॥ 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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E-mail: bos@srtmun.ac.in

विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार पदव्युत्तर स्तरावरील प्रथम वर्षाचे अभ्यासक्रम शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्याबाबत.

प रि प त्र क

संदर्भ:– १. जा.क्र.शै–१/एनईपी२०२०/S&T/अक्र/२०२३–२४/१३० दिनांक ३०/०६/२०२३

२. जा.क्र.शै–१/एनईपी२०२०/S&T/अक्र/२०२३–२४/१३३ दिनांक ०७/०७/२०२३

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, संदर्भीय परिपत्रकान्वये दिनांक १६ जून २०२३ रोजी संपन्न झालेल्या मा. विद्यापरिषदेच्या बैठकीतील ऐनवेळचा विषय क्र. ०५/५६–२०२३ अन्वये मान्यता दिल्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरणानुसार अभ्यासक्रम शैक्षणिक वर्ष २०२३–२४ पासून लागू करण्यात आलेले आहेत. तथापी वरील संदर्भीय परिपत्रक १ व २ अन्वये प्रकाशित केलेल्या अभ्यासक्रमामध्ये अभ्यासमंडळानी किरकोळ दुरूस्ती करून अभ्यासक्रम सादर केले आहेत. त्यानुसार दुरूस्तीसह खालील अभ्यासक्रम लागू करण्यात येत आहेत.

1. M. Sc. Chemistry I year (University Campus)
2. M. Sc. Zoology I year (University Campus)

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.:शैक्षणिक–१/परिपत्रक/एनईपीपीजी/S&T/
२०२३–२४/302

आपली विश्वासू

डॉ. सरिता यन्नावार
सहाय्यक.कुलसचिव

दिनांक : १८.०९.२०२३.

प्रत माहिती व पुढील कार्यवाहीस्तव :

१) मा. अधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
२) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
३) मा. प्राचार्य, सर्व संबधित महाविद्यालये, प्रस्तुत विद्यापीठ.
४) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. यानां देवून कळविण्यात येते की, सदरील परिपत्रक विद्यापीठाच्या संकेतस्थळावर प्रसिध्द करण्यात यावे.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY

NANDED- 431606

Maharashtra State- India

SYLLABUS

M. Sc. Zoology- First Year- Seme-I and Sem-II

For the University Campus

Department of Zoology, School of Life Sciences, S. R. T. M. University, Nanded

(Two Years PG Program)

As per Semester Based Credit and Grading System

As per NEP-2020

Effective from 2023-24

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 needs to be addressed, debated and taken forward in a systematic manner. Faculty of Science and Technology of SRTMUN, Nanded has taken a lead in incorporating philosophy of outcome based education in the [process of curriculum development.

Faculty of Science and Technology, SRTMUN Nanded is unanimously resolved that, each Board of studies shall prepare some program educational objectives (PEO's) and give freedom to affiliated colleges and the University campus Schools and the departments working under it to add few PEO's and course objectives and course outcomes to be clearly defined for the each course; so that all faculty members in the affiliated colleges understand the depth and approach of course to be taught, which will enhance learners learning process. It was also resolved that, maximum Senir faculty from the Colleges, University and experts from Industry to be involved while preparing the curriculum. I am happy to state that, each Board of studies 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 enhance the 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 adapted 10 point scale to grade learner' s performance. Credit assignment for the courses is based on 15 weeks teaching learning process, however content of courses is to be taught in 12-13 weeks and remaining 2-3 weeks to be utilized for the revision, guest lectures, coverage of content beyond syllabus etc.

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

Dr. L. M. Waghmare, Dean, Faculty of Science and technology,
Dr. M. K. Patil, Associate Dean, Faculty of Science and technology,
Swami Ramanand Teerth Marathwada University, Nanded

From Desk of Chairman, B. O. S. Zoology and Director, SLS and HOD Zoology, SLS, S. R. T. M. University, Nanded

Under the New Educational Policy (NEP) 2020 the University Grants Commission, New Delhi (UGC) has initiated some important measures to enhance academic standards in higher education in India, for the purpose improvement in curriculum is one of the important concern in this regard. Swami Ramanand Teerth Marathwada University, Nanded has already initiated reforms in higher education by implementing semester system for the continuous teaching and learning process using Choice Based Credit System (CBCS) as per the UGC guidelines. Revision and updating the syllabus is a continuous process as per the demand for the development of self reliable and useful human resource for the society and ready to work human resource for the country. The CBCS provides choice for students to select any particular subject from the same course or from the same Program (DSE) and also from other sources and Programs within the School of Life Sciences. There is also choice for the students to choose NPTL, SWYAM, MOOC like online educational portals as an additional credit earning resources. In the new curriculum reform, there is compulsory slot for Skill Enhancement/Development Courses so as to provide skills for the students through this course. Therefore Board of Studies (BOS) in Zoology has prepared the curriculum for PG Course in subject Zoology, Department of Zoology at School of Life Sciences this University. The curriculum is designed to include updated contents on various branches of subject Zoology and animal sciences in general.

Already the comments and opinion from students, stakeholders, parents, research students and industries are considered positively to revise the syllabus and the suggestions are incorporated. Moreover, the valuable suggestions for further improvement and quality enhancement in this regard are welcome.

Two Year (**Four Semester**) CBCS pattern teaching program M. Sc. Zoology at this University Campus is having autonomous status has an intake of 20 students. The program curriculum also includes the courses such as Research methodology to introduce the students about research needs in higher education that may be immediately implemented. Also it includes research projects and on job training, field based projects. It indicates the promotion of research in the new education policy instead of more theoretical knowledge. In the third and fourth semester Department specific electives included so as to take care of student choice as per their interest and the mindset to study a particular subject and a specific course during completion of this PG program M. Sc. Zoology. The medium of instruction and examination of this course is English. The M. Sc. Zoology course offers 06 credit research project as an important component that convert as dissertation as one of the important components. It is for those students who are interested in pursuing their career in research. There is an option against Research Project to write a scientific review on selected research topics. Based on the academic performance of a student in semester-I, Semester-II the Dissertation Allocation Committee (DAC) under the chairmanship of Head of the Department to advice the students whether to go for the dissertation or Research Review. Under this new policy a uniformity in assessment system has been introduced i.e. 20:80 as continuous assessment (CA) for 20 % marks and 80 % as end semester assessment (ESA)

Program Educational Objectives:

1. Exposure of students to animal diversity and to provide them systematic tools of traditional and modern types to acquire this knowledge and skill.
2. To update the syllabus essential for appearing in NET, SET, GATE, ASRB and other competitive exams of UPSC and MPSC.
3. To make aware the students to know the natural resources of country, to utilize by sustainable methods and conservation of living resources.
4. To develop trained and knowledgeable human resource for educational and research institutions and industries; to use this human resource for self-reliant India.
5. To develop self-employable ability and to apply knowledge for several agro-based industries like sericulture, Goat farming and Apiculture; it will also provide employment to other dependents.

Program Specific Outcome (PSO):

1. The students will be acquainted to animal diversity, its present status and applied use.
2. Students will get the knowledge and skill from learning this course for self employment and will provide job for others for entrepreneurship development.
3. The students will get updated knowledge of basic and applied branches of Zoology so as to qualify for various state and national level competitive examinations to get employment.
4. The learned students of this course will be leaders in the educational and research institutions and for the industries in the country and abroad.
5. To develop self-reliant human resource for entrepreneurship and employability to make our country self reliant.

Prerequisite:

This Post Graduate Degree Course will be offered to the students having basic knowledge of Zoology and willing to gain additional knowledge in applied and research aspects of Zoology. Admission to this PG Program are given to the students who have studied Zoology subject as one of the optional subject or honors in subject Zoology at their graduation level.

Admission: The Admission will be given to the students for this program on the basis of merit of Marks secured in the Entrance Examination conducted by this University. The students interested for the admission for this program should have Zoology as their major subject or one of the Optional Subject or Zoology Honors for UG level (B. Sc.). The rules for admission including reservation are as per the S. R. T. M. University, Nanded and Maharashtra State Govt. Policy for the Admissions to PG Courses.

Dr. H. S. Jagtap
Chairman, BOS, Zoology,
S. R. T. M. University, Nanded- 431606

Prof. S. P. Chavan
Director School of Life Sciences,
HOD, Zoology, School of Life Sciences
S. R. T. M. University, Nanded - 431606

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	Dept. of Zoology, Shri Shivaji College, Parbhani	9423717670 Email: hsjagtap1704@gmail.com
2	Dr. Shivaji Prabhakar Chavan	Member	HOD. Zoology, School of Life Sciences, S. R. T. M. University, Nanded. Director, School of Life Sciences, S. R. T. M. U., Nanded	8830995765, 9421046372 schavan646@gmail.com dr_spchavan@rediffmail.com
3	Dr. Dhanraj Bhure	Member	Yeshwant Mahavidylaya, Nanded	8149407814 drajbhure82@gmail.com
4	Dr. Sanjay. S. Nanaware	Member	HOD Zoology, Yeshwant Mahavidhyalaya, Nanded	9423401227 snanware@rediffmail.com
5	Dr. P. P. Joshi	Member	Asso. Prof. Department of Zoology, Aadarsh Mahavidhyalaya, Hingoli	9595648535 drprashantjo@gmail.com
6	Dr. Ratna Kirtane	Member	Dayanand Science College, Latur	9422185834 ratnakirtane@gmail.com
7	Dr. Deepak Pandurang Katore	Member	Asso. Prof. Dept. of Zoology, Nagnath College, Aundha Nagnath, Dist. Hingoli	9765737373 katoredeepak@gmail.com
8	Dr. Karmaveer Nagnathrao Kadam	Member	HOD Zoology, Kumarswami Mahavidhyalaya, Ausa	karmbeernk@gmail.com 9970129929
9	Dr. Sanjay Sadashivrao kale	Member	AsooKumarswami Mahavidhyalaya, Ausa	9423348798 Sanjaykale.sks@gmail.com
10	Dr. Anil M. Mane	Member	Arts, Science and Commerce College, Shankarnagar, Dist. Nanded	9422874110 Anilmane531@gmail.com

11	Dr. Ramrao Janardhanrao Chavan	Member	Professor, Department of Zoology, Dr. B. A. M. University, Aurangabad. M. S.	9423030859 chavanrj@gmail.com
12	Dr. Ranjitsingh Krishnarao Nimbalkar	Member	Govt. Institute of Forensic Science, Aurangabad	9422345234 rknimbalkar@gmail.com
13	Dr. Shivesh Pratap Singh	Member	Govt. P. G. College, Satna, M. P.	7987155634 drshiveshsingh2004@gmail.com
14	Dr. Chandrashekhar Devidasrao Basarkar	Member	Director, Nimkar seeds Pvt Ltd, Phaltan, Dist. Satara	basarkarcd@gmail.com 9822652659
15	Pandharpure Laxmi Gurunath (UG Merit student	Invitee member	Maharashtra Mahavidhyalaya, Nilanga	9529251388
16	Dusnale Prashant Baliram (PG Merit student)	Invitee member	Yeshwant Mahavidhyalaya, Nanded	9834642631

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDEE
FACULTY OF SCIENCE AND TECHNOLOGY
Credit Framework for Two Year PG Program (M. Sc.) at Department of Zoology, School of Life Sciences, S. R. T. M. U. Nanded

Subject: Zoology

Year and Level 1	Sem. 2	Major Subject (DSC) 3	Major Subject (DSE) 4	RM 5	OJT/FP 6	Research Project 7	Practicals 8	Crdits 9	Total Credits 10
1	1	**SZOOC401 (4 Cr)** **SZOOC402 (4 Cr)** **SZOOC403 (4 Cr)**	**SZOOE401** **SZOOE402** **(3 Cr)**	**SZOOR401** Research Methodology **(3 Cr)**	**----**		**SZOOP401 (1 Cr)** **SZOOP402 (1 Cr)** **SZOOP403 (1 Cr)** **SZOEP401 (1 Cr)**	**22**	**44**
	2	**SZOOC451 (4 Cr)** **SZOOC452 (4 Cr)** **SZOOC453 (4 Cr)**	**SZOOE451 /** **SZOOE452** **(3 Cr)**	**---**	**SZOJT451** **(3 Cr)**	**-** **-**	**SZOOP451 (1 Cr)** **SZOOP452 (1 Cr)** **SZOOP453 (1 Cr)** **SZOEP451 (1 Cr)**	**22**	
Exit Option: Exit option with PG Diploma (After 2024-25)									
2	3	**SZOOC501 (4 Cr)** **SZOOC502 (4 Cr)** **SZOOC503 (4 Cr)**	**SZOOE501/** **SZOOE502 (3 Cr)** (From Same Department/School)	**---**		Research Project SZOOR551 (4Cr)	**SZOOP501 (1 Cr)** **SZOOP502 (1 Cr)** **SZOEP501 (1 Cr)**	**22**	**44**
	4	**SZOOC551(4Cr)** **SZOOC552(4Cr)**	**SZOOE551 /** **SZOOE552** **(3 Cr)** (From Same Department/School)	SZOOP551 Publication Ethics (2 Cr)		Research Project SZOOR552 (6Cr)	**SZOOP551 (1 Cr)** **SZOOP552 (1 Cr)** **SZOEP551 (1 Cr)**	**22**	
Total Credits		**44**	**16**	**05**	**03**	**10**	**10**		**88**

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

Credit Framework for Two Year PG Program (M. Sc.) at Department of Zoology, School of Life Sciences, S. R. T. M. U. Nanded

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SZOOC401**	Animal Taxonomy and Evolution	04	--	**04**	04	--
	SZOOC402	Cell Biology	04	--	**04**	04	--
	SZOOC403	Non-Chordates and Protochordates	04	--	**04**	04	--
Elective (DSE)	**SZOOE401/ SZOOE402**	Sericulture and Management / Goat Farming	03	--	**03**	03	--
Research Methodology	**SZOOR401**	Research Methodology	03	--	**03**	03	
DSC Practical	**SZOOP401**	Lab 1 – Practical in Animal Taxonomy and Evolution	--	01	**01**	--	02
	SZOOP402	Lab 2 – Practical in Non-Chordates and Protochordates	--	01	**01**	--	02
	SZOOP403	Lab 3 – Practical in Cell Biology	--	01	**01**	--	02
DSE Practical	**SZOEP401/ SZOEP402**	Elective Lab- Practical in Sericulture and Management / Goat Farming	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**18**	**08**

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

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

Credit Framework for Two Year PG Program (M. Sc.) at Department of Zoology, School of Life Sciences, S. R. T. M. U. Nanded

Examination Schem

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

Subject	Course Code	Course Name	Theory				Practical		Total Col (6+7) / Col (8+9)
			Continuous Assessment (CA)			ESA			
			Test I	Test II	Avg. of (T1+T2)/2	Total	CA	ESA	
Major	**SZOOC401**	Animal Taxonomy and Evolution	20	20	20	80	--	--	100
	SZOOC402	Cell Biology	20	20	20	80	--	--	100
	SZOOC403	Non-Chordates and Protochordates	20	20	20	80	--	--	100
Elective (DSE)	**SZOOE401/ SZOOE402**	Sericulture and Management / Goat Farming	15	15	15	60	--	--	75
Research Methodology	**SZOOR401**	Research Methodology	15	15	15	60	--	--	75
DSC Practical	**SZOOP401**	Lab 1 – Practical in Animal Taxonomy and Evolution	--	--	--	--	05	20	25
	SZOOP402	Lab 2 – Practical in Non-Chordates and Protochordates	--	--	--	--	05	20	25
	SZOOP403	Lab 3 – Practical in Cell Biology	--	--	--	--	05	20	25
DSE Practical	**SZOEP401/ SZOEP402**	Elective Lab- Practical in Sericulture and Management / Goat Farming	--	--	--	--	05	20	25

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

Credit Framework for Two Year PG Program (M. Sc.) at Department of Zoology, School of Life Sciences, S. R. T. M. U. Nanded

Teaching Scheme

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

	Course Code	Course Name	Credits Assign ed			Teaching Scheme (Hrs/ week)	
			Theory	Practical	Total	Theory	Practical
Major	**SZOOC451**	Animal Developmental Biology	04	--	**04**	04	--
	SZOOC452	Genetics and Genetic Engineering	04	--	**04**	04	--
	SZOOC453	Chordate Structure and Function	04	--	**04**	04	--
Elective (DSE)	**SZOOE451/ SZOOE452**	Bee Keeping and Management / Parasitology	03	--	**03**	03	--
On Job Training	**SZOJT451**	Internship / ON Job Training/ Field Project	03	--	**03**	03	
DSC Practical	**SZOOP451**	Lab 1- Practical in Animal Developmental Biology	--	01	**01**	--	02
	SZOOP452	Lab 2 – Practical in Genetics and Genetic Engineering	--	01	**01**	--	02
	SZOOP453	**Lab 3-** Chordate Structure and Function	--	01	**01**	--	02
DSE Practical	**SZOEP451/ SZOEP452**	Elective Lab - Bee Keeping and Management / Parasitology	--	01	**01**	--	02
Total Credits			**18**	**04**	**22**	**18**	**08**

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

Credit Framework for Two Year PG Program (M. Sc.) at Department of Zoology, School of Life Sciences, S. R. T. M. U. Nanded

Examination Scheme

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

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	**SZOOC451**	Animal Developmental Biology	20	20	20	80	--	--	100
	SZOOC452	Genetics and Genetic Engineering	20	20	20	80	--	--	100
	SZOOC453	Chordate Structure and Function	20	20	20	80	--	--	100
Elective (DSE)	**SZOOE451/ SZOOE452**	Bee Keeping and Management/Parasitology	15	15	15	60	--	--	75
On Job Training	**SZOOJ451**	On Job Training /Internship/Field Project	15	15	15	60	--	--	75
DSE Practical	**SZOOP451**	Practical in Animal Developmental Biology	--	--	--	--	05	20	25
	SZOOP452	Practical in Genetics and Genetic Engineering	--	--	--	--	05	20	25
	SZOOP453	Practical in Chordate Structure and Function	--	--	--	--	05	20	25
DSE Practical	**SZOEP451/ SZOEP452**	Bee Keeping and Management/Parasitology	--	--	--	--	05	20	25

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

Guidelines for Course Assessment: Examination and Evaluation System.

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 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: 1. 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.
2. for a course of two credits 30 lectures of one hour duration are assigned, while that for a three credit course 45 lectures.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Faculty of Science and Technology,

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Faculty of Science and Technology,

Two Years PG Program, Syllabus (w.e.f., 2023), SLS, SRTMUN M.
Sc. Zoology, First Year - Semester- I

Course Code: SZOOC401. Title- Animal Taxonomy and Evolution

Periods: 60 No. of Credits: 4 (Marks: 100)

Course pre-requisite:

1. Students having basic knowledge of Zoology and willing to gain additional knowledge in applied and research aspects of Zoology.

2. Admission to this PG Program are given to the students who have studied Zoology subject as one of the optional subject or honours in subject Zoology at their graduation level.

Course objectives:
1. This course is designed to make students aware of the great diversity which is being displayed by animals around us.
2. To prepare them theoretically and practically to study and arrange the Bio-diversity in scientific and natural manner.
3. To determine the evolutionary sequence and process of Fauna in the world biomes.

Course outcomes:

1. The students will get basic and advanced knowledge about animal systematics.
2. The Knowledge what they will acquire will be useful to understand the animal world around them.
3. The students may apply this knowledge in taxonomy related research and job opportunities, conservation of faunal resources in the world.

Curriculum Details

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	Definition and basic concept of Biosystematics, taxonomy and classification, History of taxonomy, systematics, Taxonomic characters and their kinds.	15
	1.2	Trends in animal taxonomy: Chemo-taxonomy, Cyto-taxonomy, Molecular taxonomy, Immuno-taxonomy & Para-taxonomy.	
	1.3	Theories of animal classification, Hierarchy of categories in animal classification. Scientific name of some important domestic and wild animals (05 examples from each Phylum of invertebrates and each class of vertebrates).	
	1.4	Importance and application of Taxonomy (biosystematics) in biological studies. Systematics as a profession and its future perspectives.	
2.0	**2.1**	Species categories and species concept. a) Typological species concept. b) Nominalistic species concept. c) Biological species concept d) Evolutionary species concept.	15

	2.2	Difficulties in application of Biological species concept. Intra-specific categories & Taxons: a) variety, b) Subspecies c) super species d) Sibling species.	
	2.3	Isolation and types of Isolation.	
	2.4	Origin of new species (Speciation).	
3.0	**3.1**	Theories of origin of Life: Introduction to Special creation, Abiogenesis, Biogenesis, extra-terrestrial origin-(Panspermia theory).	15
	3.2	a. Lamarck and Lamarckism. b. Darwin and Darwinism: Concept of variations, Neo-Darwinism, Natural selection, mutation.	
	3.3	a. Origin of cells and unicellular evolution: Origin of basic biological molecules, Abiotic synthesis of organic monomers and polymers. b. Concept of Oparin and Haldane, experiment of Millar.	
	3.4	Evolution of first Prokaryotic cell, Origin of Eukaryotic cell, Evolution of unicellular Eukaryotes.	
4.0	**4.1**	a. Palaeontology and evolutionary history (Evolutionary time scale, Era, Periods and epoch) b. Major events in evolutionary time scale (Origin of Unicellular and multicellular organisms).	15
	4.2	Stages in evolution of Primates.	
	4.3	Molecular evolution (Molecular clock, molecular tools in Phylogeny, origin of new genes and proteins, gene duplication and diversion).	
	4.4	a. Hardy Weinberg's law of genetic equilibrium. b. Genetic Drift the process and its role in evolution. Bottle neck effect and evolution.	

References:

Text Book:

1. Theory and Practices in Animal Taxonomy: V. C. Kapoor (Oxford and IBH, New Delhi).
2. Mayr E. ' Elements of taxonomy
3. Simpson G. G., Principles of Animal Taxonomy. Oxford IBH Publishing Co. **Reference Books:**

1. Principles of Animal Taxonomy: Simpson George Gaylord. Columbia University Press, PP. 248, (1961) 2. Elements of Systematic Zoology (second Edition): Mayr Ernest and Peter D. Ashlock. McGraw- Hill Inc. US Pp. 416. (1991).
3. Biodiversity. Wilson E. O.
4. Evolutionary Biology (Vol. 2). Dobzahnskey, Theodosius, Hecht, Max K, Steere, William C. Springer Books. (1968).
5. Genetics and Origin of species. Dobzhanskey, Columbia University Press. (1987) 7.
8. Evolution: Savage Jay M. Holt, Rinehart and Winston of Canada Ltd. Pp. 161. (1971).
9. Organic Evolution: Richard Swann Lull . Nabu Press . pp. 812, (Nov. 2011). 10. Evolution of Vertebrates. Edwin H. Colbert. Wiley, 1 January (2011) 11. Evolution and Genetics. Merrel D. J.,

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
Faculty of Science and Technology,

School of Life Sciences, S. R. T. M. U. N.

Two Years PG Program, Syllabus (w.e.f., 2023) SLS, SRTMUN

M. Sc. Zoology, First Year - Semester- I

Course Code: SZOOC402. Title of the Course – Cell Biology

Periods: 60 No. of Credits: 4 (Marks: 100)

Course pre-requisite:

1. Students having basic knowledge of Zoology and willing to gain additional knowledge in applied and research aspects of Zoology that includes cellular organization in animal body and cell specific functions. Types of cells in animals.
2. Admission to this PG Program are given to the students who have studied Zoology subject as one of the optional subject or honours in subject Zoology at their graduation level.

Course objectives:

1.To study the structure and function of the basic unit of living organisms.

2. To study stages in cell cycle (including cell death and cancer), cell differentiation, and organelles and other cellular structures in the growth and functioning of the cell (including membrane transport and signalling).

3. To understand the basic concepts and processes in development of an organism.

Course outcomes:

The students will be able to apply the knowledge in education and research on Cell biology in various fields at industrial, institutional levels. Nationally as well as Internationally.

Curriculum Details

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	a. Introduction to basic concepts of cell Biology, Overview of Prokaryotic and Eukaryotic cells.	15
	1.2	a. Plasma membrane: Structure and function- Introduction to models of plasma membrane, Lipid bilayer and membrane protein. b. Composition of Plasma membrane (Protein, Lipids and carbohydrates).	
	1.3	Transport across cell membrane: Active transport (Primary and secondary), Passive transport (Simple diffusion and facilitated diffusion).	
	1.4	Transport of macro-molecules (Phagocytosis, Pinocytosis), Receptor mediated endocytosis and bulk transport.	
2.0	**2.1**	Structural organization and function of Intra-cellular organelles: Cell wall, nucleus, Mitochondria, Golgi Body, Lysosomes, Endoplasmic reticulum (ER), Peroxysomes, Chloroplast, Vacuoles.	15
	2.2	Structure, composition and functions of cytoskeleton (Microfilaments, Microtubules, Intermediate filaments).	
	2.3	Role of Cytoskeleton in Motility	
	2.4	Protein sorting in different cell organelles.	

3.0	**3.1**	Organization of genes and chromosomes: Structure and organization of Chromatin.	
	3.2	Structure and functions of chromosomes: Polytene and Lamp brush chromosomes.	15
	3.3	Unique and repetitive DNA	
	3.4	Types of chromatins: Heterochromatin, Euchromatin and transposomes. Operon, Interrupted genes, Gene family.	
4.0	**4.1**	Cell division and cell cycle Cell Cycle: Major events during G1, S, & G2 phases.	15
	4.2	Regulation of cell cycle.	
	4.3	a. Apoptosis (intrinsic and extrinsic pathways). b. Microbial physiology- Growth, yield and characteristics, strategy of cell division, stress response.	
	4.4	Cell-Cell communication and cell signalling.	

References:

Reference Books:

1. Molecular Cell Biology (2nd Edition) J. Darnell, H. Lodish and d. Baltimore, Scientific American Books, Inc., USA, 1994.
2. Molecular Biology of the Cell (2nd Edition) B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. d. Watson Garland publishing, Inc., New York, 1994.
3. Gene VI (6th Edition) Benjamin Lewin, Oxford University Press, U.K., 1998.
4. Molecular Biology and Biotechnology. A comparative desk reference, R. A. Meyers (Ed.) VCH Publishers, Inc., New York, 1995.
5. Cell and Molecular Biology – De Robertis.
6. Gene – IX, Benjamin Lewin, Oxford University Press..
7. Cell and Molecular Biology. – Gerald Karp, 5th Edition, John Willy and Sons. Inc. 2008.
8. Cell Biology – David E. Sadava, Jones and Bartlett Publishers, London, 1993.
9. Molecular Biology of Gene (V- Edition) – J. D. Watson, Lania A. Raker, Stephan P. Bell, Alexander Gann, Micheal Eveni – Pearson Education and Publication.

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED
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Two Years PG Program, Syllabus (w.e.f., 2023) SLS, SRTMUN M. Sc. Zoology, First Year - Semester- I

Course Code: SZOC403.

Title of the Course – Non-Chordates and Protochordates

Periods: 60 No. of Credits: 4 (Marks: 100)

Curriculum Details

Course pre-requisite:

1. Knowledge about diversity and distribution of major animal phyla in the nature. Students having basic knowledge of Zoology and willing to gain additional knowledge in applied and research aspects of Zoology that includes cellular organization in animal body and cell specific functions. Types of cells in animals.
2. Admission to this PG Program will be given to the students who have studied Zoology subject as one of the optional subject or honours in subject Zoology at their graduation level.

Course objectives:

1. To describe and explain the basic principles of animal classification, form and function among non-chordate phyla.
2. To describe the main elements of the biology and evolutionary relationships of the major groups of nonchordates
3. To describe the structure and function of vital organs among non-chordate phyla.

Course outcomes:

1. The students will get an idea about how the life processes goes on in the animals in their surrounding.
2. The knowledge they gain will use for the wellbeing of animals and the ecosystem by processes like monitor, manage, conserve and utilize these creatures.
3. it gives an idea about how a Human being is evolved in sequential evolution process from the Invertebrates to Vertebrates to Mammals.

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	Organization of Coelom: Acoelomata, Coelomata, Pseudocoelomata. Protostomia and Deuterostomia.	15
	1.2	Food, feeding and reproduction in Protozoa.	
	1.3	Paramecium: Structure, Food and Feeding, Locomotion. Introduction to Spongocoel, Coelenteron.	
	1.4	A. Types of Cells and their functions in Sponges B. Polymorphism, functions of zooids in Obelia Colony and alternation of generation in Coelenterates.	
2.0	**2.1**	Reproduction and Alternation of generation in Coelenterates. Primitive nervous system : Coelenterata and Echinodermata.	
	2.2	Structure and working of respiratory organs in Insects, Scorpion, Prawn, Bivalve, *Pila globosa.*	

	2.3	Excretion – Structure and working of coelom, coelomoducts, flame cells, Nephridia and Malphigian tubules.	15
	2.4	Advanced nervous system in Annelida, Arthropoda and Mollusca (Cephalopoda).	
3.0	**3.1**	Larval forms in Invertebrates (Porifera to Echinodermata) and their Evolutionary Significance.	15
	3.2	General characters of Cephalochordates.	
	3.3	General characters of Urochordata	
	3.4	Affinities of Cephalochordates to Vertebrates and Origin of Vertebrates. Introduction to Minor Phyla.	
4.0	**4.1**	Cyclostomes: General characters; Classification and characters of Pertomyzon and Myxin.	15
	4.2	Ostracoderms: Characters, examples and importance in evolution.	
	4.3	Placoderms: Characters and examples of fossil Placoderms.	
	4.4	*Ltimeria chalumni*- Living fossil fish. Occurrence and characters.	

REFERENCES:

1. Text Books-

1. Modern Textbook of Zoology (12th Edition): R. L. Kotpal. Rastogi Publication. (2019).
2. Invertebrate Zoology: A Laboratory Manual: Alan R. Holyoak. Creatspace Independent publisher. Pp. 130. (2013).
3. Parker T. J. , Haswell W. A.' Text Book of Zoology', Macmillion Co. London.

2.Reference Books-

1. Invertebrate Structure and Function. EJW BARRINGTON. E-book, (1967).
2. Hyman L. H. "The Invertebrate – Vol. I (Protozoa through Ctenophora) McGrew Hill. New York, London
3. Hyman L. H. "The Invertebrate – Vol. II , McGrew Hill. New York, London 4. Hyman L. H. "The Invertebrate – Vol. VIII , McGrew Hill. New York, London
5. Berns R. D. Invertebrate Zoology, W. B. Saunders, Philadelphia.

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Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year - Semester- I

Course Code: SZOOE-401.

Title of the Course – Sericulture and Management

Periods: 45 No. of Credits: 3 (Marks: 75)

Curriculum Details

Course pre-requisite:

1. Student should know about diversity and distribution of major Insects in the nature. Students having basic knowledge of Zoology and willing to gain additional knowledge in applied and research aspects of Zoology that includes economically important Insect species.
2. Admission to this PG Program will be given to the students who have studied Zoology subject as one of the optional subject or honours in subject Zoology at their graduation level. **Course objectives:**

1. To develop the knowledgeful human resource for the management of growing silk industry as agro-based business in India.
2. To develop skill-full human resource to establish their own entrepreneurship and support the local population

Course outcomes:

The students will get the knowledge about what is sericulture, types of sericulture and its importance as agro-based, employment generating industry.

2. The students will get knowledge about Life cycle of silk worm, Cocoon formation and Silk thread. 3. The students will acquire skill of how to manage a sericulture farm: Rearing shade, Mulberry garden, Silk and cocoon market and other value added and byproducts from sericulture.

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	History of sericulture, sericulture in India and importance of sericulture. Sericulture Education, training and Research Institutes in India.	15
	1.2	a. Sericulture products and by-products. b. Silk producing species of insects and their food.	
	1.3	a. Morphology and anatomy of Silkworm Larva: Digestive System, Circulatory System, Excretory System, Respiratory system, Nervous system, Endocrine System b. Morphology and Anatomy of Silk Moth: Reproductive System c. Food and feeding to different stages of silk worm.	
	1.4	a. Life cycle of Mulberry silk worm b. Morphology and Anatomical structure of Silk Gland. c. Biosynthesis of Silk and biochemical composition of silk. Characters of Good quality silk.	
2.0	**2.1**	Botanical Study of salient features of family Moraceae.	
	2.2	Methods of silk worm rearing.	

	2.3	a. Morphology of Mulberry plant. b. Mulberry garden: Plantation, harvesting, irrigation, disease management.	15
	2.4	Equipment's and their uses in sericulture and its practical demonstration.	
3.0	**3.1**	a. Sericulture House: Various models, Ideal regional model and its construction. b. Management of Sericulture House/Shade: disinfection, control on	
	3.2	Management of bacterial, viral and protozoan diseases of silk worm.	15
	3.3	a. Management and maintenance of cocoons, Cocoon markets and sale. b. Economics of investment, expenditure, Sale and profit from sericulture.	
	3.4	a. Insect pests, rodent pests and bird pests. b. Visit to Sericulture farm and report writing.	

REFERENCES:

1. Reference Books-

1. Silk Culture. Ananthnarayan
2. Silk Reeling. S. K. Ananthanarayan 3. Silk Worm Rearing. S. K. Ananthnarayan.
4. Silk Production and Export. Td. Koshey.
5. Sericulture and Pest Management. T.V. Sathe and A. D. Jadhav
6. Silk Reeling and Testing. Yong Woo Lee.
7. Textbook of Sericulture. S. K. Sehegal.
8. Tropical Wild Sericulture. P. K. Mohanty.
9. Silk and Sericulture. Chowdhary S. N.
10. Silk Culture: A Manual with complete Instructions in Sericulture. M. C. Buckner. Principles of Sericulture. Hisao Aruga. CRC Press.

2. Text Books:

1. Sericulture Manual. R. K. Patnaik
2. Sericulture. G. Ganga and J. Solochana Chetty. Oxford and IBH Publisher, New Delhi

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Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year - Semester- I

Course Code: SZOOE-402.

Title of the Course – Goat Farming

Periods: 45 No. of Credits: 3 (Marks: 75)

Curriculum Details

Course pre-requisite:

1. Student should know about diversity and distribution of Goat species in their surroundings. Students having basic knowledge of Zoology and willing to gain additional knowledge in applied and research aspects of Zoology that includes economically important vertebrates especially Mammals.

2.Admission to this PG Program will be given to the students who have studied Zoology subject as one of the optional subject or honours in subject Zoology at their graduation level. **Course objectives:**

1. To introduce the zoology students for applied education-based courses like Goat Farming.
2. To promote the agro-based business like Goat-farming in the local farmers and unemployed youth for their self-employment.
3. To introduce the business thought about Goat meat is highly demanded meat all over the world hence high need of goat farming.

Course outcomes: 1. Students can start their own small scale or large scale business.

2. Students may get the jobs in the goat farms as scientific expert and manager of the farm.
3. There are research opportunities in the Goat research Institutes, Goat milk, meat and leather industries for those who complete the course successfully.

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	Introduction to goat farming and support of goat farming for low income group.	15
	1.2	Goat Breeds in the world: For meat, fur, milk, leather. Biography of commercially important goat species in India, Wild species of Goats. Exotic goat species introduced in India: their success and failure.	
	1.3	Basic requirements, Planning for goat farming: Finance by self and bank loans, self help groups. Project formulation, Investment, income and profit in goat farming business.	
	1.4	Types of goat farming: success and problems in types of shelter. Structure, engineering and basic requirements to establish a goat farm.	
2.0	**2.1**	External morphology of goat, commercial use of goat body parts: SkinLeather, Hairs, Hooves and horns, bones, Muscles and organs, Blood.	
	2.2	Characters, composition and uses of Goat milk. Nutritional value of Goat meat (Chevon) and its biochemical composition. Preservation and processing of meat. Desirable features of Chevon.	

	2.3	a. Digestive system of goat. Basic, supplementary and nutritional food for goats. b. Reproduction, Oestrus cycle, breeding and reproduction in Goats. Management and care of Bucks, doe and kids.	15
	2.4	a. Diseases in Goat: Causative organism, symptoms, diagnosis and treatment and preventive measures. Vaccination against infectious diseases in goats. b. Disease management_ Bacterial, Viral, Fungal, Parasitic, Nutritional. Causes and mortality in goat.	
3.0	**3.1**	Fodder plants for goat: Shrubs, trees, grass, agriculture waste.	15
	3.2	Goat meat: slaughter of goat, separation of goat meat, preservation, processing, marketing, distribution and export. Goat leather processing and uses.	
	3.3	Faecal waste, urine from goat farm and its management, goat manure. Labour, office staff, instruments, transport vehicles, maintenance and management.	
	3.4	Goat market, Local Bazaars: processes and places. Economics of goat farming. Goat farming research and education institutes in India.	

Reference Books-

1. Hand Book of Goat farming In India**.** Engineers India Research Institute (EIRI)
2. Kumar, Shalander : Commercialization of Goat Farming and Marketing of Goats in India.
3. Handbook of Goat farming: Shivaji P. Chavan and Pooja Thakur Guhilot (2023), Ramanshil Publication, Aurangabad. M.s. PP: 179.
4. Final Report of ICAR Ad-hoc Research Scheme 2004-07, Central Institute for Research on Goats, Makhdoom, Mathura. Agricultural Economics Research Review Vol.20 (Conf. Issue)
5. Birthal, P.S. and P.K. Joshi (2006) High Value Agriculture for Accelerated and Equitable Growth: Policy Brief. No. 24, National Centre for Agricultural Economics and Policy Research, New Delhi, December.
6. Dalgado, C., M. Rosegrant, H. Steinfedl, S. Ehui,and C. Courbois (1999) Livestock to 2020 — The Next Food Revolution. Food, Agriculture and Environment Discussion Paper 28, IFPRI, Washington.
7. Kumar, Shalander (2007) Commercialization of Goat Farming and Marketing of Goats in India. Final Report of ICAR Ad-hoc Research Scheme 2004-07, Central Institute for Research on Goats, Makhdoom, Mathura.
8. Kumar, Shalander (2007) Multi-disciplinary project on transfer of technology for sustainable goat production, Annual Report 2006-07, Central Institute for Research on Goats, Makhdoom, Mathura.
9. Kumar, Shalander and P.R. Deoghare (2002) Goat rearing and rural poor: A case study in south- western semiarid zone of Uttar Pradesh. Annals of Arid Zone, 41(1): 79-84.
10. Kumar, S., V.S. Vihan and P.R. Deoghare (2003) Economic implication of diseases in goats in India with special reference to implementation of a health plan calendar. Small Ruminant Research, 47: 159-164.
11. Singh, N.P. (2006) Technological advances for commercial goat production. In: Commercial Goat and Sheep Farming and Marketing: Farmer-Industry- Researcher Interface, Eds: N.P. Singh, S. Kumar, A.K. Goel and R.K. Vaid, Central Institute for Research on Goats, Makhdoom, Mathura, pp. 1-17.
12. Singh, N.P. and Shalander Kumar (2007) An alternative approach to research for harnessing production potential of goats. Proceedings of 4th National Extension Congress, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur,

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Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year - Semester- I

Course Code: SZOOR 401 Title of the Course – Research Methodology

Periods: 45 No. of Credits: 3 (Marks: 75)

Curriculum Details

Course pre-requisite:

Students should have minimum, expected background of knowledge in Biology, Mathematics, Statistics and computer Science

Course objectives:

1. The students will know how to access new facts using systematic thinking, analyzing phenomena, problems and seeking solutions based on reliable facts. The analysis of a phenomenon and trace its basics and refute its cause.
2. The prediction based on scientific evidence, documented methodology and consecutive logical steps. Provide logical solution to the problem. To reach new and innovative results based on the latest facts and research.

Course outcomes: The students will get following ideas, skills and techniques-

1. Understand basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Present a research report and paper
5. Write a research proposal for grant

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0		**Research Methodology**	10
	1.1	Meaning of Research, objectives of research and types of research	
	1.2	Research approaches, Significance of research, Research methods vs. methodology. Research and scientific methods	
	1.3	Research processes, criteria for good research	
	1.4	Research problem, selection of problem, necessity of defining the problem, techniques involved in defining the problem.	
2.0		**Research Design and sample survey**	
	2.1	Meaning and need for research design, features of a good design	

	2.2	Important concept related to research design, dependent and independent variables, extraneous variables, Control. Research hypothesis. Experimental and nonexperimental hypothesis- Testing research, experimental and control group	12
	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 for selecting a sampling procedure, characteristics of a good sample design, different types of sample design, different types of sample design	
3.0		**Data Collection and data processing**	12
	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 methods for data collection. Case study method	
	3.4	Data processing, processing operations: Editing, coding, classification, tabulation, graphical representation, types of analysis, statistics in reseach, Dispersion and asymmetry, measures of relationship, regression analysis.	
4.0		Testing of Hypotheses and Chi-Square test	11
	4.1	Basic concepts concerning testing of hypothesis, procedure and flow diagram for testing of hypotheses, Measuring a power of hypotheses test, Tests of Hypotheses. Hypotheses testing of corelation coefficient and limitations of the tests of hypotheses.	
	4.2	Chi-square Test: Chi Square test for comparing variance. Chi-Square as nonparametric Test. Conditions for the application of Chi-Square test. Steps involved in application of Chi-Square Test. Important characteristics of ChiSquare test and cautions of using it. Chi-Square Test relationship between spearman's r's and Kendall's. Characteristics of distribution free or nonparametric 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 Periods

Text Book:

1. Quantitative techniques: C. R. Kothari, Vikas Publication House, New Delhi **Reference Books:**

1.Michael Alley, *The Craft of Scientific Wrtting (3rd Edition), Springer, new York*

2.Philip Reubens (General Editor), Science and technical Writing- A Mannual of Style (2nd Edition) Routledge, New York, 2001.Research Methods in Aquatic Biology: Welch. 3. Bio-Statistics. S. P. Gupta

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Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year - Semester- I

Course Code: SZOOP-401.

Title of the Course – Lab 1 – Practical in Animal Taxonomy and Evolution

Periods: 30 No. of Credits: 1 (Marks: 25)

Course objectives:

1. To observe, collect and process the fauna for the practical study purpose
2. To know the structure, systems and behaviour of animals in nature by laboratory study by practical and virtual methods. **Course outcomes:**

1. The student will learn about practical methods, field methods in animal studies in Taxonomy, that will be applicable in the teaching, research and extension.

Practical No.	Title of the Practical	Hrs. Required to cover the Practical
1.	Collection, Identification and description of the following local fauna (Any 02 from each) Protozoans: from fresh water, blood samples, faecal wastes of animals. Specimen study of porifera and coelenterate. Helminths: from Faecal wastes, Blood samples, Gut of edible fishes and Poultry. Arthropods: Collection of local insects and their identification- Zooplankton Ants, Beetles, Mosquito, Butterflies and Moths Mollusca: Collection and identification of locally available Gastropods and Bivalves Fishes: Angling, Netting methods for collection and identification of Local fishes. And 02 Marine fishes Photography/ Video/Audio of frogs, Hyla, Toads, Lizards and snakes and identification Photography/Video/Audio of Birds and Identification.	06
2	Collection methods for the study of Birds: Mist netting and identification.	04
3	Methods of Processing and preservation of Invertebrates and vertebrates: Formalin, Ethanol, Cryo-preservation	02
4	Types of Microscopes and their application in Animal Taxonomy.	02
5	Studies on fossils, living fossils and connecting links Archaeopteryx, Peripatus, Limulus, Nautilus, *Latimeria* using models, photo.	04
6	Structure, types, management and maintenance of Museum and aquarium.	04
7	Molecular systematics of Fishes/Helminths and phylogenetics.	04
8	Animal sample preparation for SEM, TEM, Molecular study and Barcoding.	04

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M. Sc. Zoology, First Year - Semester- I

Course Code: SZOOP-402.

Title of the Course – Lab 2 – Practical in Non-Chordates and Protochordates

Periods: 30 No. of Credits: 1 (Marks: 25)

Curriculum Details

Course objectives:

1. **To determine the diversity and distribution of animals by field visits.**
2. **Laboratory investigations on morphology, anatomy and behaviour of various fauna Course outcomes:**

The students will learn about the structure and function of animals in nature by practical study methods, that will be applicable in conservation and ecological management of nature.

Practical No.	Title of the Practical	Hrs. Requir to cover the Practical
1.	Museum study- based on Photo and /or models of the animals: minimum any two from each Class/Phyla given below. (Use of Photo, Model, Video, Audio, Sketches/Specimen) Protozoans- for the structural differences and habitat specificity, locomotory structures;	04
2	Museum study- based on Photo and /or models of the animals: minimum any two from each Class/Phyla given below. (Use of Photo, Model, Video, Audio, Sketches/Specimen). Porifera spicules; Typical colony of Coelenterata; Arthropoda; Echinoderms; Cestodes,.	04
3	Museum study- based on Photo and /or models of the animals: minimum any two from each Class/Phyla given below. (Use of Photo, Model, Video, Audio, Sketches/Specimen)Trematodes, Nematodes and Molluscs, Amphioxux, Belanoglossus	04
4	Study of various types of spicules and canal systems in sponges using specimen, slides, e-resources.	04
5	Larval forms in Helminths.	02
6	Larval forms in Arthropods.	04
7	Permanent mounting and specimen study of various zooids in coelenterate colony/Phytoplankton/Zooplankton.	04
8	Participation of students in One study tour: long distance/1-4 Days preferably to the sea coast, to observe the animals in their natural habitat and report writing/Seminar.	04

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Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year - Semester- I

Course Code: SZOOP-403.

Title of the Course – Lab 3 – Practical in Cell Biology

Periods: 30 No. of Credits: 1 (Marks: 25)

Course objectives:

1. To observe, collect and process the fauna for the practical study purpose.
2. To know the structure, systems and behaviour of animals in nature by laboratory study by practical and virtual methods.

Course outcomes:

The student will learn about practical methods, field methods in animal studies in Taxonomy, that will be applicablein the teaching, research and extension.

Curriculum Details

Practical No.	Title of the Practical	Hrs. Requiredthe to cover Practical
1.	Study the care, use and handling of compound Microscope. Measurement of the length and breadth of the given cell sample by using micro-meter.	04
2	Preparation of slide for different stages of mitosis in onion root tips. Preparation of slide for different stages of meiosis in onion buds/ Grasshopper testis.	04
3	Study of Osmotic stress on cell membrane.	02
4	Preparation of human blood smear and Identification blood cell types.	04
5	Staining and visualization of Mitochondria by Janus green stain.	04
6	Cell organelle separation by Centrifugation: Nucleus. Mitochondria, Chloroplast.	04
7	Micro-preparation and observation of polytene chromosomes from Chironomus larvae.	04
8	Preparation, characterization, identification and submission of five slides of cells isolated from different organs of invertebrate and vertebrate animals. Study of sex chromatin from mammalian buccal epithelial cell.	04

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Faculty of Science and Technology, School of Life Sciences, S. R. T. M. U. N. Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year – Semester-I

Course Code: SZOEP-401.

Title of the Course – Elective Lab 1 – Sericulture and Management

Periods: 30 No. of Credits: 1 (Marks: 25)

Course objectives:

To determine the life of silk producing Insect species.

To learn the skills, procedures and protocols in the sericulture practice and silkworm rearing centre management practices. **Course outcomes:**

The student will learn about practical methods, field methods in Silkworm rearing and management. The knowledge they will acquire will be useful in sericulture practice as own business and assistance as scientific expert for the others, especially sericulturists, silk processing units and extension services.

Curriculum Details

Practical No.	Title of the Practical	Hrs. Requirecthe to cover Practical
1.	Identification and Characters of different stages of Life cycle of Silk worm (Eggs, Larvae, Caterpillar stage, Adult moth).	04
2	Anatomy of Silk worm for identification and characterization of following organs: Mouth Parts, Digestive system, Silk gland and spinneret.	04
3	Mulberry Plant: anatomy and uses of various parts: Root, Stem, Leaves, Fruits.	04
4	Mulberry Plantation: Methods, Maintenance, Irrigation, Disease management. Harvesting of leaves and fruits	04
5	Study of Various equipment's used in sericulture: Mulberry Plant leaf cutter, Leaf storage Box, Larval rearing methods and equipment (Netrica, Chandrica), Platform and racks method for larval rearing. Handling and feeding to silkworm etc.	04
6	Anatomy of silkworm Cocoon and structure of Pupa. Methods and equipment's for silk fibre and thread preparation and riling.	04
7	Maintenance and management of sericulture house. Preperation of model.	02
8	Pests and diseases of silk worm.	04

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Two Years PG Program, Syllabus (w.e.f. 2023)

M. Sc. Zoology, First Year – Semester-I Course

Code: SZOEP-402.

Title of the Course – Elective Lab 1– Goat Farming

Periods: 30 No. of Credits: 1 (Marks: 25)

Course objectives:

To determine the life of Goats, their systems and survival.

To learn the skills, procedures and protocols in the Goat farming.

Course outcomes:

The student will learn about practical methods, field methods in Goat s and Goat farm management. The knowledge they will acquire will be useful in Goat farming practice as own business and assistance as scientific expert for the others, especially Goat farmers, Goat product and by-product processing units and extension services.

Curriculum Details

Practical No.	Title of the Practical	Hrs. Requiredthe to cover Practical
1.	Identification and characters of Goat species in India: Osmanabadi, African Bore, Sanen, Pashmina, Beetal, Jamnapari, Barbari, Marvari, Surti, Sirohi, Malabari.	04
2	Anatomy of goat: Digestive system, Udder, Reproductive system in male and female	04
3	Common diseases, characters and control measures of goat diseases.	04
4	Fodder and forage plants for goats: Dry, wet. Characters and identification. Supplementary food formulation preparation. Oil seed cake types.	02
5	Model study Types of shelter for goats. Types of goat farming. Model of Modern Goat farm and its management.	04
6	Analysis of goat milk and meat (Chevon) for its nutritional composition: Protein, Fats, Minerals, Vitamins.	04
7	Artificial insemination in Goats: Equipments and components.	04
8	Visit to goat farm, Goat Bazar and report writing.	04

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M. Sc. Zoology, First Year - Semester- II

Course Code: SZOOC451. Title- Animal Developmental Biology

Periods: 60 No. of Credits: 4 (Marks: 100)

Curriculum Details

Course objectives:

1. To study the structure and function of the basic unit of living organisms.
2. To study steps in animal development.
3. To determine the modern trends and tools, techniques in Animal embryology and development.

Course outcomes:

After learning the development of life from cell to multicellularity complex and coordinated systems in organisms the students can apply this knowledge for research, and education, to solve the problems related to development in animals through research.

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	Concept of Potency. Commitment.	15
	1.2	Specification. Induction. Competence.	
	1.3	Determination and differentiation. Morphogenetic gradients	
	1.4	Cell fate and cell lineages. Stem cells: The concept of totipotency embryonic stem cells. Imprinting; mutants and transgenics. Cell death and ageing analysis of development.	
2.0	**2.1**	Production of gametes- Spermatogenesis in mammals, structure of sperm, Semen formation and composition.	15
	2.2	Oogenesis in mammals, Structure of egg and types.	
	2.3	Cell surface molecules in sperm-egg recognition in animals;	
	2.4	External fertilization in sea urchin. Internal fertilization in mammals	
3.0	**3.1**	Prevention to polyspermy (Fast block and slow block	15
	3.2	Activation of Egg metabolism. Type of eggs, Cleavage and patterns of embryonic cleavage.	

	3.3	Blastula formation and fate map of blastula.	
	3.4	Gastrulation and formation of 3 germ layers in animals (Ex. Frog and Chick)	

4.0	**4.1**	Cell aggregation and differentiation in *Dictyostelium*. Post embryonic development- Larval formation, 6.2. Metamorphosis; Environmental regulation of normal development;	15
	4.2	Axes and pattern formation in *Drosophila*, Segmentation genes, Homeotic genes	
	4.3	Nuclear transplantation and cloning in mammals. Differentiation of neurons,	
	4.4	Sex determination.	

Reference Books:

1. Developmental Biology by Gilbert Scott
2. Molecular biology of the cell By Albert et al
3. Molecular biology of the Gene by Watson et al
4. Principle of Development by Wolpert
5. Genes VIII/ IX By Benjamin Lewin
6. Balinsky, Introduction to Embryology. Sounders, Philadelphia
7. Developmental Biology by Berril 8. Developmental Biology by Waddington

Text Book:

1. Chordate Embryology: Verma and Agarwal.- A Modern Synthesis. Oxford and IBH Pub. Co. Pvt. Ltd.
2. Vasudeo Rao, Developmental Biology

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Two Years PG Program, Syllabus (w.e.f., 2023) M. Sc. Zoology, First Year - Semester- II

Course Code: SZOOC452.

Title- Genetics and Genetic Engineering

Periods: 60 No. of Credits: 4 (Marks: 100)

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. Preparing and analysing pedigree charts and karyograms from provided data.
2. Describe Mendelian and polygenic inheritance.
3. Elaborate about sex chromatin, meiotic, mitotic and polytene chromosomes.

Visualize and estimation of DNA/RNA using appropriate techniques

Curriculum Details

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	Mendel's Laws of inheritance: Law of Dominance, Law of Segregation, Law of independent assortment,	15
	1.2	Test cross, Back cross. Interaction of genes and modifying genes. Complementary gene factors, Supplementary gene factors.	
	1.3	Inhibitory factors. Lethal gene factors. Sex chromosomes and sex linked inheritance. Types of sex chromosomes and sex chromatin	
	1.4	Sex linkage in Drosophila. Sex linkage in man. Sex linked lethal genes. Sex determination in- Heterogametic males, Heterogametic females.	
2.0	**2.1**	Linkage and crossing over Kinds of linkages and significance Mitotic and meiotic crossing over	15
	2.2	Mechanism of crossing over Kinds of crossing over	

	2.3	Mutations: Gene mutation, Chromosome mutation- Deletion, Duplication, Inversion, Translocation, Polyploidy, Aneuploidy, 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	**3.1**	Introduction to recombinant DNA technology. Enzymes used in DNA technology	15
	3.2	Cloning vectors- Plasmids, Phages, Cosmid. Cloning techniques- Isolation and purification of genomic and plasmid DNA and RNA, Gel electrophoresis of nucleic acids.	
	3.3	Gene transfer techniques- Electroportation and microinjection	
	3.4	Applications of recombinant DNA technology. Monitoring of gene expression in live Cells, crop and live stock improvement.	
4.0	**4.1**	Introduction to recombinant DNA technology. Enzymes used in DNA technology	15
	4.2	Cloning vectors- Plasmids, Phages, Cosmid. Cloning techniques- Isolation and purification of genomic and plasmid DNA and RNA,	
	4.3	Gel electrophoresis of nucleic acids. Gene transfer techniques- Electroportation and microinjection Applications of recombinant DNA technology.	
	4.4	Monitoring of gene expression in live Cells, crop and live stock improvement.	

Reference Books:

1. Genetics – P. K. Gupta (Rastogi Publication, Meerut).
2. Genetics – Verma P. S. and Agarwal V. K. (S. Chand Publication Delhi).
3. Cytology, Genetics and Evolution – P. K. Gupta (Rastogi Publication Delhi).
4. Elementary Genetics – Single tone.
5. Genetics – Winchester (Oxford LBH Publication).
6. Genetics and Evolution – A. P. Jha (Macmillon India).
7. Concepts of genetics – W. S. Clug (Pearson Education ISBN).
8. Genetics – Strickberger (Prentice – Hall).
9. Principle of genetics – R. H. Tamarin (Tata Mc Graw Hill Publication India).
10. Concepts of Genetics – R. L. Kotpal (Rastogi Publication).
11. Genetics and Genetic Engineering – Dr. R. P. Meyyan (Saras Publication).
12. Foundations of Genetics – Pai A. C. (Mc Graw Hill Publication).
13. Molecular Genetics – Gunther, S. Stent, (Macmillon).
14. Principles of Genetics – Sinnott, Dunn and Dobzansky (Tata McGraw Hill Pub. Delhi).
15. Genetic – Sarin C. (Tata McGraw Hill Publication Delhi).
16. Principles of Gene Manipulation and Introduction of Genetic Engineering – R.W. Old and S. B. Primerose.

Text Book:

1. A Text Book of Genetics – H.S. Bhamrah (Amol Publication, New Delhi).
2. Genetics – M. P. Arora (Himalaya Publication).
3. Genetics and Evolution – N. Armugam (Saras Publication).
4. Genetic – Veer Bala (Rastogi Publication). 5. Cytology and genetics – Dyansagar V.R. (Tata McGraw Hill Pub. 1992 Reprint).

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Two Years PG Program, Syllabus (w.e.f., 2023) M.
Sc. Zoology, First Year - Semester- II

Course Code: SZOOC453. Title- Chordate Structure and Function

Periods: 60 No. of Credits: 4 (Marks: 100)

Objectives:

To study the basic structure and function of Chordates. To determine the progress and complexity in the development and evolution of different chordate groups for their habitat selection, adaptation and regulation of the life processes.

Course outcome:
Students will get an idea about how the evolution process incurred, its sequences, adaptations and degenerations. It is a basic study can be useful for all kinds of application issues in animal science.

Curriculum Details

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	Basic structure of Chordate animal and its characters. Difference between Vertebrates and Chordates.	15
	1.2	General structure and functions of Integument and its derivatives in vertebrate	
	1.3	Adaptive Radiation in Vertebrates	
	1.4	Distribution and characters of Lung fishes.	
2.0	**2.1**	Evolution of Heart and Aortic arches in Vertebrates.	15
	2.2	Respiratory pigments in animals.	
	2.3	Structure of Gill and respiration in fishes.	
	2.4	Structure of lung and respiration in Mammals. Integumentary respiration in Amphibia.	
3.0	**3.1**	Comparative structure of alimentary canal and associated digestive glands in vertebrates.	15
	3.2	Structure of brain and spinal cord in Fishes and mammals. Cranial nerves and their functions in fishes and Mammals.	
	3.3	Comparative structure of heart in Elasmobranchs, Teleost, Frog, Calotes and Typical Mammal. Single and double circulation of blood.	
	3.4	Structure and functions of Kidney in fishes and Mammals.	

4.0	**4.1**	Jaw suspension in vertebrates.	15
	4.2	Structure and functions of Brain and cranial nerves in fishes and Mammal.	
	4.3	Structure and working of Mammalian Ear and Eye. Classification and characters of Chiroptera.	
	4.4	Distribution and Characters of pouched mammals- Kangaroo, Aquatic mammals- Whales. Introduction to Dugong, Seal and Walrus, Characters and distribution	

Reference Books

1. Vertebrate Zoology – Prasad.
2. Vertebrate Zoology- Kotpal and Kshetrapal- Rastogi Publication, Meerut.
3. Invertebrate Zoology-Kotpal and Kshetrapal- Rastogi Publication, Meerut.
4. Chordate Zoology- Jordan and Verma
5. Vertebrate Body – Romer, W. B. Saunders and Co. Philadelphia.
6. Life of Mammals – Young J. Z., Oxford University Press, London.
7. Evolution of Chordate Structure – Smith H. S.
8. Chordate Zoology – Dhami and Dhami.

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Two Years PG Program, Syllabus (w.e.f., 2023) M. Sc. Zoology, First Year - Semester- II

Course Code: SZOOE451. Title- Bee Keeping and Management.

Periods: 45 No. of Credits: 3 (Marks: 75)

Course Objectives:

To introduce the students about potential of useful insect the Bees for getting Honey and other by-products from their scientific culture methods.
To educate the students about conservation of bees to increase the production in agriculture due to effective pollination.

Course outcome:
Students can start their own business of Apiculture/Bee farming, train others and will be able to enter in private, Govt sectors or in the research related to Apiculture/Bee keeping.

Curriculum Details

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	History, Scope and Importance of beekeeping and economics.	15
	1.2	Bee species.	
	1.3	Cast differentiation, Colony organization Division of labour in honeybee	
	1.4	Life cycle of honeybee and nuptial flight .	
2.0	**2.1**	Equipments for improving efficiency of honeybees Inspection and Handling the Colony	15
	2.2	Equipments for improving efficiency of bee's keepers Equipments for improving hygienic conditions	
	2.3	Methods of Swarm capturing. Capturing a Swarm from a tree branch . Capturing a Swarm from Ground	
	2.4	Hiving by dividing an established colony. Establishment, Seasonal Management of apiary and inspection of bee colonies.	
3.0	**3.1**	Bee plants and floral calendar- Importance and qualities of good bee flora. Pollination, Need of bee pollination Management of honeybees for pollination.	15
	3.2	Migratory beekeeping	
	3.3	Honeybee products	

	3.4	Honey- Its constituents, methods of collection and uses. Importance of other bee products to mankind	

Reference Books

1) Introduction to disease of bee –Bailey, L 2) World of honeybee –Butter C. G.

3) Beekeeping in India –Sardar Sing (ICAR)

4) The Principle of Insect Physiology-Wigglesworth, V.S.

5) Applied Zoology- B. B. Waykar, A. Y. Mahajan, B. C. More . (Prashant Publication Jalgaon)

6) D. K. Belsare, Beekeeping for livelihood

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Two Years PG Program, Syllabus (w.e.f., 2023) M. Sc. Zoology, First Year - Semester- II

Course Code: SZOOE452. Title- Parasitology

Periods: 45 No. of Credits: 3 (Marks: 75)

Course Objectives:
To study the major types of parasites of medical & veterinary importance.
To understand the basics of identification of common parasites of humans and animals. To design and evaluate an intervention to control food and waterborne diseases. To understand and evaluate epidemiological studies in different disease.

Course outcome:
The students after completing this course based on the expertise he may join the parasitological research institute, may be a scientist in the WHO, UN Parasitological researcher, scientist. May join as Parasitologist in the state and central government public health programs as officer. My get job opportunities in the pathological labs as parasitologist.

Curriculum Details

Module No.	Unit No.	Title of the Topics	Hrs. Required to cover the topic
1.0	**1.1**	Introduction to Parasitology, Parasitism- Definition & concept. Types of Parasites.	15
	1.2	Factors influencing Parasitism; Influence of season, host age and other phonological factors on parasitic population (prevalence, intensity etc). Inter-specific biological relationships phoresis, symbiosis, Commensalisms and parasitism.	
	1.3	Origin and evolution of parasites and adaptation in parasites. Advantages and Disadvantages in parasitic life. Parasitoids. Types of hosts- Definitive and intermediate, primary and secondary specific host, Paratenic, Carrier, Susceptible, Resistant, Accidental, Vectors, Host specificity.	
	1.4	Introduction to Immunology of Parasitic infections. Natural & acquired immunity. Immuno-diagnosis.	
2.0	**2.1**	Parasite and global public health. Global burden of infectious diseases. Parasitic zoonosis.	15
	2.2	General principles of immunization and Hypersensitivity reactions.	
	2.3	Strategies in designing parasitic vaccines and Limitations.	
	2.4	Life cycle and pathogenecity of malarial parasites and control on malaria	

3.0	**3.1**	Study of coccidian parasites in vertebrates. Study of class Piroplasma to special reference to *Theleria* and *Babesia.* Introduction to Parasitic Acanthocephala and Annelida (Any one example each)	
	3.2	General organization of the parasitic Protozoa occurring in oral cavity, urinogenital tract, muscles and blood. i) *Trichomonas vaginalis* ii) *Trichomonas foetus* iii) *Trypanosoma gambiense* iv) *Trypanosoma cruzi* v) *Leshmania donovani vi) vii) Giardia lambiia. Viii) Entamoeba gingivalis ix) Toxoplasma gondii x) Balantidium coli.*	15
	3.3	Life Cycle and Control of *Taenia solium, T. saginata, Echinococcus granulosus, Trichinella spiralis, Enterobius vermicularis, Wuchereria bancrofti Schistosoma haematobium, Fasciola hepatica.*	
	3.4	Parasitic Diptera, Parasitic Hemiptera and Pentastomidea Parasitic Crustacean and Acarids (any one example).	

Reference Books

1. 'Infectious Disease Epidemiology: theory and practice' 2nd edition. Nelson & Williams (Eds.). 2007.
2. A good additional online text: Global Burden of Disease and Risk Factors. Disease Control Priorities Project. It is available at: http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=gbd.TOC&depth=2
3. Medical Parasitology by Markell, Voge and John, 8th ed. W.B. Saunders Co.
4. Reingold, A.L. Outbreak Investigations – A Perspective. Emerging Infectious Diseases 1998; 4(1): 21-27.
5. Jones, K.E., Patel, N.G., Levy, M.A., Storeygard, A., Balk, D., Gittleman, J.L. and P. Daszak. Global trends in emerging infectious diseases. Nature 2008; 451(21): 990-993.
6. The Trematode - Dausese B
7. Taxonomy of Cestode Parasites of vertebrates: Khalil and Bray (CABI Publication, London)
8. An introduction to Nematodology -Chitwood
9. Helminth, Arthropod and Protozoa of domesticated animal -Solbsy E.J.W
10. Laboratory methods of work with plant and soil nematodes -Southey
11. Human helmintology Munual for Clinicals, Sanitarians Medical Zoologists –Faust, Emerest Caroll
12. Practical exercise in Parasitology -Halton, Behave, Marshall.
13. Chatterjee K. D. (1969) -Parasitology (Protozoology and Helminthology)
14. Cheng T.C. (1964)-The Biology of animal parasites, Saunders International Student Edition.
15. The Invertebrates Vol II, McGraw Hill, New York.- Dawes B. (1946).
16. Text book Medical Parasitology of Jaypee Brothers, - Panikar C.K.J (1988)
17. Medical Publishers, New York. - Panikar C.K.J (1988)
18. The Parasitology of Trematodes Oliver and Boyd Ltd. Edinburgh - Smyth J.D (1977)
19. The Zoology of Tapeworm. - Wardle and Mcleod (1952)
20. The advances in the Zoology of tapeworm from - 1970- Wardle and Mcleod
21. Systema Helmenthum Vol. II Cestoda. - Satyu Yamaguti (1959)
22. The Physiology of Cestodes. - J.D Smyth

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Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year – Semester-II

Course Code: SZOOP451 Title of the Course – Lab 1 – Animal Developmental Biology

Periods 30 Credits: 01 (Marks : 25)

Course objectives:

To determine the processes, occur in animal development.

To determine various cell types, gametes in animals and larval development.

Course outcomes: The students will get a skill to observe the cells, microscopy and gametic processes. The techniques acquired will be useful in applied embryology and gamete biology.

Curriculum Details

Practical No.	Title of the Practical	Hrs. Requirecthe to cover Practical
1.	Microscopic study of structure of sperms. Study of semen for sperm motility and abnormalities in Male Goat/cattle semen.	04
2	Micro techniques for histology and histo-chemistry of tissue preparation.	04
3	Study of developmental stages in fertilized egg of hen (Various Hrs. stages of Embryonic Development) and demonstration of organogenesis in chick embryo.	04
4	Study of regeneration in earthworms and cultivable fishes.	04
5	Techniques of cryopreservation of Ova and sperms in fish/Cattle.	04
6	Identification of various types of eggs in animals.	04
7	Preparation and submission of five slides of cells isolated from different organs of invertebrate and vertebrate animals.	04
8	Computer simulated experiments in animal embryology and cell biology.	02

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Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year – Semester-II

Course Code: SZOOP452 **Title of the Course – Lab 2 – Practical in Genetics and Genetic Engineering**
Periods 30 **Credits: 01 (Marks: 25)**

Course objectives:

To learn the practical methods in Genetics and Molecular Biology
To know about the techniques to isolate the DNA, RNA and some cellular Organelles **Course outcomes:**

Course Outcome:
The students will get expertise in Genetics and Genetic Engineering, Isolation, Characterizati

Curriculum Details

Practical No.	Title of the Practical	Hrs. Requiredthe to cover Practical
1.	Separation of amino acids by paper chromatography method.	04
2	Separation of antigen, antibody by gel electrophoresis	04
3	Solution Preparation, understanding Molarity, Normality, buffer, pH Meter.	04
4	Isolation of DNA; Amplification of DNA by using PCR Tools.	04
5	Experiments on enzyme activity (Amylase, Protease, Lipase, inhibitors) Problems on Mendelian Genetics and Interaction of Genes.	04
6	Introduction to Gas Chromatography (GC).	02
7	Separation of amino acids and proteins from blood samples by polyacrylamide Gel Electrophoresis ((PAGE).	04
8	Separation and identification of sugars by Thin Layer Chromatography (TLC). Introduction and uses of HPLC	04

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M. Sc. Zoology, First Year – Semester-II

Course Code: SZOOP453 **Title of the Course – Lab 3 – Practical in Chordate Structure and Function**

Periods 30 Credits: 01 (Marks : 25)

Course objectives:

To determine the structure and function various fauna in the nature to understand their survival need and modifications found in these creatures accordingly. **Course outcomes:**

Knowledge about the structure and function of various animals living in different biomes and the structural differences found in their body. This will be useful to understand how animals are being adapted in their thousand of years of evolutionary history. The current environmental change also corelated

Curriculum Details

Practical No.	Title of the Practical	Hrs. Required to cover the Practical
1.	Virtual dissection of Rat and Frog for various systems. (Computer Simulated demonstrations and Problems)	04
2	Structure and Function of Pisces- Photo/models/specimen- *Zygaena*, Stingray, Electric Ray, *Channa sp. , Catla catla, Wallago attu, Notopterus sp., Mastacembellus armatus, exocoetus, Echenius, Diodon, Hippocampus, Puntius sp.*	04
3	Structure and Function of Amphibians- Photo/Model based study of *Ichthyophis sp., Rhacophorus sp., Hyla sp.*	04
4	Structure and Function of Aves- Photo/Model based study of Bubo, Duck, Vulture, Pigeon, Sparrow, Crow.	04
5	Structure and Function of Reptiles- Photo/Model based study of Chameleon sp., *Phrynosoma* sp., Varanus sp., Viper sp., Rat snake sp., Cobra sp., Turtle sp.	04
6	Structure and Function of Mammals- Photo/Model based study of Loris Sp. Bat sp., Funambulus sp., Duckbill platypus, Echidna, Kangaroo.	04
7	Structure and Function of Mounting of scales in fishes for the structural differences: Cycloid, Ctenoid, Placoid.	04
8	Structure and Function of Model or Photo based study of Horns in mammals; beak and claws in birds.	02

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

Faculty of Science and Technology,
School of Life Sciences, S. R. T. M. U. N.

Two Years PG Program, Syllabus (w.e.f., 2023)

M. Sc. Zoology, First Year – Semester-II

Course Code: SZOEP451 Title of the Course – Lab 3 – Practical in Bee keeping and management
Periods 30 Credits: 01 (Marks : 25)

Course objectives:

To get practical knowledge the different species and their role in bee product and byproduct development

To determine the role of bees that how they can be used in agricultural development through Bee services to nature.

Course outcomes:

The students will learn practical approach in Bee keeping and management, that will be useful in service to farmers, NGO and to open new entrepreneurship, self business start-up.

Curriculum Details

Practical No.	Title of the Practical	Hrs. Requiredthe to cover Practical
1.	Study of external morphology of honeybee: Difference between Queen, Drones and Worker bees.	04
2	Study of Indian species of honeybee (External morphological features, comparative differences and special identification features)	04
3	Study of life cycle of honeybees	04
4	Study of architecture of honey comb.	04
5	Study of diseases, pests, parasites and predators of the honeybee Study of bee keeping equipments and their uses.	04
6	Microscopic study of morphology of bee sting.	04
7	Chemical analysis of honey- test for pure honey. Honey, Proposlis, Bee wax, Pollen, Royal Jelly, Bee Bread, Bee venom. Identification and uses of various products and by-products from Apiculture:	04
8	Visit to an apiary to study bee-crop relationship and management practices of honeybees for Pollination. Maintenance of honeybee colony (Rearing of live colony) in University campus. Demonstration and setting of various parts of Bee Box.	02

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M. Sc. Zoology, First Year – Semester-II

Course Code: SZOEP452, Title of the Course: Lab 3 – Practical in Parasitology

Periods 30 Credits: 01 (Marks : 25)

Curriculum Details:

Course Objectives:

To Collect and study the major types of parasites of medical & veterinary importance.
To understand the basics of identification of common parasites of humans and animals.
To design and evaluate an intervention to control food and waterborne diseases. To understand and evaluate epidemiological studies in different disease.

Course outcome:

The students after completing this course based on the expertise he may join the parasitological research institute, may be a scientist in the WHO, UN Parasitological researcher, scientist. May join as Parasitologist in the state and central government public health programs as officer. My get job opportunities in the pathological labs as parasitologist.

Practical No	Title of the Practical	No. of Periods
1	Parasitological examination of fecal waste of poultry and wild birds, Mammals for protozoan parasites, helminth eggs, larvae and adult worms. Parasite population indices and its uses.	4
2	General principles of Collection, Preservation, Staining and Mounting of Trematodes and Cestodes.	4
3	Preparation of stains: Haematoxylin, Acetocarmine, Borax caramine and Bouins fluid.	2
4	Collection of Trematodes and Cestode parasites from locally available different hosts.	2
5	Preparation and identification of collected helminth parasites (Trematodes and cestodes) at least ten.	4
6	Standard reference books, literature and e-sources used in Taxonomy of Parasitic Protozoa, Parasitic Arthropods, Trematodes, Cestodes and Nematodes.	4
7	Fixation of Helminth parasites for SEM and TEM studies and its importance in modern Taxonomy.	2
8	Molecular techniques for identification of Parasitic infection.	2
9	Study of permanent mounts of Trematodes, cestodes, Parasitic Insects and Arthropods viz. Mouth Parts, legs and adaptations. *a) Gyrodactylus b) Paramphistomum c) Fasciola hepatica d) Fasciolopsis buski e) Schistosoma Japonicum f) Schistosoma mansoni g) Paragonimus wetermani. h) Taenia solium& Taenia saginata i) Moniezia expansa j) Railletina k) Cotugnia l) Echinococcus granulosus m) Diphyllobothrium latum n) Dipylidium caninum o) Hymenolepis nanap) Gyrocotyle q) Mosquito sp., Ticks sp., Mites sp. Leech sp.*	6