

॥ सा विद्या या विमुक्तये ॥



# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

“ज्ञानतीर्थ” परिसर, विष्णुपुरी, नांदेड - ४३१६०६ (महाराष्ट्र)

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY NANDED**

“Dnyanteerth”, Vishnupuri, Nanded - 431606 Maharashtra State (INDIA)

Established on 17th September 1994 – Recognized by the UGC U/s 2(f) and 12(B), NAAC Re-accredited with 'A' Grade



## ACADEMIC (1-BOARD OF STUDIES) SECTION

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प्रस्तुत विद्यापीठाच्या संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे CBCS Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९-२० पासून लागू करण्याबाबत.

### प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक ०८ जून २०१९ रोजी संपन्न झालेल्या ४४व्या मा. विद्या परिषद बैठकीतील ऐनवेळचा विषय क्र.११/४४-२०१९ च्या ठरावानुसार प्रस्तुत विद्यापीठाच्या प्रस्तुत विद्यापीठाच्या संकुलातील विज्ञान व तंत्रज्ञान विद्याशाखेतील पदव्युत्तर स्तरावरील प्रथम वर्षाचे खालील विषयांचे C.B.C.S. (Choice Based Credit System) Pattern नुसारचे अभ्यासक्रम शैक्षणिक वर्ष २०१९-२० पासून लागू करण्यात येत आहेत.

1. Botany
2. Certificate Course in Industrial Safety, Health and Environmental Management (SHM)
3. Chemistry
4. Computer Application
5. Computer Network
6. Computer Science
7. Geophysics
8. Mathematics
9. M.C.A.
10. Microbiology
11. Physics
12. Zoology

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या [www.srtmun.ac.in](http://www.srtmun.ac.in) या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी.

‘ज्ञानतीर्थ’ परिसर,

विष्णुपुरी, नांदेड - ४३१ ६०६.

जा.क्र.: शैक्षणिक-१/परिपत्रक/संकुले/पदव्युत्तर-सीबीसीएस  
अभ्यासक्रम/२०१९-२०/४६५

दिनांक : ११.०७.२०१९.

प्रत माहिती व पुढील कार्यवाहीस्तव :

- १) मा. कुलसचिव यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- २) मा. संचालक, परीक्षा व मूल्यमापन मंडळ यांचे कार्यालय, प्रस्तुत विद्यापीठ.
- ३) मा. संचालक, सर्व संबंधित संकुले, विद्यापीठ परिसर, प्रस्तुत विद्यापीठ.
- ४) साहाय्यक कुलसचिव, पदव्युत्तर विभाग, प्रस्तुत विद्यापीठ.
- ५) उपकुलसचिव, पात्रता विभाग, प्रस्तुत विद्यापीठ.
- ६) सिस्टम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ.

स्वाक्षरित/—

**उपकुलसचिव**

शैक्षणिक (१-अभ्यासमंडळ) विभाग



**Swami Ramanand Teerth Marathwada University,**  
**Nanded, PIN – 431 603**  
**Maharashtra State, INDIA.**  
(NAAC 'A' Grade)

**SCHOOL OF LIFE SCIENCES**  
**Department of Zoology**

**Syllabus M. Sc. Zoology (First Year)**  
**(Semester- I and Semester- II)**  
(CBCS Pattern)

**Effective from June, 2019 onwards**



**Swami Ramanand Teerth Marathwada University, Nanded, PIN – 431 603  
Maharashtra State, INDIA**

**SCHOOL OF LIFE SCIENCES  
SYLLABUS- M. Sc. ZOOLOGY (First Year and Second Year) CBCS Pattern-  
THEORY AND PRACTICAL**

### **Year June, 2019 Onwards**

The Two Year (**Four Semester**) CBCS teaching program in Zoology has an intake of 20 students. The course structure is of Choice Based Credit System (CBCS) pattern as per UGC guidelines. The course curriculum also includes dissertation for the partial fulfilment of the Postgraduate degree in Zoology from third semester onwards. The medium of instruction and examination of this course is English.

The course includes Subject specific electives (SSE) and Skill Enhancement Courses (SEC). Also there are open electives (OEC) as per the UGC Model curriculum of CBCS Pattern. The students are also encouraged to learn SWAYM and NPTL courses as web based learning.

The M. Sc. Zoology course offers Dissertation as one of the important component, it is for those students who are interested in pursuing their career in research. There is an option against dissertation to write a review on selected research topics. There is one more choice for the students those who are not willing to enter in the research field and experimentation , for such students they have to complete the Practical Paper-VIII that includes important experiments related to research and application based topics. Based on the academic performance of a student in semester-I, Semester-II the Dissertation Allocation Committee (DAC) may advice the students whether to go for the dissertation or not.

The department is also actively involved in organizing other Academic Activities, study tours for the benefit of students and researchers. For each paper in the course there is seminar component to develop the confidence of expression and explanation of the content they studied and learned during the completion of this course.



Swami Ramanand Teerth Marathwada University, Nanded, PIN – 431 603 Maharashtra State,  
INDIA.

**SCHOOL OF LIFE SCIENCES**

**Department of Zoology**

**M. Sc. Zoology Syllabus- June, 2019 onwards**

**(CBCS Pattern)**

**OUTLINE OF THE COURSE STRUCTURE**

Semester	Code No.	Name of the Paper	No. of Periods /Semester	Type of Paper	Total Credits	Internal Exam Marks	External Exam Marks	Total Marks
First Semester	<b>THEORY</b>							
	ZOT-101	Animal Taxonomy and Evolution	60	Core Paper	04	50	50	100
	ZOT-102	Non-Chordate and Protochordates	60	Core Paper	04	50	50	100
	ZOT-103	Cell Biology, Genetics and Molecular Biology	60	Core Paper	04	50	50	100
	*ZOT-104	Elective-I	60	Discipline Specific Elective (DSE)	04	50	50	100
			240		16	200	200	400
	<b>Total Credits for Theory in Semester First = 16</b>							
	<b>Practical Papers for Semester First</b>							
		Name of the Paper	Credits	Internal Exam.	External Exam.	Total Marks		
	ZOL-1	Zoology Lab Course – I	4	50	50	100		
ZOL-2	Zoology Lab Course – II	4	50	50	100			
		08	100	100	200			
<b>Total Credits for Practical for Semester First = 08</b>								
Semester	Code No.	Name of the Paper	No. of Periods / Semester		Total Credits	Internal Exam Marks	External Exam Marks	Total Marks
Second Semester	<b>Theory Papers for Semester Second</b>							
	ZOT-201	Developmental Biology	60	Core Paper	04	50	50	100
	ZOT-202	Chordate Structure and Function	60	Core Paper	04	50	50	100
	ZOT-203	Biochemistry and Immunology	60	Core Paper	04	50	50	100
	*ZOT-204	Elective-II	60	Discipline Specific Elective (DSE)	04	50	50	100
			240		16	200	200	400
<b>Total Credits for Theory for Semester Second = 16</b>								

<b>Practical Papers For Semester Second</b>						
	Name of the Paper	Credits	Internal Exam	External Exam	Total Marks	
ZOL-3	Zoology Lab Course - III	4	50	50	100	
ZOL-4	Zoology Lab Course – IV	4	50	50	100	
		08	100	100	200	
<b>Total Credits for Practical for Semester Second = 08</b>						

**Credits of Theory Papers of Semester First and semester Second = 32 Credits**

- Note: \* indicates Elective Paper. The student may select elective paper from other courses of the schools in the University Campus.

**Credits of Practical Papers for semester First and Second = 16 Credits**

**Total Credits of Semester First and Second for Theory and Practical = 48 Credits**

**Total Marks of First Year Zoology at Campus SLS, SRTMUN = 1200 Marks**

- The Codes T- indicates Theory, D- indicates Dissertation and ZOL -indicates Laboratory Course.
- SEC-Skill Enhancement Courses.
- Core Paper- Core content of main content of the course.
- SSE- Subject Specific Elective

**Internal Assessment = 50 %**

- Two Internal Exams each of 15 Marks (based on MCQs and Theory) Assignment of 10 Marks, Seminar for 10 Marks for each paper is compulsory (15+15+10+10).

**External Assessment = 50%**

- At the end of Each Semester there will be Theory Examination (External) for Theory Papers as per the University Examination Time Table.
- The examinations for Laboratory Courses (External) will be held at the end of Semesters.

**Non-Major Elective Course:**

There are 4 Credits of theory offered to other disciplines in I, II, III Semester. Therefore the M. Sc. Zoology students have to choose one elective paper from other PG courses like M. Sc. Botany, M. Sc. Microbiology, M. Sc. Biotechnology or any other PG courses from other departments within this University.

**About the Elective papers:**

Following given three elective papers are offered for PG courses other than M. Sc. Zoology. Therefore M. Sc. Zoology students have to choose one elective paper in Semester-I, II, III offered by other PG Courses as given in the syllabus structure. However for M. Sc. Zoology Students earning the credits of any two elective papers of the following will be an additional credit earning and that will be counted against the completion of Dissertation/Review Writing or Practical paper-VIII.

- For Semester-I- Generic / Open Elective– Apiculture.
- For Semester-II- Generic/Open Elective - Goat farming.
- For Semester-III- Generic/Open Elective - Sericulture.

Student Can complete the courses from other learning sources like NPTL, SWYM in the First Year of PG Course and produce the details of credits completed to the Head Of the Department of Zoology and The Office of Director, School of Life Sciences, based on how many credits he earned he may be eligible for exemption from completing Dissertation or any other paper/s in Second Year of the

Course. The Students are not allowed for such external courses when they are in second year to avoid the delay in Final results of the PG Course.



**S.R.T.M. University, Nanded,  
School of Life Sciences  
Department of Zoology  
M. Sc. Zoology-First Year, Semester – I (June, 2019 onwards)  
(Pattern- Choice Based Credit System)  
Syllabus- Theory Paper  
Paper Code: ZOT- 101**

**Title of the Paper – Animal Taxonomy and Evolution**

**Total Credits – 04**

**Number of Periods – 60**

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**Course Objective:**

The paper is designed to make students aware not only of the great diversity which is being displayed by animals around us but also to prepare them theoretically and practically to study and arrange the Bio-diversity in scientific and natural manner. The theoretical background of systematics and taxonomy thus will go a long way in elucidating the natural grouping which exists in the biodiversity around us.

**Course outcome:**

The students will get basic knowledge about animal taxonomy and it will be useful to understand the animal world around them. The students may apply this knowledge in taxonomy related job opportunities.

**UNIT – I**

1. Definition and basic concept of Biosystematics, taxonomy and classification, History of taxonomy, systematics, Taxonomic characters and their kinds and wetage.
2. Trends in animal taxonomy: Chemo-taxonomy, Cyto-taxonomy, Molecular taxonomy, Immuno-taxonomy & Para-taxonomy.
3. Theories of animal classification, Hierarchy of categories in animal classification.
4. Importance and application of Taxonomy (biosystematics) in biological studies.
5. Systematics as a profession and its future perspectives,

**UNIT – II**

1. Species categories and species concept.
  - a) Typological species concept. b) Nominalistic species concept.
  - c) Biological species concept d) Evolutionary species concept.
2. Difficulties in application of Biological species concept.
3. Intra-specific categories & Taxons: a) variety, b) Subspecies c) super species d) Sibling species.
4. Origin of new species taxa and their delimitation.
5. Taxonomic Characters, Types of taxonomic characters, origin of reproductive isolation,

biological mechanism of genetic incompatibility.

### UNIT – III

1. Taxonomic procedures, Taxonomic collections. Preservations and process of identification of Insects, Helminth Parasites, Fishes.
2. Taxonomic keys: Different categories of taxonomy and their merits, demerits, Taxonomic publications.
3. International Code of Zoological Nomenclature (ICZN): Operative principles, interpretation and application of different rules, formation of scientific Name of various taxa.
4. Different types of camera for the field and laboratory studies.
5. Sound Recording and Echo-sound recording devices used in animal detection, Recording and Taxonomic studies.
6. Reference work in Taxonomy: Zoological Records, Biological Abstracts, Protozoological Abstracts, Entomology Abstracts, Agri-Index, Bibliography of Agriculture with Subject Index, Books and Journals, Latin Abbreviations, Linnaean Signs.

### UNIT – IV

1. Neo-Darwinism and Population Genetics: Hardy-Weinberg law of genetic equilibrium,
2. Forces for destabilization in the process of organic evolution : Natural selection, mutation, genetic drift, migration and meiotic drive.
3. Origin and evolution of Fishes. Dinosaurs and their extinction.
4. Molecular Population Genetics: Gene mutation- Patterns of changes in nucleotide and amino acid sequences.
5. Ecological significance of molecular variations (Genetic Polymorphism), Micro-evolution and Macro-evolution.
6. Phylogeny: Cladistics, dendrogram, construction of Phylogenetic tree and analysis.

### SUGGESTED READINGS:

- |   |  |
|---|--|
| 1. Molecular Markers,                         | Avise, J. C. .                           |
| 2. Principles of Animal Taxonomy              | Simpson G.G.                             |
| 3. Elements of Taxonomy                       | Mayer E.                                 |
| 4. Biodiversity                               | Wilson E. O.                             |
| 5. Evolution                                  | Dobzhanskey, F. J. Ayala, J. M. V. V. V. |
| 6. Genetics and Origin of species             | Dobzhanskey, Columbia University Press.  |
| 7. Theory and Practices in<br>Animal Taxonomy | S. C. Kapoor (Oxford and IBH, New Delhi) |
| 8. Evolution                                  | Sawage                                   |
| 9. Organic Evolution                          | Lull.                                    |
| 10. Evolution of Vertebrates                  | Colbert                                  |
| 11. Evolution and Genetics                    | Merrel D. J., Jones                      |





**S.R.T.M. University, Nanded,**  
**School of Life Sciences**  
**Department of Zoology**  
**M. Sc. Zoology First Year, Semester – I (Year 2019 Onwards)**  
**(Choice Based Credit System)**  
**Syllabus- Theory Paper**  
Paper Code: ZOT- 102  
**Title of the Paper –Non-Chordate and Protochordates**  
**Total Credits – 04, Number of Periods – 60**

**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 non-chordates
3. To describe the structure and function of vital organs among non-chordate phyla.

**Course outcome:**

The students will get an idea about how the life processes goes on in the animals in their surrounding . Also the knowledge they use to monitor, manage, conserve and utilize these creatures. Also it gives an idea about how a Human being is evolved in sequential evolution process.

**UNIT – I**

1. Organization of Coelom : Acoelomata, Coelomata, Pseudocoelomata. Protostomia and Deuterostomia.
2. Food, feeding and reproduction in Protozoa.
3. Paramecium: Structure, Food and Feeding, Locomotion.
4. Spongocoel, Coelenteron.
5. Types of Cells and their functions in Sponges
6. Polymorphism, functions of zooids in Obelia Colony.

**UNIT- II**

1. Reproduction and Alternation of generation in Coelenterates.
2. Structure and working of respiratory organs in Insects, Scorpion, Prawn, Bivalve, *Pila globosa*.
3. Excretion – Structure and working of Coelom, Coelomoducts, flame cells, Nephridia and Malphigian tubules.
4. Primitive nervous system : Coelenterata and Echinodermata.
5. Advanced nervous system in Annelida, Arthropoda and Mollusca (Cephalopoda).

**UNIT – III**

1. Larval forms in Invertebrates (Porifera to Echinodermata) and their Evolutionary Significance.
2. General characters of Cephalochordates.
3. General characters of Urochordata
4. Affinities of Cephalochordates to Vertebrates and Origin of Vertebrates.
5. Introduction to Minor Phyla.

**UNIT – IV**

1. Cyclostomes: General characters; Classification and characters of Pertomyzon and Myxin.
2. Ostracoderms: Characters of Jawless fossil fishes.
3. Placoderms: Characters of fossil Placoderms.
4. Latimeria: Living fossil fish- occurrence and characters.



**S.R.T.M. University, Nanded,  
School of Life Sciences  
M. Sc. Zoology, First Year, Semester – I (Year 2019 Onwards)  
(Choice Based Credit System)**

**Syllabus- Theory Paper**

Paper Code: ZOT- 103

**Title of the Paper – Cell Biology, Genetics, Molecular Biology**

**Total Credits – 04**

**Number of Periods – 60**

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**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 signaling).
3. To understand the basic concepts and processes in development of an organism.
4. The objective of this course is to provide a clear understanding of DNA so that they can manipulate and understand the basic tools and techniques involved in it. Strong foundation in genetics and molecular biology enables the students to familiarize themselves with genetic engineering.

**Course Outcome:**

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

**Unit-1**

1. Introduction to basic concepts of cell Biology, Overview of Prokaryotic and Eukaryotic cells.
2. Types of cells in animals.
3. Nucleus, Mitochondria and its genetic organization, Structure and organization of Chromatin. Cytoskeleton: Microfilaments, Microtubules, Intermediate filaments - structure, composition, functions.
4. Transport across cell membrane: Types of transport- Na & K ATPases, proton pumps, Bulk transport.

**Unit-II**

1. Cell interactions: cell adhesion, role of cell adhesion in inflammation and metastasis.
2. Cell Cycle: Major events during G1, S, & G2 phases, regulation of cell cycle, cell cycle and apoptosis.
3. Cell signaling: Introduction to cell signaling, types of receptors, extra-cellular messengers and signal transduction with examples.
4. Cell Differentiation & differential gene activity, Biology of Cancer: Types and characteristics, Oncogenes & tumour suppressor genes and chemical carcinogenesis, biomarkers of cancer detection. Developmental genetics of *C. elegans* and *Drosophila melanogaster*.

**Unit III**

1. Overview of Mendelian Genetics, Fine structure of gene, types of mutations, UV and chemical mutagens; Ames test for mutagenesis; Retroviruses.
2. Prokaryotic and eukaryotic DNA replication, Mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication,
3. Types & mechanism of DNA Repair, Process & types of Recombinations, Holiday junction, gene targeting, FLP/FRT and Cre/Lox recombination, Rec A and other recombinases.

#### **Unit IV**

1. Modifications in RNA: 5'-Capping, 3'-polyadenylation, and splicing, RNA editing, RNA stability, Process of Prokaryotic and Eukaryotic transcription, RNA polymerase,
2. General and specific transcription factors, Regulatory elements and mechanisms of transcription regulation, Transcriptional and post-transcriptional gene silencing.
3. Prokaryotic and eukaryotic translation, the translation machinery, Mechanisms of initiation, elongation and termination.
4. Regulation of translation, co-and post-translational modifications of proteins. Synthesis of secretory and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes. Receptor mediated endocytosis.

#### **References:**

1. Molecular Cloning: a Laboratory Manual. J. Sambrook. E.F. Fritsch and T. Maniatis, Cold Spring Harbor Laboratory Press, New York, 2000.
2. Introduction to Practical Molecular Biology, P.D. Dabre, John Wiley & Sons Ltd., New York, 1988.
3. Molecular Biology LabFax, T.A. Bown (Ed.) Bios Scientific Publishers Ltd., Oxford, 1991.
4. Molecular Biology of the Gene (4<sup>th</sup> Edition), J. D. Watson, N.H. Hopkins, J. W. Roberts, J. A. Steeitz and M. A. Weiner, The Benjamin/Cummings Publ. Co., Inc., California, 1987.
5. Molecular Cell Biology (2<sup>nd</sup> Edition) J. Darnell, H. Lodish and d. Baltimore, Scientific American Books, Inc., USA, 1994.
6. Molecular Biology of the Cell (2<sup>nd</sup> Edition) B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts, and J. d. Watson Garland publishing, Inc., New York, 1994.
7. Gene VI (6<sup>th</sup> Edition) Benjamin Lewin, Oxford University Press, U.K., 1998.
8. Molecular Biology and Biotechnology. A comparative desk reference, R. A. Meyers (Ed.) VCH Publishers, Inc., New York, 1995.
9. Genomes, T. A. Brown.8<sup>th</sup> Day of Creations
10. Cell and Molecular Biology – De Robertis.
11. Gene – IX, Benjamin Lewin, Oxford University Press..
12. Cell and Molecular Biology. – Gerald Karp, 5<sup>th</sup> Edition, John Willy and Sons. Inc. 2008.
13. Cell Biology – David E. Sadava, Jones and Bartlett Publishers, London, 1993.
14. Molecular Biology of Gene (V- Edition) – J. D. Watson, Lania A. Raker, Stephan P. Bell, Alexander Gann, Micheal Eveni – Pearson Education and Publication.



**S.R.T.M. University, Nanded,  
School of Life Sciences  
M. Sc. Zoology, First Year, Semester – I (Year 2019 Onwards)  
(Choice Based Credit System)  
Syllabus- Theory Paper (Elective for First semester)  
Paper Code: ZOT- 104  
Title of the Paper – Apiculture**

**Total Credits – 04**

**Number of Periods – 60**

**Course Objectives:**

To introduce the students about potential of useful insect the Bees for getting Honey and other byproducts from their scientific culture methods.

To educate the students about conservation of bees to increase the production in agriculture duce 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.

**Unit- I - Introduction of Modern bee keeping**

- 1.1. Importance of beekeeping
- 1.2. Scope of beekeeping
- 1.3. Bee species
- 1.4. Cast differentiation, Colony organization
- 1.5. Division of labor in honeybee
- 1.6. Life cycle of honeybee and nuptial flight

**Unit- II. Scientific bee keeping**

**2.1 Beekeeping equipment's**

- 2.1.1 Equipments for improving efficiency of honeybees
- 2.1.2 Equipments for improving efficiency of bee's keepers
- 2.1.3. Equipments for improving hygienic conditions
- 2.2. Methods of Swarm capturing. 2.2.1. Capturing a Swarm from a tree branch . 2.2.2. Capturing a Swarm from Ground
- 2.3. Inspection and Handling the Colony
- 2.4. Hiving by dividing an established colony.
- 2.5. Establishment, Seasonal Management of apiary and inspection of bee colonies.

**Unit III - Apiculture in Agriculture**

- 3.1. Bee plants and floral calendar- Importance and qualities of good bee flora.
- 3.2. Pollination, Need of bee pollination
- 3.4. Management of honeybees for pollination.
- 3.5. Migratory beekeeping
- 3.6. Honeybee products
- 3.6.1. Honey- Its constituents, methods of collection and uses.
- 3.6.2. Importance of other bee products to mankind
- a) Pollen –Method of collection, constituents, uses.
- b) Royal jelly- Method of collection, constituents, uses.
- c) Propolis - Method of collection, constituents, uses.
- d) Bee wax- Method of collection, constituents, uses.
- e) Bee venom- Method of collection, constituents, uses.

**Unit-IV Problems of beekeeping industries,**

1. Natural Climate Condition,
2. Natural enemies, pest and diseases, human activities
3. Apiary and Hive Hygiene
4. Economics of beekeeping

**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



**S.R.T.M. University, Nanded,  
School of Life Sciences  
M. Sc. Zoology, First Year, Semester – II (Year 2019 Onwards)  
(Choice Based Credit System)  
Syllabus- Theory Paper  
Paper Code: ZOT- 201  
Title of the Paper – Developmental Biology**

**Total Credits – 04**

**Number of Periods – 60**

**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 Outcome:**

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.

**Unit I. Gametogenesis, fertilization and early development:**

1. Production of gametes-
  - 1.1. Spermatogenesis in mammals, structure of sperm, Semen formation and composition.
  - 1.2. Oogenesis in mammals, Structure of egg and types.
2. Cell surface molecules in sperm-egg recognition in animals;

**Unit II Zygote formation in animals**

- 1.1. Capacitation
- 1.2. Prevention to polyspermy (Fast block and slow block)
- 1.3. Acrosome reaction.
- 1.4. Activation of Egg metabolism.
2. Type of eggs, Cleavage and patterns of embryonic cleavage.
3. Blastula formation and fate map of blastula .
4. Gastrulation and formation of 3 germ layers in animals (Ex. Frog and Chick)
5. Extra embryonic membrane formation.

**Unit III Basic concepts of animal development:**

1. Potency.
2. Commitment.
3. Specification.
4. Induction.
5. Competence.
6. Determination and differentiation.

7. Morphogenetic gradients.
8. Cell fate and cell lineages.
9. Stem cells.
10. Imprinting; mutants and transgenics in analysis of development.

**Unit IV Morphogenesis and organogenesis in animals:**

1. Cell aggregation and differentiation in *Dictyostelium*;
2. Axes and pattern formation in *Drosophila*,
- 2.1. Segmentation genes, 2.2. Homeotic genes
3. Nuclear transplantation and cloning in mammals.
4. The concept of totipotency embryonic stem cells
5. Differentiation of neurons,
6. Post embryonic development- 6.1. Larval formation, 6.2. Metamorphosis; 6.3. Environmental regulation of normal development;
7. Sex determination.

**Suggested readings:**

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. Developmental Biology by Balinsky
7. Developmental Biology by Berril
8. Developmental Biology by Waddington
9. Chordate Embryology: Verma and Agarwal.
9. Readings are also assigned from journals and from Internet resources such as Medline( [Http://www.ncbi.nlm.nih.gov/entrez/quey.fcgi](http://www.ncbi.nlm.nih.gov/entrez/quey.fcgi)) and bio Med Net ( <http://www.bmn.com/>) Wikipedia etc



**S.R.T.M. University, Nanded,  
School of Life Sciences  
M. Sc. Zoology, First year, Semester – II (Year 2019 Onwards)  
(Choice Based Credit System)  
Syllabus- Theory Paper  
Paper Code: ZOT- 202  
Title of the Paper – Chordates structure and function  
Total Credits – 04, Number of Periods – 60**

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**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.

**UNIT-I**

1. Basic structure of Chordate animal and its characters.
2. Difference between Vertebrates and Chordates.
3. Adaptive Radiation in Vertebrates.
4. Distribution and characters of Lung fishes.
5. General structure and functions of Integument and its derivatives in vertebrates.

**UNIT-II**

1. Evolution of Heart and Aortic arches in Vertebrates.
2. Respiratory pigments in animals.
3. Structure of Gill and respiration in fishes.
4. Structure of lung and respiration in Mammals.
5. Integumentary respiration in Amphibia.

**UNIT-III**

1. Comparative structure of alimentary canal and associated digestive glands in vertebrates.
2. Structure of brain and spinal cord in Fishes and mammals. Cranial nerves and their functions in fishes and Mammals.
3. Comparative structure of heart in Elasmobranches, Teleost, Frog, Calotes and Typical Mammal. Single and double circulation of blood.
4. Structure and functions of Kidney in fishes and Mammals.

**UNIT-IV**

1. Jaw suspension in vertebrates.
2. Structure and functions of Brain and cranial nerves in fishes and Mammal.
3. Structure and working of Mammalian Ear and Eye.
4. Distribution and Characters of pouched mammals- Kangaroo, Aquatic mammals- Whales.
5. Introduction to Dugong, Seal and Walrus.
6. Classification and characters of Chiroptera.

**SUGGESTED READINGS**

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 – Dhama and Dhama.





**S.R.T.M. University, Nanded,  
School of Life Sciences  
M. Sc. Zoology, First Year, Semester – II (Year 2019 onwards)  
(CBCS Pattern)  
Syllabus- Theory Paper  
Paper Code: ZOT- 203  
Title of the Paper – Biochemistry and Immunology  
Total Credits – 04, Number of Periods – 60**

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**Course Objective:**

1. Objective of this course is to help the student to navigate the discipline of Biochemistry that explains how the collection of inanimate molecules.
2. To determine the biochemistry and biochemical reactions in the animals as their life processes.

**Course Outcome:**

1. The students may clear the NET/SET/GATE and other scientific screening tests conducted by various departments and agencies involved actively in research and development in science and technology.
2. There are opportunities for the students after completing this course in bioprocessing and biotechnological research institutes.

**Unit-I:**

1. Acids and bases, Buffer solutions, Physiological and Biological Buffers.
2. Introduction to Amino acids and proteins. Amino acid, structure and properties of Amino Acids. Non-standard, Modified Amino acids.
3. Biologically important peptides.
4. Structure of proteins, Ramchandran plot. Fibrous proteins, Globular proteins, collagen, elastin, keratins, myoglobins, haemoglobins, haemoglobin variants and pathological effects, Protein sequencing.

**Unit-II**

1. Nucleic acids: Structure and functions .
2. Double stranded DNA (A, B, Z DNA). Triple and quadruplex structures.
3. RNA Types and biological functions.
4. Glycolysis, Glycogenesis, Gluconeogenesis, Krebs's Cycle (TCA Cycle).
5. Introduction to Enzymes and their Classification. Enzyme action. Coenzymes.

**UNIT-III**

1. Acquired or adaptive immunity.
2. Active and Passive immunity.
3. Cells and organs related to immunity- (Generation, activation and differentiation) T-Cells and B-cells
4. Immunoglobulins- Classification, structure and functions.
5. Antigen-Antibody interaction and its applications.

**UNIT-IV**

1. Hypersensitivity: Types and causing factors.
2. Immunodeficiency and AIDS.
3. Auto-immune diseases.
4. Hybridoma Technology: Monoclonal antibodies and polyclonal antibodies.
5. MHC (Major Histo-compatibility Complex) Structure and functions.

**Suggested readings:**

- Biochemical calculations- Erwin, H. Segel. John Willy and Sons.  
General Chemistry- Linus Pauling. W. H. Freeman and Company  
Biochemistry-D. Voet and J. G. Wileymand Sons.  
Physical Biochemistry- D. Frefielder. W. H. Freemand and Company.  
Laboratory Techniques in Biochemistry and Molecular Biology, Worth and Work.  
Understanding Chemistry, CNR Rao, Universities Press, Hyderabad.  
A biologists Guide to Principles and Practices in Biochemistry- K. Wilson and K. H. Coulding.  
ELBS, 1986.  
Tools of Biochemistry- T. G. Cooper.  
Biochemistry- G. H. Well.



**S.R.T.M. University, Nanded,  
School of Life Sciences  
M. Sc. Zoology, First Year, Semester – II (Year 2019 Onwards)  
(Choice Based Credit System)  
Syllabus- Theory Paper (Elective Paper)  
Paper Code: ZOT- 204  
Title of the Paper – Goat Farming  
Total Credits – 04, Number of Periods – 60**

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**Objectives of the course:**

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.

**Outcome of the course:**

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.

**Unit-I. Introduction and Planning**

1. Introduction to goat farming and support of goat farming for low income group.
2. Goat Breeds in the world: For meat, fur, milk, leather. Biography of commercially important goat species in India
3. Exotic goat species introduced in India: their success and failure.
4. 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.
5. Types of goat farming: success and problems in types of shelter
6. Structure, engineering and basic requirements to establish a goat farm.

**Unit-II. Goat Health and Management**

1. External morphology of goat, commercial use of goat body parts: Skin-Leather, Hairs, Hooves and horns, bones, Muscles and organs, Blood.
2. Characters, composition and uses of Goat milk.
3. Nutritional value of Goat meat (Chevon) and its biochemical composition. Preservation and processing of meat. Desirable features of Chevon.
4. Digestive system of goat. Basic, supplementary and nutritional food for goats.
5. Reproduction, estrus cycle, breeding and reproduction in Goats. Management and care of Bucks, doe and kids.
6. Diseases in Goat: Causative organism, symptoms, diagnosis and treatment and preventive measures. Vaccination against infectious diseases in goats. Disease management\_ Bacterial, Viral, Fungal, Parasitic, Nutritional. Causes and mortality in goat.

**Unit-III. Goat products, by-products, marketing management**

1. Fodder plants for goat: Shrubs, trees, grass, agriculture waste.
2. Goat meat: slaughter of goat, separation of goat meat, preservation, processing, marketing, distribution and export.
3. Goat leather processing and uses.
4. Fecal waste, urine from goat farm and its management, goat manure.

**Unit-IV Farm management and Economics.**

1. Labour, office staff, instruments, transport vehicles, maintenance and management.
2. Goat market, Local Bazaars: processes and places.
3. Economics of goat farming.
4. Goat farming research and education institutes in India.
5. Wild goat species in India.

**Suggested Readings:**

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. 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)
3. 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.
4. Dalgado, C., M. Rosegrant, H. Steinfeld, S. Ehui, and C. Courbois (1999) Livestock to 2020 — The Next Food Revolution. Food, Agriculture and Environment Discussion Paper 28, IFPRI, Washington.
5. 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.
6. 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.
7. 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.
8. 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.
9. 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.
10. 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,



**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,  
SCHOOL OF LIFE SCIENCES,**

**List of Laboratory Exercises for M. Sc. Zoology, First year (Semester- First)  
(Choice Based Credit System)**

**(Year 2019 Onwards)**

**Paper Code- ZOL-1**

**Title of the paper- Zoology Lab Course – I  
(Taxonomy, Invertebrates, Vertebrates)**

**Credits: 4**

**Marks 100**

- 
1. Equipments and collection methods for the invertebrates and vertebrates from terrestrial and aquatic habitats: Protozoa, Helminthes, Arthropods, Fishes.
  2. Taxonomic study and taxonomic preparation of Insects, Parasites, Fishes and higher vertebrates.
  3. Soft copy documentation of animals for taxonomic studies.
    - a. Use of still camera and Video-camera, Use of Infrared night vision camera, Sound recording in animals & Underwater camera.
  4. Study of local fauna for the taxonomy, distribution and conservational status and their preservation.
  5. Studies on fossils, living fossils and connecting links Archaeopteryx, Peripatus, Limulus, Nautilus, Latimeria using models, photo.
  6. Structure, types, management and maintenance of Museum and aquarium.
  7. Problems and exercises in phylogeny of model organisms.
  8. Demonstration of following organs/systems from any teleosts (Food Fish) for the study of Heart and afferent branchial arteries, Cranial nerves, Weberian ossicles, Air Bladder & Gill rakers.
  9. Virtual dissection of Rat and Frog for various systems. (Computer Simulated demonstrations and Problems)
  10. Museum study- based on Photo and /or models of the animals: minimum any two from each Class/Phyla given below.
    - a. Protozoans- for the structural differences and habitat specificity, locomotory structures; Porifera spicules; Typical colony of Coelenterata; Arthropoda; Echinoderms; Cestodes, Trematodes, Nematodes and Molluscs.

- b. Pisces- Photo/models/specimen- *Zygaena*, Stingray, Electric Ray, *Channa sp.*, *Catla catla*, *Wallago attu*, *Notopterus sp.*, *Mastacembellus armatus*, *exocoetus*, *Echenius*, *Diodon*, *Hippocampus*, *Puntius sp.*
  - c. Amphibians- Photo/Model based study of *Ichthyophis sp.*, *Rhacophorus sp.*, *Hyla sp.*
  - d. Reptiles- Photo/Model based study of Chameleon sp., *Phrynosoma sp.*, *Varanus sp.*, *Viper sp.*, *Rat snake sp.*, *Cobra sp.*, *Turtle sp.*
  - e. Aves- Photo/Model based study of *Bubo*, *Duck*, *Vulture*, *Pigeon*, *Sparrow*, *Crow*.
  - f. Mammals- Photo/Model based study of *Loris Sp.*, *Bat sp.*, *Funambulus sp.*, *Duckbill platypus*, *Echidna*, *Kangaroo*.
11. Mounting of scales in fishes for the structural differences: Cycloid, Ctenoid, Placoid.
12. Model or Photo based study of Horns in mammals; beak and claws in birds.
13. One long distance study tour preferably to the sea coast, to observe the animals in their natural habitat and report writing/Seminar.
14. Access and use of web based data for the taxonomy of animals.

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**List of Laboratory Exercises for M. Sc. Zoology First Year (Semester- First)  
(Choice Based Credit System)**

**(Year 2019 Onwards)**

**Paper Code-ZOL-2**

**Title of the Paper- Zoology Lab Course-II**

**(Biochemistry, Molecular Biology)**

**Credits- 4**

**Marks - 100 Marks**

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1. Determination of Blood group in human.
2. Estimation of Blood Cells, Blood cell count.
3. Separation of serum from Blood sample by centrifugation.
4. To determine the antigen antibody reaction by gel diffusion.
5. Separation and Identification of RBC, WBC, and Microphages from blood by using electrophoresis method.
6. To determine the blood clotting time.
7. Separation of amino acids by paper chromatography method.
8. Separation of antigen antibody by gel electrophoresis.
9. Solution Preparation, understanding Molarity, Normality, buffer, pH Meter
10. Amplification of DNA by using PCR Tools.
11. Experiments on enzyme activity ( Amylase, Protease, Lipase, inhibitors)
12. Verification of Lambert Beer's Law.
13. Estimation of Reducing/Non-Reducing sugars by colorimetry/Spectrophotometry
14. Separation and identification of sugars by Thin Layer Chromatography (TLC).  
Introduction to Gas Chromatography (GC).
15. Separation of amino acids and proteins by polyacrylamide Gel Electrophoresis  
(PAGE)
16. Introduction and uses of HPLC



**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,  
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**List of Laboratory Exercises for M. Sc. Zoology, First Year (Semester- Second)  
(Choice Based Credit System)**

**(Year 2019 Onwards)**

**Paper Code- ZOL-3**

**Title of the paper- Zoology Lab Course – III**

**(Cell Biology, Genetics, Developmental Biology)**

**Credits-4**

**100 Marks**

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1. Study of Osmotic stress on cell membrane.
2. Cell organelle separation by Centrifugation: Nucleus. Mitochondria, Chloroplast
3. Cell division study- Mitosis and Meiosis,  
Onion/Garlic root tip, Grasshopper testis, snails.
4. Microscopic study of structure of sperms.
5. Study of semen for sperm motility and abnormalities.
6. Micro techniques for histology and histo-chemistry of tissue preparation.
7. Study of developmental stages in fertilized egg of hen.
8. Study of regeneration in earthworms and cultivable fishes.
9. Preparation and submission of five slides of cells isolated from different organs of invertebrate and vertebrate animals.
10. Techniques of cryopreservation of Ova and sperms.
11. Computer simulated experiments in animal embryology and cell biology.
12. Problems based on gene linkage, sex linked inheritance and crossing over.
13. Isolation of genomic DNA/RNA from Bacteria, animal and plant cells.
14. Isolation of plasmid DNA by using alkaline lysis method.
15. Study of in-vitro transcription and translation using PCR.
16. Study of mutation in microbes/fungi by Ames Test.





**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,  
SCHOOL OF LIFE SCIENCES,  
M. Sc. Zoology First Year (Semester-Second)  
(Choice Based Credit System)  
(Year 2019 Onwards)  
Paper Code- ZOL-4  
Syllabus of Practical Paper-IV  
Title of the Paper- Zoology Lab Course–IV  
(Ecology, instrumentation and Animal Behaviour)**

4 Credits

100 Marks

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1. Ecology and Biodiversity of producers and consumers from terrestrial freshwater and marine ecosystem : Identification, characters and their role in ecosystems.
    - a) Unicellular/Filamentous algae: Aquatic weeds – Hydrilla, Ipomoea, Eichornia
    - b) Marine phytoplankton & Marine Zooplankton; Grasshopper sp, Backswimmers, Beetle, Cotton Boll-worm.
    - c) Determination of Avian diversity from a habitat like reservoir, River, Forest, Grassland.
  2. Estimation of Dissolved O<sub>2</sub>, CO<sub>2</sub>, Chlorides, Alkalinity of water samples.
  3. Quantitative estimation of plankton by Sedgwick Rafter counting cell method.
  4. Experiments on productivity in Aquatic environment & Biomass estimation
  5. Experiment on positive and negative photo taxis.
  6. Parental care in animals: Ant, Hippocampus, Tilapia & Nest building of bird sp.
  7. Computer Simulated Experiments on Ecology & Animal Behaviour.
  8. Types of Media, its preparation and use.
  9. To study the various equipments in microbial study- Standard pipettes, Wireloop, Micropipettes, Petriplates and its use.
  10. Sterilization equipments and their uses un microbial study- Autoclave, Oven, laminar Airflow, Use of ethanol, fumigation of laboratory.
  11. Isolation of bacteria from Fish gills/fish body and their gram staining.
  12. Computer simulated experiments on animal behaviour.



SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,  
SCHOOL OF LIFE SCIENCES,  
M. Sc. Zoology First Year  
(Choice Based Credit System)  
(Year 2019 Onwards)  
Practical Paper- Code- ZOL-1  
Title of the Paper- Zoology Lab Course–I

Question Paper Internal / External Practical Examination

**Marks-50** **Time-04 Hours** **Date:**

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Q. 1. Major Question 20 Marks

Q. 2. Minor Question 15 Marks

Q. 3. Record Book and submission 10 Marks

Q. 4. Viva Voce 05 Marks

1. Signature of External Examiner-----

Name, Address of the Examiner-----

2. Signature of Internal Examiner-----

Name, Address of the Examiner-----



**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,  
SCHOOL OF LIFE SCIENCES,  
M. Sc. Zoology First Year  
(Choice Based Credit System)  
(Year 2019 Onwards)  
Practical Paper- Code- ZOL-2  
Title of the Paper- Zoology Lab Course–II**

**Question Paper Internal / External Practical Examination**

**Marks-50**

**Time-04 Hours**

**Date:**

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Q. 1. Major Question

20 Marks

Q. 2. Minor Question

15 Marks

Q. 3. Record Book and submission

10 Marks

Q. 4. Viva Voce

05 Marks

1. Signature of External Examiner-----

Name, Address of the Examiner-----

2. Signature of Internal Examiner-----

Name, Address of the Examiner-----



**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,  
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M. Sc. Zoology First Year  
(Choice Based Credit System)  
(Year 2019 Onwards)  
Practical Paper-Code-3  
Title of the Paper- Zoology Lab Course–III**

**Question Paper Internal / External Practical Examination**

**Marks-50** **Time-04 Hours** **Date:**

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Q. 1. Major Question 20 Marks

Q. 2. Minor Question 15 Marks

Q. 3. Record Book and submission 10 Marks

Q. 4. Viva Voce 05 Marks

1. Signature of External Examiner-----

Name, Address of the Examiner-----

2. Signature of Internal Examiner-----

Name, Address of the Examiner-----



**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED,  
SCHOOL OF LIFE SCIENCES,  
M. Sc. Zoology First Year  
(Choice Based Credit System)  
(Year 2019 Onwards)  
Practical Paper- Code-4  
Title of the Paper- Zoology Lab Course–IV**

**Question Paper for Internal/External Practical Examination**

**Marks-50**

**Time-04 Hours**

**Date:**

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Q. 1. Major Question

20 Marks

Q. 2. Minor Question

15 Marks

Q. 3. Record Book and submission

10 Marks

Q. 4. Viva Voce

05 Marks

1. Signature of External Examiner-----

Name, Address of the Examiner-----

2. Signature of Internal Examiner-----

Name, Address of the Examiner-----