॥ सा विद्या या विमुक्तये ॥

# स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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

# SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

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

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

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

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**Academic-1 (BOS) Section**

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E-mail: bos@srtmun.ac.in

विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

## प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

| | |
|---|---|
| 01 | B.Sc. II year Zoology |
| 02 | B.Sc. II year Chemistry (General) |
| 03 | B.Sc. II year Biotechnology (Vocational) |
| 04 | B.Sc. II year Dyes & Drugs |
| 05 | B.Sc. II year Biotechnology |
| 06 | B.Sc. II year Bioinformatics |

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

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
**जा.क्र.**:शै–१/एनइपी/विवत्रंविपदवी/२०२५–२६/134
**दिनांक १६.०६.२०२५**

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.

१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुंल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

# Swami Ramanand Teerth Marathwada University, Nanded

## FACULTY OF SCIENCE AND TECHNOLOGY

# B. Sc. Second Year Zoology
# (Structure and Syllabus as per NEP-2020)

## Semester Pattern

## Effective from June, 2025

# Swami Ramanand Teerth Marathwada University, Nanded

**Faculty of Science & Technology**

**B. Sc. Second Year (Semester III & Semester IV) Syllabus w.e.f. June, 2025 as per NEP-2020 Semester Pattern; Subject: Zoology**

**NEWLY DESIGNED CURRICULA OF B.Sc. SECOND YEAR ZOOLOGY**

**Zoology** deals with study of the **animals**. It embodies study of the structure, development, classification, habits, genetics, distribution and evolution of all animals. There are several specializations available to students pursuing this field. Among the several branches of zoology like cell biology, genetics and genetic engeneering, biochemistry, physiology, evolution, developmental biology the branch of genetic engineering has grown into a huge area of research and application recently. All these fields of biology have contributed immensely to the progress of humankind.

**National Education Policy – 2020 (NEP-2020)**

National Education Policy 2020 (NEP 2020) aims at equipping students with knowledge, skills, values, leadership qualities and initiates them for lifelong learning. As a result the students will acquire expertise in specialized areas of interest, kindle their intellectual curiosity and scientific temper, and create imaginative individuals.

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

**CORE COURSES:**

The Core Courses (CC) offered to students of B.Sc. II Year Zoology are aimed at preparing the students for their study in the last year of graduation and their future career. The students are exposed to the varied fields of zoology as a foundation for them to take up higher studies. After completion of their graduation, the students would also be able to take up entrepreneurship related to biological sciences.

**THE SALIENT FEATURES:**

**Physiology, Biochemistry, Cell Biology, Developmental Biology, Cell Biology & Genetics, Evolutionary Biology & Genetic Engineering, Goat Farming, Poultry Framing** these papers offered to the B.Sc. II year students in III & IV semesters. "Physiology & Biochemistry" attempts to deal with the mode of life and physiology of animals from different taxonomic groups and from different environmental conditions. As also, this paper deals with Understanding of the relationship, environmental and evolutionary, is the core of the first paper. Added to it is also an aspect on the developmental aspects of different species of animals. The second paper on "Cell Biology, Genetics, Evolutionary Biology & Genetic Engineering" deals with study of cells, genetics, evolution and genetic engineering. Understanding the latest developments in the fields of genetics and genetic engineering are an essential aspect of their future in academics in zoology.

**UTILITY OF THE COURSE:**

Learning of such areas of Zoology as Physiology, Biochemistry, Cytology, Genetics, Evolution & Genetic Engineering, Developmental biology, Goat farming, Poultry farming equips students with necessary skills to pursue further study in a wide range of subjects. It also prepares the students for future research in any of the related fields. Such a broad coverage of topics in the second year also helps them widen their perspective of biological sciences. These courses would induce understanding of the subject so that the student could later take up specialized post-graduate courses and also pursue research in the relevant field. The students could also explore possibilities in developing themselves in such specialized fields to fit in the competitive environment.

## Swami Ramanand Teerth Marathwada University, Nanded
## Faculty of Science and Technology

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

| Sr. No. | Name of the Member | Designation | Address | Contact No. |
|---|---|---|---|---|
| 1 | Dr. Hanumant Shahaji Jagtap | **Chairman** | Shri Shivaji College, Parbhani | 9423717670 9834345722 hsjagtap1704@gmail.com |
| 2 | Dr. Shivaji Prabhakar Chavan | Member | School of Life Sciences, SRTMUN | 9421046372 dr_spchavan@rediffmail.com |
| 3 | Dr. Dhanraj Balbhim Bhure | Member | Yeshwant Mahavidyalaya, Nanded | 8149407814, 8329013983 drajbhure82@gmail.com |
| 4 | Dr. Anil M. Mane | Member | Arts, Science & Commerce College, Shankarnagar, Dist. Nanded | 9422874110, 9404464462 anilmane531@gmail.com |
| 5 | Dr. Prashant P. Joshi | Member | Adarsh Education Society's ACS College, Hingoli | 9595648535 7588081822 drprashantjo@gmail.com |
| 6 | Dr. Ratna V. Kirtane | Member | Dayanand Science College, Latur | 9422185834, 8308886686 ratnakirtane@gmail.com |
| 7 | Dr. Sanjay Shamrao Nanware | Member | Yeshwant Mahavidyalaya, Nanded, Tq. & Dist. Nanded | 9423401227, 8329199589 snanware@rediffmail.com |
| 8 | Dr. Sanjay Sadashivrao Kale | Member | Kumarswami Mahavidyalaya, Ausa, Tq. Ausa, Dist. Latur | 9423348758 sanjaykale.sks@gmail.com |
| 9 | Dr. Deepak Pandurang Katore | Member | Nagnath Arts, Commerce & Science College, Aundha Nagnath, Dist. Hingoli | 9765737373, 9134737373 katoredeepak@gmail.com |
| 10 | Dr. Ramrao Janardhanrao Chavan | Member | Dr. Babasaheb Ambedkar Marathwada University, Aurangabad | chavanrj@gmail.com 9423030859 |
| 11 | Dr. Ranjitsingh Krishnarao Nimbalkar | Member | Government Institute of Forensic Science, Aurangabad | rknimbalkar@gmail.com 9422345234 |
| 12 | Dr. Karmveer Nagnathrao Kadam | Member | Shri Kumarswami Mahavidyalaya, Ausa Dist. Latur. | karmbeernk@gmail.com 9970129919 |
| 13 | Dr. Shivesh Pratap Singh | Member | Government PG College, Santa – 485001 (MP) | drshiveshsingh2004@yahoo.com 07987155634 |
| 14 | Dr. Chandrashekhar Devidasrao Basarkar | Member | Director, Nimbkar Seeds Pvt. Ltd. Phaltan, Dist. Satara | basarkarcd@gmail.com 9822652659 |

# B.Sc. Second Year Zoology Semester III *(Level 5 )*

## *Teaching Scheme*

| | Course Code | Course Name | Credits Assigned | | | Teaching Scheme (Hrs/ week) | |
|---|---|---|---|---|---|---|---|
| | | | Theory | Practical | Total | Theory | Practical |
| **Major** | SZOOCT1201 | Animal Physiology | 02 | -- | **02** | 02 | -- |
| | SZOOCT1202 | Biochemistry | 02 | -- | **02** | 02 | -- |
| | SZOOCP1201 | Based on SZOOCT1201 (Animal Physiology) | | 02 | **02** | | 04 |
| | SZOOCP1202 | Based on SZOOCT1202 (Biochemistry) | | 02 | **02** | | 04 |
| **Minor** | SZOOMT1201 | Developmental Biology | 02 | -- | **02** | 02 | -- |
| | SZOOMP1201 | Based on SZOOMT1201 (Developmental Biology) | | 02 | **02** | | 04 |
| **Generic Electives (GE or OE)** | SZOOGE1201 | Poultry Farming | 02 | -- | **02** | 02 | -- |
| **Vocational Skill Course** | SZOOVC1201 | Haematology Or Urinology | | 02 | **02** | | 04 |
| **Total Credits** | | | **08** | **08** | **16** | **08** | **16** |

# B.Sc. Second Year Zoology Semester III *(Level 5 )*

## *Examination Scheme*

| Subject (1) | Course Code (2) | Course Name (3) | Theory | | | | Practical | | Total Col (6+7) / Col (8+9) (10) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Continuous Assessment (CA) | | | ESA | | | |
| | | | Test I (4) | Test II (5) | Avg of (T1+T2)/2 (6) | Total (7) | CA (8) | ESA (9) | |
| Major | SZOOCT1201 | Animal Physiology | 10 | 10 | 10 | 40 | -- | -- | 50 |
| | SZOOCT1202 | Biochemistry | 10 | 10 | 10 | 40 | -- | -- | 50 |
| | SZOOCP1201 | Based on SZOOCT1201 (Animal Physiology) | -- | -- | -- | -- | 20 | 30 | 50 |
| | SZOOCP1202 | Based on SZOOCT1202 (Biochemistry) | -- | -- | -- | -- | 20 | 30 | 50 |
| Minor | SZOOMT1201 | Developmental Biology | 10 | 10 | 10 | 40 | -- | -- | 50 |
| | SZOOMP1201 | Based on SZOOMT1201 (Developmental Biology) | -- | -- | -- | -- | 20 | 30 | 50 |
| Generic Electives (GE or OE) | SZOOGE1201 | Poultry Farming | 10 | 10 | 10 | 40 | -- | -- | 50 |
| Vocational Skill Course | SZOOVC1201 | Haematology Or Urinology | | | | | 20 | 30 | 50 |
| | | | | | | | | | **400** |

# B.Sc. Second Year Zoology Semester IV *(Level 5 )*

## *Teaching Scheme*

| | Course Code | Course Name | Credits Assigned | | | Teaching Scheme (Hrs/ week) | |
|---|---|---|---|---|---|---|---|
| | | | Theory | Practical | Total | Theory | Practical |
| **Major** | SZOOCT1251 | Cell Biology & Genetics | 02 | -- | **02** | 02 | -- |
| | SZOOCT1252 | Evolutionary Biology & Genetic Engineering | 02 | -- | **02** | 02 | -- |
| | SZOOCP1251 | Based on SZOOCT1251 (Cell Biology & Genetics) | | 02 | **02** | -- | 04 |
| | SZOOCP1252 | Based on SZOOCT1252 (Evolutionary Biology & Genetic Engineering) | | 02 | **02** | -- | 04 |
| **Minor** | SZOOMT1251 | Cell Biology | 02 | -- | **02** | 02 | -- |
| | SZOOMP1251 | Based on SZOOMT1251 (Cell Biology) | | 02 | **02** | -- | 04 |
| **Generic Electives (GE or OE)** | SZOOGE1251 | Goat Farming | 02 | -- | **02** | 02 | -- |
| **Vocational Skill Course** | SZOOVC1251 | Histotechnology Or Medical Lab Techniques | | 02 | **02** | | 04 |
| **Total Credits** | | | **08** | **08** | **16** | **08** | **16** |

# B.Sc. Second Year Semester IV *(Level 5 )*

## *Examination Scheme*

| Subject (1) | Course Code (2) | Course Name (3) | Theory | | | | Practical | | Total [Col (6+7) / Col (8+9)] (10) |
|---|---|---|---|---|---|---|---|---|---|
| | | | Continuous Assessment (CA) | | | ESA | | | |
| | | | Test I (4) | Test II (5) | Avg of (T1+T2)/2 (6) | Total (7) | CA (8) | ESA (9) | |
| **Major** | SZOOCT1251 | Cell Biology & Genetics | 10 | 10 | 10 | 40 | -- | -- | 50 |
| | SZOOCT1252 | Evolutionary Biology & Genetic Engineering | 10 | 10 | 10 | 40 | -- | -- | 50 |
| | SZOOCP1251 | Based on SZOOCT1251 (Cell Biology & Genetics) | -- | -- | -- | -- | 20 | 30 | 50 |
| | SZOOCP1252 | Based on SZOOCT1252 (Evolutionary Biology & Genetic Engineering) | -- | -- | -- | -- | 20 | 30 | 50 |
| **Minor** | SZOOMT1251 | Cell Biology | 10 | 10 | 10 | 40 | -- | -- | 50 |
| | SZOOMP1251 | Based on SZOOMT1251 (Cell Biology) | -- | -- | -- | -- | 20 | 30 | 50 |
| **Generic Electives (GE or OE)** | SZOOGE1251 | Goat Farming | 10 | 10 | 10 | 40 | -- | -- | 50 |
| **Vocational Skill Course** | SZOOVC1251 | Histotechnology Or Medical Lab Techniques | | | | | 20 | 30 | 50 |
| | | | | | | | | | **400** |

**Swami Ramanand Teerth Marathwada University, Nanded**
**Faculty of Science and Technology,**
**Four Year UG Program, Zoology (w.e.f. June -2024)**

## B. Sc. Second Year, Semester-III

## SZOOCT1201: Animal Physiology

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

**Course objectives:**

1. To understand the internal physical and chemical functions of animals and their parts.
2. To study the process of digestion, assimilation and excretion
3. To understand working of blood and circulatory system.
4. To understand the respiration and nervous coordination.
5. To study the endocrine function of Human reproductive organs.
6. To study the nature, function and classification of hormones.
7. To acquire knowledge on the structure of Pituitary, Thyroid, Adrenal, and Islets of Langerhans.

**Course outcomes:**

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

1. Monitor their blood pressure and identify blood groups.
2. Understand function and types of heart & circulatory system.
3. Appreciate the basic function of kidney, main function of nerves.
4. Acquire knowledge on the nature and functions of hormones and learn the mechanism of hormone action.
5. Learn the structure and functions of Endocrine glands.
6. Understand the structure, development and function of reproductive organs in human

# SZOOCT1201: Animal Physiology: Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **8** |
| | **1.1** | **Digestion**: Kinds of digestion-Intracellular and Extracellular Digestion.<br>Physiology of digestion in the alimentary canal. Absorption of Carbohydrates, Proteins, Lipids. | |
| | **1.2** | **Vitamins**: Sources and deficiency diseases of Fat soluble vitamins. | |
| | **1.3** | Sources and deficiency diseases of Water soluble vitamins. | |
| | **1.4** | **Respiration**: Kinds of Respiration- Direct and Indirect Respiration. Respiratory organs in man. Mechanism of Respiration in man. Transport of O2 and CO2 | |
| **2.0** | | | **7** |
| | **2.1** | **Excretion**: Structure of Kidney, Structure of nephron. | |
| | **2.2** | Mechanism of Urine formation (Ultra-filtration and tubular re-absorption). Counter-current Mechanism | |
| | **2.3** | **Cardiovascular system:** Composition and functions of blood.<br>Types of heart in vertebrates: Neurogenic and Myogenic heart.<br>Structure and working of Human Heart. | |
| | **2.4** | Origin and conduction of the cardiac impulse,<br>Cardiac cycle. E.C.G. and Blood Pressure | |
| **3.0** | | | **7** |
| | **3.1** | **Nerve Physiology:** Structure of generalized neuron<br>Types of neurons | |
| | **3.2** | Structure of synapse<br>Major Neurotransmitters- Acetyl choline, adrenaline & dopamine.<br>Conduction of nerve impulse | |
| | **3.3** | **Muscle Physiology:** Types of muscles- smooth muscles, skeletal muscles and cardiac muscles. | |
| | **3.4** | Ultra structure of skeletal muscles | |
| **4.0** | | | **8** |
| | **4.1** | **Reproduction:** Histological structure of human testes and ovaries.<br>Physiology of male reproduction: hormonal control of spermatogenesis | |
| | **4.2** | Physiology of female reproduction: hormonal control of oogenesis, menstrual cycle and pregnancy. | |
| | **4.3** | **Endocrine Glands:**<br>Structure, functions and hormonal disorders of Pituitary gland, Thyroid gland | |
| | **4.4** | Structure, functions and hormonal disorders of Adrenal gland, Islet's of Langerhans (Pancreas) | |
| | | **Total** | **30** |

**Text Books:**


1. Guyton, A.C. and Hall, J.E. (2011). Textbook of Medical Physiology, XII Edition, Harcourt Asia Pvt. Ltd/ W.B. Saunders Company.
2. Eckert R.- Animal Physiology (W. H. Freeman)
3. K. A. Goel and K. V. Shastri- A Textbook of Animal Physiology. Rastogi Pub.
4. A. Maria Kyttikan and N. Armugam- Animal Physiology Saras Pub.
5. C. Ladd Prosser- Comparative Animal Physiology.
6. A. K. Berry- Text book of Animal Physiology. Emkay Publications, Delhi
7. Griffin J.E., S.R. Ojeda, Oxford, New York, 1988.- Textbook of Endocrinology
8. Bloom W. and Fawcett D. W.- Text book of Histology
9. Athavale M. V. and latey A. N.- Histology of Mammals
10. Williams- Text Book of Endocrinology – Tenth Edition, Saunders, 2003


**Reference Books:**


1. Tortora, G.J. and Derrickson, B.H. (2009). Principles of Anatomy and Physiology, XII Edition, John Wiley & Sons, Inc.
2. Widmaier, E.P., Raff, H. and Strang, K.T. (2008) Vander's Human Physiology, XI Edition., McGraw Hill
3. Eckert R.- Animal Physiology (W. H. Freeman)
4. C. Ladd Prosser- Comparative Animal Physiology.
5. D. W. Wood- Principles of Animal Physiology
6. Guyton and Hall- Physiology
7. Mac E. Hadley- Endocrinology, Fifth Edition, Pearson Education, 2004
8. Greenspan, F.S., 3rd Ed., Appleton and Lange.- Basic and Clinical Endocrinology.
9. Leslie Brainerd Arey- Human Histology, (Khosla Pub. House, Delhi)
10. Goodman, H.M.,- Basic Medical Endocrinology. Raven, New York, 1988.
11. Greenspan, F.S.,- Basic and Clinical Endocrinology, 3rd Ed., Appleton and Lange.

**Swami Ramanand Teerth Marathwada University, Nanded**
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**B. Sc. Second Year, Semester-III**

**SZOOCT1202: Biochemistry**

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

## Course objectives:

1. To provide students with a deep knowledge in biochemistry.
2. To study the function and structure of Biomolecules.
3. To understand the role of biomolecules in cell membrane
4. To establish correlation between metabolism of different types of biomolecules.

## Course outcomes:

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

1. Understand the chemical structure and functions of various biomolecules.
2. Learn the signaling of biomolecules in cell membrane.
3. Understand the correlation between metabolism of different types of biomolecules.

## SZOOCT1202: Biochemistry: Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | |
| | **1.1** | **Biomolecules:** Types of Biomolecules | **8** |
| | **1.2** | Classification, Structure and Properties of Carbohydrates. | |
| | **1.3** | Classification, Structure and Properties of Proteins. | |
| | **1.4** | Classification, Structure and Properties of Lipids | |
| **2.0** | | | |
| | **2.1** | Electrochemical properties of Water, pH and Colligative properties | **7** |
| | **2.2** | Enzymes: Nomenclature and Classification | |
| | **2.3** | Mechanism of Enzyme Action- E-S Complex Formation, Lock and Key Model, Induced Fit Theory. | |
| | **2.4** | Factors affecting Enzyme Activity- Temperature, pH, Concentration of Enzyme, Concentration of Substrate | |
| **3.0** | | | |
| | **3.1** | **Carbohydrate Metabolism:** Glycolysis (EMP Pathway) | **7** |
| | **3.2** | Glycogenesis, Glycogenolysis and Glyconeogenesis. | |
| | **3.3** | Citric Acid Cycle (Krebs Cycle) | |
| | **3.4** | Pentose Phosphate Pathway (HMP shunt). | |
| **4.0** | | | |
| | **4.1** | **Lipid metabolism:** The ß-Oxidation (Beta Oxidation) Pathway, Oxidation of Unsaturated Fatty Acid | **8** |
| | **4.2** | Ketosis, Ketogenesis and Ketolysis. | |
| | **4.3** | **Protein metabolism:** Transamination, deamination and decarboxylation reactions of amino acids. | |
| | **4.4** | Disposal of nitrogenous waste. Krebs-Henseleit Urea Cycle (Ornithine cycle) | |
| | | **Total** | **30** |

### Text Books:


1. T. G. Cooper- Tools of Biochemistry
2. Arumugam et.al,- Biochemistry, Saras Publication.
3. C. B. Power- Biochemistry, Himalaya Pub.
4. Leninger A. L.- Biochemistry
5. Das- Biochemistry
6. Rao K. R.- Textbook of Biochemistry
7. West E. S., Todd W. R. Mason H. S. and VanBruggen J. T.- Textbook of Biochemistry


### Reference Books:


1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/Mc Graw3Hill.
4. Ramni Sood- Medical Laboratory Techniques. (Jaypee Brothers medical Pub. Pvt. Ltd. New Delhi)

# Swami Ramanand Teerth Marathwada University, Nanded
## Faculty of Science and Technology,
### Four Year UG Program, Zoology (w. e. f. June -2024)
### B. Sc. Second Year, Semester-III
### Practical SZOOCP1201: Animal Physiology (Based on Paper No. SZOOCT1201)

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

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**Objectives:**

1. To improve the skills of students in microscopy, slide preparation, observations, drawings and laboratory techniques.
2. To acquaint the students with operations of the different laboratory equipment.
3. Ability to carry out routine clinical analysis of blood.
4. Understand the working principle and application of Sphygmo-manometer and Haemoglobinometer. 5. Learn clinical procedures for blood analysis.

**Outcomes:**

1. Students able to improve the skills in microscopy, slide preparation, observations, drawings and laboratory techniques.
2. To acquaint the students with operations of the different laboratory equipment.
3. Ability to understand the detection of blood groups of humans.
4. Ability to Understand the estimation of blood cell counts, Haemoglobin content in humans.
5. To acquaint the students with operation of clinical procedures for blood analysis.

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1. Qualitative detection of digestive enzymes (Protease, Amylase and Lipase) in cockroach.
2. Detection of human salivary amylase.
3. Study of histological structure of following organs – Stomach, Intestine, Pancreas, Liver and Kidney.
4. Estimation of oxygen consumption in fish or any other suitable aquatic animal.
5. Qualitative detection of nitrogenous waste products (Ammonia, Urea, Uric acid) in bird's excreta and urine of Mammals.
6. Detection of Blood Groups- A, B, AB, O with Rh factor.
7. R.B.C. counting.
8. W.B.C. counting.
9. Estimation of Haemoglobin.
10. Measurement of B.P. by using B.P. apparatus (Demonstration only).
11. Preparation of Haematin crystals.
12. Structure of neurons(slide/chart);Types of nerve cells-Unipolar,Biopolar,Multipolar(slides)
13. Structure of synapse
14. Temporary preparation of squamous epithelium, ciliated epithelium, skeletal muscle fiber and blood smear.
15. Study of histological structure of following organs- Testis, Ovary, Pituitary, Thyroid, Adrenal and islets of Langerhans.
16. Location of endocrine glands through charts or models.

Short excursion / study tour is compulsory

Submission

i) Practical record book duly signed by the teacher in charge/Head of the Department.
ii) Five permanent stained micro preparations. iii) Excursion report.

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

# Swami Ramanand Teerth Marathwada University, Nanded
## Faculty of Science and Technology,
### Four Year UG Program, Zoology (w. e. f. June -2024)
### B. Sc. Second Year, Semester-III
### Practical SZOOCP1202: Biochemistry (Based on Paper No. SZOOCT1202)

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

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**Objectives:**

1. To acquaint the students with operations of the different laboratory equipment.
2. Ability to carry out routine clinical analysis of blood and tissue.
3. Learn clinical procedures for urine analysis.

**Outcomes:**

1. Students able to improve the skills in laboratory techniques.
2. To acquaint the students with operations of the different laboratory equipment.
3. To acquaint the students with operation of clinical procedures for urine analysis.

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1. Qualitative detection of Carbohydrates.
2. Qualitative detection of Proteins
3. Qualitative detection of Lipids
4. Study of colligative properties of water.
5. Effect of different factors on Enzyme activity.
6. Estimation of an Enzyme – Amylase.
7. Estimation of an Enzyme – Protease.
8. Determination of Glycogen
9. Determination of Glucose.
10. Determination of Lipids.
11. Estimation of Protein by Lowry's method.
12. Estimation of free amino acids.
13. Estimation of Urea.
14. Estimation of Uric Acid
15. Routine examination of urine (physical examination of urine)
16. Chemical examination of urine.

Short excursion / study tour is compulsory.

Submission:

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

ii) Excursion report

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

**Swami Ramanand Teerth Marathwada University, Nanded**
**Faculty of Science and Technology,**

# Four Year UG Program, Zoology (w.e.f. June -2024)

## B. Sc. Second Year, Semester-III

## SZOOMT1201: Developmental Biology

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

## Course objectives:

1. To get an insight into embryonic development of vertebrates.
2. To correlate developmental stages of different vertebrate groups.
3. To identify and describe the different embryonic structures of vertebrates.
4. To grasp the basic processes of human development.
5. To gain a comprehensive understanding of the fundamental principles of developmental biology, including embryonic development, cellular differentiation, and pattern formation.
6. To explain the major developmental processes, including fertilization, gastrulation, organogenesis, and morphogenesis.
7. Students can learned to apply principles of developmental biology to real-world problems, including the understanding of birth defects and developmental disorders.
8. To develop a curiosity and interest in developmental biology, including the desire to explore and learn more about the field.

## Course outcomes:

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

1. Students learned the major stages of embryonic development, including fertilization, gastrulation, and organogenesis.
2. To explain the processes of cellular differentiation and how they contribute to the formation of tissues and organs.
3. Can able to apply principles of developmental biology to real-world problems, including the understanding of birth defects and developmental disorders.
4. Students can be able to think critically about developmental biology concepts and apply problem-solving skills to complex problems.
5. The student can be able to explain the basics processes of vertebrate embryonic development.
6. Ability to describe the various steps in vertebrate development.
7. Identify and explain about the different embryonic structures.
8. Describe the functions of different extra-embryonic structures.
9. Understanding of the Assisted Reproductive Technologies.

## SZOOMT1201: Developmental Biology : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **7** |
| | **1.1** | **Introduction of Developmental Biology** | |
| | **1.2** | Early Embryonic Development: Gametogenesis: Spermatogenesis and oogenesis in mammals | |
| | **1.3** | Vitellogenesis in birds | |
| | **1.4** | **Types of eggs**: a) On the basis of amount of yolk b) On the basis of distribution of yolk | |
| **2.0** | | | **8** |
| | **2.1** | **Gametes of Frog**: a) Structure of sperm; b) Structure of ovum | |
| | **2.2** | **Frog Embryology**: a) Fertilization; b) Cleavage; c) Blastulation; | |
| | **2.3** | d) Gastrulation; e) Formation of three germinal layers; | |
| | **2.4** | **Regeneration in Non-chordates and Chordates** | |
| **3.0** | | | **7** |
| | **3.1** | **Chick Embryology**: (Extra-embryonic membranes) - Structure and functions of- Amnion; Chorion | |
| | **3.2** | Chick Embryology: Structure and functions of- Yolk sac; Allantois | |
| | **3.3** | **Placentation in mammals**: Classification on the basis of- Origin; Histology | |
| | **3.4** | Types of placenta based upon distribution of villi. Functions of Placenta. | |
| **4.0** | | | **8** |
| | **4.1** | **Stem Cell**: a) Sources; b) Types – Embryonic, Haemopoitic, Adult, Nervous; c) Role of stem cells in human health. | |
| | **4.2** | Infertility in Humans-Causes, diagnosis and treatment | |
| | **4.3** | Assisted Reproduction Technologies- a) In-Vitro Fertilization (IVF) b) Gamete Intra Fallopian Transfer (GIFT); c) Intra cytoplasmic Sperm injection (ICSI); d) Zygote Intrafallopian transfer (ZIFT); e) Intrauterine Insemination (IUI) | |
| | **4.4** | **Parthenogenesis**: a) Natural; b) Artificial | |
| | | **Total** | **30** |

**Text Books**

1. Jagtap H. S. (2019). Text Book of Developmental Biology, Sadhana Publication, ISBN No. 978-93-81921-65-4.

**Reference Books**

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

# Swami Ramanand Teerth Marathwada University, Nanded
## Faculty of Science and Technology,
### Four Year UG Program, Zoology (w. e. f. June -2024)
### B. Sc. Second Year, Semester-III
### Practical SZOOMP1201: Developmental Biology (Based on Paper No. SZOOMT1201)

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

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**Objectives:**

1. To understand the anatomical organization of any species.
2. To identify and handle different body parts of invertebrates and vertebrates.
3. To understand and perform temporary and permanent mountings.
4. To identify and describe structure and functions of different hours Chick embryos.

**Outcomes:**

1. Students will be able to describe the major stages of embryonic development, including fertilization, gastrulation, and organogenesis.
2. To explain the processes of cellular differentiation and how they contribute to the formation of tissues and organs.
3. Ability to understand the anatomical organization of organs and systems in representative species.
4. Ability to identify and describe structure and functions of different body parts of invertebrates and vertebrates.
5. Students would be able to prepare temporary and permanent mountings of biological material.
6. Students would make observations of organisms in their natural environment and document them.

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1. Study the life cycle of frog
2. Study of gametes - frog/rat - sperm and ova using permanent slides or photomicrographs.
3. Frog Embryology: Study of developmental stages, by permanent slides – cleavage, blastula, gastrula, neurula, tail bud stage, tadpole, external and internal gill stages.
4. Study the live stages of frog embryological development by collecting the sample from their breeding ground.
5. Study of the different types of placenta- histological sections using permanent slides or photomicrographs.
6. Study of placental development in humans by using ultrasound scan images.
7. Study of permanent slides of Chick Embryology: 18 hrs.; 24 hrs.; 36 hrs.; 48 hrs.; 72 hrs. Stages
8. Study of Incubation of chick embryos in laboratory by using incubator.
9. Study of Hydra, Planaria and Lizard (for Regeneration process)
10. To Visit a Reproductive Physiology Lab / Stem cell Center
11. Short excursion/ study Tour is compulsory.

Submission:

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

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

**Swami Ramanand Teerth Marathwada University, Nanded**
**Faculty of Science and Technology,**
**Four Year UG Program, Zoology (w.e.f. June -2024)**

**B. Sc. Second Year, Semester-III**

**SZOOGE1201: Poultry Farming**

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

## Course objectives:

1. The course is aimed with the objective of providing knowledge of the Poultry farming; their significance, types & breeds.
2. Modern system of rearing and breeding of Broilers have been incorporated in order to create interest among the Students to explore this system of practice.
3. Poultry farming create employment opportunities,

## Course outcomes:

After successful completion of the course the students will be able to:-

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

# SZOOGE1201: Poultry Farming : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **8** |
| | **1.1** | **Introduction to poultry farming in Maharashtra and India** | |
| | **1.2** | Poultry breeds and their varieties- Layers for egg production, Broiler for meat production | |
| | **1.3** | Indigenous poultry varieties- Aseel, kadaknath,Giriraj, Kalinga brown, swarnandh | |
| | **1.4** | Introduction to external body parts (morphology), Digestive system and reproductive system of poultry as a bird | |
| **2.0** | | | **7** |
| | **2.1** | **Housing system**- Types of layers, broilers and Indian breeds | |
| | **2.2** | Food, water and waste management of caged chicken, poultry. Dietary requirement, poultry food and feeding methods | |
| | **2.3** | Temperature, light, humidity, wind as environmental factors and its management in poultry house. Disinfection methods of poultry house | |
| | **2.4** | Bacterial, viral, protozoan and Helminths that cause diseases in poultry, nutritional deficiencies, vaccination | |
| **3.0** | | | **7** |
| | **3.1** | Economics of layer, broiler and Desi poultry production- Investment, profits, losses | |
| | **3.2** | Export, import of poultry and poultry products | |
| | **3.3** | Preparation of poultry projects. Investment, finance, loans, Government schemes for small scale and large scale poultry | |
| | **3.4** | Poultry markets, poultry record keeping | |
| **4.0** | | | **8** |
| | **4.1** | Poultry eggs grading and principles of incubation. Types of hatching systems. | |
| | **4.2** | Fertility of eggs, Incubation and hatching of eggs, chick care | |
| | **4.3** | Fumigation, sanitation and hygiene of hatchery | |
| | **4.4** | Hatchery records, labour requirement and chick marketing | |
| | | **Total** | **30** |

**Text Books**


1. A Text Book of Animal Husbandry, C.C. Banerjee, Oxford IBH, Publication ISBN: 9788120412606.
2. Text Book of Poultry science, P.V. Sreenivasaiah Write and Print publications, ISBN: 978819297059.


**Reference Books**


1. Principles of poultry science,1996, CAB publishers, ISBN: 9780851991221.
2. Poultry science Practices, Nilothapal Ghosh, CBS Publication & Distribut. (2015)
3. Poultry Production in Hot Climatic Zones, H. C. Saxena and E. H. Ketelaars, Klyani Publishers.
4. Poultry Production, Sunil Kumar Das, CBS Publishers & Distrbutors, Delhi

5. Layers Modern Management, Satischandra Borale & Vishwanath Bhuktar, Continental Publisher, Pune (Marathi)

**Swami Ramanand Teerth Marathwada University, Nanded**

**Faculty of Science and Technology,**

**Four Year UG Program, Zoology (w.e.f. June -2024)**

**B. Sc. Second Year, Semester-III**

## SZOOVC1201: (A) Haematology

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

### Course objectives:

1. To understand the composition and functions of human blood.
2. To appreciate different types of compounds used in processing and storage of blood.
3. To learn different techniques used in study of blood cells.
4. To develop skill of collecting, preserving and analyzing blood samples.
5. To learn about changes in blood composition in disease.

### Course outcomes:

After successful completion of the course the students will be able to:-

1. Ability to explain composition and functions of blood.
2. Knowledge about compounds used in processing and storage of blood.
3. Skill to be able to use different techniques used in study of blood cells.
4. Ability to collect, preserve and analyze blood samples.
5. Knowledge of changes in blood composition in disease.

# SZOOVC1201: (A) Haematology : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **15** |
| | **1.1** | **Introduction**- Definition, Components, Cells – Structure and Functions of cells, Lymph | |
| | **1.2** | **Collection of Blood**- Collection of capillary blood by skin puncture, Collection of blood by Venipuncture | |
| | **1.3** | Collection of arterial blood, Criteria for sample collection. | |
| | **1.4** | **Practical**- Collection of blood by Venipuncture and arterial blood. Determination of blood group of provided blood sample. | |
| **2.0** | | | **15** |
| | **2.1** | **Anticoagulants** - Definition, Action of EDTA, Oxalates, double oxalates, fluorides, acid citrate, detxtrose-trisodium citrate, heparin | |
| | **2.2** | Effect of anticoagulants on blood cell morphology | |
| | **2.3** | **Haemoglobin** - Normal structure and various haemoglobin, Determination of haemoglobin by various methods - Anaemia | |
| | **2.4** | **Practical** - Determination of haemoglobin from given blood sample, Clotting and bleeding time of blood | |
| **3.0** | | | **15** |
| | **3.1** | **Study of Blood Cell Count** - What is Complete Blood Count (CBC) ? parameters in CBC, their normal ranges, how it is done. Total WBC Count | |
| | **3.2** | Total RBC Count, Erythrocyte Sedimentation Rate (ESR) – Methods, clinical significance. | |
| | **3.3** | Platelets Count, Absolute Eosinophil Count, Reticulocyte Count. What is CBC ? parameters in CBC, their normal ranges, how it is done. Recent advances in haematology, different types of haematology analyzers, their working principles. | |
| | **3.4** | **Practical** – Determination of Total Count of RBC, WBC. | |
| **4.0** | | | **15** |
| | **4.1** | Study of Blood Smear for differential WBC Count - | |
| | **4.2** | Preparation and Staining of smears, Counting Methods, | |
| | **4.3** | Morphology of White cells, Types of White Cells, Abnormalities in morphology of blood cells and related diseases | |
| | **4.4** | **Practical** – Determination of differential WBC Count by blood Smear. Visit to pathology laboratory. | |
| | | **Total** | **60** |

**Text Books**

1. Hand Book of Medical Technology - Mrs. Chitra

**Reference Books**

1. Medical Laboratory Technology - Ramnik Sood
2. Medical Lab Technology Vol. I, II & III – Kanai Mukherjee
3. Medical Laboratory Technology – A. Ananthanarayan

4. Manual for Laboratory Technician of Primary Health by Minister of Health
5. Human Physiology Vol. I & II – C. C. Chatterjee

**Swami Ramanand Teerth Marathwada University, Nanded**

**Faculty of Science and Technology,**

**Four Year UG Program, Zoology (w.e.f. June -2024)**

**B. Sc. Second Year, Semester-III**

**SZOOVC1201: (B) Urinology**

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

## Course objectives:

1. Understanding structure and function of human urinary system.
2. Learning about formation and composition of urine.
3. Appreciate importance of urine composition in detecting disease.
4. Skill to perform basic urinary system function tests.
5. Develop ability to handle and process urine samples.

## Course outcomes:

After successful completion of the course the students will be able to:-

1. Ability to describe function of human urinary system.
2. Learned Skill to collect, preserve, process and store urine samples.
3. Skill to perform physical, chemical and microscopic examination of urine samples.
4. Ability to document findings of urine examination/analysis.

# SZOOVC1201: (B) Urinology : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **15** |
| | **1.1** | Definition, Structure of Urinary System, | |
| | **1.2** | Functions of Urinary System | |
| | **1.3** | Physiology of Mechanism of Urine formation | |
| | **1.4** | **Practical** – Study of principle and procedure of renal function test in human. | |
| **2.0** | | | **15** |
| | **2.1** | Constituents and composition of Urine | |
| | **2.2** | Normal and abnormal constituents of Urine- | |
| | **2.3** | Qualitative tests for sugar, albumin, ketone bodies, bile salts and bile pigments in urine | |
| | **2.4** | **Practical** – Study of normal and abnormal constituents of Urine. | |
| **3.0** | | | **15** |
| | **3.1** | Renal Function Tests | |
| | **3.2** | Definition, importance of tests like urea, creatinine, uric acid, proteins | |
| | **3.3** | Importance of Dialysis | |
| | **3.4** | **Practical**- Biochemical Qualitative and Quantitative tests for urine from normal and diabetic persons | |
| **4.0** | | | **15** |
| | **4.1** | Collection and preservation of Urine Sample<br>Physical and Chemical Examinations of abnormal constituents of urine | |
| | **4.2** | Microscopic Examination of urine | |
| | **4.3** | Preparation of Urine Report, Urinometer | |
| | **4.4** | **Practical**- Study of Microscopic Examination of urine. | |
| | | **Total** | **60** |

**Text Books**

1. Hand Book of Medical Technology- Mrs. Chitra

**Reference Books**

1. Medical Laboratory Technology - Ramnik Sood
2. Medical Lab Technology Vol. I, II & III – Kanai Mukherjee
3. Medical Laboratory Technology – A. Ananthanarayan
4. Manual for Laboratory Techniian of Primary Health by Minister of Health
5. Human Physiology Vol. I & II – C. C. Chatterjee

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**

**Faculty of Science & Technology**

**B. Sc. Second Year Syllabus w.e.f. June, 2025 (NEP-2020)**

**VOCATIONAL COURSE IN ZOOLOGY (VCZ)**

**CONTINUOUS ASSESSMENT (CA)**

**Zoology**

**Semester- III**

**SZOOVC1201 - VCZ- I : (A) Haematology**

**Or**

**VCZ- I : (B) Urinology**

**Centre:** **Date:**

**Marks: 20**

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

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

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER PATTERN**
**Faculty of Science & Technology**
**Practical Examination**
**B. Sc. Second Year Zoology (Semester-III) as per NEP-2020; (w.e.f. June 2025)**
**Practical (SZOOCP1201): Animal Physiology**
**Based On**
**(Paper: SZOOCT1201: Animal Physiology)**

| | |
|---|---|
| **Centre:** | **Batch No.:** |
| **Date:** | **Time: 04 Hrs;** |
| **Exam Seat No.:** | **Marks: 30** |

| | | |
|---|---|---|
| **Q.1** | Qualitative detection of digestive enzymes (Protease, Amylase and Lipase) in Cockroach (Any Two)/ Detection of human salivary amylase./ Estimation of O2 consumption in fish or any suitable aquatic animal./ Detect any two Nitrogenous Waste Products from Sample Provided. | **10 M** |
| **Q.2** | Detection of Blood Groups from given sample/ Counting of R.B.C./ W.B.C. in blood sample provided./ Estimate the Haemoglobin percentage in a given sample of blood/ Prepare Haematin Crystals from blood sample provided./ Measurement of Blood Pressure in Man. | **08 M** |
| **Q. 3** | Identify and describe Nerve Cells and synapse from Slide Provided (Any Four)/ Identify and describe the histological slides of Endocrine glands (Any Four)./ To locate, Identify and comment on endocrine glands in charts or models provided (Any Four)/ Temporary preparation of squamous/ ciliated epithelium / skeletal muscle fiber/ blood smear | **08 M** |
| **Q. 4** | Viva- Voce | **04 M** |

**Note:** 1. Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
i) Submission of Record book & Internal Test on Practical = 10 Marks;
ii) Excursion Report & Permanent slides=10 Marks;
2. Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

**Name & Signature**
**Examiner – 1**

**Name & Signature**
**Examiner – 1**

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER PATTERN**
**Faculty of Science & Technology**
**Practical Examination**
**B. Sc. Second Year Zoology (Semester-III) as per NEP-2020; (w.e.f. June 2025)**
**Practical (SZOOCP1202): Biochemistry**
**Based On**
**(Paper: SZOOCT1202: Biochemistry)**

| | |
|---|---|
| **Centre:** | **Batch No.:** |
| **Date:** | **Time: 04 Hrs;** |
| **Exam Seat No.:** | **Marks: 30** |

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**Q.1** Qualitative detection of Carbohydrates/ Proteins/Lipids or Demonstrate any one colligative property of water. **10 M**

**Q.2** Effect of different factors on Enzyme activity/Estimation of an Enzyme – Amylase or Protease/ Determination of Glycogen/ Glucose or Determination of Lipids. **08 M**

**Q. 3** Estimation of Protein by Lowry's method/ Estimation of free amino acids / Urea/Uric Acid/ Routine examination of urine (physical examination of urine)/ Chemical examination of urine **08 M**

**Q. 4** Viva- Voce **04 M**

**Note:** 1. Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
i) Submission of Record book & Internal Test on Practical = 10 Marks;
ii) Excursion Report & Permanent slides=10 Marks;
2. Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

| | |
|---|---|
| **Name & Signature** | **Name & Signature** |
| **Examiner – 1** | **Examiner – 1** |

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER PATTERN**
**Faculty of Science & Technology**
**Practical Examination**
**B. Sc. Second Year Zoology (Semester-III) as per NEP-2020; (w.e.f. June 2025)**
**Practical (SZOOMP1201): Developmental Biology**
**Based On**
**(Paper: SZOOMT1201: Developmental Biology)**

| | |
|---|---|
| **Centre:** | **Batch No.:** |
| **Date:** | **Time: 04 Hrs;** |
| **Exam Seat No.:** | **Marks: 30** |

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**Q.1.** Identify and comments on permanent slides of Chick embryology (any four) **10 M**

**Q.2.** Identify and comments on permanent slides of frog embryology (any four) **08 M**

**Q. 3.** Describe regeneration in (Hydra / Planaria / Lizard) / male gamete of frog / female gamete of frog / Placenta / Stem Cell (any two) **08 M**

**Q. 4.** Viva- Voce **04 M**

**Note:** 1. Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
i) Submission of Record book &Internal Test on Practical = 10 Marks;
ii) Excursion Report & Permanent slides=10 Marks;
2. Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

| | |
|---|---|
| **Name & Signature** | **Name & Signature** |
| **Examiner – 1** | **Examiner – 1** |

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**

**Faculty of Science & Technology**

**B. Sc. Second Year Syllabus w.e.f. June, 2025 (NEP-2020)**

**VOCATIONAL COURSE IN ZOOLOGY (VCZ)**

**END SEMESTER ASSESSMENT (ESA)**

**Zoology**

**Semester- III**

**SZOOVC1201 - VCZ- I : (A) Haematology**

**Or**

**VCZ- I : (B) Urinology**

**Centre:** **Date:**

**Marks: 30**

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

| Sr. No. | Continuous Assessment (CA) | Maximum Marks | Marks Obtained |
|---|---|---|---|
| 1 | Vocational Course Report Submission | 10 | |
| 2 | Overall Course Judgment | 10 | |
| 3 | Course Work Presentation | 10 | |
| | **Total Marks** | **30** | |

**Name & Signature**
**Examiner – 1**

**Name & Signature**
**Examiner – 2**

**Swami Ramanand Teerth Marathwada University, Nanded**
**Faculty of Science and Technology,**
**Four Year UG Program, Zoology (w.e.f. June -2024)**

**B. Sc. Second Year, Semester-IV**

# SZOOCT1251: Cell Biology and Genetics

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

## Course objectives:

1. To provide students with relevant knowledge, skills and values in contemporary cell biology.
2. To understand the structure and function of the cell as the fundamentals for understanding the functioning of all living organisms.
3. To acquire knowledge of prokaryotic, eukaryotic cells.
4. To make aware of different cell organelles, their structure and role in living organisms.
5. To acquire knowledge of Mendelian Genetics and its Extension.
6. To emphasize the central role of genes and their inheritance in the life of all organisms.

## Course outcomes:

On successful completion of the course, the students will be able to
1. Understand the structure and function of the cell as the fundamentals for understanding the functioning of all living organisms.
2. Understand structures and various cellular functions associated with the macromolecules found in cells.
3. Acquire knowledge of Mendelian Genetics and its Extension.
4. Graduates will be able to explain and interpret various processes, phenomena, states and evolutionary tendencies at a biological system level.

# SZOOCT1251: Cell Biology & Genetics: Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **8** |
| | **1.1** | Structure of Prokaryotic & Eukaryotic cells. Microscopy for cell study | |
| | **1.2** | **Plasma membrane**: Structure Biomolecular model, Trilaminar model, fluid mosaic model and functions | |
| | **1.3** | **Structure and function of cell organelles** - Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, | |
| | **1.4** | Nucleus and Mitochondria, Cell Cycle and its regulation | |
| **2.0** | | | **7** |
| | **2.1** | **Introduction to Genetics**: Mendel's work on transmission of traits, Genetic Variation. | |
| | **2.2** | **Mendel's work on transmission of traits**, Mendel's Law of dominance, Law of segregation and Law of independent assortment. | |
| | **2.3** | **Interaction of genes**: Complementary factor (9: 7), Supplementary factor (9:3:4) | |
| | **2.4** | Inhibitory factor (13:3), Duplicate genes, Lethal genes (1:2:1) | |
| **3.0** | | | **7** |
| | **3.1** | **Multiple Alleles**: Inheritance of the ABO Blood group, Rh factor and Erythroblastosis foetalis | |
| | **3.2** | **Linkage**: Types and significance. | |
| | **3.3** | Crossing over: Mechanism of crossing over, factors affecting crossing over, and significance of crossing over | |
| | **3.4** | **Mutation**: **Chromosomal mutation**- Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy and **Gene mutation**- Induced versus Spontaneous mutations, Back versus Suppressor mutations. | |
| **4.0** | | | **8** |
| | **4.1** | **Sex linked inheritance**: Sex linked inheritance in Drosophila, Sex linked inheritance in Man: Colour blindness in man, hemophilia and hypertrichosis | |
| | **4.2** | **Cytoplasmic Inheritance** - Mitochondrial inheritance (in human being); **Human genetics**: Down syndrome, Klinefelter syndrome, | |
| | **4.3** | cat-cry and Patau syndrome. | |
| | **4.4** | Human Pedigree analysis: with symbols | |
| | | **Total** | **30** |

**Text Books**

1. Dr.S.S.Nanware, Dr.D.B.Bhure & M.U.Barshe (2015). Text Book-Cell Biology. Aruna Prakashan Latur, M.S. ISBN: 978-93-5240-012-6,Publication12th June, 2015
2. Dr.D.B.Bhure, Dr.S.S.Nanware & M.U.Barshe (2016). Text Book of Fundamental Genetics. Aruna Prakashan Latur, M.S. ISBN: 978-93-5240-035-5,Publication16th June, 2016

**Reference Books**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). *Principles of Genetics*. VIII Edition. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). *Principles of Genetics*. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). *Concepts of Genetics*. X Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *Genetics- A Molecular Approach.* III Edition. Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.
6. Gardner, J.E., Simmons, J.M and Snustad D.P..(2007). *Principles of Genetics* (8th edn.).John Wiley and Sons, India.
7. Sarada K & Mathew Joseph (Editors) (1999) *Cell Biology, Genetics and Biotechnology*,
8. Thomas A. P (Editor), (2012). *Genetics and Biotechnology- The Fundamentals. Green Leaf Publications,*TIES, Kottayam.
9. Verma P.S. and Agarwal V.K. (1974). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand Publications, Delhi. Multicolour Reprint 2005.

**Swami Ramanand Teerth Marathwada University, Nanded**

**Faculty of Science and Technology,**

**Four Year UG Program, Zoology (w.e.f. June -2024)**

**B. Sc. Second Year, Semester-IV**

## SZOOCT1252: Evolutionary Biology & Genetic Engineering

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

### Course objectives:

1. To provide comprehensive overview of Concept of Evolution.
2. To explore salient features of various theories of evolution comprising of Lamarckism, Darwinism, Hugo De Vries theory, Neo-Darwinism, and Modern Synthetic theory.
3. To understand natural selection, genetic drift, isolating mechanisms, and artificial selection in driving evolutionary change.
4. To develop comprehensive knowledge regarding the biological species concept, speciation, mass extinctions, adaptive radiationand the Hardy-Weinberg Principle in evolution.
5. To provide conceptual knowledge of Genetic Engineering.
6. To provide comprehensive knowledge of the structure, types, and functions of DNA and RNA, along with the genetic code's importance.
7. To understand the principles of enzymes, vectors, and techniques like PCR and blotting in recombinant DNA technology.
8. To introduce students tothe concepts behind CRISPR-Cas9, transgenesis, and cloning and their applications.
9. To understand the Construction of Recombinant DNA (rDNA) and its applications,cDNA Libraries and Genomic Libraries along with DNA fingerprinting and its applications.

### Course outcomes:

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

1. Distinguish between key evolutionary theories (Lamarckism, Darwinism, etc.) through a demonstrated understanding of their principles.
2. Describe the mechanisms of natural selection, genetic drift, and speciation in evolutionary processes.
3. Understand the biological species concept, Hardy-Weinberg Principle, and adaptive radiation in the context of evolution.
4. Explain the foundational concepts of genetic engineering and its significance.
5. Illustrate the structure, types, and functions of DNA and RNA, along with the genetic code's role.
6. Comprehend the principles of recombinant DNA technology, including enzymes, vectors, and techniques like PCR and blotting.
7. Recognize the concepts behind CRISPR-Cas9, transgenesis, and cloning and their theoretical applications.
8. Describe the construction of recombinant DNA, cDNA/genomic libraries, and DNA fingerprinting applications.

# SZOOCT1252: Evolutionary Biology & Genetic Engineering : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **8** |
| | **1.1** | **Introduction to Evolution**<br>**Overview of Evolutionary Theories:**<br>Lamarckism, Darwinism, Hugo De Vries theory, Neo-Darwinism, and Modern Synthetic theory. | |
| | **1.2** | **Evidences of organic Evolution:**<br>i) Morphological and Anatomical evidences: Homologous, Analogous and Vestigial structures and their evolution.<br>ii)Embryological Evidences<br>iii)Palaeontological Evidences:Fossil Distribution in Strata,Fossil and Rock Dating and Conclusions drawn from Fossil Records.<br>iv)Taxonomical evidences: Evolutionary Principles of Classification, Phylogenetic Tree. | |
| | **1.3** | **Sources of Organic Variations**<br>Mutations, Recombination, Gene Flow (Migration),Genetic Drift (Founder Effect, Bottleneck Effect). | |
| | **1.4** | **Processes of Evolutionary Change:**<br>Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism);<br>Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection. | |
| **2.0** | | | **7** |
| | **2.1** | **Biological Species Concept –** Definition, advantages, and limitations.<br>**Modes of Speciation** – Allopatric and Sympatric speciation, mechanisms and examples. | |
| | **2.2** | **Extinction**:<br>Mass Extinctions – Overview of mass extinctions in Earth's history, Causes and Role of extinction in evolution. | |
| | **2.3** | **Adaptive Radiation:**<br>Causes and significance, Examples of Adaptive Radiation – Focus on Darwin's finches. | |
| | **2.4** | **Hardy-Weinberg Principle:**<br>Hardy-Weinberg Equilibrium –Definition and its mathematical expression.<br>Factors that Disrupt Hardy-Weinberg Equilibrium – Mutations, natural selection, genetic drift, gene flow, and non-random mating. | |
| **3.0** | | | **7** |
| | **3.1** | **Fundamentals of Genetic Engineering:**<br>Nature and Functions of Genetic Material<br>DNA – Structure, Types, and Functions<br>RNA – Structure, Types, and Functions<br>Genetic Code – Characteristics and Importance | |
| | **3.2** | **Introduction to Genetic Engineering**<br>Definition, Scope and Applications. | |

| | | | |
|---|---|---|---|
| | **3.3** | **Recombinant DNA Technology**<br>**I) Tools: -**<br>**A) Enzymes: -** a) Lysing Enzymes b) Ligases c) Nucleases (Exonucleases, Endonucleases, Restriction Endonucleases) d) Synthetases (DNA polymerase, Reverse transcriptase) | |
| | **3.4** | **B) Vectors: -** Cloning vectors (Plasmid -pBR322, Bacteriophage-Lambda phage, VirusSV40, Cosmid vectors) | |
| **4.0** | | | |
| | **4.1** | **Techniques:**<br>i) Southern, Northern and Western Blotting<br>ii) Gel-Electrophoresis iii) PCR (Polymerase Chain Reaction) | **8** |
| | **4.2** | Construction of Recombinant DNA (rDNA) and its applications, cDNA Libraries and Genomic Libraries | |
| | **4.3** | **Transgenesis and Cloning in Animals:**<br>Transgenesis and Transgenic animals (Transgenic cattle, sheep, pig and fish); Cloning and cloned animals (Dolly sheep) | |
| | **4.4** | DNA Fingerprinting and Its Applications | |
| | | **Total** | **30** |

**Text Books**


1. Rastogi, Veerbala, Organic Evolution (2018). Third Revised Edition. MEDTECH.
2. Singh, S. P. Tomar, B.S., Evolutionary Biology, Rastogi Publication.
3. Verma P. S., Agrawal V.K. Cell Biology, Genetics, Evolution & Ecology S.Chand Publication
4. Verma P. S. and Agarwal V. K. Genetic Engineering
5. Mane A. M. Animal Biotechnology, Agrotech Press Jaipur.


**Reference Books**


1. Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing.
2. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B. and Patel, N. H. (2007). Evolution. Cold Spring, Harbour Laboratory Press
3. Hall, B. K. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and Bartlett Publishers
4. Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates
5. Campbell, 1 N.A and Reece JB (2011) Biology (9th edition) Pearson, Benjamin, Cummings.
6. An Introduction to Genetic Engineering Third EditionDesmond S. T. Nicholl University of the West of Scotland, Paisley, UK
7. Zero to Genetic engineering Hero,Dr.Justin Pahara,2021
8. Gene Cloning and DNAAnalysis an Introduction T.A. Brown Faculty of Life Sciences University of Manchester, Sixth Edition A John Wiley & Sons, Ltd., Publication
9. Principles of Gene Manipulation: An Introduction to Genetic Engineering" by Old RW and Primrose SB.
10. An Introduction to Genetic Engineering" by Nicholl

# Swami Ramanand Teerth Marathwada University, Nanded

## Faculty of Science and Technology,

### Four Year UG Program, Zoology (w. e. f. June -2024)

### B. Sc. Second Year, Semester-IV

**Practical SZOOCP1251: Cell Biology and Genetics** (Based on Paper No. SZOOCT1251)

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

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**Objectives:**

1. To provide basic practical skills and experience in using laboratory techniques in experimentation.
2. To understand how to prepare mitotic chromosomes.
3. To Demonstrate the Mendalian traits in Man.
4. To be able to mounting of salivary glands of Drosophila larvae

**Outcomes:**

1. Students would be able to prepare temporary squash preparations of onion root tips for mitosis.
2. Demonstrate the genetic traits in Man.
3. Ability to culture Drosophila flies in the laboratory.
4. Ability for mounting of salivary glands of Drosophila larvae.

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1. Staining of eukaryotic cells: Temporary mount of buccal epithelial cells to study their structure.
2. Identification of cell organelles (based on chart/photo-micrographs)
3. Operation and maintenance of compound microscope.
4. Preparation of temporary stained squash of onion root tip to study various stages of mitosis
5. Study of various stages of meiosis.
6. Problems based on Monohybrid & Dihybrid cross.
7. Problems based on interaction of genes (Complementary, Supplementary, Inhibitory Duplicate factors, Lethal genes).
8. Problems based on blood group inheritance & sex linked inheritance (hemophilia and colour blindness) in man.
9. Preparation of temporary slides of salivary gland chromosomes from chironomous larva.
10. Study of permanent slide of sickle cell anaemia.
11. Study of normal male and female human karyotype (use photographs or prints) and abnormal (chromosomal abnormalities) human karyotypes.
12. Study of genetic syndromes:
    a) Down's syndrome b) Klinfelter's syndrome c) Turner's syndrome.
13. Human pedigree analysis-various symbols used.
14. Study of human genetic traits (PTC (phenyl thio carbamate) tasters, ear lobes)

**Submission:**

ii) Practical record book duly signed by the teacher incharge / Head of the Department.

iii) Excursion report.

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

# Swami Ramanand Teerth Marathwada University, Nanded

## Faculty of Science and Technology,

### Four Year UG Program, Zoology (w. e. f. June -2024)

### B. Sc. Second Year, Semester-IV

## Practical SZOOCP1252: Evolutionary Biology and Genetic Engineering

(Based on Paper No. SZOOCT1252)

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

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**Objectives:**

1. To analyze morphological, anatomical, and fossil evidences of evolution using charts and models.
2. To calculate allele and genotype frequencies in a population using Hardy-Weinberg Principle.
3. To study molecular techniques like DNA estimation, gel electrophoresis, PCR, and RT-PCR in genetic research.
4. To understand cloning and transgenesis through the case study of Dolly the sheep and transgenic animals.
5. To explore DNA fingerprinting and its applications in forensic science and evolutionary studies.
6. To examine the impact of mass extinctions on biodiversity through case studies.
7. To participate in field excursions and museum visits for direct observation of evolutionary specimens.

**Outcomes:**

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

1. Analyze morphological, anatomical, and fossil evidences of evolution using charts, models, and specimens.
2. Calculate allele and genotype frequencies in a population using Hardy-Weinberg Principle.
3. Perform molecular techniques like DNA estimation, study principles and applications of gel electrophoresis, PCR, and RT-PCR.
4. Explain cloning and transgenesis through the case study of Dolly the sheep and transgenic animals.
5. Understand principle of DNA fingerprinting and its applications in forensic science and evolutionary studies.
6. Assess the impact of mass extinctions on biodiversity through case studies.
7. Observe evolutionary specimens through field excursions and museum visits.

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1. **Study of evidences by using photograph/charts and models**
   a) Study of homologous organs (limbs of 5 different groups of vertebrates).
   b) Study of analogous organs (wings of bird, insect and bat).
   c) Study of connecting links (Archeopteryx and Peripatus).
   d) Study of any four vestigial organs in humans.
   e) Study of adaptive radiation in feet of birds.

2. **Charts/Diagrams/Cut-outs:**
   a) Study of evolution of man based on three hominid fossils.
   b) Phylogeny of horse limbs and teeth of horse ancestors.
   c) Darwin's Finches- beaks of different species.

3. Calculation of frequencies of recessive and dominant gene in a population by using Hardy Weinberg Principle.
4. Calculation of heterozygotes and homozygotes in population by using Hardy Weinberg's principle.
5. Estimation of DNA by Diphenyl amine (DPA method).
6. Study of the principle and applications of Electrophoresis apparatus
7. PCR- Principle and applications.
8. Real-Time PCR (RT-PCR) Principle and applications.
9. Study of transgenic animals.
10. Study the cloning process (eg. Dolly the sheep)
11. Study of the principle and applications of DNA finger printing.
12. Sequence Similarity Search using BLAST- Demonstration.
13. Study of the major mass extinctions and their impact on biodiversity.
14. Visit to Natural History Museum and submission of report.

**Submission:**

Practical record book duly signed by the teacher in charge/Head of the Department.
Excursion report.

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

**Swami Ramanand Teerth Marathwada University, Nanded**

**Faculty of Science and Technology,**

**Four Year UG Program, Zoology (w.e.f. June -2024)**

**B. Sc. Second Year, Semester-IV**

**SZOOMT1251: Cell Biology**

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

## Course objectives:

1. To know about the ultrastructure of a cell, cell membrane and cell organelles.
2. Study in detail of the cell cycle, cell division and chromosomes.
3. Acquire knowledge of cells with molecular level.

## Course outcomes:

1. Students will be able to understand the ultrastructure of the cell, cell membrane and cell organelles.
2. The students will be able to understand the details of the cell cycle, cell division and chromosomes.
3. Students will acquire knowledge of the cell with a molecular level.

# SZOOMT1251: Cell Biology : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **8** |
| | **1.1** | **Structure** : Prokaryotic cell, Eukaryotic cell, | |
| | **1.2** | Microscopy (an elementary idea) Light microscope, Electron microscope | |
| | **1.3** | **Plasma membrane** structure Bimolecular model, Trimolecular model, | |
| | **1.4** | Fluid mosaic model | |
| **2.0** | | | **7** |
| | **2.1** | Micellar model | |
| | **2.2** | Chemical composition and functions | |
| | **2.3** | **Golgi complex**: Structure and functions. | |
| | **2.4** | **Endoplasmic reticulum** Structure, types and function. | |
| **3.0** | | | **7** |
| | **3.1** | **Lysosomes**: Structure type origin and functions | |
| | **3.2** | **Ribosomes**: Structure and functions | |
| | **3.3** | Mitochondria: Structure and functions | |
| | **3.4** | Nucleus : Structure and functions. | |
| **4.0** | | | **8** |
| | **4.1** | **Cell Cycle and its regulation** | |
| | **4.2** | **Cell division**: Mitosis | |
| | **4.3** | Meiosis | |
| | **4.4** | **Cancer cell**: Malignant and non-malignant. | |
| | | **Total** | **30** |

**Text Books**


1. Jagtap H. S. (2019). Text Book of Cell Biology, Sadhana Publication, ISBN No.978-93-81921-58-6.


**Reference Books**


1. Powar C. B. (1991). Cell Biology. Himalaya Publication, New Delhi, pp. 782.
2. Dr. S.P. Singh, Dr. B.S. Tomar (2007). Cell Biology. 9th revised edition, Rastogi Publication, Meerut
3. Gupta P.K. (2018). Cell and Molecular Biology.Rastogi Publication, Meerut, pp. 942.
4. Veer BalaRastogi. Introduction to Cell Biology, Rastogi Publication, Meerut
5. Gerald Karp (2007). Cell and Molecular Biology-Concepts and Experiments, John Wiley and Sons, pp. 843.
6. De Robertis, E.D.P., Nowinski, W. W., Saez, F. A. (1965). Cell Biology, Saunders, pp. 446.
7. Verma P.S. and Agrawal V.K. Concepts of Cell Biology
8. Dowben R.M. (1971). Cell Biology. Harper and Row Limited, pp. 570.
9. Witt – Biology of Cell
10. Ambrose E.J. and Easty D.M. (1970). Cell Biology. Thomas Nelson and Sons Ltd, pp.500.
11. Loddish - Cell & Molecular Biology.
12. Cooper - Cell Biology.
13. D.Robertis- Cell and Molecular Biology.

# Swami Ramanand Teerth Marathwada University, Nanded
## Faculty of Science and Technology,
### Four Year UG Program, Zoology (w. e. f. June -2024)
### B. Sc. Second Year, Semester-IV

**Practical SZOOMP1251: Cell Biology** (Based on Paper No. SZOOMT1251)

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

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**Objectives:**

1. To provide basic practical skills and experience in using laboratory techniques in experimentation.
2. To understand how to prepare mitotic chromosomes.

**Outcomes:**

1. Students would be able to prepare temporary squash preparations of onion root tips for mitosis.
2. Students will able to describe, sketch, analyze, and explain the structure and function of the cell organelles.
3. Students could describe, sketch, analyze, and explain the structure and function of nucleus and chromatin structure, its location.
4. Students will able to describe, sketch, analyze, and explain the basic principle of life.
5. They could also demonstrate and explain how a cell divides leading to the growth of an organism.
6. Students will able to describe, sketch, analyze, and explain the abnormality in structural and functional aspects of cells.
7. Students will able handle and use microscopes and camera Lucida.

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1. Staining of eukaryotic cells: Temporary mount of buccal epithelial cells to study their structure.
2. Identification of cell organelles (based on chart/photo-micrographs)
3. Operation and maintenance of compound microscope.
4. Cell diversity in plant and animal tissue.
5. Preparation of Alcoholic grades, dehydration and cleaning of tissue.
6. Preparation of various stains – Haematoxylin, Eosin, Borax carmine, Acetocarmine.
7. Preparation of fixatives – Alcohol, Acetone, Formalin, Bouins fluid, cornoy fluid and formal sublimate.
8. Preparation of temporary stained squash of chironomus larvae / onion root tip to study various stages of mitosis.
9. Demonstration of Meiotic cell division in Tradescantia buds or Grasshopper Testis (Virtual/Pictorial).
10. Collection of various tissues/organs from slaughter houses for micro-technique.
11. Micrtome study with block preparation, section cutting and staining.

Short excursion / study tour is compulsory

Submission

1. Practical record book duly signed by the teacher in charge/ Head of the Department.
2. Excursion report.

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

**Swami Ramanand Teerth Marathwada University, Nanded**
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**B. Sc. Second Year, Semester-IV**

# SZOOGE1251: Goat Farming

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

## Course objectives:

1. The main objectives of goat farming include understanding the importance of goats in rural livelihoods, exploring the economic viability of goat farming, learning about different goat breeds and their characteristics, and gaining knowledge on goat management practices.
2. It also aims to promote scientific and sustainable goat rearing, focusing on self-sustainability and improved breeding practices.

## Course outcomes:

After successful completion of the course the students will be able to:-

1. Understand evaluate current status, prospects and opportunities in goat farming.
2. Will be able to understand the science and scientific methods of goat farming and management.
3. Able to start their own business.
4. He can also guide the newly entered in goat farming business.

# SZOOGE1251: Goat Farming : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **8** |
| | **1.1** | **Introduction to Goat Farming** Biological (zoological ) Classification of Goats. Advantages of Goat Farming. External morphology of a Goat | |
| | **1.2** | Goat species / Breeds of India : Osmanabadi, Black Bengal, Sangamneri , Gaddi, | |
| | **1.3** | Barberi , Kashmiri, Sirohi, Katchi, Ganjan, Beetal. | |
| | **1.4** | Goat of Foreign origin : - Boer of Africa , Read Sokoto or Maradi of Nigeria , South African Kalahari Red. (Identification Features , Performance for Meat , Milk and Fiber etc.) | |
| **2.0** | | | **7** |
| | **2.1** | Anatomy of male and female reproductive system | |
| | **2.2** | Estrus Cycle, development and Production of kids | |
| | **2.3** | Diseases of Goats | |
| | **2.4** | Digestive system of Goats and Vaccination | |
| **3.0** | | | **7** |
| | **3.1** | **Goat Farming** - Types of Goat Farming- Stall Fed , Semi intensive stall fed , Free range System | |
| | **3.2** | Goat Farm shed – Types and management | |
| | **3.3** | Goat Food - Types, composition and feeding methods, Fodder plants for goats | |
| | **3.4** | Products and byproducts of goat farming – Meat, Milk, Hairs, Leather , Other minor products and goat manure | |
| **4.0** | | | **8** |
| | **4.1** | **Goat Market, Marketing and Economics** - Goat Market : Price determination, retail and wholesale markets, middle men and agencies, Goat Transport | |
| | **4.2** | Goat Marketing in local bazaars | |
| | **4.3** | **Ecnomics of goat farming** – Basic investment, Income , Profit an losses, Insurance, Loans and Business Promotional Schemes of State and Central Govt. | |
| | **4.4** | Institutes and centres for Goat Farming Education and Research | |
| | | **Total** | **30** |

**Text Books**


1. Comprehensive Book on Goat Farming. S. K. Gupta and Suraj Amrutkar. Narendra Publishing House, N. Delhi. (ISBN: 9789387590816).
2. Handbook of Goat Farming. Edited By- Dr.Parth Gaur, Dr. Sandeep, Dr.Dhawal Kant Yadav, Dr.Biswanath Patra. Ink Zone Publication (ISBN: 978-81-964964-2-5) Pages-104.
3. Handbook of Goat Farming. Shivaji P. Chavan, Pooja Thakur- Guhilot. Ramanshil Publication, Aurangabad. M. S. (2022 Edit). ISBN: 978-93-92310-03-4.

4. Indigenous Goat Farming Handbook- Free PDF. Rural Development and Land Reforms. Republic of South Africa. (Guide to Boer Goat and Kalahari Goat).
5. Goat Production Handbook for Small producers (Free PDF). Sebhatu Gabrelul and Ranita Marshall (Southern University Agriculture Research and Extension Centre-SRC Program).

**Reference Books**

1. Goat Farming Technical Manual-JICA- Project. District Livestock Services Office-Gorkha. PDF.
2. Tips for commercial Goat Farming- (Free PDF). ICAR- Central Institute for Research on Goats , Makhdoom, Mathura UP.
3. Goat Science and Production. South Africa Boer Goats Breeders Association. (Free PDF).

**Swami Ramanand Teerth Marathwada University, Nanded**
**Faculty of Science and Technology,**
**Four Year UG Program, Zoology (w.e.f. June -2024)**

**B. Sc. Second Year, Semester-IV**

**SZOOVC1251: (C) Histotechnology**

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

## Course objectives:

1. Appreciation of structure of cells in various types of tissues.
2. Learning the methods in storage and histochemical processing of tissue samples.
3. Acquire the ability and skill to prepare histological slides of tissue samples.
4. Learn about tools used in histological study of tissues.

## Course outcomes:

1. Ability to identify different types of tissues and distinguish between different components of cells.
2. Skill related to fixation of tissue samples and microtechnic processing of tissues.
3. Ability to identify, handle and catalogue slides of different tissues.
4. Students' skill in operating and maintaining different types of microtomes.

# SZOOVC1251: (C) Histotechnology : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **15** |
| | **1.1** | **Introduction** – Definition of Histo-technology. | |
| | **1.2** | Methods of examination of tissues and cells, Collection and labeling of specimens. | |
| | **1.3** | Methods of preparation and examination of tissues (fresh and fixed tissue). | |
| | **1.4** | **Practical :** Study of different types of microtomes. | |
| **2.0** | | | **15** |
| | **2.1** | **Fixation of tissue** - Definition, Criteria for an ideal fixative. | |
| | **2.2** | Types of fixatives. (Simple and Compound). | |
| | **2.3** | Properties of Simple and Compounds fixatives (Micro anatomical, cytological and histochemical). | |
| | **2.4** | **Practical** –Isolation and collection of tissue, fixing and block preparation. | |
| **3.0** | | | **15** |
| | **3.1** | **Tissue processing** - Manual and automatic tissue processing, Different embedding media, Steps of tissue processing (Dehydration, Clearing, Impregnation). | |
| | **3.2** | **Embedding**- Methods of Embedding, Embedding medium, names of media and moulds. | |
| | **3.3** | Automatic Tissue Processes (Structure and Working, Advantages and Disadvantages). | |
| | **3.4** | **Practical**-Tissue processing of prepared blocks. | |
| **4.0** | | | **15** |
| | **4.1** | Section Cutting - Types of Microtome, Rotary Microtome -Parts and their functions, Microtome Knives- Types, Care and Maintenance Techniques of sharpening. | |
| | **4.2** | Technique of Section Cutting, Preparation of Adhesive Mixture, Mounting. | |
| | **4.3** | Staining - Definition and Significance of Staining, Stain and Staining Types, Theory ofStaining, Methods of Staining | |
| | **4.4** | **Practical** – Section Cutting, fixing, alcohol grading, staining and preparation of permanent slide. | |
| | | **Total** | **60** |

**Text Books**

1. Handbook of Histopathological and Histochemical Techniques – C. F. A. Culling.

**Reference Books**

1. Histochemical Techniques – J. D. Bancroft.
2. Histological and Histochemical Methods 4th Ed. – John Kiernan.

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## B. Sc. Second Year, Semester-IV

## SZOOVC1251: (D) Medical Lab Techniques

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

**Course objectives**

1Students understand the value of laboratories in the current world by focusing on an intensive study of the technology employed in modern medical science.

2. To employ clinical laboratory tests to recognize, classify, and treat illnesses and other medical conditions.

3. There are a ton of employment chances in Hospitals, Military, Research Facilities, etc.

**Course outcomes**

1. Students will be able to describe laboratory safety protocols and regulations, including biosafety and biohazard handling.

2. To explain the principles of laboratory testing, including specimen collection, processing, and analysis.

3. To analyze and interpret laboratory results, including quality control and quality assurance..

4. To pursue ongoing education and professional development, including staying current with advances in medical laboratory technology.

# SZOOVC1251: (D) Medical Lab Techniques

## : Course Contents

| Module No. | Unit No. | Topic | Hrs. Required to cover the contents |
|---|---|---|---|
| **1. 0** | | | **15** |
| | **1.1** | Introduction to Clinical laboratory<br>Basic laboratory principles – Code of Conduct of medical laboratory personnel.<br>Organization of clinical laboratory and role of medical laboratory technician. | |
| | **1.2** | Safety measures –<br>Medical Laboratory professional and professionalism in laboratory workers. | |
| | **1.3** | Common Laboratory Equipment's<br>Incubator, Hot Air Oven, Water Bath, Centrifuge, Autoclave, Spectrophotometer, Balance<br>Microscope – Fundamentals of Microscopy, Resolution & Magnification Light Microscopy,<br>Glassware – Description of Glassware, its use, handling and care, Colorimeter, Blood cell counter | |
| | **1.4** | **Practical-**<br>1. Handling common laboratory equipment's<br>2. Responsibilities of a technician in the maintenance of the analyzers.<br>3. Use and care of microscopes.<br>4. Using of autoclave hot air oven, other common laboratory equipment etc | |
| **2.0** | | | **15** |
| | **2.1** | Definition, classification and biomedical importance of Carbohydrate (absorption of glucose, Diabetes mellitus), protein (Haemoglobinopathy) and lipids. | |
| | **2.2** | Enzyme – Definition, classification, Coenzymes, Clinical importance of enzyme Enzyme pattern indisease. | |
| | **2.3** | Vitamins & minerals- Fat soluble vitamins (A,D,E,K), Water soluble vitamins, Principle elements-(Ca,<br>Na, K, Cl, Fe & S. | |
| | **2.4** | **Practical –**<br>1. Qualitative test of monosaccharides (Glucose & Fructose).<br>2. Qualitative tests of Proteins -Heat coagulation test.<br>3. Qualitative test for ketone bodies, bile salts & pigments. | |
| **3.0** | | | **15** |
| | **3.1** | Introduction to Microbiology, Morphological classification of Bacteria.<br>Culture media, types of media, special media. | |
| | **3.2** | Sterilization and Disinfection (Physical and Chemical methods)<br>Antimicrobial susceptibility test. | |

| | | | |
|---|---|---|---|
| | **3.3** | Morphology and Pathogenicity ofa) Gram positive cocci- Staphylococci, Streptococci,<br>b) Gram negative cocci- Neisseria<br>c) Gram positive bacilli- Corynebacterium, Actinomy, Listeria, Bacillus, Clostridia, Mycobacterium<br>tuberculosis and Mycobacterium leprae.<br>d) Gram negative bacilli- Pseudomonas, Vibrio, Aerononas, Plesiomonas, Brucella, Haemophillus,<br>,Rickettsia, Mycoplasm Salmonella, Shigella,Vibrio | |
| | **3.4** | **Practical –**<br>1. Staining :a) Gram staining technique b) Acid fast staining (Z-N)<br>2. Identification of bacterial culture<br>a. Colony characteristic. b. Morphological characteristic.<br>c. Interpretation of biochemical reaction.<br>3. Antibiotic sensitivity test | |
| **4.0** | | | |
| | **4.1** | Care of laboratory glassware, equipment and chemicals. | |
| | **4.2** | Specimen handling<br>Laboratory Communication<br>Laboratory Safety<br>Material managements | **15** |
| | **4.3** | Ethics & General Principles | |
| | **4.4** | **Practical –**<br>The project / field work involving visit to different institutions / pathology labs. /Hospitals units related to the subjects and critical analysis of these Units. | |
| | | **Total** | **60** |

**Text Books**

**Reference Books**

1.Medical Laboratory Technology by Ramnik Sood

2. Urinalysis and body fluids by Susan King Strasinger

3. Informatics for the Clinical Laboratory: A Practical Guide for the Pathologist by Daniel Cowan

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**

**Faculty of Science & Technology**

**B. Sc. Second Year Syllabus w.e.f. June, 2025 (NEP-2020)**

**VOCATIONAL COURSE IN ZOOLOGY (VCZ)**

**CONTINUOUS ASSESSMENT (CA)**

**Zoology**

**Semester- IV**

**SZOOVC1251 - VCZ- II : (C) Histotechnology**

**Or**

**VCZ- II : (D) Medical Lab Techniques**

**Centre:** **Date:**

**Marks: 20**

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

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

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**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER PATTERN**
**Faculty of Science & Technology**
**Practical Examination**
**B. Sc. Second Year Zoology (Semester-IV) as per NEP-2020; (w.e.f. June 2025)**
**Practical (SZOOCP1251): Cell Biology & Genetics**
**Based On**
**(Paper: SZOOCT1251: Cell Biology and Genetics)**

| | |
|---|---|
| **Centre:** | **Batch No.:** |
| **Date:** | **Time: 04 Hrs;** |
| **Exam Seat No.:** | **Marks: 30** |

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**Q.1** Temporary mount of buccal epithelial cells to study their structure / Identify any two cell organelles and comment on their structure and functions / Demonstrate operation of compound microscope and comment on it / Preparation of temporary stained squash of onion root tip to study stages of mitosis / Study of various stages of meiosis. **10**

**Q. 2** Solve One problem based on Monohybrid Cross & One problem based on Dihybrid Cross

**OR**

Solve any two problems on Interaction of Genes.
(Complementary, Supplementary, Inhibitory Factors, Duplicate genes, Lethal genes)

**OR**

Solve Problems based on blood group in heritance in man/Sex-Linked Inheritance **08**

Identification of Human Syndromes (any two)/

**Q. 3** Preparation of Temporary Mount of Salivary Gland Chromosomes of Chironomous Larvae

**OR** **08**

PTC tasting test in a group of individuals and reporting of results

**OR**

Identify and Comment on as per instructions. a) Sickle cell anemia–slide/photograph/ charts.
b) Humans pedigree analysis (Any Four symbols)

**Q.4.**Viva-voce **04**

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**Note:** 1. Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
i) Submission of Record book &Internal Test on Practical = 10 Marks;
ii) Excursion Report & Permanent slides=10 Marks;
2. Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

| | |
|---|---|
| **Name & Signature** | **Name & Signature** |
| **Examiner – 1** | **Examiner – 1** |

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER PATTERN**
**Faculty of Science & Technology**
**Practical Examination**
**B. Sc. Second Year Zoology (Semester-IV) as per NEP-2020; (w.e.f. June 2025)**
**Practical (SZOOCP1252): Evolutionary Biology & Genetic Engineering**
**Based On**
**(Paper: SZOOCT1252: Evolutionary Biology & Genetic Engineering)**

| | |
|---|---|
| **Centre:** | **Batch No.:** |
| **Date:** | **Time: 04 Hrs;** |
| **Exam Seat No.:** | **Marks: 30** |

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Q.1). Identify and comments on as per the instructions (Any Four)

(homologous organs, analogous organs, connecting links, vestigial organs, adaptive radiation **(10)**

OR

Problems (Any Two) based on Hardy- Weinberg Principle.

Q.2). Estimation of DNA by Diphenyl amine (DPA method) / Study of the principle and applications of Electrophoresis apparatus/PCR/RT-PCR. **(08)**

OR

Study of the principle and applications DNA Finger printing/ /Sequence Similarity Search using BLAST –Demonstration/ Study of transgenic animals

Q.3). Study the case of Dolly the sheep and explain the cloning process step-by-step/ Study of transgenic animals/ Study of the major mass extinctions and their impact on biodiversity. **(08)**

Q.4). Viva-voce **(04)**

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**Note:** 1. Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
i) Submission of Record book &Internal Test on Practical = 10 Marks;
ii) Excursion Report & Permanent slides=10 Marks;
2. Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

| | |
|---|---|
| **Name & Signature** | **Name & Signature** |
| **Examiner – 1** | **Examiner – 1** |

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**
**CHOICE BASED CREDIT SYSTEM (CBCS)**
**SEMESTER PATTERN**
**Faculty of Science & Technology**
**Practical Examination**
**B. Sc. Second Year Zoology (Semester-IV) as per NEP-2020; (w.e.f. June 2025)**
**Practical (SZOOMP1251): Cell Biology**
**Based On**
**(Paper: SZOOMT1251: Cell Biology)**

| | |
|---|---|
| **Centre:** | **Batch No.:** |
| **Date:** | **Time: 04 Hrs;** |
| **Exam Seat No.:** | **Marks: 30** |

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Q.1. Temporary mount of buccal epithelial cells to study their structure / Identify any two cell organelles and comment on their structure and functions / Demonstrate operation of compound microscope and comment on it. **10**

Q. 2 Preparation of temporary stained squash of onion root tip to study stages of mitosis/ Prepare various grades of preservatives / Stains / Organ or tissue block preparation. **08**

Q. 3 Preparation of Temporary Mount of Salivary Gland Chromosomes of Chironomous Larvae / Study of various stages of meiosis /Cell lysis methods. **08**

**Q.4.** Viva-voce **04**

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**Note:** 1. Practical Internal Evaluation (Continuous Assessment CA) = 20 Marks
i) Submission of Record book &Internal Test on Practical = 10 Marks;
ii) Excursion Report & Permanent slides=10 Marks;
2. Demonstration of animal Dissections through Models, Charts or Computer Aided Techniques as per U.G.C Guidelines.

| | |
|---|---|
| **Name & Signature** | **Name & Signature** |
| **Examiner – 1** | **Examiner – 1** |

**SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED**

**Faculty of Science & Technology**

**B. Sc. Second Year Syllabus w.e.f. June, 2025 (NEP-2020)**

**VOCATIONAL COURSE ZOOLOGY (VCZ)**

**END SEMESTER ASSESSMENT (ESA)**

**Zoology**

**Semester- IV**

**SZOOVC1251 - VCZ- II : (C) Histotechnology**

**Or**

**VCZ- II : (D) Medical Lab Techniques**

**Centre:** **Date:**

**Marks: 30**

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

| Sr. No. | Continuous Assessment (CA) | Maximum Marks | Marks Obtained |
|---|---|---|---|
| 1 | Vocational Course Report Submission | 10 | |
| 2 | Overall Course Judgment | 10 | |
| 3 | Course Work Presentation | 10 | |
| | **Total Marks** | **30** | |

**Name & Signature**
**Examiner – 1**

**Name & Signature**
**Examiner - 2**

| Swami Ramanand Teerth Marathwada University, Nanded | | | |
|---|---|---|---|
| **Faculty of Science & Technology** | | | |
| **Summer/Winter-20-------, Examination** | | | |
| Name of Subject: | | **Zoology** | |
| Subject Code :<br>(as per examination time table): | | | |
| Class: | **B.Sc. Second Year** | Semester: | **III & IV** |
| Paper Title and Paper No<br>(as per examination time table): | | **…….**<br>**Paper No. ……..(NEP-2020 Pattern)** | |
| Time: | **2 Hours** | Maximum Marks: | **40** |

**nportant Instructions:**

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

**Q.1 Answer each of the following:** **10 Marks**

**a) (Based on Module 1)**
**b) (Based on Module 2)**
**c) (Based on Module 3)**
**d) (Based on Module 4)**

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

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

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

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

**Q.6 Answer each of the following:** **10 Marks**

**a) (Based on Module 1)**
**b) (Based on Module 2)**
**c) (Based on Module 3)**
**d) (Based on Module 4)**