vaginalis* and *Trichomonas foetus*)
12. Study of flagellates in alimentary canal and urinogenital tract of vertebrates and invertebrates.
13. Collection, fixation, staining and preservation of protozoa by wet and dry methods.
14. Demonstration of silver line system of staining ciliate protozoans by Klein's method.
15. Study of haemoflagellates from vertebrate's blood.
16. Preparation of blood smear, staining and identification of haemosporina.
17. Preparation of specimens for the study of Fecal smear, Alimentary tract and Blood smear (At least 5 slides)
18. Zine sulphate floatation technique for protozoan cyst
19. Autopsy and recovery of protozoan parasites from suitable hosts.
    Submission of permanent slides at the time of exam.

    Visit to parasitology research center and submission of report at the time of exam.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

2) Essential animal material should collected from slaughter house.

M.Sc. SY (Semester-III)

SZOOEP501 (A) : Applied Parasitology – I (A) (Trematodes and Cestodes)

(Based on theory paper SZOOET501(A)

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Course objectives:

1. To familiarize students with morphologic criteria to differentiate the most common Trematode and Cestode parasites.
2. To improve diagnostic skills by studying mophology and pathogenesis of helminth parasites.
3. To develop skills of micro-preparation and microscopy of parasitic worms for identification and study.

Course outcomes:

1. Familiarity with laboratory techniques of micro-preparation and microscopy.
2. Knowledge of morphologic criteria to differentiate Trematode and Cestode parasites.
3. Diagnosis of helminth parasites by studying mophology and pathogenesis.

SZOOEP501 (A) : Applied Parasitology – I (A) (Trematodes and Cestodes)

(Based on SZOOET501(A)

Course Contents

1. Practical Preparation of stains: Haematoxylin, Acetocarmine, Borax caramine, Bouins fluid and alcohols grades.
2. Collection, fixation, preservation of metacercaria from suitable animal.
3. Collection, Preservation, Staining, Mounting, identification and description of Trematodes from locally available different hosts (Gills & intestines).
4. Identification, classification and description of Parasitic Trematodes through permanent slides/photomicrographs or specimens- *Fasciolopsis buski; Schistosoma japonicum; Schistosoma mansoni; Clonorchis sinensis; Paragonimus wetermani. Fasciola hepatica*
5. Pathology in host tissue caused by Trematode parasites to study host parasite relation.
6. Collection and examination of molluscan hosts for larvae of Trematodes.
7. Effect of light, and temperature on the emergence of cercaria.
8. Collection, Preservation, Staining, Mounting, identification and description of Cestodes from locally available different hosts.
9. Identification, classification and description of Parasitic Cestodes through permanent slides/photomicrographs or specimens- *Taenia solium; Echinococcus granulosus; Diphyllobothrium latum; Hymenolepis nana; Dipylidium caninum* **a**nd *Moniezia* spp
10. Pathology of host tissue caused by Cestode parasites to study host parasite relation.
11. Study of different Hold fast organs in Helminthes.
12. Demonstrate/Measure the effect of season/phenological factors as the prevalence, intensity, density and index of helminth parasites.
13. Examination of faecal sample for different helminthes ova and their identification.
14. Estimation of glycogen, protein and lipids in parasite and its host tissue.
15. Histochemical demonstration of alkaline phosphatase activity in tissues of parasitic helminthes.
16. Autopsy of hosts for helminth parasite infection.

Submission of permanent slides at the time of exam.

Visit to veterinary & medical Parasitology (Pathology lab).

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)

M.Sc. SY (Semester-III)

SZOOEP501(B) : Fishery Science – I (B) Fish Morphology, Anatomy and Physiology

(Based on theory paper SZOOET501 (B))

Curriculum Details

Periods : 30 Hrs **No. of Credits: 01 (Marks: 25)**

Objectives

1. To understand methods of determination of fecundity, age and biometric constants in fish.
2. To learn morphology of fish of different groups.
3. To study structure of different types of scales in fish.
4. To learn about different feeding habits of fish based on their gut content.
5. To expose and study internal anatomy of fish of different groups.
6. To learn about histology of endocrine glands in fish.

Outcomes

1. Describe morphology of fish from different groups.
2. Explain the structure of different types of scales in fish.
3. Identify and describe skeletal components of fish.
4. To learn about different feeding habits of fish based on their gut content.
5. To expose and study internal anatomy of fish of different groups.

Practicals

1. Identification of any four specimens from Elasmobranchs.
2. Identification of any four specimens from Actinopterygii.
3. Identification of any two specimens from Crosspterygii.
4. Identification of caudal fin types in Fishes.
5. Mounting of placoid scales- temporary and permanent preparations.
6. Mounting of cycloid and ctenoid scales- temporary and permanent preparations.
7. Study of aggregation and dispersion phenomena of chromatophores in fish.
8. Study of digestive system of herbivorous and carnivorous fish.
9. Study of gut content of herbivorous and carnivorous fish.
10. Study of accessory respiratory organs in Clarius, Channa, Anabas and Heteropneustus fossilis.
11. Estimation of Fecundity.
12. Study of spawning periodicity of fish by ova diameter method.
13. Determination of age of given fish by scale method.
14. Study of relationship between length and weight of fish; and condition factor of fish.
15. Determination of gonado-somatic index (GSI) of given fish.
16. Study of structure of reproductive system in bony fish.
17. Study of structure of reproductive system in cartilaginous fish.
18. Study of structure of Weberian ossicles in bony fish.
19. Study of structure of air bladder in bony fish.

Submission of all permanent slides and other models prepared at the time of exam.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)

M.Sc. SY (Semester-III)

SZOOEP501 (C) : Entomology- I (C) - Insect, Taxonomy, Development and Ecology)

(Based on theory paper SZOOET501(C)

Curriculum Details

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Objectives

1. Study anatomical and morphological structures of insects.
2. Learn dissecting skills required in study of insect anatomy.
3. To develop the skills of collection, curation and preservation of insect specimens.
4. To understand the systematics and taxonomy of insects.
5. To develop skill of rearing insects of economic and academic importance

Outcomes

1. Perform collection, curation and preservation of insect specimens.
2. Explain the systematics and taxonomy of insects.
3. Identify and describe insect pests on plants.
4. Demonstrate dissecting skills required in study of entomology.
5. Prepare permanent slides of insect organs.

Practicals

1. Insect collection, preservation, curation and identification of insects belonging to different Exopterygote orders (any five).
2. Study of representative species of insects from Exopterygota (any five).
3. Study of representative species of insects from Endopterygota (any five).
4. Study of insect eggs, larvae and pupae.
5. Study of external morphology of locally available insect (any five).
6. Study of insect head and its segmentation.
7. Study of structure of thorax and abdomen in male and female insects.
8. Study of wing venation and modification of wings in insects.
9. Study of genitalia and ovipositor in insects.
10. Mounting of mouth parts of mosquito, housefly, butterfly, cockroach and; sting apparatus of honey bee.
11. Study and mounting of trachea, antennae, wings, halteres and legs of insects.
12. Dissection of Digestive system in Cockroach, Grasshopper, Honey bee or Nepa.
13. Dissection of Nervous system in Cockroach, Grasshopper, Honey bee or Nepa.
14. Dissection of Reproductive system in Cockroach, Grasshopper, Honey bee or Nepa.
15. Study of metamorphosis steps of insects (Rearing of at least one insect to be done).
16. Study of insect host plant relationship, host range.
17. Study of different castes in honey bee and termite colonies.
18. Histological study of any five insect organs by microtechnique.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)
Semester-III

SZOOEP501 (D) : Animal Physiology- I (D) (Based on theory paper SZOOET501 (D))

Curriculum Details

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Objectives

1. To learn about relationship between respiration and external factors in animals.
2. To study structure of neuro-endocrine function in animals.
3. To study haemotological parameters of animals.
4. To learn about the distinctions between prokaryote and eukaryote structure.
5. To study the relation between different aspects of metabolism.
6. To explore different enzymes, their properties, functions and interactions.
7. To understand energy pathways, intermediaries and dynamics in cells.
8. To understand response of animals to stress.
9. To acquire skills of estimation of organic biomolecules from animal tissues.
10. To study toxicity of chemicals on animal physiology.

Outcomes

1. Correlate respiration with external environmental factors in animals.
2.Describe structure of neuro-endocrine function in animals.
3.Explain the different haemotological parameters of animals.
4.Elaborate about responses of animals to different types of stress.
5.Identify and describe eukaryotic cells organelles using a microscope.
6.Estimate organic biomolecules from animal tissues and body fluids.
7.Perform toxicity testing for chemicals in animals.

Practicals

1.To study the rate of oxygen consumption by aquatic animals in relation to salinity and temperature.
2.To study the changes of blood glucose level under environmental stresses in a vertebrate species.
3.Estimation of acetylcholine in given blood sample.
4.Study of nerve cells and neurosecretory cells of cockroach (temporary slide & permanent slid).
5.Demonstration of reflex action in frog & knee-jerk reflex in human.
6.Study of heart beat and respiration in man at high altitude.
7. Study of blood pressure under normal condition and during exercise.
8.Effect of temperature and load on muscle activity; Effect of low atmospheric pressure on heart rate in suitable animal
9.Effect of exercise on breathing rate, pulse rate and blood lactate in human.
10.Study of osmosis by using RBCs of vertebrate animals.
11. Determination of respiratory quotient (R.Q.) of any aquatic animal.
12.To study effect of hormone on respiratory metabolism in any aquatic animal.
13.Estimation of blood glucose and haemoglobin in human.
14.Study of effect of pH and temperature on enzyme activity (Salivary amylase).
15.Estimation of ATPase.
16.Quantitative estimation of Calcium, Sodium and Potassium in blood serum / plasma.
17.Quantitative estimation of digestive enzymes in hepatopancreas of crab or liver of vertebrate.
18.Estimation of Succinic Dehydrogenase (SDH) (Fresh tissue from slaughter house).
19.Effect of selected toxicant on RBC, WBC, Hemoglobin of fish.

Visit to Yoga Centre / Demonstration by expert.

Visit to zoology research center/ pathology lab and submission of report at the time of exam.

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern w.e.f. June 2023

M.Sc. Practical Examination – (Second Year, Semester - III)

ZOOLOGY DSC Practical

SZOOCP501 : Lab Course in Vertebrates: Structure and Function

Based on theory paper [SZOOCT501]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Dissect/Demonstrate Scoliodon so as to expose its Afferent and Efferent Arterial System/ Cranial system/ Membranous Labyrinth / Brain with well labeled diagram. **(08)**

OR

Dissect / Demonstrate Rat so as to expose its Arterial System / Venous system / Neck Nerves / Urinogenital System with labeled diagram.

Q.2 Identify, classify and comment on one museum specimen of each class – Amphibia, Reptilia, Aves and Mammals (One from each) **(08)**

OR

Identify and comment on skull, vertebrae, Pelvic Girdle, Pectoral Girdle of Fowl / Rabbit / Dog. (One from each)

Q.3. Submission / Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - III)
ZOOLOGY DSC Practical

SZOOCP502 : Lab Course in Molecular Cell Biology

Based on theory paper [SZOOCT502]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Estimation of DNA/RNA from given tissue. **(08)**

OR

Preparation of different Mitotic stages / Meiotic stages from given material. (Identify, draw labeled diagram and describe any **four** stages)

Q.2. Dissection of Salivary Gland from Chironomous Larva and demonstration of Giant Chromosome / Northern Blotting / Western Blotting Technique **(08)**
.

OR

Study of sex chromatin from Mammalian Buccal Epithelium or Root Cells / Separation of Cell Proteins by Electrophoresis / separation of DNA fragments by Agarose Gel Electrophoresis / Study of Cancer Cell Histology

Q.3. Submission / Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - III)
ZOOLOGY DSC Practical

SZOOCP503 : Lab Course in Applied Zoology- Microbes, Arthropods and Protozoans of Medical Importance (Based on theory paper [SZOOCT503])

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Microbiological examination of water/ food ***OR*** Study of microbial cultivation techniques **(08)**
OR
Prepare, Temporary Mount & Observe specimens of microbes. ***OR*** Isolation and characterization of microbes ***OR*** Staining techniques for microbes ***OR***
Mounting technique, potassium hydroxide method for clearing arthropods ***OR***
Prepare a permanent slide of mouth parts of- House fly/ Mosquito/ Bed bug/
Head louse and identify giving reasons ***OR*** Identify, classify and describe arthropods, arthropods parasites and pests, Insect vectors through permanent slides/ photographs: (*Aedes, Culex, Anopheles, Pediculus humanus, Xenopsylla cheopis, Cimex lectularius, Phlebotomus argentipes, Musca domestica, Glossina palpalis*.) (Any Four)

Q.2 Standardization of microscope; drawings of protozoans to scale, measurement of protozoans/ Prepare any one stain used in staining protozoans ***OR*** **(08)**
Identify and describe: type of animal association (01 Spots), Types of Parasites (02 Spots) & Types of Vectors (01 Spot) ***OR***
Identify, classify and describe Protozoan Parasites (04 spot from 07 groups, at least 1 Spot from the each group) through permanent slides/photomicrographs- Sarcodine amoeba (*Entamoeba histolytica, Entamoeba coli*); Opalinids (*Opalina* spp); Sporozoan (*Toxoplasma* spp,/*Plasmodium vivax/ P. falciparum/ Sarcocystis cruzi*); Ciliates (*Balantidium coli/ Nyctotherus* spp/ *Ichthyopthirius* spp); Haemoflagellates (*Trypanosoma gambiense/ T. cruzi*/*Leishmania donovanii*)); Intestinal Flagellates (*Giardia lamblia/ Trichomonas vaginalis/ Trichomonas foetus*) ***OR***
Collection, fixation, staining and preservation of flagellates in alimentary canal/ urinogenital tract of vertebrates /invertebrates/ Hemoflagellates from Vertebrate Blood ***OR***
Collection, fixation, staining and preservation of protozoa by wet and dry methods ***OR***
Demonstration of silver line system of staining ciliate protozoans by Klein's method. ***OR***
Preparation of blood smear, staining and identification of Haemosporina ***OR***
Study of Host Autopsy & recovery of Protozoan Parasites from suitable host. ***OR***
Study of Zinc sulphate floatation technique for protozoan cyst ***OR***
Preparation of specimens for the study of Fecal smear/ Alimentary tract/ Blood smear

Q.3. Submission of Excursion report and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

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Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - III)
ZOOLOGY DSE Practical

SZOOEP501 (A) : Lab Course in Applied Parasitology – I (A) (Trematodes and Cestodes)

Based on theory paper [SZOOET501(A)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Collection & Preservation/ Staining & Mounting, identification and description of Metacercaria /Trematodes/ Larve of Trematodes from locally available hosts ***OR*** **(08)**
Identify, classify and describe Parasitic Trematodes (04 Spots from *Fasciolopsis buski; Schistosoma japonicum; Schistosoma mansoni; Clonorchis sinensis; Paragonimus wetermani. Fasciola hepatica*); (through permanent slides/ photomicrographs or specimens) ***OR***
Prepare temporary slide of host tissue and describe the histopathological changes caused by Trematode parasites to study host parasite relation ***OR***
Study of effect of light and temperature on the emergence of cercaria

Q.2. Collection & Preservation/ Staining & Mounting, identification and description of Cestodes from locally available hosts ***OR*** **(08)**
Identify, classify and describe Parasitic Cestodes (03 Spots from *Taenia solium; Echinococcus granulosus; Diphyllobothrium latum; Hymenolepis nana; Dipylidium caninum and Moniezia spp*) (through permanent slides/ photomicrographs or specimens and Identify & comment on Hold fast organ in Helminth (01 Spot) ***OR***
Prepare temporary slide of host tissue and describe the histopathological changes caused by Cestode parasites to study host parasite relation ***OR***
Calculate to show the effect of season/phenological factors as the prevalence, intensity, density and index of helminth parasites from data provided ***OR***
Examination of faecal sample for different helminth ova and their identification ***OR***
Estimation of glycogen/protein/ lipids in parasitic helminths and its host tissue provided ***OR***
Histochemical demonstration of alkaline phosphatase activity in tissues of parasitic helminthes ***OR***
Study of Host Autopsy & recovery of Parasitic Helminths from suitable host

Q.3. Submission of excursion report, Stained permanent slides and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - III)
ZOOLOGY DSE Practical

SZOOEP501(B) : Lab Course in Elective 501(B) – Fishery Science – I (Fish Morphology, Anatomy & Physiology) Based on theory paper [SZOOET501(B)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Dissect to expose the Brain /Pituitary Gland from locally available fish / Mounting of Placoid, Cycloid, Ctenoid scales (Any two scales) **(08)**

OR

Dissect to expose Digestive System of Herbivorous or Carnivorous Fish and Study the Gut Content.

OR

Identify, classify and describe Four Specimens from the Elasmobranchs, Actinopterygii, Crosspterygii and Teleostomi (each from One)

Q.2. Dissect to expose Cranial Nerves / Reproductive System / Weberian Ossicles from locally available fish / Estimation of fecundity of given fish / Determination of Age of given fish by scale method. **(08)**

OR

Identify and describe Migratory Fishes (Any One) / Identify and describe Parental Care in given fish (Any One) / Identify and describe Pituitary, Thyroid, Adrenal Gland of Fish (Permanent Slides) (Any Two).

Q.3. Submission and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

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Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - III)
ZOOLOGY DSE Practical
SZOOEP501(C) : Lab Course in Elective Entomology- I (C) - Insect, Taxonomy, Development and Ecology
Based on theory paper [SZOOET501(C)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Demonstrate Grasshopper/Honey bee/Nepa so as to expose its Digestive system/Nervous system/Reproductive system/ Excretory system. **(08)**

OR

Identify and describe trachea, antennae, mouth parts, wings, wing venation, modification of wings, genitalia or ovipositor, legs of insect (Any Four).

OR

Mount mouth parts of mosquito/housefly/butterfly/cockroach

OR

Mount sting apparatus of honey bee.

Q.2. Identify & describe metamorphosis stages of insects provided (Any Four). **(08)**

OR

Describe methods of collection, preservation, curation and identification of insect provide ***OR***

Identify and describe (05 spot)- Exopterygote insect; Endopterygote insect; type of eggs; larvae & pupae of insects (any four)

OR

Histological study of any four insect organs by microtechnique.

Q.3. Submission of Excursion report and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern w.e.f. June 2023

M.Sc. Practical Examination – (Second Year, Semester - III)

ZOOLOGY DSE Practical

SZOOEP501(D) : Lab Course in Elective 501(D) - Animal Physiology- I

Based on theory paper [SZOOET501(D)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. To study the rate of oxygen consumption by aquatic animals in relation to salinity and temperature/ Estimation of acetylcholine in given blood sample/ Demonstration of reflex action in knee-jerk reflex in human/ Study of blood pressure under normal condition and during exercise/ **(08)**

Q.2. Effect of exercise on breathing rate, pulse rate and blood lactate in human/Determination of respiratory quotient (R.Q.) of any aquatic animal/ Estimation of blood glucose / haemoglobin in human/ Study of effect of pH and temperature on enzyme activity (Salivary amylase)/ Quantitative estimation of digestive enzymes in hepatopancreas of crab or liver of vertebrate. **(08)**

Q.3. Submission of Excursion report and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

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Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded			
Faculty of Science & Technology			
Summer / Winter -20--- Examination			
Name of Subject:		**Zoology**	
Subject Code : (as per examination time table):			
Class:	**M.Sc.**	Semester:	
Paper Title and Paper No (as per examination time table):		**…….** **Paper No. ……..(NEP-2020 Pattern)**	
Time:	**3 Hours**	Maximum Marks:	**80**

Important Instructions:

i. Question Number 1 is compulsory.
ii. Out of remaining 5 Questions (Q. No. 2 to Q. No. 6) answer any 3 Questions.
iii. All Questions carry equal marks.
iv. Illustrate your answers with suitable labeled diagrams, wherever necessary.

Q.1 Answer each of the following: **20 Marks**

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Q.2 a) (Based on Module 1) **10 Marks**

b) (Based on Module 1) **10 Marks**

Q.3 a) (Based on Module 2) **10 Marks**

b) (Based on Module 2) **10 Marks**

Q.4 a) (Based on Module 3) **10 Marks**

b) (Based on Module 3) **10 Marks**

Q.5 a) (Based on Module 4) **10 Marks**

b) (Based on Module 4) **10 Marks**

Q.6 Answer each of the following: **20 Marks**

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Swami Ramanand Teerth Marathwada University, Nanded			
Faculty of Science & Technology			
Summer / Winter – 20------ Examination			
Name of Subject:		**Zoology**	
Subject Code : (as per examination time table):			
Class:	**M.Sc.**	Semester:	
Paper title and Paper no (as per examination time table):		**…….** **Paper No. ……..(NEP-2020 Pattern)**	
Time:	**2 ½ Hour**	Maximum Marks:	**60**

Important Instructions:

i. Question Number 1 is compulsory.
ii. Out of remaining 5 Questions (Q. No. 2 to Q. No. 6) answer any 3 Questions.
iii. All Questions carry equal marks.
iv. Illustrate your answers with suitable labeled diagrams, wherever necessary.

Q.1 Answer *Any Three* of the following: 15 Marks

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Q.2 a) (Based on Module 1) 08 Marks

b) (Based on Module 1) 07 Marks

Q.3 a) (Based on Module 2) 08 Marks

b) (Based on Module 2) 07 Marks

Q.4 a) (Based on Module 3) 08 Marks

b) (Based on Module 3) 07 Marks

Q.5 a) (Based on Module 4) 08 Marks

b) (Based on Module 4) 07 Marks

Q.6 Answer *Any Three* of the following: 15 Marks

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)

M.Sc. SY (Semester-IV)

SZOOCT551 : Mammalian Endocrinology

Periods : 60 **No. of Credits: 04 (Marks: 100)**

Course pre-requisite:

Require basic knowledge about hormones, endocrine glands, role of hormones.

Course objectives:

1. To study nature, functions and classification of hormones.
2. To study general structure and functions of endocrine glands in mammals.
3. To understand functional relation between pituitary and other endocrine glands.
4. To learn about endocrine role of adrenal, pancreatic and pineal tissue in humans.
5. To study the function of gastro-intestinal and reproductive hormones in humans.
6. To learn about the different endocrine disorders in humans.

Course outcomes:

1. Appreciate the nature, functions and classification of hormones.
2. Describe general structure and functions of endocrine glands in mammals.
3. Trace the relation between pituitary and other endocrine glands.
4. Elaborate about endocrine role of adrenal, pancreatic and pineal tissue in humans.
5. Explain about functions of gastro-intestinal and reproductive hormones in humans.
6. Elaborate about the different endocrine disorders in humans.

SZOOCT551 : Mammalian Endocrinology : Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	**Introduction to Endocrinology** Chemical nature and classification of hormones. Hormones as chemical messengers. Feedback control of hormone action.	
	1.2	Hypothalamo-Hypophysial portal system. Pituitary gland- location and anatomy.	
	1.3	Histology and hormones of Adenohypophysis.	
	1.4	Histology and hormones of Neurohypophysis. Disorders of pituitary hormones.	
2.0			**15**
	2.1	**Adrenal Gland:** Structure and histology of Adrenal gland Adrenal cortex hormones- Mineralocorticoids and Glucocorticoids and Renin-Angiotensin system.	
	2.2	Hormones of Adrenal Medulla- Epinephrine and Norepinephrine. Disorders of adrenal steroids hormones.	
	2.3	Hormones of Pancreas- Insulin and Glucagon	
	2.4	Types of Diabetes: Insulin Dependent Diabetes Mellitus (IDDM) and Insulin; Independent Diabetes Mellitus (IIDM)	
3.0			**15**
	3.1	**Thyroid and other endocrine systems** Endocrine Role of Pineal Gland- Melatonin. Properties and role of Local hormones- NO (Nitric oxide), Histamine, Endorphins, neuropeptides.	
	3.2	Structure and Histology of Thyroid Gland, Hormones of Thyroid- Thyroxine and Triiodothyroxine biosynthesis. Disorders of hormones of thyroid.	
	3.3	Structure and histology of parathyroid gland; Parathyroid hormones- Parathormone and calcium metabolism.	
	3.4	Gastrointestinal Hormones- Gastrin, Secretin, Cholecystokinin (CCK), Gastric Inhibitory Peptide (GIP), Vasoactive Intestinal Peptide (VIP).	
4.0			**15**
	4.1	**Reproductive and Gastro-intestinal endocrinology** Hormones of Female Reproductive Physiology- Estrogens and Progesterone	
	4.2	Hormonal regulation of pregnancy, parturition and lactation. Structure of placenta, functions of hormones of placenta- HCG.	
	4.3	Hormones of Male Reproductive Physiology- Testosterone, Dihydrotesterone. Male and female contraceptives and their mode of functioning.	
	4.4	Disorders of reproductive steroid hormones. Infertility in humans and their remedial measures.	
		Total	**60**

Text Books

1. Williams Text Book of Endocrinology – 10th Ed, Saunders, 2003.
2. Textbook of Endocrinology – Griffin J.E., S.R. Ojeda, Oxford, New York, 1988.
3. Text Book Medical Physiology – Guyton Hall, 10th Ed, Saunders, 2003.

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Endocrinology – Mac E. Hadley, 5th Ed, Pearson Education, 2004.
3. Molecular Endocrinology – Bolander, F.F., Academic, Son–Diego, 1989.
4. Basic and Clinical Endocrinology – Greenspan, F.S., 3rd Ed., Appleton and Lange.
5. Basic Medical Endocrinology – Goodman, H.M., Raven, New York, 1988.
6. Hormones - From Molecules to Diseable, Bailiene, E.E. & P.A. Kelly, Herman, New York, 1991.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)

M.Sc. SY (Semester-IV)

SZOOCT552 : Genetics and Genetic Engineering

Periods : 60 **No. of Credits: 04 (Marks: 100)**

Course pre-requisite:

Require basic knowledge about genetics, genetic engineering

Course objectives:

1. Study principles of Mendelian genetics.
2. Learn about gene and chromosomal inheritance and associated disorders.
3. Study the different tools and techniques used in recombinant DNA technology.
4. Study the different tools used in cloning and gene transfer technology.

Course outcomes:

1.Explain the principles of Mendelian inheritance.
2. Describe gene and chromosomal inheritance and their disorders.
3. Elaborate about different tools and techniques used in recombinant DNA technology.
4. Discern the different tools used in cloning and gene transfer technology.

SZOOCT552 : Genetics and Genetic Engineering : Curriculum Details

ModuleNo.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	**Mendel's Laws of inheritance** Law of Dominance; Law of Segregation Law of independent assortment;Test cross, Back cross.	
	1.2	**Interaction of genes and modifying genes** Complementary gene factors; Supplementary gene factors Inhibitory factors; Lethal gene factors	
	1.3	**Sex chromosomes and sex linked inheritance** Types of sex chromosomes and sex chromatin Sex linkage in Drosophila; Sex linkage in man Sex linked lethal genes	
	1.4	Sex determination in-Heterogametic males; Heterogametic females	
2.0			**15**
	2.1	**Linkage and crossing over** Kinds of linkages and significance; Mitotic and meiotic crossing over; Mechanism of crossing over; Kinds of crossing over	
	2.2	**Mutations:** Gene mutation ; Chromosome mutation- Deletion, Duplication, Inversion, Translocation, Polyploidy, Aneuploidy	
	2.3	Induced mutation; Mutagenic agents	
	2.4	**Multiple Alleles and Inheritance** Multiple allelism A–B–O blood groups Inheritance of A-B-O blood groups and medico–legal applications; Rh-factor and Erythroblastosis foetalis	
3.0			**15**
	3.1	**Human Genetics** Numerical abnormalities of human chromosomes and related syndromes; Non-disjunction, Aneuploidy, Patau syndrome; Down syndrome, Sex chromosomes Turner's syndrome, Klinefilter's syndrome	
	3.2	Structural abnormalities of human chromosomes and related syndromes; Cri-du-chat syndrome; Robertsonian translocation; Prader-Willi Syndrome; William's Syndrome	
	3.3	**Human metabolic disorders** Phenylketouria; Alcaptoneuria, Tay-Sach's disease; Glucose–6–phosphate dehydrogenase deficiency, Emphysemia	
	3.4	**Polygenic inheritance** Cob length in maize; Kernel color in wheat. Skin color in human.	
4.0			**15**
	4.1	Introduction to recombinant DNA technology Enzymes used in DNA technology Cloning vectors- Plasmids, Phages, Cosmids	
	4.2	Cloning techniques- Isolation and purification of genomic and plasmid DNA and RNA, Gel; electrophoresis of nucleic acids.	
	4.3	Gene transfer techniques- Electroportation and microinjection	
	4.4	Applications of recombinant DNA technology. Monitoring of gene expression in live Cells; crop and live stock improvement.	
		Total	**60**

Text Books

1. Text Book of Genetics – H.S. Bhamrah (Amol Publication, New Delhi).
2. Text Book of Fundamental Genetics - Dr.D.B.Bhure, Dr.S.S.Nanware & M.U.Barshe

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Genetics – P. K. Gupta (Rastogi Publication, Meerut).
3. Genetics – Verma P. S. and Agarwal V. K. (S. Chand Publication Delhi).
4. Cytology, Genetics and Evolution – P. K. Gupta (Rastogi Publication Delhi).
5. Elementary Genetics – Single tone.
6. Genetics – Winchester (Oxford LBH Publication).
7. Genetics and Evolution – A. P. Jha (Macmillon India).
8. Concepts of genetics – W. S. Clug (Pearson Education ISBN).
9. Genetics – Strickberger (Prentice – Hall).
10. Principle of genetics – R. H. Tamarin (Tata Mc Graw Hill Publication India).
11. Concepts of Genetics – R. L. Kotpal (Rastogi Publication).
12. Genetics and Genetic Engineering – Dr. R. P. Meyyan (Saras Publication).
13. Foundations of Genetics – Pai A. C. (Mc Graw Hill Publication).
14. Molecular Genetics – Gunther, S. Stent, (Macmillon).
15. Principles of Genetics – Sinnott, Dunn and Dobzansky (Tata McGraw Hill Pub. Delhi).
16. Genetic – Sarin C. (Tata McGraw Hill Publication Delhi).
17. Principles of Gene Manipulation and Introduction of Genetic Engineering – R.W. Old and S. B. Primerose.
18. Genetics – M. P. Arora (Himalaya Publication).
19. Genetics and Evolution – N. Armugam (Saras Publication).
20. Genetic – Veer Bala (Rastogi Publication).
21. Cytology and genetics – Dyansagar V.R. (Tata McGraw Hill Pub. 1992 Reprint).
22. Aruna Prakashan Latur, M.S. ISBN: 978-93-5240-035-5,Publication16th June,2016

Swami Ramanand Teerth Marathwada University, Nanded
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M.Sc. SY (Semester-IV)

SZOOET551 (A) : Applied Parasitology- II (A) (Animal Nematodes and Plant Nematodes)

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

Course pre-requisite:

A minimum background in parasites of human and other animals.

Course objectives:

1. To provide knowledge and understanding of Parasitology with special emphasis on Nematodes.
2. To provide an overview of plant nematology with an emphasis on disease caused by plant parasitic nematods.
3. To acquire insight into structural and functional organization of nematodes.
4. To study pathogenesis of nematode parasites of plants and animals.
5. To understand broad methods of nematode disease prevention.
6. To learn about the ecology of larval and adult nematodes.

Course outcomes:

1. A good understanding of parasitology in general and Nematodes in particular.
1. Knowledge of plant nematology, especially of disease caused by parasitic nematods.
2. Understanding of structural and functional organization of nematodes.
3. Knowledge of pathogenesis of plant and animal nematode parasites.
4. An understanding of methods of nematode disease prevention.
5. Knowledge of life history and ecology of larval and adult nematodes.

SZOOET551(A) : Applied Parasitology- II (A) (Animal Nematodes and Plant Nematodes)

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Introduction, Classification, General organization of Animal Nematodes.	
	1.2	Ultra structure of Cuticle-Chemical Composition and Organization	
	1.3	Feeding and Nutrition in Nematodes. Carbohydrate and Protein Metabolism in Nematodes.	
	1.4	Nematode egg, Development, Hatching, Moulting. Functional anatomy of reproductive system of Nematodes.	
2.0			**11**
	2.1	Larval forms in Nematodes with special reference to Pathogenicity. Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- i) *Ancylostoma duodenale ii) Wucheria bancrofti*	
	2.2	*iii) Dracunculus medinensis iv) Trichinella spiralis, v) Strongyloides stercoralis. Vi) Enterobius vermicularis.*	
	2.3	General account of entomophilic Nematodes- Characteristics and classification.	
	2.4	Nematode as model organism (Toxicity, Gerantology, Parasitic, Genetic)	
3.0			**11**
	3.1	Introduction, Classification, General organization of Plant Parasitic Nematodes. Plant parasitic Nematodes- symptoms of nematode injuries to plants. i) Above ground symptoms.ii) Below ground symptoms. Nematode ecology and population dynamics.	
	3.2	Controlling of the Nemic Diseases of Plant- Heat, fallow, crop rotation, Biological control, organic matter and mulching, Root Diffusates, natural enemies.	
	3.3	Chemical Control- Nematicidal chemicals, Application of Nematicides; Procedure in soil fumigation.	
	3.4	Techniques in Nematology: Methods of sampling (soil & plant samples), Methods of extracting nematodes from soil & plant samples, Methods of processing nematodes for observation.	
4.0			**11**
	4.1	Study of Systematic Position, Geographical distribution, Morphology, Life Cycle, Pathogenicity, Diagnosis, Prophylaxis and Treatment of- i) *Anguina (seed gall- nematode)*	
	4.2	*ii) Meloidogyne (root knot nematode)*	
	4.3	*iii) Heterodera (cyst nematode) iv)Tylenchulus (citrus nematode)*	
	4.4	*v) Pratylenchus (lesion nematode)* *vi) Radopholus (burrowning nematode)*	
		Total	**45**

Text Books

1. Introduction to animal parasitology by J. D. Smith.

Reference Books

2. Online resources like academic, research databases etc are recommended.
3. Principles of nematology- by Chitwood B.G. and Chitwood M.B.
4. Nematode parasites of domestic animals and of man- by Levine Norman D Burgess publishing Co. Minneapolis.
5. The natural history of Nematodes by Pionar G.O., Prentice Hall, New Jersey.
6. The organization of nematodes by Croll N.A., Acdemic press.
7. The physiology of nematodes by Lee D. L. & At. Kinson, Columbia University Press, New York.
8. Agricultural Helminthology- Filipjev I. N.
9. General Parasitology by Cheng T.C.
10. Entomophilic nematodes and their role as biological control of pest insects by George Poiner, Pub. INC Engle wood cliffs, New Jersey.
11. Parasitology by Noble & Noble.
12. Parasitology by K. D. Chatterjee.
13. Parasitology by Chandler.
14. Human Helminthology- by Faust.
15. Medical Zoology by Sobti.
16. General Parasitology by Cheng T. C.
17. Biology of Parasites by Cheng
18. Systema Helminthum by S. Yamaguti
19. Biology of Animal parasites by Saunders.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)

M.Sc. SY (Semester-IV)

SZOOET551(B) : Fishery Science – II (B) Fisheries and Fish Culture

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

Course pre-requisite:

Basic knowledge about fish culture, non-fish organism.

Course objectives:

1.General study of capture and culture fishery of India and methods adopted.
2. Understand design, management and maintenance of fish farm.
3. Learn about the principles and methods of artificial fish breeding and weed control.
4. Study of various fish disease, treatment, fish preservation and fish by-products.
5. Understand the aquaculture and fishery resources of India.
6. Learn about the culturable organisms and culture methods.
7. Explore the anthropogenic threats to fishery industry in India.

Course outcomes:

1. Knowledge of capture and culture fishery practices of India and methods adopted.
2. Suggest design and management procedures for a fish farm.
3. Carry out artificial fish breeding and weed control in a fish farm.
4. Identify various fish diseases and suggest treatments.
5. Elaborate about different fish preservation methods.
6. Evaluate suitability of different fish for making by-products.
7. Describe the fishery resources of India.
8. Knowledge about culturable organisms and different culture methods.
9. Identify and assess the anthropogenic threats to fishery industry.
10. Knowledge of marine capture and culture fishery of India and legislative framework to regulate it.

SZOOET551(B) : Fishery Science – II(B) Fisheries and Fish Culture

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Introduction, Scope and importance of Capture and Culture Fisheries. Study of commercially important cultivable fresh water fishes- Growth, Food and Feeding habits, Maturity, Spawning; Indian major carps and Exotic Carps.	
	1.2	Monoculture and Polyculture.	
	1.3	Scope and importance of Aquaculture; Culture methods- Cage Culture, Pen Culture. Integrated Fish Farming- Paddy cum Fish Culture	
	1.4	Sewage Fed Fish Culture Prawn Culture and allied activities – Feed for Prawn seed, Transport of Prawn seed, Prawn seed diseases. Ornamental fishery- Aquarium fish species, Genetically modified ornamental fish, Ornamental fish breeding, Export potential, Aquarium management.	
2.0			**11**
	2.1	Fish Farm Engineering - Topography, Soil type, Water supply, Design Fish Farm Management - Types of Ponds required, Management of Hatcheries, Types of Hatcheries- Hatching pit, Hapa, Chinese Hatchery System Pre-stocking, Stocking and Post-stocking management of Nursery, Rearing & Stocking ponds	
	2.2	Aquatic weeds and their Control- Types of Aquatic Weeds, Advantages and Disadvantages of Aquatic Weeds, Weed Control by manual, mechanical, chemical and biological methods.	
	2.3	Man made hazards and Aquaculture.	
	2.4	Methods of Fishing- Craft and Gear, Electric Fishing, Light Fishing, Fish finder.	
3.0			**11**
	3.1	Induced breeding by hormones- Selection of breeders, hormone injection and dosage, Breeding happa and spawning.	
	3.2	Fish Transport- Scope and requirement of fish transport, Tools and Techniques used for fish transport, Problems in fish transport.	
	3.3	Marine Fisheries- Mackerel Fishery, Oil Sardine Fishery,	
	3.4	Bombay Duck Fishery, Prawn Fishery.	
4.0			**11**
	4.1	Fish Pathology- Symptoms and treatment of Parasitic diseases, Non Parasitic diseases, Miscellaneous diseases.	
	4.2	Fish Preservation- Causes of Fish spoilage, Various methods of Fish preservation.	
	4.3	Fish by-products: Fish meal, Isinglass, Fish fillets, Pearl essence, Shark fin rays, Surgical sutures from fish gut, etc.	
	4.4	Fishery education- National Fishery Research Institutes (CIFE, CMFRI, CIFT, NIO, FSI)	
		Total	**45**

Text Books

1. A Text Book of Fishery Science in India - C. B. L. Srivastava
2. Huet M. 1972 Text Book of Fish culture Breeding and cultivation of fish fishing New (Books) Ltd. Surrey England.
3. A Text Book of Fish Biology and Fisheries - by S.S. Khanna and H.R. Singh.

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Fish and fisheries of India - V. J. Jhingran.
3. A manual of freshwater fish culture - R. Santharmma N. Sakuran and Natrajan.
4. An Introduction to Indian Fisheries. - Sharma and Grover
5. Introduction of Fishes by - S. S. Khanna
6. Bal D.V. and Rao K.V. 1989 - Marine Fisheries
7. Hand Book Breeding of Indian Major carps by Chondar S.Z.
8. Jayaram K.C. 1978 Fresh Water Fishes of India, Pakistan, Bangladesh, Burma and Srilanka - Hand Book Zoological Survey of India Calcutta.
9. C.V. and Sebastian V.O. 1986 Prawns and Fisheries of India Hindustan Publishing Corp, Delhi.
10. Moyle P.B. and Cech. J.J. Jr 1988 - Fishes an Introduction to Ichthyology - Prentice all, Englewood cliffs N.J.
11. Norman J.R. 1975 A History of Fishes Third Edn by PH.
12. Balkrishnan N.N. and Thampy D.M. 1980 A Text Book of Marine Ecology, Macmillan India.
13. Anatomy and Physiology of Fishes - by Santosh Kumar and Manju Tembhre
14. Practical Manual on Fish Biology by Ashok Kumar, Jaiswal, S.K. Chakraverthy, CIFE Publication.
15. An Introduction to Fishes - by S.S. Khanna.
16. Ichthyology - by Lagler
17. Behaviour and Physiology of Fish- Sloman, K. A., Wilson, R. W., & Balshine, S. (2005). (1st Ed., Vol. 24). Academic Press.

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M.Sc. SY (Semester-IV)

SZOOET551(C) : Entomology – II(C)
Economic, Agricultural Entomology and Pest Management

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

Course pre-requisite:

Basic knowledge about insect classification, biology etc.

Course objectives:

1. To explore the principle and practices in sericulture and lac culture.
2. To learn about methods and techniques in apiculture and butterfly farming.
3. To learn about insect pests of agricultural crops.
4. To study agricultural insect pests and their control measures.

Course outcomes:

1. Describe the principle and practices in sericulture and lac culture.
2. Identify agricultural insect pests and suggest control measures.
3. Explain and demonstrate techniques used in apiculture and butterfly farming.
4. Knowledge about different types of pesticides used in agriculture.
5. Identify and initiate control measures against household insect pests.

SZOOET551(C) : Entomology – II (C)

Economic, Agricultural Entomology and Pest Management

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			
	1.1	**Sericulture:** Mulberry silkworm: life history, seed production, silkworm rearing, silk glands and silk production, cocoon formation, cocoon harvesting and reeling, silkworm diseases and management, non-mulberry sericulture, sericulture as a cottage industry.	**12**
	1.2	**Apiculture:** types of honey bees, life cycle, apiary products, bee keeping and techniques, bee rearing management, movable frame hive; economic importance of honey, wax and apiary products.	
	1.3	**Lac Culture:** Biology, Cultivation and economic importance of Lac.	
	1.4	Insect as Pollinators, food, source of drugs and dyes. Butterfly farming.	
2.0			
	2.1	Concept of pest; origin of pest; types of pests; nature of damage; pest resurgence.	**11**
	2.2	**Classification, morphology, bionomics, damage and control measures of** Pests of cotton: Cotton bollworms; Red cotton bug; Pests of sugarcane: sugarcane leafhopper. Fruit crops: Mango Stem Borer, Lemon Butterfly.	
	2.3	**Classification, Morphology, bionomics, damage and control measures of** Pests of Jowar: Jowar stem borer, Jowar shoot fly, Jowar midge fly.	
	2.4	Pests of oil seed crops: Safflower aphid, Groundnut whitegrub. Pests of stored grains: Rice weevil, Pulse beetle. Pest of forest tree: Defoliators, Sap suckers.	
3.0			
	3.1	**Medical entomology:** Human insect pests (Morphology, vectorship, pathogenecity& control measures of: mosquito, housefly, ratfleas, head louse).	**11**
	3.2	Household insect pests (Morphology, damage caused & Control measure of: Cockroach, Cricket, Carpet beetle, Ants	
	3.3	and termites, Bed bugs, Lepisma, Wasps).	
	3.4	Domestic animalinsect pest (Morphology, vectorship, pathogenecity& control measures of : Stable flies, ticks)	
4.0			
	4.1	**Pest Management** **Chemical control:** Insecticidal formulations, classification of insecticides, mode of action of insecticide, merits and demerits of chemical control. Physical and mechanical control, cultural control, legal control.	**11**
	4.2	**Biological control:** Principles, procedure, Biological agents; success and limitations.	

	4.3	**Hormonal control** of insect pests, Genetic control of insect pests.	
	4.4	**Integrated Pest Management** (IPM) - Principles, modeling and application.	
		Total	**45**

Text Books

1. Hemsingh Pruthi : A Text Book of Agricultural Entomology
2. M.S. Mani : A Text Book of General Entomology
3. Shrivastava, K.P. : A Text Book of Applied Entomology (Vol. I–H)
4. Ross, H.A. : Text Book of Entomology

Reference Books

1. Online resources like academic, research databases etc are recommended.
2. Nayer, K.K., T. Anant Krishnan and B.W. David : General and Applied Entomology
3. Metcalf, G.L. and W.P. Fling : Destructive and Useful Insects
4. Wigglesworth : Principles of Insect Physiology
5. ESSIG : College Entomology
6. Government of Maharashtra Publication : Crop Pests and How to Fight Them
7. Oldroyd : A Collection, Preserving and Studying Insects
8. Roger P. and Anderson : Forest and Shade Tree Entomology
9. Tembhare, D.B. : Modem Entomology
10. Fradt, R.E. : Fundamentals of Applied Entomology
11. Smith, K.G.V. : Insects and Other Arthropods of Medical Importance
12. Ray, D.N. and A.W.A. Brown : Entomology Medical & Veterinary
13. Chandler, A.C. and Read, C.P. : Introduction of Parasitology
14. Debatch, R. : Biological Control of Natural Enemies
15. Apple, J.L. and Smith, R.F. : Integrated Pest Management
16. Cheny : General Parasitology
17. Corbet, J. R. : The Biochemical Mode of Action of Pesticides
18. Champaman, R.F. : Insects – Structure and Function
19. Richards, O.W. and R.G. Davies, IMMS : Text Book of Entomology
20. Bursel, E. : An Introduction to Insect Physiology
21. Rockstein M. : The Physiology of Insects (Vol. 1–VI)
22. Johnson, O.A. : Embryology of Insects and Myriopods
23. Roddick : Insect Physiology

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M.Sc. SY (Semester-IV)

SZOOET551(D) : Animal Physiology- II(D)

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

Course pre-requisite:

Basic knowledge about animal physiology.

Course objectives:

1. To study digestive system structure, functions, its regulation & related disorders.
2. To understand respiratory system function and its pathological conditions.
3. To learn about circulatory system, its components, functions & diseases.
4. To study excretory system structure, functions & related disorders.
5. To learn about nervous system components and their functions.
6. To understand reproductive system structure, functions, related conditions and remedies.
7. To study muscle structure, functioning mechanism, and disorders
8. To learn about the sensory system, their working, and disorders.

Course outcomes:

1. An understanding of digestive system structure, functions & its disorders.
2. Knowledge of respiratory system function and its pathological conditions.
3. Ability to describe circulatory system, its components, functions & diseases.
4. Appreciation of excretory system structure, functions & related disorders & their tests.
5. To describe and elaborate about nervous system components and their functions.
6. To outline reproductive system structure, functions, related conditions and remedies.
7. To delineate muscle structure, functioning mechanism, and disorders
8. To represent about the sensory system, their working, and disorders.

SZOOET551(D) : Animal Physiology- II(D)

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	**a) Digestive System** 1.Histological Structure and Functions of stomach; small intestine; Liver; Pancreas; Gall Bladder 2.Gastro Intestinal Hormones and their role.	
	1.2	3.Physiology of digestion and absorption of protein, carbohydrate and lipid. 4.Disorders- i) Peptic Ulcers, ii) Cirrhosis, iii) Hepatitis, iv) Gallstones	
	1.3	**b) Respiratory System** 1.Structure of Respiratory System, Mechanism of breathing. 2.Transport of oxygen and carbon dioxide between blood and tissues.	
	1.4	3.Chemical and nervous control of respiration. 4.Disorders– i) Asthma, ii) Emphysema, iii) Pneumonia, iv) Cystic Fibrosis.	
2.0			**11**
	2.1	**a) Cardiovascular System** 1.Composition and functions of blood; Formation of blood cells – Erythropoiesis, Leucopoiesis 2.Lymph and Lymph Nodes – Structure, composition and Functions; Erythrocyte Sedimentation Rate (E.S.R.); Blood Cholesterol	
	2.2	3.Heart –Internal structure, Heart beat and regulation of heart beat; Cardiac cycle, cardiac output and ECG 4.Disorders – Anaemia, Leukaemia, Heart attack: causes & treatment; Coronary Artery Disease (CAD)	
	2.3	**b) Excretory System- Kidney** 1.Kidney– Anatomy and Functions; Structure and histology of Nephron 2.Renal Physiology- Mechanism of urine formation- Glomerular Filtration, Tubular Reabsorption and Tubular Secretion; Counter – Current mechanism; Physiology of Micturition	
	2.4	3.Dialysis therapy- Definition and types; Renal function tests 4.Disorders– i) Urinary tract infections, ii) Acute and Chronic Renal Failure	
3.0			**11**
	3.1	**a) Nervous System** 1. Central Nervous System- Structure and functions of forebrain (Olfactory lobes, Cerebrum and Diencephalon): Midbrain (Corpora quadrigemina and Crura cerebri); Hindbrain (Pons varolli & medulla oblongata)&Spinal Cord	

	3.2	2. Peripheral Nervous System- Nerves and their functions 3. Autonomic Nervous System (ANS)- Sympathetic and Parasympathetic Nervous System	
	3.3	**b) Reproductive System** 1. Male Reproductive System- external morphology and histological structure of testis; Spermatogenesis, hormonal control of spermatogenesis; Semen- composition and functions of seminal fluids 2. Female Reproductive System – external morphology and histological Structure of ovaries; Oogenesis, hormonal control of oogenesis; Phases of female reproductive cycle and their hormonal control; Histology and development of mammary glands, physiology of breast cancer	
	3.4	3. Birth Control Measures – Sterilization in male and female 4. Hormonal Methods; Intra Uterine Devices; Barrier Methods; Chemical Methods; Physiological Methods	
4.0			
	4.1	**a) Muscle Physiology** 1. Types, functions and characteristics of muscles; Ultra structure of skeletal muscle and protein activities 2. Chemical composition of muscle fiber, neuromuscular junction; Contraction of muscle – Sliding filament mechanism; Twitch contraction, Tetanus, Staircase effect CT	
	4.2	3. Muscle Metabolism- Phosphagen system and Glycogen-Lactic acid system 4. Disorders- i) Muscular dystrophy, ii) Myasthenia gravis.	**11**
	4.3	**b) Special Senses** 1. Ear- External, Middle and Internal Structure and Physiology of hearing; Properties of Sound and Sound Perception 2. Physiology of Equilibrium- Otolithic organs, Semicircular canals and path of vestibular impulses	
	4.4	3. Eye- Accessory structures and anatomy of the eyeball; Physiology of Vision- Refraction of light rays, accommodation of near point vision, constriction of pupil. 4. Disorders of ear and eye.	
		Total	**45**

Text Book

1. Text Book of Medical Physiology- Arthur C. Guyton and John E. Hall, 10th Ed., 2000, Saundus An Imprint of Elsevier.

2. Text Book of Physiology- Smith, Patterson, Read and Scratched, ELBS, 11th Edition, 1988.

Reference Books

1. Online resources like academic, research databases etc are recommended.

2. Review of Medical Physiology- W.F. Ganong 16th Edition, 1993, Appleon and Lange (A Publishing Division of Prentice Hall).

3. Human Physiology- Lauralee Sherwood, 6th Edition 2007, Thomson, India Edition.

4. Human Physiology- Vander, Sherman, Luciano, 6th Edition, McGraw-Hill Inc., International Ed. 1994.

5. Principles of Anatomy and Physiology- Gerard J. Tortora and Sandra Reynolds Grabowsky Harper Collins College Publishers, 8th Edition, 1996.

6. Marshall's Physiology of Reproduction- Vol. 1 to 5, Amming C.E., Edition, Churchill Livingstone, 1984.

7. Physiology- Bullock, J. Boyle, Harward Pull, 1991.

8. Essential Endocrinology- Laycock, J.F., and Wise, Peter, H. ELBS, 1983.

9. Hole's Human Anatomy and Physiology, 7th Edition By David Shier.

10. Human Physiology- Stuart Ira Fox, McGraw Hill, 6th Edition, 1999.

11. Human Physiology- David Moffett, Stacia Moffett Charles Schauf, Mosby International Ed. 1993.

12. Human Anatomy and Physiology- Elaine N. Marieb, 3rd Ed., The Benjamin / Cummings Publishing Inc., 1995.

13. Physiology- Berne, R.M. and M.N. Levy, Mosby, 3rd Ed., St. Louis.

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Semester-IV

SZOOPE551 : Publication Ethics

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

Course pre-requisite:

Learner should know the basic rules and regulations of research ethics.

Course objectives:

1. To know rules, issues, options, and resources for research ethics.
2. To familiarize with various institutional ethics review boards/academic integrity guidelines.
3. To understand the purpose and value of ethical decision-making.
4. To have a positive disposition towards continued learning about research ethics

Course outcomes:

1. To have a positive disposition towards continued learning about research philosophy & ethics.
2. To know Rules, Regulations, Issues, Options, and Scientific Resources of Research Ethics.
3. To learn the culture of fairness, honesty and integrity in academic communications and to understand the purpose and value of ethical decision-making.
4. Avoid wasteful and duplicate publications & encourage original contributions to advance Academic Research and Scholarship.
5. Acquiring knowledge & professional competence and expertise about Patents, Copyrights, and other forms of Intellectual Property Rights.
6. To promote social good and prevent or mitigate societal hazards through innovative ideas, creativity and research advocacy.

SZOOPE551: Publication Ethics ; Curriculum Details:

Module No.	Unit No.	Topic	No. of hours required to cover the contents
1. 0	**PUBLICATION ETHICS**		**08 Hours**
	1.1	Publication ethics: definition, introduction and importance. Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest	
	1.2	Publication misconduct: definition, concept, problems that lead to unethical behavior and vice verse, types	
	1.3	Violation of publication ethics, authorship and contributor-ship	
	1.4	Identification of publication misconduct, complaints and appeals. Predatory publishers and journals	
2.0	**OPEN ACCESS PUBLISHING**		**08 Hours**
	2.1	Open access publications and initiatives.	
	2.2	SHERPA/RoMEO online resource to check publisher copyright and self- archiving policies	
	2.3	Software tool to identify predatory publications developed by SPPU	
	2.4	Journal finder/ journal suggestion tools viz. JANE	
3.0	**PUBLICATION MISCONDUCT**		**07 Hours**
	3.1	Subject specific ethical issues, FFP, authorship	
	3.2	Conflicts of interest	
	3.3	Complaints and appeals: examples and fraud from India and abroad	
	3.4	Use of plagiarism software like Turnitin, Urkund and other open source software tools.	
4.0	**DATABASES AND RESEARCH METRICS**		**07 Hours**
	4.1	Databases: Indexing databases	
	4.2	Citation databases: Web of Science, Scopus, etc.	
	4.3	Research Metrics: Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score.	
	4.4	Metrics: h-index, g index, i10 index, altmetrics	
		Total	**30 Hours**

Text Books :

1. The Handbook of Social Research Ethics, Donna M. Mertens, Pauline E. Ginsberg, SAGE (2009).

Reference Books:

1. What are Qualitative Research Ethics? Rose Wiles, Bloomsbury (2013).
2. Research Ethics: Cases and Materials, Robin Levin Penslar, eds, Indiana University Press (1995).
3. Research Ethics: A Philosophical Guide to the Responsible Conduct of Research, Gary Comstock, Cambridge University Press (2013).
4. Bird, A. (2006). Philosophy of Science. Routledge.
5. MacIntyre, Alasdair (1967) A Short History of Ethics London.
6. P. Chaddah, (2018) Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN:978-8. 9387480865.
7. National Academy of Sciences, National Academy of Engineering and Institute of Medicine. (2009).
8. On Being a Scientist: A Guide to Responsible Conduct in Research. Third Edition. National Academies Press.
7. Resnik, D. B. (2011). What is ethics in research & why is it important. National Institute of Environmental.
8. Health Sciences, 1-10. Retrieved from https www.nichs.nih.gov/research/resources/bioethics/whatis/index.cfm
9. Beall, J. (2012). Predatory publishers are corrupting open access. Nature, 489(7415), 179-179.
10. https://doi.org/10.1038/489179a
11. Indian National Science Academy (INSA), Ethics in Science Education, Research and Governance(2019).
12. ISBN:978-81-939482-1-7. http://www.insaindia.res.in/pdf/Ethics Book.pdf.

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Two Year PG Program, Zoology (w.e.f. June -2023)
M.Sc. SY (Semester-IV)
Research Project Course
Course Code - SZOORP551
Title of the Course : Research Project

Periods : 180 **No. of Credits: 06 (Marks: 150)**

Course objectives:

1. To provide opportunity to involve in research related to zoological aspects.
2. To gain the knowledge of referring research journals, writing research articles and submit the dissertation report.
3. To inculcate research culture.
4. To enhance the rational and innovative thinking capabilities.

Course outcomes:

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

1. Identify research problem and carry out literature survey.
2. Analyze the research gap and formulate the problem.
3. Interpret the data and synthesize research findings.
4. Students apply their knowledge in a practical setting.
5. It helps students develop their critical thinking skills.
6. It gives students the opportunity to work independently.
7. It provides students with the opportunity to collaborate with others.
8. It helps students develop their research skills.
9. It gives students the opportunity to gain real-world experience.

SZOORP551 : Research Project

Curriculum Details:

		Topic /Content	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 fulfill the specified objective. There are **Seven** main sections to a research project these are **Introduction** The aims of the project and what you hope to achieve. **Literature Review** Evaluating and reviewing existing knowledge of the topic. **Methodology** The methods you will use for your primary research. **Findings and 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.	**180**
		Total	**180**

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 each semester in their subject of specialization is compulsory.
4. Project work must be carried out only in specialized branch.
5. The project work carried out during the year should be presented in power point presentation in presence of University Examiners.

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M.Sc. SY (Semester-IV)

SZOOCP551 : Mammalian Endocrinology

Based on theory paper [SZOOCT551]

Curriculum Details

Periods : 30 Hrs **No. of Credits: 01 (Marks: 25)**

Objectives

1. To study anatomical location and surgical removal of endocrine glands in vertebrates.
2. To learn skills of micro-preparation of endocrine glands of vertebrates.
3. To study functional role of hormones in physiology of animals.
4. To study hormonal control of reproductive system in mammals.

Outcomes

1. Pinpoint anatomical location and surgical removal of endocrine glands in vertebrates.
2. To learn skills of micro-preparation of endocrine glands of vertebrates.
3. To study functional role of hormones in physiology of animals.
4. To study hormonal control of reproductive system in mammals.

Practicals

1. In-situ demonstration of endocrine glands in any suitable vertebrate.
2. Determination of protein and glycogen in endocrine material (using spectrophotometer).
3. Determination of sugar level in diabetic and non-diabetic blood and urine samples.
4. Microtomy of endocrine glands (Tissue preservation, fixation, dehydration, impregnation, block preparation, section cutting, staining and mounting).
5. Histology of Rat / Rabbit / Mammal Endocrine glands- Observation of permanent slides of different endocrine glands.
6. Histology of Rat / Rabbit / Mammal placenta by observation of permanent slides.
7. Histology of Rat / Rabbit / Mammal uterus by observation of permanent slides.
8. Demonstration of Hypophysectomy, Thyroidectomy, Adrenalectomy in Rat / Mammal.
9. Demonstration of Orchidectomy, Ovariectomy, Hysterectomy, Vasectomy in Rat / Mammal.
10. Pregnancy testing from urine sample in any suitable mammal.
11. Effect of thyroxin on oxygen consumption of a suitable animal or fish.
12. Effect of adrenaline on oxygen consumption of a suitable animal or fish.
13. Separation of plasma proteins by electrophoresis.
14. Estimation of at least one hormone from sample.
15. Detection of steroid hormones in urine sample from suitable mammal.
16. Preparation of vaginal smear, staining and identification of reproductive phase in Rat.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

2) Essential animal material should collected from slaughter house.

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M.Sc. SY (Semester-IV)

SZOOCP552 : Genetics and Genetic Engineering

Based on theory paper [SZOOCT552]

Curriculum Details

Periods : 30 Hrs **No. of Credits: 01 (Marks: 25)**

Objectives

1. Learn methods of preparing and analyzing pedigree charts and karyograms.
2. Understanding Mendelian and polygenic inheritance.
3. Study of sex chromatin, meiotic, mitotic and polytene chromosomes by preparing slides.
4. Learn the methods of visualization and estimation of DNA/RNA.

Outcomes

1. Preparing and analyzing pedigree charts and karyograms from provided data.
2. Describe Mendelian and polygenic inheritance.
3. Elaborate about sex chromatin, meiotic, mitotic and polytene chromosomes.
4. Visualize and estimation of DNA/RNA using appropriate techniques.

Practicals

1. Preparation of pedigree chart of some phenotypic characters of human.
2. Study and observation of sex-chromatin from buccal epithelial cells in humans.
3. Identification and preparation of human Karyogram.
4. Study of hereditary disorders with the aid of chromosome karyotyping.
5. Study of monohybrid, dihybrid crosses and interaction of genes with suitable examples.
6. Problems based on polygenic inheritance.
7. Identification of sex-linked and mutant characters in drosophila.
8. Study chromosomal abnormalities in human.
9. Survey of frequency of PTC tasters and non-tasters in local human population.
10. Study of mitosis using onion root tip cells.
11. Study of meiosis in grasshopper testis.
12. Study of polytene chromosomes in chironomous larval salivary glands.
13. Estimation of blood sugar in normal and diabetic patients.
14. Estimation of DNA by spectrophotometer.
15. Isolation of DNA/RNA from blood.
16. Gel electrophoresis of nucleic acids (DNA/RNA). Isolation and detection of DNA/RNA on agarose gel.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

2) Essential animal material should collected from slaughter house.

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M.Sc. SY (Semester-IV)

SZOOEP551 (A) : Applied Parasitology- II (A) (Animal Nematodes and Plant Nematodes
(Based on theory paper SZOOET551 (A)

Curriculum Details

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Objectives

1. To identify diagnostic stages of nematode parasites in blood, urine, tissue and stool samples of animals.
2. To acquire skills of collection, preservation, processing and identification of nematodes.
3. To understand the importance of nematodes and their role in spread of plant diseases.
4. To learn about methods of analysis of population dynamics data of nematodes.
5. To learn about analytical, histochemical, histopathological and biochemical methods used in nematology.

Outcomes

1. Identify different stages of nematodes in body fluids, tissue and stools of animals.
2. Demonstrate skills of collection, preservation, processing and identification of nematodes.
3. Elucidate the importance of nematodes in spread of plant diseases.
4. Describe methods of analysis of population dynamics data of nematodes.
5. Perform histochemical, histopathological and biochemical analysis of nematodes.
6. Recognize safety procedures relevant to parasitic diseases.

Practicals

1. Basic techniques of preservation and mounting of Nematodes.
2. Collections of Nematodes from locally available animals.
3. Collection, Preservation, Mounting, identification and description of Animal Nematodes from locally available different hosts (intestines).
4. Identification, classification and description of Animal Parasitic Nematodes (Animals) through permanent slides/photomicrographs or specimens- *Ancylostoma duodenale*; *Wucheria bancrofti*; *Dracunculus medinensis; Trichinella spiralis; Strongyloides stercoralis; Enterobius vermicularis.*
5. Identification of collected Nematodes.
6. Fecal sample analysis for collection and identification of ova.
7. Collection, Preservation, Mounting, identification and description of Plant Nematodes from soil samples.
8. Collection & Identification of Phytonema.
9. Identification, classification and description of Plant Parasitic Nematodes through permanent slides/photomicrographs or specimens- *Anguina (Seed Gall- nematode); Meloidogyne (root knot nematode); Heterodera (cyst nematode); Tylenchulus (citrus nematode); Pratylenchus (Lesion nematode)*
10. Techniques of collection, fixation, mounting and preparation of permanent slides- Baerman's funnel techniques and Oostenbrinks Cottonwool Filter Method (1954 &1960).
11. Quantitative estimation of Carbohydrates in normal, infected tissues and parasites.
12. Quantitative estimation of Proteins in normal,infected tissues and parasites.
13. Quantitative estimation of Lipids in normal,infected tissues and parasites.
14. Histochemical demonstration of polysacharides, proteins, lipids, alkaline & acid phosphatase in tissue of parasitic nematods.
15. Ecology and biostatistical calculation- Prevalence, density, intensity and index of Nematode parasites.
16. Autopsy of hosts for parasitic nematode infection.
    Submission of permanent slides at the time of examinations.
    Visit to parasitology research center and submission of report at the time of exam.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)
M.Sc. SY (Semester-IV)

SZOOEP551(B) : Fishery Science – II (B) Fisheries and Fish Culture (Based on Theory paper SZOOET551(B)

Curriculum Details

Periods : 30 Hrs **No. of Credits: 01 (Marks: 25)**

Course Objectives

1. Study of Indian Major Carps, Exotic Carps and their developmental stages.
2. Learn about design of fish farm.
3. Learn the different soil tests in farm management.
4. Study about fish parasites, fish by-products, fish feed formulations and their processing.
5. To study types of cages used in culture of fish and other organisms.
6. To learn about economically important fish and shell fish.
7. To explore different craft and gear used in fishery activity.
8. To learn about the water analysis techniques used in fish farm management.

Course Outcomes

1. Able to identify and describe the Indian Major Carps and Exotic Carps.
2. Drafting the layout of a fish farm.
3. Perform different soil tests used in farm management.
4. Describe the different fish parasites and suggest their control measures.
5. Discuss different fish by-products and their processing methods.
6. Elaborate on method of preparation of different fish feed formulations.
7. Identify and describe different types of cages used in aquaculture.
8. Describe the different economically important fish and shell fish.
9. Explain the structure and operation of different craft and gear used in fishery activity.
10. Perform water analysis tests used in fish farm management.

Practicals

1. Identification of Indian Major Carps & Exotic Carps.
2. Study of Layout of Fish Farm.
3. Determination of water holding capacity, pH, total alkalinity of soil.
4. Identification of Aquatic weeds infesting a fish farm.
5. Identification of Predatory & Weed Fish infesting a fish farm.
6. Identification of Aquatic insects infesting a fish farm.
7. Identification of Spawn, Fry and fingerlings of Indian Major Carps.
8. Identification of Spawn, Fry and fingerlings of exotic carps.
9. Collection and preservation of Pituitary gland.
10. Preparation of Pituitary extract and injection of Pituitary extract – by demonstration
11. Identification and mounting of fish ecto & endo parasites and their control.
12. Study of different methods of fish preservation.
13. Preparation of (any two) fish by-products like pearl essence, fish manure, fish meal, isinglass etc.
14. Identification of different prawns and seed of different species.
15. Determination of protein and lipid content of edible tissues of prawns.
16. Study of craft used in fishery- Catamaran, Masula boat, Coracle, Trawler (model).
17. Study of gear used in fishery- line & hook, cast net, gill net, drag net, hand net, Chinese dip net. 18. Identification of freshwater and marine water food fishes.
19. Identification of sewage fed fish.
20. Analysis of sewage water- pH, dissolved O2, dissolved CO2 total suspended solids.
21. Estimation of Primary productivity of freshwater and sewage water by Light and Dark bottle method.
22. Identification of aquarium fish (5 indigenous and 5 exotic species), Aquarium fabrication and setting.

Visit to fish breeding/farming/research center and submission of report at the time of exam.
Visit to fish landing/marketing/research center and submission of report at the time of exam.
Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

M.Sc. SY (Semester-IV)

SZOOEP551 (C) : Entomology- II (C) - Economic, Agricultural Entomology and Pest Management

(Based on theory paper SZOOET551(C)

Curriculum Details

Periods : 30 **No. of Credits: 01 (Marks: 25)**

Course Objectives

1. Study anatomical and morphological structures of insects.
2. Learn dissecting skills required in study of insect anatomy.
3. Develop skills of microtechnique and prepare permanent slides of insect organs.

Course Outcomes

1. Describe the various anatomical and morphological structures of insects.
2. Demonstrate dissecting skills required in study of entomology.
3. Prepare permanent slides of insect organs.

Practicals

1. Study of Silk worm adult, caterpillar and cocoon.
2. Study of sericulture practices, equipment used in sericulture.
3. Study of silk worm diseases and its management.
4. Study of honey bees and their castes.
5. Study of bee keeping techniques and equipment.
6. Study of by-products of apiculture and their economic importance.
7. Study of equipment used in apiculture.
8. Study of life cycle of lac insects.
9. Study of lac cultivation, equipment used in lac culture and lac products.
10. Study of morphology , identification and nature of damage of pests of Jowar, Cotton, Sugarcane and paddy.
11. Study of morphology, identification, nature of damage of pests of stored grains, vegetables and fruit crops.
12. Study of household pests viz. House fly, Cockroach, Lepisma, Ants, termites, Cricket.
13. Study of insect vectors like Mosquito, bed bug, flea, body louse, rat flea.
14. Study of beneficial insects (Predatory and parasite insects) and their importance.
15. Study of pollinating insects (any five).
16. Collection and study of forensically important insects (any five).
17. Collection and study of medically important insects (any five).
18. Study of chemical insecticidal formulations (emulsion, dust and suspension) and insect control appliances.
19. Study of equipment used in mechanical control of insect pests.
20. Collection and study of insect infested/ damaged parts of plants.
21. Collection and study of parasitic and predatory insects.
22. Collection and study of pollinator insects & biological control agents.
23. Study of parasitoid insects as agricultural pest control agents.
24. Culture of parasitoid insect species for biological control of agricultural pests.
25. Identification of common insect pathogens.

Visit to any entomology research institute center of agricultural entomology, IPM and submission of report at the time of exam.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.

2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology,
Two Year PG Program, Zoology (w.e.f. June -2023)
M.Sc. SY (Semester-IV)

SZOOEP551 (D) : Animal Physiology- II (D)
Curriculum Details

Periods : 30 Hrs **No. of Credits: 01 (Marks: 25)**

Objectives

1. To learn analytical techniques for study of animal tissue and body fluid composition.
2. To study relation between body fluid composition and health of animals.
3. To learn about effect of environmental factors on body functions.
4. To experimentally study structure and function of muscles.
5. To learn about techniques of separation and estimation of carbohydrates and proteins from tissues.
6. To learn methods of localization of carbohydrates, proteins and lipids in tissues.

Outcomes

1. Perform analysis of animal tissue and body fluids like saliva, blood and urine.
2.Explain the relation between body fluid composition and health status of animals.
3.Elaborate about relation between environmental factors on body functions and health.
4.Perform experiments to demonstrate structure and function of muscles.
5.Separate and estimate carbohydrates and proteins from tissues.
6.Demonstrate localization of carbohydrates, proteins and lipids in tissues.

Practicals

1. Estimation of serum amylase; SGOT / SGPT.
2. Estimation of serum / plasma glucose by colorimetric method.
3. Estimation of total proteins; total cholesterol in blood; Estimation of serum urea.
4. Estimation of Low Density Lipoproteins (LDL) and High Density Lipoproteins (HDL) in blood.
5. Microscopic examination of urine.
6. Detection of excretory product in suitable animals.
7. Estimation of blood chlorides in suitable animal acclimated to different osmotic conditions.
8. Detection of normal and abnormal constituents of urine.
9. Effect of adrenaline; temperature on heart rate of any suitable animal.
10. Detection of salivary amylase in human saliva.
11. Detection of protein and carbohydrate digesting enzymes.
12. Preparation of simple muscle curve; Mounting and study of muscle fibers.
13. To study the effect of fatigue on muscle contraction.
14. Dissection of male reproductive system; female reproductive system and Brain of Rat (demonstration only).
15. Separation and identification of amino acids (in plasma/ tissue extracts) by paper chromatography.
16. Separation of plasma proteins/tissue proteins by Paper Electrophoresis/Gel Electrophoresis.
17. Demonstration of proteins; Glycogen and Lipids (in tissue paraffin sections) by Nile Blue Sulphate, Best Carmine and Sudan Black method or any other histochemical staining method.
18. Demonstration of tests for color blindness in humans.
19. Quantitative estimation of Na; K; Ca and P in provided sample.
20. Pregnancy Test (using commercially available pregnancy test kits).
21. Estimation of serum creatinine and serum urea.

Visit to pathology laboratory/medical hospital and submission of report at the time of exam.

Note- 1) Demonstration of animal dissections through Models, Charts or Computer Aided Techniques as per UGC Guidelines.
2) Essential animal material should collected from slaughter house.

Swami Ramanand Teerth Marathwada University, Nanded
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NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - IV)
ZOOLOGY DSC Practical

SZOOCP551 : Lab Course in Mammalian Endocrinology

Based on theory paper [SZOOCT551]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Dissect / Demonstrate Rat / any Vertebrate to show Endocrine Glands. **(08)**

OR

Determine Protein / Glycogen in the given endocrine tissue.

OR

To study effect of thyroxin on Oxygen consumption of Fish / Estimation of any Hormone in the Given Animal / Separation of Plasma proteins by Electrophoresis.

Q.2. Hypophysectomy / Thyroidectomy / Adrenalectomy / Ovariectomy / Vasectomy in Rat / Mammal. **(08)**

OR

Identify and describe Histological Slides of any **Four** Endocrine Glands of Rat / Rabbit.

OR

Preparation of vaginal smear, staining and identification of Reproductive phase in Rat / Demonstration of Microtomy of endocrine tissue.

Q.3. Submission / Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded

Faculty of Science and Technology

NEP-2020 Pattern w.e.f. June 2023

M.Sc. Practical Examination – (Second Year, Semester - IV)

ZOOLOGY DSC Practical

SZOOCP552 : Lab Course in Genetics and Genetic Engineering

Based on theory paper [SZOOCT552]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Identification and preparation of Human Karyotype / Estimation of DNA by Spectrophotometer / Study of Sex Chromatin from Buccal Smear or Hair Root Cells. **(08)**

OR

Study of Polytene chromosomes from Chironomus Larva / Estimation of Blood sugar in Normal and Diabetic Patients / Study of Mitosis using Onion Root tip / Study of Meiosis in Grasshopper Testes.

OR

Q.2 Solve one from Monohybrid Cross and Solve one problem from Dihybrid Cross / Interaction of Genes **(08)**

OR

Isolation of DNA / RNA from blood / Plasmid isolation from Bacterium / Restriction digestion of DNA.

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Q.3. Submission / Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - IV)
ZOOLOGY DSE Practical

SZOOEP551 (A) : Lab course in Applied Parasitology- II (A) (Animal Nematodes and Plant Nematodes) based on theory paper [SZOOET551(A)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Demonstrate and describe basic techniques of preservation and mounting of Nematodes ***OR*** **(08)**
Collection, Preservation, Mounting, identification and description of Animal Nematodes from locally available different hosts (intestines)***OR***
Analyze fecal sample for collection and identification of nematode ova ***OR***
Identify, classify and describe specimens of Animal Parasitic Nematodes (04 Spots of *Ancylostoma duodenale; Wuchereria bancrofti; Dracunculus medinensis; Trichinella spiralis; Strongyloides stercoralis; Enterobius vermicularis*) through permanent slides/photomicrographs or specimens ***OR***

Q.2 Collection, Preservation, Mounting, identification and description of Plant Nematodes from soil samples ***OR*** **(08)**
Identify, classify and describe specimens of Plant parasitic Nematodes (04 Spots of *Anguina* (Seed Gall- nematode); *Meloidogyne* (root knot nematode); *Heterodera* (cyst nematode); *Tylenchulus* (citrus nematode); *Pratylenchus* (Lesion nematode) through permanent slides/photomicrographs or specimens ***OR***
Techniques of collection, fixation, mounting and preparation of permanent slides- Baerman's funnel technique and Oostenbrinks Cottonwool Filter Method ***OR***
Estimate Carbohydrate/ Protein/ Lipid content in normal and infected tissues and parasites ***OR*** Histochemical demonstration of polysaccharides/proteins/ lipids/ alkaline & acid phosphatase in tissue of parasitic nematodes ***OR***
Calculate to demonstrate the Prevalence, density, intensity and index of Nematode parasitic infestation from data provided ***OR***
Study of Host Autopsy & recovery of Nematode Parasites from suitable host

Q.3. Submission of Excursion report and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - IV)
ZOOLOGY DSE Practical

SZOOEP551(B) : Lab course in Fishery Science – II (B) Fisheries and Fish Culture

Based on theory paper [SZOOET551(B)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Dissect to expose Pituitary gland of fish and prepare Pituitary gland extract for fish injection. **(08)**

OR

Study of Layout of Fish farm, draw well labeled diagram.

OR

Identify and describe One Indian Major carp, One Exotic Carp and Two fish parasites (1-4).

OR

Identify and describe One Aquatic Weed, One Predatory fish, One Weed Fish and One Aquatic Insect (1-4).

Q.2. Identify and describe Cage and Pen culture (Any Two model) **(08)**

OR

Identify and describe any **Two** crafts and any **Two** Gears.

OR

Identify and describe any **Four** Food fishes.

Q.3. Submission and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - IV)
ZOOLOGY DSE Practical

SZOOEP551 (C) : Lab course in Entomology-II (C) - Economic, Agricultural Entomology and Pest Management

Based on theory paper [SZOOET551(C)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Identify & describe spot of silk worm adult/caterpillar/cocoon/ sericulture equipment (one from each) / spot of bee keeping tools/ biological control agents/life stage of lac insect/ by-products of apiculture (one from each) / spot of insect vectors/ pests/ pollinating insects/ beneficial insects/ forensically/ medically important insects (any four). **(08)**

OR

Describe in detail with diagrams silk worm diseases/ Lac cultivation, equipment used in lac culture and lac products.

Q.2. Identify & comment on spot of pest damage (in Jowar/Cotton/ Paddy/ Vegetables/ Fruit crops/ Stored grains (any four) **(08)**

OR

Identify & comment on spot of insect infested/damaged parts of plants/plant protection equipment/ mechanical insect pest control equipment/parasitic/predatory/parasitoid insect (any four)

OR

Describe in detail life history stages of insect pest provided ***OR***

Detect and estimate infestation losses in provided sample crop. ***OR***

Describe chemical insecticidal formulation and insect control appliances. ***OR***
Preparation of plant extracts for larvicidal activity ***OR***

Q.3. Submission of Excursion report and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature
Examiner – 1

Name & Signature
Examiner – 2

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded
Faculty of Science and Technology
NEP-2020 Pattern w.e.f. June 2023
M.Sc. Practical Examination – (Second Year, Semester - IV)
ZOOLOGY DSE Practical

SZOOEP551(D) : Lab Course in Animal Physiology- II

Based on [SZOOET551(D)]

Centre:	**Batch No.:**
Date:	**Duration: 04 Hrs.**
	Time:
Exam. Seat Number:	**Credits: 01 (25 Marks; ESE 20 & CA 05)**

Q.1. Estimation of serum / plasma glucose by colorimetric method / Study of Microscopic examination of urine / Detection of excretory product in suitable animals/ Effect of adrenaline; temperature on heart rate of any suitable animal. **(08)**

Q.2. Detection of salivary amylase in human saliva / Dissection of male reproductive system/female reproductive system/Brain of Rat (demonstration only)/ Separation and identification of amino acids (in plasma/ tissue extracts) by paper chromatography/ Demonstration of tests for color blindness in humans/ Estimation of serum creatinine/serum urea **(08)**

Q.3. Submission of Excursion report and Practical Record book. **(02)**

Q.4. Viva-voce. **(02)**

***

Note: Demonstration of Dissections through Models, Charts and Computer Aided Techniques as per U.G.C. Guidelines.

Name & Signature	**Name & Signature**
Examiner – 1	**Examiner – 2**

(Continuous Assessment (CA)-05 Marks- Test on Practical)

Swami Ramanand Teerth Marathwada University, Nanded			
Faculty of Science & Technology			
Summer / Winter -20--- Examination			
Name of Subject:		**Zoology**	
Subject Code : (as per examination time table):			
Class:	**M.Sc.**	Semester:	
Paper Title and Paper No (as per examination time table):		**…….** **Paper No. ……..(NEP-2020 Pattern)**	
Time:	**3 Hours**	Maximum Marks:	**80**

Important Instructions:

i. Question Number 1 is compulsory.
ii. Out of remaining 5 Questions (Q. No. 2 to Q. No. 6) answer any 3 Questions.
iii. All Questions carry equal marks.
iv. Illustrate your answers with suitable labeled diagrams, wherever necessary.

Q.1 Answer each of the following: **20 Marks**

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Q.2 a) (Based on Module 1) **10 Marks**

b) (Based on Module 1) **10 Marks**

Q.3 a) (Based on Module 2) **10 Marks**

b) (Based on Module 2) **10 Marks**

Q.4 a) (Based on Module 3) **10 Marks**

b) (Based on Module 3) **10 Marks**

Q.5 a) (Based on Module 4) **10 Marks**

b) (Based on Module 4) **10 Marks**

Q.6 Answer each of the following: **20 Marks**

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Swami Ramanand Teerth Marathwada University, Nanded			
Faculty of Science & Technology			
Summer / Winter – 20------ Examination			
Name of Subject:		**Zoology**	
Subject Code : (as per examination time table):			
Class:	**M.Sc.**	Semester:	
Paper title and Paper no (as per examination time table):		**…….** **Paper No. ……..(NEP-2020 Pattern)**	
Time:	**2 ½ Hour**	Maximum Marks:	**60**

Important Instructions:

i. Question Number 1 is compulsory.
ii. Out of remaining 5 Questions (Q. No. 2 to Q. No. 6) answer any 3 Questions.
iii. All Questions carry equal marks.
iv. Illustrate your answers with suitable labeled diagrams, wherever necessary.

Q.1 Answer *Any Three* of the following: 15 Marks

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Q.2 a) (Based on Module 1) 08 Marks

b) (Based on Module 1) 07 Marks

Q.3 a) (Based on Module 2) 08 Marks

b) (Based on Module 2) 07 Marks

Q.4 a) (Based on Module 3) 08 Marks

b) (Based on Module 3) 07 Marks

Q.5 a) (Based on Module 4) 08 Marks

b) (Based on Module 4) 07 Marks

Q.6 Answer *Any Three* of the following: 15 Marks

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Swami Ramanand Teerth Marathwada University, Nanded			
Faculty of Science & Technology			
Summer / Winter – 20--- Examination			
Name of Subject:		**Zoology**	
Subject Code : (as per examination time table):			
Class:	**M.Sc.**	Semester:	
Paper title and Paper no (as per examination time table):		**…….** **Paper No. ……..(NEP-2020 Pattern)**	
Time:	**2 Hour**	Maximum Marks:	**40**

Important Instructions:

i. Question Number 1 is compulsory.
ii. Out of remaining 5 Questions (Q. No. 2 to Q. No. 6) answer any 3 Questions.
iii. All Questions carry equal marks.
iv. Illustrate your answers with suitable labeled diagrams, wherever necessary.

Q.1 Answer *Any Two* of the following: **10 Marks**

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Q.2 a) (Based on Module 1) **05 Marks**

b) (Based on Module 1) **05 Marks**

Q.3 a) (Based on Module 2) **05 Marks**

b) (Based on Module 2) **05 Marks**

Q.4 a) (Based on Module 3) **05 Marks**

b) (Based on Module 3) **05 Marks**

Q.5 a) (Based on Module 4) **05 Marks**

b) (Based on Module 4) **05 Marks**

Q.6 Answer *Any Two* of the following: **10 Marks**

a) (Based on Module 1)

b) (Based on Module 2)

c) (Based on Module 3)

d) (Based on Module 4)

Guidelines for Course Assessment:

A. Continuous Assessment (CA) (20% of the Maximum Marks):

This will form 20% of the Maximum Marks and will be carried out throughout the semester. It may be done by conducting **Two Tests** (Test I on 40% curriculum) and **Test II** (remaining 40% syllabus). Average of the marks scored by a student in these two tests of the theory paper will make his **CA** score (col. 6).

B. End Semester Assessment (80% of the Maximum Marks):

(For illustration we have considered a paper of 04 credits, 100 marks and need to be modified depending upon credits of an individual paper)

1. **ESA Question paper will consists of 6 questions, each of 20 marks.**
2. **Students are required to solve a total of 4 Questions.**
3. **Question No.1 will be compulsory and shall be based on entire syllabus.**
4. Students need to solve **ANY THREE** of the remaining Five Questions (Q.2 to Q.6) and shall be based on entire syllabus.

Note: **Number of lectures required to cover syllabus of a course depends on the number of credits assigned to a particular course. One credit of theory corresponds to 15 Hours lecturing and for practical course one credit corresponds to 30 Hours. For example, for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45 lectures.**

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