॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

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

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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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Academic-1 (BOS) Section

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० च्या अनुषंगाने शैक्षणिक वर्ष २०२३–२४ पासून संलग्न महाविद्यालये व विद्यापीठ संकुलांत पदव्युत्तर पदवी प्रथम वर्ष आणि विद्यापीठ संकुले व न्यू मॉडेल डिग्री कॉलेज मध्ये पदवी प्रथमवर्ष अभ्यासक्रम लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, शासन निर्णय क्र. एनईपी २०२०/प. क्र. ०९/विशि–३/शिकाना, दिनांक २० एप्रिल २०२३ व शासन पत्र. क्र एनईपी २०२०/प. क्र. ०९/विशि–३, दिनांक १६ जून २०२३ अन्वये सूचित केल्यानुसार राष्ट्रीय शैक्षणिक धोरण २०२०च्या अनुषंगाने दिलेल्या आराखडया नुसार दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीत ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार प्रस्तुत विद्यापीठाच्या विज्ञान व तंत्रज्ञान विद्याशाखा अंतर्गत खालील पदव्युत्तर पदवी अभ्यासक्रम (AICTE, PCL, BCI, CoA, NCTE इ. सारख्या नियमक संस्थाची मान्यता आवश्यक असलेले अभ्यासक्रम वगळून) संलग्न महाविद्यालये, विद्यापीठ परिसर व उपपरिसर संकुलांमध्ये आणि पदवी प्रथम वर्ष अभ्यासक्रम विद्यापीठ परिसर व उपपरिसर संकुले व विद्यापीठ संचलित न्यू मॉडेल डिग्री कॉलेज, हिंगोली येथे शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात येत आहे.

1) M.Sc. Biotechnology (1st Year) - Campus School
2) M.Sc. Biotechnology (1st Year) – Affiliated colleges
3) B.Sc. Biotechnology (1st Year) – New Model Degree College, Hingoli
4) M.Sc. Botany (1st Year) - Campus School
5) M.Sc. Botany (1st Year) – Affiliated colleges
6) M.Sc. Herbal Medicine (1st Year) - Affiliated colleges
7) M.Sc. Chemistry (1st Year) - Campus School
8) M.Sc. Chemistry (1st Year) - Affiliated colleges
9) M.Sc. Computer Science / Computer Network / Computer Applications (1st Year) University campus, sub campus Latur
10) M.Sc. System Administration & Networking (1st Year) – Affiliated colleges
11) M.Sc. Computer Management (1st Year) – Affiliated Colleges
12) M.Sc. Computer Science (1st Year) – Affiliated Colleges
13) M.Sc. Dairy Science (1st Year) - Affiliated colleges
14) M.Sc. Electronic (1st Year) - Affiliated colleges
15) M.Sc. Geology (1st Year) – University Campus
16) M.Sc. Geography (1st Year) – University Campus
17) M.Sc. Applied Mathematics (1st Year) – Affiliated Colleges
18) M.Sc. Mathematics (1st Year) – Affiliated Colleges
19) M.Sc. Microbiology (1st Year) - University Campus
20) M.Sc. Microbiology (1st Year) – Affiliated colleges

21) M.Sc. Physics (1st Year) - University Campus
22) M.Sc. Physics (1st Year) – Affiliated Colleges
23) M.Sc. Statistics (1st Year) - University Campus
24) M.Sc. Statistics (1st Year) – Affiliated colleges
25) M.Sc. Biochemistry (1st Year) – Affiliated Colleges
26) M.Sc. Zoology (1st Year) – Affiliated Colleges

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

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी२०२०/S&T/अक/२०२३–२४/ 130

सहा.कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

दिनांक : ३०.०६.२०२३.

प्रत : १) मा. प्राचार्य, सर्व संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
२) मा. संचालक, सर्व संकुले परिसर व उपपरिसर, प्रस्तुत विद्यापीठ
३) मा. प्राचार्य, न्यु मॉडेल डिग्री कॉलेज हिंगोली.
४) मा. समन्यवक, कै. श्री उत्तमराव राठोड आदिवासी विकास व संशोधन केंद्र, किनवट.

प्रत माहितीस्तव :
१) मा. कुलगुरू महोदयांचे कार्यालय, प्रस्तुत विद्यापीठ.
२) मा. कुलसचिव, प्रस्तुत विद्यापीठ.
३) मा. सर्व आधिष्ठाता, प्रस्तुत विद्यापीठ.
४) सर्व प्रशासकीय विभाग प्रमुख साहाय्यक, प्रस्तुत विद्यापीठ.
५) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

SWAMI RAMANAND TEERTH
MARATHWADA UNIVERSITY, NANDED - 431 606

(R-2023)

TWO YEAR MASTERS PROGRAMME IN SCIENCE

M. Sc. First Year

Subject: **Zoology**
(Affiliated Colleges)

Under the Faculty of
Science and Technology

(As per NEP-2020)

With effect from academic year 2023-24

From the Desk of the Dean, Faculty of Science and Technology

Swami Ramanand Teerth Marathwada University, Nanded, enduring to its vision statement "***Enlightened Student: A Source of Immense Power",*** is trying hard consistently to enrich the quality of science education in its jurisdiction by implementing several quality initiatives. Revision and updating curriculum to meet the standard of the courses at national and international level, implementing innovative methods of teaching-learning, improvisation in the examination and evaluation processes are some of the important measures that enabled the University to achieve the **3Es, the *equity, the efficiency and the excellence*** in higher education of this region. To overcome the difficulty of comparing the performances of the graduating students and also to provide mobility to them to join other institutions the University has adopted the *cumulative grade point average* (CGPA) system in the year 2014-2015. Further, following the suggestions by the UGC and looking at the better employability, entrepreneurship possibilities and to enhance the latent skills of the stakeholders the University has adopted the *Choice Based Credit System* (CBCS) in the year 2018-2019 at graduate and post-graduate level. This provided flexibility to the students to choose courses of their own interests. To encourage the students to opt the world-class courses offered on the online platforms like, NPTEL, SWAYM, and other MOOCS platforms the University has implemented the credit transfer policy approved by its Academic Council and also has made a provision of reimbursing registration fees of the successful students completing such courses.

SRTM University has been producing a good number of high caliber graduates; however, it is necessary to ensure that our aspiring students are able to pursue the right education. Like the engineering students, the youngsters pursuing science education need to be equipped and trained as per the requirements of the R&D institutes and industries. This would become possible only when the students undergo studies with an updated and evolving curriculum to match global scenario.

Higher education is a dynamic process and in the present era the stakeholders need to be educated and trained in view of the self-employment and self-sustaining skills like start-ups. Revision of the curriculum alone is not the measure for bringing reforms in the higher education, but invite several other initiatives. Establishing industry-institute linkages and initiating internship, on job training for the graduates in reputed industries are some of the important steps that the University would like to take in the coming time. As a result, revision of the curriculum was the need of the hour and such an opportunity was provided by the New Education Policy 2020. National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

The curriculum given in this document has been developed following the guidelines of NEP-2020 and is crucial as well as challenging due to the reason that it is a transition from general science-based to the discipline-specific-based curriculum. All the recommendations of the ***Sukanu Samiti*** given in the **NEP Curriculum Framework-2023** have been followed, keeping the disciplinary approach with rigor and

depth, appropriate to the comprehension level of learners. All the Board of Studies (BoS) under the Faculty of Science and Technology of this university have put in their tremendous efforts in making this curriculum of international standard. They have taken care of maintaining logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding of the students. We take this opportunity to congratulate the Chairman(s) and all the members of various Boards of Studies for their immense contributions in preparing the revised curriculum for the benefits of the stakeholders in line with the guidelines of the Government of Maharashtra regarding NEP-2020. We also acknowledge the suggestions and contributions of the academic and industry experts of various disciplines.

We are sure that the adoption of the revised curriculum will be advantageous for the students to enhance their skills and employability. Introduction of the mandatory ***On Job Training, Internship*** program for science background students is praise worthy and certainly help the students to imbibe first-hand work experience, team work management. These initiatives will also help the students to inculcate the workmanship spirit and explore the possibilities of setting up of their own enterprises.

Dr. L. M. Waghmare, *Dean,* *Faculty of Science and Technology*
Dr. M. K. Patil, *Associate Dean,* *Faculty of Science and Technology*

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.

Dr. H. S. Jagtap
Chairman,
Board of Studies of the **Zoology**
Swami Ramanand Teerth Marathwada University, Nanded (MS)

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	Major Subject (DSE) 4	RM 5	OJT / FP 6	Research Project 7	Practicals 8	Credits 9	Total Credits 10
1	1	**SZOOC401 (4 Cr)** **SZOOC402 (4 Cr)** **SZOOC403 (4 Cr)**	**SZOOE401** (3+1 Cr)	**SVECR 401** *Research Methodology* **(3 Cr)**	--		**SZOOP401 (1Cr)** **SZOOP402 (1Cr)** **SZOOP403 (1Cr)**	**22**	**44**
	2	**SZOOC451 (4 Cr)** **SZOOC452 (4 Cr)** **SZOOC453 (4 Cr)**	**SZOOE451** (3+1 Cr)	**---**	**SDSCOJ 451** **(3 Cr)**	--	**SZOOP451 (1Cr)** **SZOOP452 (1Cr)** **SZOOP453 (1Cr)**	**22**	
Exit option: Exit Option with PG Diploma *(after 2024-25)*									
2	3	**SZOOC501 (4 Cr)** **SZOOC502 (4 Cr)** **SZOOC503 (4 Cr)**	**SZOOE501 (4 Cr)** ***(From same Department / School)***	--		Research Project **SZOOR551 (4Cr)**	**SZOOP501 (1 Cr)** **SZOOE502 (1 Cr)**	**22**	**44**
	4	**SZOOC551 (4 Cr)** **SZOOC552 (4 Cr)**	**SZOOE551 (4 Cr)** ***(From same Department / School)***	**SVECP 551** Publication Ethics (2 Cr)		Research Project **SZOOR552** **(6 Cr)**	**SZOOP551 (1Cr)** **SZOOE552 (1Cr)**	**22**	
Total Credits		**44**	**16**	**05**	**03**	**10**	**10**	**88**	

M. Sc. First Year Zoology Semester I *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SZOOC401(T)**	Invertebrate structure and function	04	--	**04**	04	--
	SZOOC402(T)	Biosystamatics, Taxonomy & Evolution	04	--	**04**	04	--
	SZOOC403(T)	Economic Zoology & Animal Behavior	04	--	**04**	04	--
Elective (DSE)	**SZOOE401(T)**	Quantitaive Biology & Bioinformatics OR Conservation Biology	03	--	**03**	03	--
Research Methodology	**SVECR401(T)**	Research Methodology	03	--	**03**	03	
DSC Practical	**SZOOCP401(P)**	Lab Course in Invertebrate structure and function	--	01	**01**	--	02
	SZOOCP402(P)	Lab Course in Biosystamatics, Taxonomy & Evolution	--	01	**01**	--	02
	SZOOCP403(P)	Lab Course in Economic Zoology & Animal Behavior	--	01	**01**	--	02
DSE Practical	**SZOOEP401(P)**	Lab Course in Elective 1 E-401- Quantitaive Biology & Bioinformatics / Conservation Biology	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**14**	**08**

M. Sc. First Year Zoology Semester I *(Level 6.0)*

Examination Scheme

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)		Avg of	ESA			
			Test I (4)	Test II (5)	(T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SZOOC401(T)**	Invertebrate structure and function	20	20	20	80	--	--	100
	SZOOC402(T)	Biosystamatics, Taxonomy&Evolution	20	20	20	80	--	--	100
	SZOOC403(T)	Economic Zoology & Animal Behavior	20	20	20	80	--	--	100
Elective (DSE)	**SZOOE401(T)**	Quantitaive Biology & Bioinformatics OR Conservation Biology	15	15	15	60	--	--	75
Research Methodology	**SVECR401(T)**	Research Methodology	15	15	15	60	--	--	75
DSE Practical	**SZOOCP401(P)**	Lab Course in Invertebrate structure and function	--	--	--	--	05	20	25
	SZOOCP402(P)	Lab Course in Biosystamatics, Taxonomy&Evolution	--	--	--	--	05	20	25
	SZOOCP403(P)	Lab Course in Economic Zoology & Animal Behavior	--	--	--	--	05	20	25
DSE Practical	**SZOOEP401(P)**	Lab Course in Elective 1 E-401- Quantitaive Biology & Bioinformatics / Conservation Biology	--	--	--	--	05	20	25

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

M. Sc. First Year Zoology Semester II *(Level 6.0)*

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SZOOC451(T)**	Animal ecology, Toxicology & Environmental pollution	04	--	**04**	04	--
	SZOOC452(T)	Gamete biology & Animal Development	04	--	**04**	04	--
	SZOOC453(T)	Biochemistry & Immunology	04	--	**04**	04	--
Elective (DSE)	**SZOOE451(T)**	Tools and Techniques for Biology / Pathobiology & Medical Zoology	03	--	**03**	03	--
On Job Training	**SZOOO451(T)**	ON Job Training	03	--	**03**	03	
DSC Practical	**SZOOCP451(P)**	Lab Course in Animal ecology, Toxicology & Environmental pollution	--	01	**01**	--	02
	SZOOCP452(P)	Lab Course in Gamete biology & Animal Development	--	01	**01**	--	02
	SZOOCP453(P)	Lab Course in Biochemistry & Immunology	--	01	**01**	--	02
DSE Practical	**SZOOEP451(P)**	Lab Course in Elective 2 E-451. Tools & Techniques for Biology / Pathobiology & Medical Zoology	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**14**	**08**

M. Sc. First Year Zoology Semester II *(Level 6.0)*

Examination Scheme

Subject (1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)		Avg of	ESA			
			Test I (4)	Test II (5)	(T1+T2)/2 (6)	Total (7)	CA (8)	ESA (9)	
Major	**SZOOC451(T)**	Animal ecology, Toxicology & Environmental pollution	20	20	20	80	--	--	100
	SZOOC452(T)	Gamete biology & Animal Development	20	20	20	80	--	--	100
	SZOOC453(T)	Biochemistry & Immunology	20	20	20	80	--	--	100
Elective (DSE)	**SZOOE451(T)**	Tools & Techniques for Biology / Pathobiology & Medical Zoology	15	15	15	60	--	--	75
On Job Training	**SZOOO451(T)**	ON Job Training	15	15	15	60	--	--	75
DSE Practical	**SZOOCP451(P)**	Lab Course in Animal ecology, Toxicology & Environmental pollution	--	--	--	--	05	20	25
	SZOOCP452(P)	Lab Course in Gamete biology & Animal Development	--	--	--	--	05	20	25
	SZOOCP453(P)	Lab Course in Biochemistry & Immunology	--	--	--	--	05	20	25
DSE Practical	**SZOOEP451(P)**	Lab Course in Elective 2 E-451. Techniques for Biology / Pathobiology & Medical Zoology	--	--	--	--	05	20	25

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

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

Semester-I

SZOOC401(T) : Invertebrate Structure and Function

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

Course pre-requisite:

Require basic knowledge about invertebrate and species identification of invertebrates

Course objectives:

1. To study the importance of biodiversity, habitat, adaptations, body organization and taxonomic status of non-chordates.
2. To study basic aspects of classification of non-chordates.
3. To understand and describe structural and functional details of anatomy of non-chordates.
4. To develop a correlated view of all non-chordate groups: extinct and living.

Course outcomes:

1. Classify animals from different groups based on their features.
2. Explain the similarity and differences in structure and function of organs in different groups of animals.
3. Understanding about importance of integument and skeletal systems.
4. Compare the functional morphology different groups of invertebrates.

SZOOC401(T) : Invertebrate Structure and Function

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Organization of coelom : Acoelomates Organization of coelom: Pseudocoelomates.	
	1.2	Organization of coelom : Protostomia and Dueterostomia	
	1.3	Locomotion : Flagellar and Ciliary movement in Protozoa	
	1.4	Locomotion : Hydrostatic movement in Coelenterata, Annelida, and Echinodermata	
2.0			**15**
	2.1	Nutrition in Protozoa	
	2.2	Patterns of feeding and digestion in lower Metazoan	
	2.3	Filter feeding in Polychaeta, Mollusca and Echinodermata	
	2.4	Respiration: Organs of respiration: Gills, lungs and trachea Respiratory pigments; Mechanism of respiration	
3.0			**15**
	3.1	Organs of excretion: Coelom, Coelomoducts, Nephridia and Malphigian tubules	
	3.2	Mechanism of excretion; Excretion and Osmoregulation	
	3.3	Primitive nervous system: Coelenterata and Echinodermata	
	3.4	Advanced nervous system: Annelida, Arthropoda, (Crustacea and Insecta) and Mollusca (Cephalopoda)	
4.0			**15**
	4.1	Larval forms of invertebrates (Helminthes, Annelida, Arthropoda and Echinodermata)	
	4.2	Strategies and evolutionary significance of larval forms	
	4.3	Concept and significance of minor phyla	
	4.4	Organization and general characters of minor phyla Hemichordata: Characters, Classification, Affinities and Economic importance.	
		Total	**60**

Text Books

1. Sedgwick, A.A. 'Students Text Book of Zoology', Vol. I, II and III. Central Book Depot, Allahabad.
2. Parker, T.J., Haswell, W.A. 'Text Book of Zoology', Macmillan Co., London.
3. R.L.Kotpal 'Modern Text Book of Zoology Invertebrates'. Rastogi Publications, Meerut.

Reference Books

1. Hyman L.H. 'The Invertebrates. Vol I-Protozoa through Ctenophora', McGraw Hill Co, New York.
2. Hyman, L.H. 'The Invertebrates Vol-II', McGraw Hill Co., New York.
3. Hyman, L.H. 'The Invertebrates. Vol-VIII', McGraw Hill Co., New York and London.
4. Barnes, R.D. 'Invertebrate Zoology, 3rd edition', W.B. Saunders Co., Philadelphia.
5. Barrington, E.J.W. 'Invertebrate Structure and Function', Thomas Nelson and Sons Ltd., London.

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Semester-I

SZOOC402(T) : Biosystamatics, Taxonomy & Evolution

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

Course pre-requisite:

Needs knowledge about animal classification, the relationship among different organisms and to know about their evolution.

Course objectives:

1. To learn the basics of taxonomy and classification of animals.
2. To upgrade knowledge of new taxonomical concepts.
3. To acquaint with different taxonomic databases.
4. To learn the different theories of evolution.
5. To study evolutionary relations and different phylogenetic methods.

Course outcomes:

1. Classify animals from different groups based on their features.
2. Describe different taxa and elaborate on their anatomical and morphological features.
3. Identify and describe homologies between different groups of animals.
4. Identify and access taxonomic information in different online databases.
5. Describe evolutionary relationship between different taxa.
6. Explain about evolutionary distance between different taxa.
7. Infer phylogenetic information and prepare phylogenetic trees.

SZOOC402(T) : Biosystamatics, Taxonomy&Evolution

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Definition and basic concepts of Biosystematics and Taxonomy. Brief historical resume of systematic. Importance and applications of Biosystematics in Biology.	
	1.2	Trends in Biosystematics: Chemotaxonomy, Cytotaxonomy, Molecular Taxonomy and Immunotaxonomy. Dimensions of speciation. Mechanism of speciation.	
	1.3	Species concepts: Species category, different species concepts, sub-species and other infra-specific categories.	
	1.4	Theories of Biological classification; Hierarchy of categories.	
2.0			**15**
	2.1	Taxonomic characters: Different kinds, origin of reproductive isolation, biological mechanism of genetic incompatibility.	
	2.2	Taxonomic procedures: Taxonomic collections, preservation, curating, process of identification.	
	2.3	Taxonomic publications, Preparation of taxonomic publication and taxonomic paper.	
	2.4	Taxonomic keys: Different kinds of keys, their merits and demerits.	
3.0			**15**
	3.1	International Code of Zoological Nomenclature (ICZN); Operative principles, interpretation and application of important rules,	
	3.2	Formation of scientific names of various taxa; Synonyms, homonyms and tautonomy.	
	3.3	Biodiversity- characterization, generation, maintenance and loss;	
	3.4	Magnitude and distribution of biodiversity, economic value, wildlife biology, conservation strategies.	
4.0			**15**
	4.1	Concepts of Evolution. Darwin's Theory of evolution; Modern Synthetic Theory of evolution. Lamark's Theory of Evolution; Mutation Theory of Evolution by Hugo De Vries.	
	4.2	Population genetics: Bottleneck Effect (Founder Effect), Hardy-Weinberg law of genetic equilibrium. Destabilizing forces, natural selection, mutation, genetic drift, migration.	
	4.3	Pattern of changes in nucleotide sequences.	
	4.4	Molecular Evolution, Gene evolution, Evolution of gene families.	
		Total	**60**

Reference Books

1. Kato, M. 'The Biology of Biodiversity', Springer.
2. Avise, J.C. 'Molecular Markers, Natural History and Evolution', Chapman & Hall, New York.
3. Wilson, E.O. 'Biodiversity', Academic press, Washington.
4. Simpson, G.G. 'Principles of Animal Taxonomy', Oxford IBH publishing company.
5. Mayr, E. 'Elements of Taxonomy'.
6. Wilson, E.O. 'The Diversity of life (College Edition)', W.W. Northem & Co.
7. Tikadar, B.K. 'Threatened Animals of India', ZSI Publication, Caculatta.
8. Dobzhansky, Th. 'Genetics and Origin of Species', Columbia University, Press.
9. Dobzhansky, Th., F.J. Ayala, G.L. Stebbines and J.M. Valetine 'Evolution', Surjeet Publicaiton, Dehli.
10. Futuyama, D.J. 'Evolutionary Biology', Suinuaer Associates, INC Publishers, Dunderland.
11. Jha, A.P. 'Genes and Evolution', John Publication, New Delhi.
12. Merrel, D.J. 'Evolution and Genetics', Holt, Rinchart and Winston, Inc.
13. Lull 'Organic Evolution'.
14 Austin Balfour & Dominic Fasso- Principles of Plant and Animal Taxonomy. Syrawood Publishing House.
15 Ashok Verma-Principles of Animal Taxonomy. Alpha Science International Ltd
16 Kapoor V C-Theory and Practice of Animal Taxonomy and Biodiversity, 8th Edition Oxford & Ibh
17 Kapoor V C-Principles and Practices of Animal Taxonomy, Science Publishers.
18 R.C Dalela & R.S Sharma- Animal Taxonomy & Museology. Jai Prakash Nath & Co.

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Semester-I

SZOOC403(T) : Economic Zoology & Animal Behavior

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

Course pre-requisite:

The students know about basic knowledge of applied animals and their behavior.

Course objectives:

1. To learn about communicable and non-communicable diseases in humans.
2. To study the economic importance of animals and animal husbandry.
3. To know culture practices and economic importance of aquaculture.
4. To study different types of behaviour in animals.
5. To learn about application of behavioral knowledge in animal husbandry and other areas of interest.

Course outcomes:

1. Identify animal pathogenic diseases in humans and suggest remedial measures.
2. Evaluate and describe the economic impact of animals on human society.
3. Describe different culture methods relevant to aquaculture.
4. Identify and describe economically important fish and other animals.
5. Identify and explain different types of behavior patterns in animals.
6. Describe the importance of different behaviors in animal husbandry.

SZOOC403(T) : Economic Zoology & Animal Behavior

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Protozoan Parasites Pathogenic to man- Entamoeba histolytica, Trypanosoma gambiense- Binomics, prevention & control.	
	1.2	Zooparasitic Helminths – Structure, Life cycle, Pathogenicity and control. Trematoda – *Schistosoma haematobium*. Cestoda – *Taenia solium and Taenia saginata.* Nematodes – *Wuchereria bancrofti*.	
	1.3	Mosquitoes as vector of Human diseases with special reference to - Malaria, Dengue, Filaria, Chickengunya and control of Mosquitoes.	
	1.4	Introduction to Arthropods of Forensic importance.	
2.0			**15**
	2.1	Apiculture – Social Organization of Honey Bees, Life Cycle, Bee keeping and Economic Importance. Sericulture - Types of Silk moth, Life cycle and rearing of Silk moth.	
	2.2	Fresh Water Fish Culture – Indian major Carps. Management of fish farm. Breeding Pond, Hatching Pit, Nursery and Stocking Pond.	
	2.3	Pearl Culture Pearl producing molluscs. Pearl formation and pearl industries.	
	2.4	Vermiculture and Vermicomposting. Poultry: Breeds, biology of fowl, methods of rearing and maintenance, diseases of poultry and their control measures.	
3.0			**15**
	3.1	Introduction. Concept of Ethology, its Branches and Scope.	
	3.2	Classification of behavioral patterns. a) Innate Behavior. b) Acquired Behavior.	
	3.3	Motivated Behaviour; Goal Directed Behaviour	
	3.4	Different Types of Biological Drives a) The Thirst Drive b) The Hunger Drive c) The Sleep Drive d) Heat and Cold Drive e) The Sexual Drive	
4.0			**15**
	4.1	Perception of environment and Animal communication. Chemical; Olfactory; Auditory; Visual.	
	4.2	Ecological aspects of Behavior- Habitat selection – Optimal foraging theory, Anti predator defenses.	

	4.3	Role of Hormones in Behaviour a) Sexual Behaviour; b) Aggressive Behavoiur Pheromones- Categories; Role of pheromones in animals; Social Organization in Insects and Primates.	
	4.4	Reproductive Behavior – Evolution of Sex and Reproductive Strategies. Mating Systems; Courtship. Parental care in Animals – Fish and Amphibians.	
		Total	**60**

Text Book

1. H. S. Gundevia and H. G. Singh, 'A Text Book of Animal Behaviour', S. Chand & Company Ltd., 2001.

Reference Books

1. Vinod Kumar, 'Animal Behaviour' Himalaya Publishing House, Bombay.
2. Hinde, R.A, 'Animal Behaviour: A Synthesis of Ethology and Comparative Psychology', Mc Graw- Hill, New York.
3. Afcock, J, 'Animal Behaviour: An Evolutionary Approach', Sinauer Assoc. Sunderland Massachsets, USA.
4. G.S.Shukla & V.B. Upadhyay, 'Economic Zoology'.

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Semester-I

SZOOE401 (Elective-A) (T): Quantitaive Biology & Bioinformatics

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

Course pre-requisite:

A minimum background in biology, computer science and mathematics is mandatory.

Course objectives:

1. To study different methods of data processing.
2. To develop skill of data handling using computer.
3. To learn about different data representation methods.
4. To study the different online databases of biological information.
5. To study the different DNA and Protein analysis software.

Course outcomes:

1. Describe different methods of data handling using computers.
2) Feed and tabulate raw data using computer.
3) Explain and perform data representation using digital methods.
4) Access and download relevant information from different online databases of biological information.
5) Perform basic operations of gene sequence retrieval and compare them using different software.
6) Perform basic operations of protein structure retrieval and comparison using different software.

SZOOE401 (Elective-A) (T): Quantitaive Biology & Bioinformatics

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Introduction to Biostatistics – Definition, Terms, Applications and Role of biostatistics in modern research.	
	1.2	Types of data and methods of data collection.	
	1.3	Classification and tabulation of Data.	
	1.4	Measures of Central Tendency- Mean, Median, Mode.	
2.0			**11**
	2.1	Data Dispersion, Correlation and Standard Deviation	
	2.2	Statistical Data Analysis Methods using Computer Programs- Excel, SPSS, Openoffice.	
	2.3	Data Presentation Methods usning Computer Programs- Power Point, Excel, SPSS, Openoffice.	
	2.4	Graphic Representation of Data- Line Graph, Bar Graph, Pie Chart.	
3.0			**11**
	3.1	Bioinformatics: Definition & Scope.	
	3.2	Application Software: Sequence analysis- BLAST, Unipro Ugene; Protein analysis- Chimera.	
	3.3	Role of Internet in Bioinformatics.	
	3.4	Bioinformatics Databases- Genomic and Gene Databases- NCBI, Genbank. Protein Databases- Protein Data Bank (PDB), SwissProt. Metabolic Databases- ptools, reactome.	
4.0			**11**
	4.1	Biological Search Engines.	
	4.2	Introduction to gene sequence search, comparison, alignment and analysis, its scope and applications.	
	4.3	Introduction to protein structure analysis, its scope and applications.	
	4.4	Introduction to drug discovery, Role of protein structure data in drug discovery, software used in drug discovery, general approach to drug discovery.	
		Total	**45**

Reference Books

1. Batschetlet, E. 'Introduction to Mathematics for Life Scientists' Springer-Verlag, Berling.
2. Jorgensen, S. E. 'Fundamentals of Ecological Modelling' Ensevier, New York.
3. Swartzman, G. L. and S. P. O. Kaluzny, 'Ecological Simulation-Primer', Macmillan, New York.
4. Lendren, D. 'Modelling in Behavioral Ecology', Chapman and Hal, London, U. K.
5. Sokal , R. R. and F. J. Rohlf, ' Biometry', Freeman San Francisco.
6. Snedecor, G. W. and W. G. Cochran, 'Statistical Methods' Affiliated East- West Press, New Delhi (Indian ed.)
7. Green, R. H. 'Sampling Design and Statistical Methods for Environmental Biologists', John Wiley and Sons, New York.
8. Murrary, J. D. 'Mathematical Biology', Springer Verlag, Berlin.
9. Pielou, E. C. 'The Interpretation of Ecological Data: A Primer on Classification and Ordination'.
10. P. Rama Krishnan, 'Biostatics', Saras Publication, 2005.
11. Brown,S. M. 'Bioinformatics- A Biologists Guide to Biocomputing and Internet' Eaton Publishing, New York, 2000.
12. Lesk, A. M. 'Introduction to Bioinformatics', Oxford, 2002.
13. Bioinformatics - Methods and Protocols. In: Methods in molecular Biology, Vol.132, Humana Press, 2001.
14. Higgins & Taylor. 'Bioinformatics - Sequence, Structure and Databanks', Oxford, 2000.
15. Baxevanis and Ouellete. 'Bioinformatics' John Wiley & Sons, 1998.
16. Krane and Raymer, 'Fundamental concept of Bioinformatics', Pearson Education, 2003.
17. Attwood and Parry-Smith, 'Introduction to Bioinformatics', Pearson Education, 2003.

Semester-I

SZOOE401 (Elective-B) (T) : Conservation Biology

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

Course pre-requisite:

Basic knowledge about biology, environmental science, and geography for study in conservation biology.

Course objectives:

1. To study concepts of biodiversity and its quantification methods.
2. To learn about factors affecting biodiversity index and Indian biodiversity hotspots.
3. To explore tools used in biodiversity conservation.
4. To study Laws governing management and conservation of biodiversity.
5. To get awareness of significance of biodiversity and be able to inform about its importance to others.

Course outcomes:

1. Ability to describe biodiversity and its role in ecosystem health.
2. Ability to understand and analyze ecological factors affecting biodiversity.
3. Knowledge about different biodiversity hotspots of India and their unique characteristics.
4. An understanding of methods and tools used for wildlife conservation in India.
5. An understanding of and ability to interpret the Laws governing natural biodiversity in India.
6. Ability to disseminate knowledge about biodiversity in India and the significance of its conservation.

SZOOE401 (Elective-B) (T): Conservation Biology

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Concept of Biodiversity Components of Biodiversity (Ecological, Genetic and Species diversity)	
	1.2	Value of Biodiversity Biodiversity at global and national level- a comparative account.	
	1.3	Measures of species diversity: Species richness indices- Menhinick's index, Margalef's index, Species abundance indices- Simpson's index, Shannon index.	
	1.4	Biodiversity Hotspots in India- Himalayas, Indo-Burma, Sundalands and Western Ghats.	
2.0			**11**
	2.1	Threats to Biodiversity: Ecological- competition, predation, climate; and anthropogenichabitat destruction, Human population growth, pollution, land use patterns. Representative wild species of India.	
	2.2	Endemic Species of India- Marine species, Vertebrate and Invertebrate species. Exotic and Invasive species, their effect on native species.	
	2.3	Endangered species of India; IUCN Red List Categories, Red Data Book and Threatened Animals of India.	
	2.4	Conservation of Biodiversity- In-situ conservation; Ex-situ conservation, Techniques used in In-situ & Ex-situ conservation.	
3.0			**11**
	3.1	Basic concept of wildlife Biological Importance and Necessity for wild life conservation	
	3.2	Economic and other benefits of wild life Causes for wildlife depletion Aims and objective of wildlife conservation	
	3.3	Different approaches of wild life conservation Modes and methods of wildlife conservation	
	3.4	National and International Organizations involved in wildlife conservation Sanctuaries, National parks & Biosphere reserves in India.	
4.0			**11**
	4.1	Conservation tools- Geographical Information System (GIS); Remote Sensing; Geographic positioning System (GPS) in brief. Wildlife Health: Diseases of wild animals and their	

		management- A brief account.	
	4.2	Legislative and Administrative measures for conservation of wildlife: Wildlife (Protection) Act of India (1972); International Union for Conservation of Nature (IUCN); World wildlife Fund (WWF)	
	4.3	Present status of wildlife in India.	
	4.4	Challenges in wildlife conservation and management in India- Role of Educational institutes, NGO's and Government organizations in wildlife conservation.	
		Total	**45**

Text Book

1. Anon. 1992. Convention on Biological Diversity - Text and annexes. World Wide Fund for Nature - India.

Reference Books

1. Anon. 2004. Indian Wildlife Protection Act 1972. Natraj Publishers, Dehra Dun. 104p.
2. Anon. 1997. Wildlife (Protection) Act of India, Nataraj Publishers, Dehradun
3. Caughley, G., and A. Gunn. 1995. Conservation Biology in Theory and Practice. Blackwell Publishers.
4. Cody, M.L. and J.M. Diamond 1975. Ecology and Evolution of Communities. Harvard University Press. Cambridge. 545p.
5. Gaston, K. J. 1996. Biodiversity- A Biology of Numbers and Difference. Blackwell Science, Oxford. 396 p.
6. Goutam Kumar Saha, Subhendu Mazumdar-Wildlife Biology : An Indian Perspective.PHI Learning.
7. Giles, H. 1984. Wildlife Management Techniques. Natraj Publishers, Dehra Dun.
8. Gopal, R. 1992. Fundamentals of Wildlife Management. Justice Home. Allahabad. 668p.
9. Groom bridge, B.1992.Global Biodiversity. Status of the Earth's Living Resources. Chapman and Hall, London.
10. Handa, S.K. 1999. Principles of Pesticide Chemistry. Agrobios Publishers, Jodhpur. 309p.
11. Heyer, W.R. *et al* 1994. Measuring and Monitoring Biological Diversity, Standard methods for Amphibians. Smithsonian Institution Press. Washington. 364p.
12. Huffaker, C.B. and A.P. Gutierrez 1999. Ecological Entomology. John Wilely and Sons, New York. 756p.
13. H.R.Singh and Neeraj Kumar- Ecology and Environmental Science. Vishal Publishing Co. Jalandhar.
14. International Commission of Zoological Nomenclature 1999. International code of zoological nomenclature. 4th Edition. International Trust for Zoological Nomenclature, London. 306p.
15. IUCN, The World Conservation Union. http://www.iucn.org/.21
16. Kikkawa, J. and D.J. Anderson 1986. Community Ecology: Pattern and Process. Blackwell Scientific Publications, Oxford. 432p.
17. Meffe, G. K. and C. R. Carroll 1994.Principles of Conservation Biology, Sinauer Associates, USA
18. Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata Mc Graw Hill Publishing Company Limited, New Delhi. 404 p.
19. Odum, E.P. 1996. Fundamentals of Ecology. Natraj Publishers, Dehra Dun 574p. *M.Sc. Zoology-2018-19 onwards-UD-obe Annexure No:83 Page 44 of 62 SCAA Dated: 11.06.2018*
20. Primack, R. B. 2006. Essentials of Conservation Biology, Sinauer Associates, USA.
21. Reaka, M.L., Kudla, D. E. Wilson and E. O. Wilson 1997. Biodiversity II: Understanding and Protecting our Biological Resources. Joseph Henry Press, Washington, DC.
22. Rodgers, W.A. and H.S. Panwar 1988. Planning a Protected Area Network in India. Wildlife Institute of India, Dehra Dun.
23. Soule, M. E. 1986. Conservation Biology: The Science of Scarcity and Diversity, Sinauer Associates Inc., USA.

24. Sutherland, W. J., 1998. Conservation science and action. Blackwell Science, Oxford, England.
25. William J. Sutherland 1996. Ecological census: techniques, (Cambridge University press.
26. William Morris, Daniel Doak, Martha Groom et al., 1999. A Practical handbook for Population Viability Analysis, The Nature Conservancy.
27. Wilson, E. O., and D. Perlman. 2000. Conserving earth's biodiversity. Island Press, Washington, D.C.

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Semester-I

SZOOP401(Practical) : Invertebrate Structure and Function

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Demonstration of Digestive, Reproductive and Nervous system of crab, Earthworms, Cockroach.
2. Mounting of Nephridium & Spermatheca of Earthworm: Trachea of Cockroach, Gills of Crab.
3. Mounting of larvae of insects and crustacea (Any five).
4. Museum specimens from invertebrate phyla: Salient characteristics, identification and classification of representative types of Invertebrate groups from Protozoa, Porifera, Coelenterata, Ctenophora, Platyhelminthes, Aschelminthes, Mollusca, Annelida, Arthropoda, Echinodermata and Hemichordata (Five specimens from each phylum).
5. Identification and study the larval forms all major phyla of Invertebrates.
6. Study of the following specimens to bring out their affinities; a. Balanoglossus b. Cephalodiscus.
7. Five permanent stained micro preparations prepared by the examinee are to be submitted at the time of practical examinations.

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

Semester-I

SZOOP402(Practical) : Biosystematics, Taxonomy and Evolution

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Composition assessment of taxonomic diversity/Bio-diversity in habitat, e.g. Grassland, Wetland, forest etc.
2. Equipments and Specimen Collection Methods.
3. Collection of Insects, Spreading, Pinning and Studying of Insects.
4. Methods of collection, preservation and identification of plankton and representative forms of terrestrial and aquatic fauna.
5. Study of Local Fauna- Collection & Preservation of Animals.
6. Systematic studies of Animals from Protozoa to Mammals (At least five Animals from each group.).
7. Museum preservation techniques of selected vertebrates and invertebrates.
8. Submission of Insects/Animals Collected (Compulsory.)
9. Studies on fossils, connecting links like *Peripatus, Archaeopteryx, Limulus.*
10. Study of Homologous Organs and Analogous Organs.
11. Excursion/Study Tour Compulsory- Visit to ZSI and other places.

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

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Semester-I

SZOOP403(Practical) : Economic Zoology and Animal Behavior

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

Economic Zoology

1. Study of Protozoan Parasites of Man –

i) *Entamoeba histolytica*, ii) *Trypanosoma iii) Plasmodium.*

2. Study of Parasitic helminthes –

i) Schistosoma haematobium. ii) Taenia solium. iii) *Taenia saginata. iv*) *Wuchereria bancrofti.*

3. Study of – i) Social organization of bees; ii) Life cycle of Honey bee; iii) Hive iv) Mosquitoes-Life cycle.

4. Identification of Food Fishes and Molluscsi)

Labeo rohita; ii) *Catla catla;* iii) *Cirrhina mrigala;* iv) *Channa;*

v) *Perna indica;* vi) *Crassostrea.*

5. Visit to Fish breeding Farm.

6. Study of life cycle of Silk moth.

7. Study of Vermiculture.

Animal Behavior

8. Study of Positive and negative phototrophism.

9. To study the habituation to light stimulus in the earthworm *Pheritima.*

10. To study the distribution of light stimuli in the earthworm *Pheritima*

11. To demonstrate photo tactic and geotactic responses of the animal provided (House fly *Musca domestica*)

12. Study of Positive and Negative Chemotactic Response with suitable examples.

13. Righting response in crab or any other animal.

14. Communication – Examples from invertebrates and vertebrates (Terrestrial, Aerial, Aquatic habitats)

15. Ecological aspects – Food selection, optimal foraging, prey and predator, Host-Parasite relationship.

16. Social behaviour – Aggregations – Examples from fishes, birds and mammals, social organization – insects

17. Reproductive behaviour – mating systems, sexual selection, parental care in animals.

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

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Semester-I

SZOOEP401(Elective-A; Practical) : Quantitative Biology and Bio-Informatics

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Classification of data
2. Preparation of Histograms.
3. Preparation of Bar Diagrams.
4. Preparation of Pie Chart.
5. Drawing Graphs and Tables on Computer.
6. Problems based on Mean, Median and Mode.
7. Problems based on Standard Deviation.
8. Problems based on Correlation.
9. Graphic representation of Data- Tables, Graphs, Scatter plots.
10. Searching given nucleotide sequence in a database using BLAST and reporting the results.
11. Comparison of given nucleotide sequences and reporting the results.
12. Searching, downloading and visualizing a protein structure file.
13. Comparison of given protein sequence files and reporting the results.
14. Searching a given metabolic pathway and visualizing it.
15. Searching biological information about a given gene sequence in an online database and report.
16. Searching biological information about a given protein in an online database and report.

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

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Semester-I

SZOOEP401(Elective-B) (Practical) : Conservation Biology

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Collection and preservation of fauna.
2. Sampling Techniques (Transect and quadrate method).
3. Identification and use of keys – reference specimen.
4. Wildlife photography and documentation of locally occurring wild species of animals.
5. Remote sensing GIS and their modules for conservation.
6. IUCN Red List Exercise, VORTEX and SIS.
7. Statistical analysis – Shannon Weiner Index, Simpson's index, Species richness and evenness.
8. Museum study of Vertebrate Endangered Species or Threatened Wild Animals on the Basis of charts/ models/ photographs (Any Five).
9. Survey/Study of local/nearby natural habitat and reporting of its biodiversity and health status.
10. Submission of local biodiversity album (soft copy in ppt or pdf format).
11. Field Visit to wild life sanctuaries and National parks (Tour report submission)

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

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

Semester-I

SVECR 401 : Research Methodology

Curriculum Details

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

Course pre-requisite:

A minimum background in biology, computer science and mathematics is mandatory.

Course objectives:

1. This course offers overview of Research Methodology including quantitative and qualitative research in basic as well as applied aspects of Biological Sciences.
2. It is designed to provide hands-on experience with collection, analysis and interpretation of data and also writing a report/thesis.
3. Moreover, this course focusses on developing the skills necessary for pursuing a career in research.
4. The students will be motivated to learn scientific investigation to solve problems, test hypothesis, develop or invent new products for the benefit of society.

Course outcomes:

After completing this course, the students should be able to:

- 1. Describe basic concepts of research and its methodologies
- 2. Identify appropriate research topics and set up hypothesis
- 3. Perform literature review using library (print) and internet (online) resources
- 4. Design experiments/surveys, collect data and represent data in tables/figures
- 5. Analyze data with appropriate software tools, interpret results and draw conclusion
- 6. Write scientific report/ review/ thesis and prepare seminar/ conference presentations - oral as well as poster
- 7. Understand the methods of citation and referencing styles, check plagiarism and get insight of intellectual property right

Curriculum Details:

SVECRM401: *Research Methodology*

Module No.	Unit No.	Topic	No. of hours required to cover the contents
1. 0		**Research Methodology**	**10 Hours**
	1.1	Meaning of research, Objectives of research, Types of research,	
	1.2	Research approaches, Significance of research, Research methods versus methodology, Research and scientific methods,	
	1.3	Research processes, Criteria for good research	
	1.4	Research problem, Selecting the problem, Necessity of defining the problem, Techniques involved in defining a problem	
2.0		**Research Design and Sample Surveys**	**12 Hours**
	2.1	Meaning and need for research design, features of a good design.	
	2.2	Important concepts relating to research design: Dependent and independent variables, Extraneous variables, Control, Research hypothesis, Experimental and non-experimental hypothesis – Testing research, Experimental and control group	
	2.3	Different research designs: Research design in case of exploratory research studies, Research design in case of hypothesis- testing research studies, basic principles of experimental designs, Important Experimental Designs	
	2.4	Sampling Design, steps in sample design, criteria of selecting a sampling procedure, characteristics of a good sample design, different types of sample design	
3.0		**Data Collection and Data Processing**	**12 Hours**
	3.1	Measurements in Research, Measurement Scales, Sources of errors in measurement	
	3.2	Collection of primary data: Observation Method, Interview Method, through questionnaires, through schedules, difference between questionnaire and schedule	
	3.3	Collection of secondary data, Selection of appropriate methods for data collection, Case study method	
	3.4	Data processing, processing operations: editing, coding, classification, tabulation, graphical representation, types of analysis, Statistics in research, Dispersion and Asymmetry, Measures of Relationship, Regression Analysis	
4.0		**Testing of Hypothesis and Chi-Square Test**	**11 Hours**
	4.1	Basic Concepts Concerning Testing of Hypotheses, Procedure and Flow diagram for Hypothesis Testing, Measuring the Power of a Hypothesis Test, Tests of Hypotheses , Hypothesis Testing of Correlation Coefficients and Limitations of the Tests of Hypotheses	
	4.2	Chi-Square Test: Chi-Square Test for Comparing Variance, Chi-square as a Non-parametric Test, Conditions for the Application of Chi-Square Test, Steps Involved in Applying Chi-square Test, Important Characteristics of Chi-Square Test and caution in using Chi-Square test. Relationship between Spearman's r's and Kendall's, Characteristics of	

	4.3	Distribution-free or Non-parametric Tests Analysis of Variance (ANOVA), Analysis of Co-Variance (ANOCOVA), Distribution-free Tests, its importance	
	4.4	Multivariate Analysis Techniques, Characteristics and Applications, Classification of Multivariate Techniques, Variables in Multivariate Analysis, Important Multivariate Techniques.	
		Total	**45 Hours**

Text Book:

1. C. R. Kothari, *Quantitative Technique*, New Delhi, Vikas Publication House

Reference Books:

1. Michael Alley, *The Craft of Scientific Writing (3rd Edition)*, Springer, New York, 1996
2. Philip Reubens (General editor), *Science and Technical Writing – A Manual ofStyle (2nd Edition)*, Routledge, New York, 2001

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Semester-II

SZOOC451(T) : Animal Ecology, Toxicology and Environmental Pollution

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

Course pre-requisite:

Know about natural environment, Pollution, harmful effects of various components on living organisms.

Course objectives:

1. Study the greenhouse effect and global warming.
2. Learn about pollution and its effects on ecosystems.
3. Study the adaptations of animals to different ecosystems.
4. Explore different environmental conservation and management techniques.

Course outcomes:

1. Describe the role of different gases in greenhouse effect.
2. Identify and suggest remedial measures to deal with different types of pollution.
3. Identify and describe adaptations of animals to different ecosystems.
4. Suggest and develop conservation and management stategies for a particular ecological problem.

SZOOC451 (T) : Animal Ecology, Toxicology and Environmental Pollution Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Ecology- Basic Concept. Nature of Ecosystem- Abiotic and Biotic Factors. Energy Flow in Ecosystem.	
	1.2	The Abiotic Environment Temperature, Water and Soil as an Ecological Factors.	
	1.3	Minimums, Tolerances and the Medium. Liebig's Law of Minimum. Law of Limiting Factors. Shelford's Law of Tolerance.	
	1.4	Ecological Adaptations Volant Adaptations Aquatic Adaptations Desert Adaptations	
2.0			**15**
	2.1	Biogeochemical Cycles and Ecosystem Carbon Cycle	
	2.2	Nitrogen Cycle Sulphur Cycle	
	2.3	Phosphorous Cycle Water Cycle	
	2.4	Population Ecology Characteristics of Population Population Growth Population Fluctuations and Equilibrium Population Regulation	
3.0			**15**
	3.1	Introduction to Toxicology and Pollution Environmental Toxicology Common Toxic Manifestations Toxic Metal Pollutants	
	3.2	Toxic Gaseous Pollutants Toxic Inorganic and Organic Compounds Environmental Carcinogens	
	3.3	Air Pollution Introduction Composition of the Atmosphere Sources of Air Pollution Effects of Air Pollution Air Pollution Monitoring and Control.	
	3.4	Global Warming- Consequences and Effects. Soil pollution sources, effect and control	
4.0			**15**

	4.1	Water Pollution Sources & effects of Water Pollution Physical and Chemical Examinations of Water	
	4.2	Water Pollution and Diseases Waste Water Treatment Processes a) Chemical Treatment and Biological Treatments	
	4.3	Noise Pollution – Sources, Effects and Control of Noise Pollution	
	4.4	Pollution by Solid Wastes. Sources and Effects Introduction to Indian legislations for pollution control.	
		Total	**60**

Reference Books

1. Odum – 'Ecology'.
2. P.D. Sharma, 'Ecology and Environment' Rastogi Publications, Meerut-250 002, India.
3. Edward J. Kormondy, 'Concepts of Ecology', Himalaya Publications House, Mumbai.
4. Mohan P. Arora, 'Ecology' Himalaya Publications House, Mumbai.
5. H. Loggen, 'Environmental Pollution' 2nd Edition, Holt Reinhort Wintson (1978).
6. APHA, 'Standard methods of Examinations of Water and Waste Water' 20th Edition (2000).
7. J. H. Seinfield , ' Air Pollution; Physical and Chemical Fundamentals', Mc Graw Hill, New York (1975).
8. T. N. Tiwari,V. P. Kudesia, ' Noise Pollution and it's Control' , Pragati Prakashan, New Delhi (1990).
9. G. R. Chatwal, M. C. Mehra, ' Environmeatal Radiation, Thermal Pollution And Control' Amol Publication, New Delhi (1989).

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Semester-II

SZOOC452(T) : Gamete Biology and Animal Development

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

Course pre-requisite:

Basic knowledge about formation of gametes, fertilization, development of animals from embryo.

Course objectives:

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

Course outcomes:

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

SZOOC452(T) : Gamete Biology and Animal Development

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Spermatogenesis Ultra structure of mammalian sperm. Different phases of spermatogenesis. Factors Controlling Spermatogenesis.	
	1.2	Oogenesis: Morphology of generalized mature ovum. Different phases of Oogenesis.	
	1.3	Fertilization: Pre fertilization events Post fertilization events Biochemistry of fertilization	
	1.4	Biochemistry of semen: Semen composition and formation in human. Assessment of sperm function. Semen related disabilities.	
2.0			**15**
	2.1	Ovarian follicular growth & differentiation Morphology Endocrinology Molecular biology Ovulation and ovum transport in mammals.	
	2.2	Multiple ovulation and Embryo transfer technology (MOET)	
	2.3	Invitro Oocyte maturation Super ovulation Invitro fertilization **(**IVF) Care and breeding of experimental animals including bioethics.	
	2.4	Assisted reproductive technologies Embryo sexing and cloning Screening for genetic disorders ICSI, ZIFT, GIFT etc. Cloning of animals by nuclear transfer Embryonic stem cells, renewal by stem cells, stem cell disorders: Brief Account.	
3.0			**15**
	3.1	Chick embryology: Structure of egg of Hen	
	3.2	Fertilization, Cleavage,	
	3.3	Blastulation, Gastrulation,	
	3.4	Foetal Membranes in chick	
4.0			**15**

	4.1	Metamorphosis Metamorphosis in amphibians & its hormonal control	
	4.2	Metamorphosis in insects & its hormonal control.	
	4.3	Regeneration	
	4.4	Regeneration in Invertebrate & Vertebrate animals.	
		Total	**60**

Reference Books

1. Balinsky, B.I. 'Introduction to Embryology', Saunders, Philadelphia
2. Beril, N.J. and Karp, G 'Developmental Biology' Tata McGraw Hill, New Delhi
3. Davidson, E.H. 'Gene activity during early development' Academic press, New York
4. Gilibert, S.F. 'Developmental Biology', Sinaver Associated IAC; Massachusetts
5. Muthukaruppam 'Animal Development' A laboratory Guide 1979 MKV Madurai.
6. Patten Foundation of Embryology
7. Suresh. C. Goel 'Principles of Animal Developmental Biology' Himalaya Publishing House,
8. Vasudeo Rao 'Developmental Biology – A Modern Synthesis' Oxford & IBH Pub. Co. Pvt Ltd.
9. Verma & Agarwal 'Chordate Embryology'.

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Semester-II

SZOOC453(T) : Biochemistry and Immunology

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

Course pre-requisite:

Knowledge about chemistry of living things, immune system of living organisms.

Course objectives:

1. To provide students with a deep knowledge in biochemistry.
2. To study the function and structure of Biomolecules.
3. To establish correlation between metabolism of different types of Biomolecules
4. To understand the structure and working of vertebrate immune system.
5. To study the innate and adaptive immunity.
6. To study the different immunological disorders found in man.
7. To study the new techniques in immunology and application of antibodies in clinical therapy and biological research.

Course outcomes:

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

1. Understand the chemical structure and functions of various biomolecules
2. Understand the correlation between metabolism of different types of Biomolecules
3. Describe the structure and working of different components of vertebrate immune system.
4. Elaborate about the innate and adaptive immune responses in vertebrates.
5. Describe the different immunological disorders found in man.
6. Explain the different techniques in immunology
7. Elaborate about structure and application of antibodies in clinical therapy and biological research.

SZOOC453 (T) : Biochemistry and Immunology

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**15**
	1.1	Biomolecules- Classification, Structure and Properties of Carbohydrates. Classification, Structure and Properties of Lipids. Classification, Structure and Properties of Proteins.	
	1.2	Metabolism- Carbohydrate Metabolism Steps of Glycolysis (EMP Pathway). Energy and Electron balance sheet. Regulation of Glycolysis. Glycogenesis, Glycogenolysis and Glyconeogenesis.	
	1.3	Citric Acid Cycle- Pyruvate oxidation. Various steps in citric acid cycle. Enzymes of citric acid cycle. Energetics of citric acid cycle.	
	1.4	Pentose Phosphate Pathway (HMP shunt).	
2.0			**15**
	2.1	Lipid Metabolism- The _ Oxidation (beta oxidation) pathway. Energy yield from fatty acid oxidation	
	2.2	Oxidation of unsaturated fatty acids. Control of fatty acid oxidation. Ketosis, Ketolysis and Ketogenesis	
	2.3	Fatty Acid Biosynthesis- Biosynthesis of Palmitate from acetyl Co A. Control of fatty acid synthesis.	
	2.4	Nitrogen Metabolism- Amino acid degradation Transamination, deamination and decarboxylation reactions of amino acids. Disposal of Ammonia (Detoxification & Excretion) – Krebs-Henseleit Urea Cycle	
3.0			**15**
	3.1	Innate (Non-specific) Immunity. Adaptive or Acquired (Specific) Immunity- Passive & Active Acquired Immunity	
	3.2	Cells & Organs of Immune System- T- cell & T- cell receptor. T- cell maturation, activation & differentiation. B-Cell, B-cell generation, activation and differentiation	
	3.3	Immunoglobulin: Introduction Structure of Antibody Classification, Structure and Functions of Immunoglobulin	
	3.4	Nature of antigen & super antigens- Epitopes & haptens. Antigenicity & immunogenicity.	

		Factors influencing immunogenicity. Antigen- antibody interaction & their applications.	
4.0			**15**
	4.1	Hypersensitivity Introduction & Factors causing Hypersensitivity. Types of Hypersensitivity. Type-I : Anaphylactic Hypersensitivity Type-II: Antibody Dependent Cytotoxic Hypersensitivity Type-III: Immune Complex Mediated Hypersensitivity Type-IV: Cell Mediated Delayed Hypersensitivity Type-V: Stimulatory Hypersensitivity	
	4.2	Cytokines- Properties of cytokines. General structure of cytokines, functions of cytokines.	
	4.3	Complement System- Complement components. Classical & alternative pathway. Significance of complement system.	
	4.4	Hybridoma Technology- Monoclonal antibodies- production & clinical uses. Polyclonal antibodies. Immunodeficiency Disorders-Reticular Dysgenesis, AIDS. Autoimmune Diseases- Haemolytic anaemia, Myasthenia gravis and Lupus erythromatosis	
		Total	**60**

Text Book:

1. Text Book of Biochemistry- Devlin, T. M. John Wiley & Sons.

Reference Books:

1. Principles of Biochemistry- Lehninger, Nelson & Cox, CBS Publishers, New Delhi.
2. Biochemistry- Lubert Stryer.
3. Biochemistry- Voet D. & Voet J. G. John Wiley & Sons.
4. Biochemistry- Zubay, CBS Publication.
5. Fundamentals of Biochemistry- J. L. Jain, Sanjay Jain & Nitin Jain, S. Chand and Company.
6. Harpers Illustrated Biochemistry- Robert K. Murray, Daryll K. Cranner, Peter A. Mayes & Victor W. Rodwell, International Edition, LANGE- Mc Graw Hill.
7. Biochemistry- Christopher K. Mathews, K. E. Van Holde & Kelvin G. Ahern-Pearson Education.
8. Modern Experimental Biochemistry, Rodney Boyer, Pearson Education Third Edition.
9. A Biologists Guide to Principles & Techniques of Biochemistry- K. Wilson & K.H. Goulding.
10. Hawks Physiological Chemistry- B. L. Oser, Tata Mc Graw Hill Company, New Delhi.
11. Practical Biochemistry- Wilson and Walker, Cambridge.
12. Experimental Biochemistry- Clark- Swizer.

Immunology

13. Kuby Immunology- Richard A. Goldsby, Thomas J. Kindt & Barbara A.Osborne, W. H. Freeman & Company, New York.
14. Essential Immunology- Roitt I. M., ELBS Edition.
15. Fundamentals of Immunology- Paul W.
16. Modern Immunology- Das Gupta.
17. Immunology & Serology- Carpenter.
18. The Immune System- Hobert & Mc Cornel. 20. Practical Immunology- Hay & Hudson.
19. Immunology- Donald M. Weir & John Stewart, ELBS Publication.
20. Practical Immunology- Volume I & II, Talwar and Gupta.

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Semester-II

SZOOE451(Elective-C) (T) : Tools and Techniques for Biology

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

Course pre-requisite:

Basic knowledge about various tools used in biological sciences and their techniques.

Course objectives:

1. To study the different tools used in biology and research.
2. To learn about the operational handling and maintenance of laboratory instruments and glassware.
3. To study different types of microscopy used in biology.
4. To learn about different molecular and cellular separation techniques and their application in biological research.
5. To study principles and methods of microtechnique.

Course outcomes:

1. Identify and describe the different equipment and tools used in a biology laboratory.
2. Correctly operate different laboratory instruments.
3. Correctly operate different types of microscopes.
4. Prepare tissue for section cutting and correctly operate a microtome.
5. Choose and perform correct staining technique for any given tissue sections.
6. Describe cellular separation techniques.
7. Properly handle and maintain glassware.
8. Properly operate laboratory equipment.

SZOOE451(Elective-C) (T) : Tools and Techniques for Biology

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**12**
	1.1	Operation, Maintenance and care of Equipment Distillation units	
	1.2	Incubators and Ovens Digital Balances	
	1.3	Heating equipment- Water bath, Heating mantle, Hot plate.	
	1.4	Handling and cleaning of Laboratory glassware.	
2.0			**11**
	2.1	Importance of Tools and Techniques for Biology.	
	2.2	Principles, Working Mechanisms and Uses of Analytical Instruments – Balances, pH Meter,	
	2.3	Colorimeter, Spectrophotometer, Ultracentrifuge,	
	2.4	Spectroflurometer, Radioactive Counters.	
3.0			**11**
	3.1	Microscopy: Principles and Application of Light, Phase Contrast, Fluorescence, Scanning and Transmission Electron Microscopy. Operation and maintenance of simple and compound microscopes.	
	3.2	Microtomy: Types and applications; Collection & Preservation of animal tissue – Fixation, Embedding, Section Cutting, Staining and Mounting.	
	3.3	Staining Techniques for different histochemical studies	
	3.4	Cryotechniques: History and applications of Cryotechniques,	
4.0			**11**
	4.1	Importance of Separation Techniques in Biology	
	4.2	Separation by Chromatography- Paper, Thin Layer, Column, Affinity chromatography and HPLC.	
	4.3	Electrophoresis- Agarose Gel Electrophoresis, PAGE, Iso-electric focusing.	
	4.4	Centrifugation- Ultra centrifugation, Density Gradient Centrifugation; Cell Separation- Flow Cytometry	
		Total	**45**

Reference Books:

1. Robert Braun, 'Introduction to Instrumental Analysis', Mc Graw Hill International Editions.
2. K. Wilson and K. H. Golding, A Biologists Guide, 'Principles and Techniques of practical Biochemistry', ELBS Editions.
3. Keith Wilson and John Walker, 'Practical Biochemistry' (Principles and Techniques).
4. Mido and Satake, 'Introduction to Nuclear Chemistry'.
5. John R. W., 'A Practical Approach- Animal Cell Culture', IRL Press.
6. Arora M. P. and Singh, 'Nuclear Chemistry'.

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Semester-II

SZOOE451(Elective-D) (T) : Pathobiology & Medical Zoology

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

Course pre-requisite:

Knowledge about various disease their causes, effects etc. in human and other living organisms.

Course objectives:

1. To learn about communicable and non-communicable diseases in humans.
2. To learn about pathological agents causing disease in man.
3. To study parasitic diseases in man and farm animals.
4. To understand biology of disease carrying vectors and their mode of transmission of pathogens.
5. To learn about changes taking place in human body upon infection by pathogens.

Course outcomes:

1. Explain about the different pathogens causing disease in man.
2. Describe the different parasites causing disease and disability in man and animals.
3. Ability to elaborate about the life cycle and biology of disease carrying vectors; suggest preventive and control measures for the said diseases.
4. An understanding of the relationship between changes in physiology of host and progress of pathogenesis in human beings and animals.

SZOOE451(Elective-D) (T) : Pathobiology & Medical Zoology

Curriculum Details:

Module No.	UnitNo.	Topic	Hrs. Required to cover the contents
1. 0			**11**
	1.1	Human Diseases. Categories of Diseases Symptoms and preventive measures of-	
	1.2	Communicable Diseases: Influenza, Cholera, Tuberculosis.	
	1.3	Non-communicable Diseases: Diabetes, Cancer, Arthritis.	
	1.4	Genetic Diseases: Hemophilia, Color blindness, Muscular dystrophy.	
2.0			**12**
	2.1	Important human and veterinary parasites (Protozoan and helminthes) Life cycle, biology, symptoms and control of *Plasmodium vivax, Entamoeba histolytica,*	
	2.2	*Trypanosoma gambiense, Leishmania donovani,*	
	2.3	*Schistosoma haematobium, Taenia solium, Ascaris lumbricoides.*	
	2.4	Host - Parasite interactions	
3.0			**11**
	3.1	Biology of house fly (*Musca domestica*) and	
	3.2	Biology of mosquitoes (*Culex, Anophiles*)	
	3.3	Arthropods as vectors of human diseases (Mosquitoes, Lice, Flies and Ticks)	
	3.4	Mode of transmission of pathogens by vectors Vector Control methods- Chemical, Physical, and Biological control.	
4.0			**11**
	4.1	Important tests for diagnosis of pathogenesis- blood cell counts, enzyme tests, and other tests.	
	4.2	Changes in the blood during infection & disease.	
	4.3	Types of anaemia, Biochemical and Microscopic changes in tissues.	
	4.4	Basic concepts of immunology–vaccines; HIV and AIDs; Adolescence, drug and alcohol abuse.	
		Total	**45**

Text Book:

1. Text book of Pathology - an introduction to medicine 6th edition Philadelphia. Lea & Febiger, 1953.

Reference Books:

1. Animal parasites, their life cycles and ecology - O. W. Oslsen.
2. Clinical Haematology - Dy. L. Aksencu &A. Dranaikota, 1972.
3. Principles of Pathobiology - Lavia, Mariano F.Hill, Rolla B. Oxford University Press, London, 1975.
4. Veterinary clinical pathology, E.H. Coles D 1967.

Semester-II

SZOOP451(Practical) : Animal Ecology, Toxicology and Environmental Pollution

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Estimation of pH, Dissolved oxygen, Carbon di-oxide, Salinity and Carbonates and Bicarbonates in water samples.
2. Study of Population Growth by model assumption and problems.
3. Estimation of Carbonate or Nitrate from the soil sample.
4. Estimation of Sulphate or Phosphate in the water sample.
5. Animal Association - parasitism, mutualism and commensalisms.
6. Ecological Adaptations (Any two examples from each to be studied)

a) Volant Adaptations; b) Aquatic Animals (from fresh water and marine environment);

c) Desert Animals.

7. To study the effect of pollutant on heart beat on given animal (Crab/Fish/ Daphnia).
8. Estimation of Chlorides/Salinity/Hardness from given water sample.
9. Determination of LC50 in relation to any toxicant in given aquatic animal.
10. Study of rate of oxygen consumption by aquatic animals under environmental stresses.
11. Visit to treatment Plants- a) Drinking water treatment plant.

b) Effluent Treatment.

c) Sewage treatment

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

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Semester-II

SZOOP452(Practical) : Gamete Biology and Animal Development

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Histological study of different stages of Gametogenesis.
2. Physical and chemical examination of semen
3. Microscopic examination of semen
4. Histological study of gonads of Frog/ Rat.
5. Demonstration of Reproductive system of Leech and Rat.
6. Study of types of eggs.
7. Estimation of calcium in egg shell by EDTA method
8. Mounting of Chick embryos of different hours (whole mount).
9. Study of permanent whole mount slides of Chick embryos of different hours.
10. Study of L.S/ T.S. of chick embryo through head and heart regions.
11. Study of Development of Frog/Embryology of Frog.
12. Studies on metamorphosis of Insect.
13. Experiments in regeneration in Hydra or Planaria.

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

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Semester-II

SZOOP453 (Practical) : Biochemistry and Immunology

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

Biochemistry

1. Determination of Glycogen/ Glucose.
2. Determination of Lipids/ Cholesterol.
3. Separation of serum proteins /tissue proteins by Electrophoresis.
4. Estimation of SDH & LDH activity.
5. Estimation of free amino acids / Proteins/Urea/Uric Acid.
6. Routine examination of urine (physical examination of urine)
7. Determination of specific gravity of urine by urinometer and refractormeter.
8. Chemical examination of urine.
9. Microscopic examination of urine
10. Estimation of an Enzyme – Amylase, Protease, Acetylcholine Esterase (AchE) activity (Any one).

Immunology

11. Identification of Blood Groups: A, B, AB, O with Rh factor.
12. Qualitative test for ABO Blood grouping with antisera by slide method
13. Separation of Proteins (alpha, beta, gamma) by Paper / Gel Electrophoresis.
14. Differential Leucocytes Count (DLC).
15. Identification of histological slides of lymphoid tissue - Spleen, thymus, lymph node and bone marrow.
16. Preparation and Observation of Bone Marrow Smear.
17. ELISA (Enzyme Linked Immuno Sorbent Assay).
18. HIV test (Tridot method).

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

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Semester-II

SZOOEP451(Elective-C) (Practical) : Tools and Techniques for Biology

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Cleaning and overhauling a microscope.
2. Operation of any three different types of microscopes.
3. Fixing, embedding and block preparation of given tissue.
4. Section cutting of given tissue blocks using a microtome.
5. Staining and mounting of given tissue sections.
6. Operation of distillation plant.
7. Operation of oven and incubator.
8. Separation of pigments by paper chromatography.
9. Separation of Amino Acids from tissue extracts by chromatography.
10. Separation of Proteins using Gel Electrophoresis.
11. Principles, Uses and Working Mechanism of High Performance Liquid Chromatography (HPLC).
12. Centrifugation of given sample using a laboratory centrifuge.
13. Colorimetric estimation of Protein / Glucose from given tissue sample.

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

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

Semester-II

SZOOEP451(Elective-D) (Practical) : Pathobiology/ Medical Zoology

Curriculum Details

Periods : 30 (15 Practical's) **No. of Credits: 01 (Marks: 25)**

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1. Estimation of blood glucose
2. Measurement of Blood Pressure.
3. Identification, classification and description of Protozoan Parasites through permanent slides/photomicrographs- a) *Plasmodium vivax*, b) *Entamoeba histolytica*, *c)Trypanosoma gambiense,* d)*Leishmania donovani e)Trichomonas vaginalis*.
4. Collection, staining, identification and description of Parasitic protozoa from Blood sample of Human/ suitable animals –a)Flagellates, b) Malarial parasites c) Coccidian Parasites
5. Identification, classification and description of Parasitic Helminths through permanent slides/photomicrographs or specimens- *a)Schistosoma haematobium b)Taenia solium c)Ascaris lumbricoides d) Wuchereria bancrofti*.
6. Collection, Preservation, Staining, Mounting, identification and description of Parasitic Helminths from locally available different hosts.
7. Study of following arthropods through permanent slides/ photographs: *Aedes, Culex, Anopheles, Pediculus humanus, Xenopsylla cheopis, Cimex lectularius Phlebotomus argentipes, Musca domestica*.
8. Collection, preservation, Preparation of permanent slides and description of mouth-parts of –
i. House fly ii. Mosquito iii. Bed bug iv. Head louse.
9). Estimation of total proteins, carbohydrates and lipids in Human blood sample.
10. Estimation of total proteins, carbohydrates and lipids in Helminths.
11. Blood smear preparation and identification of lymphocyts.
12. Estimation of Haemoglobin in Human blood sample.

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

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.

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