

**UNIVERSITY OF MUMBAI**  
**SOPHIA COLLEGE (AUTONOMOUS)**  
**SYLLABUS FOR F.Y. B.Sc.COURSE (ZOOLOGY)**  
**(To be implemented from 2018-19)**

**SEMESTER I**

**Theory Course: US.ZOO.1.01 - SYSTEMATIC CLASSIFICATION OF  
INVERTEBRATES AND ECOLOGY**

**Theory Course: US.ZOO.1.02 - APPLIED BIOLOGY**

**Practical Course: USZOO.P.1**

**SEMESTER II**

**Theory Course: US.ZOO.2.01 - BIODIVERSITY, EVOLUTION AND  
ETHOLOGY**

**Theory Course: US.ZOO.2.01 - GENETICS AND BIOCHEMISTRY**

**Practical Course: USZOO.P.2**

## SEMESTERWISE SYLLABUS GRID FOR EACH PAPER

SEMESTER I		SEMESTER II	
<b>US.ZOO.1.02</b>  <b>SYSTEMATIC CLASSIFICATION OF INVERTEBRATES AND ECOLOGY</b>	<b>US.ZOO.1.02</b>  <b>APPLIED BIOLOGY</b>	<b>US.ZOO.2.01</b>  <b>BIODIVERSITY, EVOLUTION AND ETHOLOGY</b>	<b>US.ZOO.2.02</b>  <b>GENETICS AND BIOCHEMISTRY</b>
Unit 1 Classification of Animal Kingdom	Unit 1 Laboratory Safety and Units of Measurement	Unit 1 National Parks and Sanctuaries	Unit 1 Genetics and Nucleic acids
Unit 2 Ecosystem	Unit 2 Animal Biotechnology	Unit 2 Evolution	Unit 2 Biochemistry
Unit 3 Population Ecology	Unit 3 Instrumentation	Unit 3 Ethology	Unit 3 Nutrition and Public Health
<b>Practical US.ZOOP.1</b>		<b>Practical US.ZOOP.2</b>	

**Syllabus for F.Y.B.Sc. Course –ZOOLOGY**  
**(To be implemented from Academic year 2018-19)**  
**SEMESTER – I**

<b>Course Code</b>	<b>Unit</b>	<b>Title</b>	<b>Credits</b>
<b>US.ZOO.1.01</b>		<b>SYSTEMATIC CLASSIFICATION OF INVERTEBRATES AND ECOLOGY</b>	2 Credits (45 lectures)
	1	Classification of Animal Kingdom	15 lectures
	2	Ecosystem	15 lectures
	3	Population Ecology	15 lectures
<b>US.ZOO.1.02</b>		<b>APPLIED BIOLOGY</b>	2 Credits (45 lectures)
	1	Laboratory Safety and Units of Measurement	15 lectures
	2	Animal Biotechnology	15 lectures
	3	Instrumentation	15 lectures
		<b>PRACTICALS</b>	
<b>US.ZOOP.1</b>		Practicals based on both the courses	2 Credits

# FYSBC ZOOLOGY SYLLABUS - SEMESTER I

## THEORY COURSE- US.ZOO.1.01

### SYSTEMATIC CLASSIFICATION OF INVERTEBRATES AND ECOLOGY

#### Unit 1 - Classification of Animal Kingdom

(15 Lectures)

##### **Objective:**

- *To comprehend classification of Invertebrates through the general characteristics of phyla and specific characters of the respective organisms.*

##### **Desired outcome:**

- *The learners will be familiarized with invertebrate classification and will also be able to understand the evolution of invertebrates from phylogenic aspect.*

#### **1.1 Unicellular organization: Phylum Protozoa**

#### **1.2 Multicellular organization:**

1.2.1: Colonization level - Phylum Porifera

1.2.2: Division of labour – Phylum Coelenterata

#### **1.3 Triploblastic acoelomate and pseudoceoleomate organization**

1.3.1: Acoelomate organization – Phylum Platyhelminthes

1.3.2: Pseudocoelomate organization – Phylum Nemathelminthes

#### **1.4 Triploblastic Coelomate organization**

1.4.1: Animals with metameric segmentation: Phylum Annelida

1.4.2: Animals with jointed appendages: Phylum Arthropoda

1.4.3: Animals with mantle: Phylum Mollusca

1.4.4: Animals with enterocoel: Phylum Echinodermata

#### Unit 2- Ecosystem

(15 Lectures)

##### **Objective:**

- *To impart knowledge of different components of ecosystem and educate about essentials of coexistence of human beings with all other living organisms.*

##### **Desired Outcome:**

- *Learners will grasp the concept of interdependence and interaction of physical, chemical and biological factors in the environment.*
- *It would lead to better understanding about implications of loss of fauna specifically on human beings, erupting a spur of desire for conservation of all flora and fauna.*

## **2.1: Concept of ecosystems**

2.1.1: Definition and components

## **2.2 Biogeochemical cycles**

2.2.1: Water, Oxygen, Nitrogen, Sulphur

## **2.3 Freshwater ecosystem**

2.3.1: Lentic

2.3.2: Lotic

## **2.4 Food chains and food webs in ecosystems**

2.4.1: Freshwater

2.4.2: Grassland

## **2.5 Ecological pyramids of energy, biomass and number**

## **2.6 Animal interactions:**

2.6.1: Commensalism

2.6.2: Mutualism

2.6.3: Predation

2.6.4: Parasitism

2.6.5: Antibiosis

## **Unit 3 - Population Ecology**

**(15 Lectures)**

### **Objective:**

- *To facilitate the learning of population ecology, its dynamics and regulatory factors important for its sustenance.*

### **Desired Outcome:**

- *This unit would allow learners to study about nature of animal population, specific factors affecting its growth and its impact on the population of other life forms.*

## **3.1 Population Dynamics**

3.1.1: Population density, Natality, Mortality

3.1.2: Fecundity, Age structure, Sex ratio

3.1.3: Survivorship curves

3.1.4: Population dispersal and distribution patterns

3.1.5: Niche concept

### **3.2 Population growth regulation**

- 3.2.1: Intrinsic mechanism – Density dependent fluctuations and oscillations
- 3.2.2: Extrinsic mechanisms – Density dependent, environmental and climatic factors
- 3.2.3: Population interaction

### **3.3 Population growth pattern**

- 3.3.1: Sigmoid
- 3.3.2: 'J' shaped

### **3.4 Human Census in India: Concept, mechanism and significance**

## **THEORY COURSE US.ZOO.1.02**

### **APPLIED BIOLOGY**

#### **Unit 1- Laboratory Safety and Units of Measurement**

**(15 Lectures)**

##### **Objective:**

- *To make learners aware of risks involved in handling of different hazardous chemicals, sensitive (electrical/electronic) instruments and infectious biological specimens, especially during practical sessions in the laboratory and to train them to avoid mishap.*
- *To understand the concepts of measurements.*
- *To understand parameters used in biostatistics.*

##### **Desired Outcome:**

- *Learners would work safely in the laboratory thus enhancing their scholastic performance and economy in use of materials/chemicals during practical sessions.*
- *Learners would be able to realize the micro and macro quantities of the matter and chemical concentrations.*
- *Learners would be able to appreciate the importance of biostatistics tools of data analysis.*

#### **1.1: Introduction to good laboratory practices**

#### **1.2: Use of safety symbols: meaning, types of hazards and precautions**

#### **1.3: Units of measurement:**

1.3.1: Calculations and related conversions of each: Metric system- length (meter to micrometer), weight (gram to microgram), Volumetric (Cubic measures)

1.3.2: Temperature: Celsius, Fahrenheit, Kelvin

1.3.3: Biostatistics: Introduction and scope, Sampling and its types, Central tendencies (mean, median, mode), Tabulation, Graphical representations (Histograms, bar diagrams, pie diagrams).

#### **Unit 2- Animal Biotechnology**

**(15 Lectures)**

##### **Objective:**

- *To acquaint learners to the modern developments and concepts of Zoology highlighting the biotechnological applications in various fields.*

##### **Desired Outcome:**

- *Learners would understand recent advances in the subject and their applications for the betterment of mankind.*
- *Learners may get enthused to take up research as their future academic endeavour.*

- 2.1: Biotechnology:** Scope and achievements of Biotechnology (Fishery, Animal Husbandry, Medical, Industrial)
- 2.2: Transgenesis:** Retroviral vector method, Nuclear transplantation method, DNA microinjection method and Embryonic stem cell method
- 2.3: Cloning (Dolly)**
- 2.4: Ethical issues of transgenic and cloned animals**
- 2.5: Applications of Biotechnology:**
- 2.5.1: DNA fingerprinting: Technique in brief and its application in forensic science (Crime Investigation)
  - 2.5.2: Recombinant DNA in medicines (recombinant insulin)
  - 2.5.3: Gene therapy: Ex-vivo and *In vivo*, Severe Combined Immunodeficiency (SCID), Cystic Fibrosis
  - 2.5.4: Green genes: Green Fluorescent Protein (GFP) from Jelly fish-valuable as reporter genes used to detect food poisoning.

### **Unit 3- Instrumentation**

**(15 Lectures)**

#### **Objective:**

- *To provide all learners a complete insight about the structure and working of different instruments used in Zoology.*
- *To impart hands on operational skills.*

#### **Desired Outcome:**

- *Learners will appreciate the use of techniques and the application of the instruments used in the laboratory.*
- *Learners will be skilled to select and operate suitable instruments for this course and also for higher classes including research.*

- 3.1: Microscopy** - Construction, principle and applications of dissecting and compound microscope
- 3.2: Colorimetry and Spectroscopy** - Principle and applications
- 3.3: pH** - Sorenson's pH scale, pH meter - principle and applications
- 3.3: Centrifuge** - Principle and applications (clinical and ultra centrifuges)
- 3.4: Chromatography** - Principle and applications (Partition and Adsorption)
- 3.5: Electrophoresis** - Principle and applications (AGE and PAGE)



# PRACTICAL COURSE US.ZOOP.1

## PRACTICAL I

### 1. Classification of Animal Kingdom

1.1: Protozoa : *Amoeba*, *Paramoecium*, *Euglena*, *Plasmodium*

1.2: Porifera: *Leucosolenia*, *Euplectella*, Bath sponge

1.3: Coelenterata: *Hydra*, *Obelia* colony, *Aurelia*, Sea anemone

1.4: Platyhelminthes: *Planaria*, Liverfluke, Tapeworm

1.5: Nematelminthes: *Ascaris* – male and female

1.6: Annelida: *Nereis*, Earthworm, Leech

1.7: Arthropoda: Crab, lobster, dragonfly, butterfly, spider, scorpion, centipede, millipede

1.8 : Mollusca : *Chiton*, *Dentalium*, *Pila*, *Unio*, *Sepia*, *Nautilus*

1.9 Echinodermata: Starfish, brittlestar, featherstar, sea urchin, sea cucumber

2. Study of *Paramoecium* culture to observe food vacuole, contractile vacuole and ciliary movement

3. Determination of population density (*Daphnia* or any other suitable organism) by sub-sampling method.

4. Mounting of foraminiferan shells from sand.

5. Study of parapodium of *Nereis*.

6. Mouthparts of insects – Biting and chewing, piercing and sucking, siphoning, sponging

7. Study of food webs and food chains in an ecosystem - To be conducted using Research based pedagogy (students to present their study through PPT / Chart presentations).

8. Field report on excursion to Nature Park / Zoological garden.

## PRACTICAL II

1. Study of instruments used in the lab – Principle and working
  - a. Colorimeter
  - b. Centrifuge
  - c. Spectroscopy
  - d. Compound microscope
  - e. Dissecting microscope
2. Interpretation of safety symbols (toxic, corrosive, explosive, flammable, skin irritant, oxidizing, compressed gases, aspiration hazards and Biohazardous infectious material).
3. Study of Aseptic techniques to aseptically transfer culture media.
4. Separation of pigments by adsorption chromatography using chalk.
5. Separation of amino acids using Paper Chromatography.
6. Separation of lipids by TLC.
7. Study of Beer- Lambert law using different concentrations of coloured solutions.
8. Estimation of pH of different solutions using BDH indicator, red cabbage and pH paper.
9. Identification of transgenic fish (Trout and Salmon) / cloned animals (Dolly sheep, CC cat and Snuppy dog) from photograph.
10. Application of DNA Fingerprinting in criminology (photograph of electrophoretic pattern to be given for interpretation by the students).
11. Study of central tendencies and plotting of bar diagram, histogram and pie diagram.

**N.B.** The practicals could be conducted by using specimens authorized by the wildlife and such other regulating authorities. However, adhering to the directions as given in the UGC Circular F14-4/2006 (CPP-II), the practicals will be taught by using photographs/audio-visual aids/simulations / models, etc. as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies.

## SCHEME OF EXAMINATION

**Maximum Marks allotted for each theory course per semester: 100 marks**

**This will have two components as follows:**

- (a) Internal assessment of total of twenty five (25) marks per course per semester shall be conducted as: out of 20 marks based on the test / project and out of 5 marks based on the active participation in the class.
- (b) External assessment out of seventy five (75) marks per course per semester shall be conducted as semester end theory examination as per the given question paper pattern.

**Maximum Marks allotted for the entire practical course per semester: 100 marks which will be distributed into the following two examination sessions and conducted as per the given question paper pattern:**

- (a) Practical I examination of fifty (50) marks shall be conducted at the end of every semester.
- (b) Practical II examination of fifty (50) marks shall be conducted at the end of every semester.

### PAPER PATTERN OF INTERNAL ASSESSMENT US.ZOO.1.01 &US.ZOO.1.02

**All Questions are compulsory  
Figures to the right indicate full marks**

**Time: 50 minutes**

**Total marks: 20**

Q.1.	*Objective type questions	05 marks
Q.2.	Answer in one sentence OR Define the following	05 marks
Q.3.	Answer any two out of three (05 marks each)	10 marks

\*For Question 1 objective type of questions such as –

- a) Match the column
- b) Give one word for
- c) Define the term
- d) MCQ
- e) True and False

**PAPER PATTERN OF THEORY EXTERNAL ASSESSMENT  
US.ZOO.1.01 & US.ZOO.1.02**

**All Questions are compulsory  
Figures to the right indicate full marks**

**Time: 2.5 hours**

**Total marks: 75**

Q.1.	Based on UNIT 1 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.2.	Based on UNIT 2 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.3.	Based on UNIT 3 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.4.	Based on all three units – two from each unit Answer any three out of six (5 marks each)	15 marks

**PAPER PATTERN OF PRACTICAL EXAMINATION  
US. ZOOP.1**

**PRACTICAL I EXAMINATION**

**Duration : 2 hrs 30 min**

**Marks: 50**

Q. 1. Prepare the temporary mounting of foraminiferan shells and identify minimum three types. (10 Marks)

**OR**

Q.1. Prepare the temporary mounting of parapodium of *Nereis*. (10 Marks)

Q.2. Determine of population density of the given organism by sub-sampling method.(10 Marks)

**OR**

Q.2. Demonstrate the observations of food vacuole, contractile vacuole and ciliary movement of *Paramoecium* from the given culture. (10 Marks)

Q.3. Identification based on animal classification and mouthparts of insects. (A-E) (15 Marks)

Q.5. Field study report and viva on it. (10 Marks)

Q.4. Certified journal (05 Marks)

## PRACTICAL II EXAMINATION

**Duration: 2 hrs 30 min**

**Marks: 50**

Q.1. Estimate concentration of the given unknown solution using colorimeter from the standard as well as calculations. (15 marks)

**OR**

Determine pH of the given samples with the help of the given indicators and pH meter and comment on their chemical nature. (15 marks)

**OR**

Q. 2. Perform experiment for separation of pigments by adsorption chromatography. (10Marks)

**OR**

Perform experiment for separation of mixture of amino acids by paper chromatography. (10Marks)

**OR**

Perform Thin Layer Chromatography (TLC) for separation of lipids. (10Marks)

Q. 3. Prepare a frequency distribution table / Plot histogram / Pie diagram / Bar diagram from the given data. (5 marks)

**OR**

Demonstrate aseptic technique to transfer culture media (5 Marks)

Q. 4. Identification (A-E) (10 Marks)  
(Safety Symbols (two), lab instruments, transgenic animals, DNA fingerprinting)

Q.5. Certified journal & Viva based on practicals (10 Marks)

## Syllabus for F.Y.B.Sc. Course –ZOOLOGY

(To be implemented from Academic year 2018-19)

### SEMESTER – II

Course Code	Unit	Title	Credits
<b>US.ZOO.2.01</b>		<b>BIODIVERSITY, EVOLUTION AND ETHOLOGY</b>	2 Credits (45 lectures)
	1	National Parks and Sanctuaries	15 lectures
	2	Evolution	15 lectures
	3	Ethology	15 lectures
<b>US.ZOO.2.02</b>		<b>GENETICS AND BIOCHEMISTRY</b>	2 Credits (45 lectures)
	1	Unit 1- Genetics and Nucleic acids	15 lectures
	2	Unit 2 – Biochemistry	15 lectures
	3	Unit 3- Nutrition and Public Health	15 lectures
		<b>PRACTICALS</b>	
<b>US.ZOOP.2</b>		Practicals based on both the courses	2 Credits

## **THEORY COURSE US.ZOO.2.01**

### **BIODIVERSITY, EVOLUTION AND ETHOLOGY**

#### **Unit 1- National Parks and Sanctuaries**

**(15 Lectures)**

##### **Objective:**

- *To enlighten learners about the current status of wild life conservation in India in the light of guidelines from different relevant governing agencies vis-à-vis with adversity of poaching and biopiracy.*

##### **Desired Outcome:**

- *Learners would be inspired to choose career options in the field of wild life conservation, research, photography and ecotourism*

#### **1.1 Concept of endangered and critically endangered species using examples of Indian Wildlife with respect to National Parks and Wildlife Sanctuaries of India**

- 1.1.1: Sanjay Gandhi National Park
- 1.1.2: Tadoba Tiger Reserve
- 1.1.3: Corbett National Park
- 1.1.4: Kaziranga National Park
- 1.1.5: Gir National Park
- 1.1.6: Silent Valley
- 1.1.7: Pirontan Island Marine Park
- 1.1.8: Ghana National Park
- 1.1.9: Bandipur Sanctuary

#### **1.2 Management strategies with special reference to Tiger and Rhinoceros in India**

- 2.2.1: Project Tiger
- 2.2.2: Project Rhinoceros

#### **1.3 Ecotourism**

#### **1.4 Biopiracy**

#### **Unit 2 – Evolution**

**(15 Lectures)**

##### **Objective:**

- *To enlighten learners about how life started on earth and then evolved into the myriad species seen today.*

##### **Desired Outcome:**

- *The learners will gain the insight into process of evolution through various theories and evidences*

#### **2.1 Introduction:** Origin of universe, Chemical evolution - Miller-Urey experiment, Haldane and Oparin theory

## **2.2: Origin of life, Origin of eukaryotic cell**

## **2.3: Geological Time Scale**

**2.4: Evidences in favour of organic evolution:** Geographical distribution, Paleontology Anatomy, Embryology, Physiology and Genetics.

## **2.5: Theories of organic evolution**

2.5.1: Theory of Lamarck

2.5.2: Theory of Darwin and Neo Darwinism

2.5.3: Mutation Theory

2.5.4: Modern Synthetic Theory

2.5.5: Weismann's Germplasm Theory

2.5.6: Neutral Theory of Molecular Evolution

## **Unit 3– Ethology**

**(15 Lectures)**

### **Objective:**

- To acquaint the learners about the aspects of animal behaviour.
- To make the concepts of animal learning understandable considering various aspects.

### **Desired outcome:**

- Learners will be able to understand the characteristics of animal behaviour.
- Learners will be able to appreciate the animal learning and its different aspects.
- Learners may be enthused to take up field studies to observe such behaviours and learning mechanisms of animals in their natural habitat.

### **3.1: Development of behaviour:**

3.1.1: Ontogeny of behavior

3.1.2: Environmental influence on behaviour

3.1.3: Sensitive periods during development

3.1.4: Juvenile behavior

3.1.5: Innate behavior

### **3.2 Animal Learning:**

3.2.1: Conditioning and learning

3.2.2: Classical Conditioning, acquisition, extinction

3.2.3: Habituation and generalization

3.2.3: Instrument learning,

3.2.4: Reinforcement, Operant behavior

### **3.3: Biological aspects of learning**



**3.4: Constraints of learning:**

3.4.1: Learning to avoid enemies, mimicry

3.4.2: Learning to avoid sickness

3.4.3: Stimulus relevance

**3.5: Cognitive aspects of learning:**

3.5.1: Hidden Nature of conditioning

3.5.2: Nature of cognitive process

3.5.3: Insight learning

3.5.4: Associative learning and representation

## THEORY COURSE US.ZOO.2.02

### GENETICS AND BIOCHEMISTRY

#### Unit 1- Genetics

(15 Lectures)

##### **Objective:**

- *To introduce the learner to the basic terms and concepts of genetics.*
- *To study Mendelian and other types of inheritance.*
- *To understand application of genetic studies.*

##### **Desired outcome:**

- *Learners will understand and apply the principles of inheritance for various case studies.*
- *Learners would be able to realize the importance of genetic studies.*

##### **1.1: Introduction to genetics:**

1.1.1: Definition, scope and importance of genetics

1.1.2: Classical and Modern concept of Gene

1.1.3: Explanation of terms: Allele, wild type and mutant alleles, locus, dominant and recessive traits, genotype and phenotype, homozygous and heterozygous

##### **1.2: Mendelian Inheritance:**

1.2.1: Monohybrid and Dihybrid cross

1.2.2: Test cross and Back cross

1.2.3: Exceptions to Mendelian inheritance: Incomplete dominance, Co-dominance, Lethal alleles, Epistasis and its types

**1.3: Pedigree analysis:** Autosomal dominant and recessive, sex-linked dominant and recessive traits.

**1.4: Genetic Counselling:** Risk of recurrence of hereditary diseases, causes and significance of genetic counseling.

**1.5: Cytoplasmic Inheritance:** Kappa particles in *Paramecium*, Sigma factor in *Drosophila*, Shell coiling in Gastropoda.

#### Unit 2 – Biochemistry

(15 Lectures)

##### **Objective:**

- *To give learners insights about the structure and function of the biomolecules.*

##### **Desired outcome:**

- *Learner will be well versed with the foundations of biochemistry.*
- *Learners will realize the biological role and clinical significance of the biomolecules.*

**2.1: Biomolecules:** Concept of Micromolecules and Macromolecules and their significance

**2.2: Carbohydrates**

2.2.1: Definition Classification, Properties and Isomerism, Glycosidic bond

2.2.2: Structure of Monosaccharides- Glucose, Galactose and Fructose

2.2.3: Disaccharides –Maltose, Lactose and Sucrose

2.2.4: Polysaccharides - Cellulose, Starch, Glycogen and Chitin

2.2.5: Biological role and their Clinical significance

**2.3: Amino Acids and Proteins**

2.3.1: Basic structure of amino acid, Classification of amino acids, Essential and Non-essential amino acids

2.3.2: Peptide bond

2.3.2: Protein conformation: Primary, Secondary, Tertiary, and Quaternary

2.3.4: Biological role of proteins and their Clinical significance

**2.4: Lipids**

2.4.1: Definition, Saturated and Unsaturated fatty acids, Essential fatty acids

2.4.2: Ester linkage and Classification of lipids with examples,

2.4.3: Structure of Triacylglycerides, Phospholipids (Lecithin and Cephalin) and Cholesterol

2.4.4: Biological role and their Clinical significance

**Unit 3- Nutrition and Public Health**

**(15 Lectures)**

**Objective:**

- *To make learners understand the importance of balanced diet and essential nutrients of food at different stages of life.*

**Desired Outcome:**

- *Awareness about healthy dietary habits and importance of a healthy life style would be created among the learners.*
- *Learners will also appreciate various health initiatives taken at national level.*

**3.1: Concept of balanced diet,** dietary recommendation to a normal adult, infant, pregnant women and aged, importance of fibres in food.

**3.2: Concept of Health:**

2.2.1: Definition of health, need for health education and health goals

2.2.2: Physical, Psychological and Social health issues

2.2.3: WHO and its programmes – Polio, Small pox, Malaria and Leprosy

**3.3: Malnutrition disorders and their status in India** – Anaemia, Rickets, Marasmus, Goitre, Kwashiokar

### **3.4: Obesity, BMI calculation and its significance**

**3.5: Stress related disorders:** Hypertension, Anxiety, Insomnia, Migraine, Depression (cause, symptoms, precaution and remedy).

## **PRACTICAL COURSE US.ZOOP.2**

### **PRACTICAL I**

1. Study of national parks, sanctuaries and bio reserves in India with respect to its brand fauna as listed in theory.
2. Study of endangered / critically endangered species in India.
3. Project submission on any of the conservation efforts carried out by the Indian Government (Eg. Project Tiger, Project Rhinoceros etc). Students will present a PPT presentation on the chosen topic).
4. Study of identification of homologous and analogous organs as evidences of evolution.
5. Study of Ecotourism with the help of case studies:
  - a. Garhwal region
  - b. Konkan region
6. Study of ethology:
  - a. Classical conditioning
  - b. Juvenile behavior in animals
  - c. Innate behavior
  - d. Instrument learning
  - e. Learning to avoid enemies, mimicry
  - f. Learning to avoid sickness
  - g. Insight learning
7. Study of biodiversity hotspots in India (Western Ghats and Indo- Burma).
8. Identification and study of fossils:
  - a. Arthropods: Trilobite

- b. Mollusca: Ammonite
  - c. Aves: Archaeopteryx
9. Field report based on study excursion.

## **PRACTICAL II**

1. Qualitative tests for carbohydrates (Molisch's test, Benedict's test, Barfoed's test, Anthrone test).
2. Qualitative tests for protein (Ninhydrin test, Biuret test, Xanthoproteic test).
3. Qualitative test for lipids (solubility test, Sudan III test).
4. Study of rancidity of lipid by titrimetric method.
5. PPT presentations by students on clinical disorders due to carbohydrates, proteins and lipids imbalance. (Photograph to be provided / significance to given and disorder to be identified).
  - a. Hyperglycemia , Hypoglycemia and Diabetes
  - b. Kwashiorkar, Marasmus
  - c. Obesity, Atherosclerosis
  - d. Thalessemia, Anaemia
  - e. Goitre, Rickets
6. Problems in genetics based on monohybrid and dihybrid ratios.
7. Problems based on analysis of pedigree charts - Autosomal dominant and recessive, sex-linked dominant and recessive traits.
8. BMI analysis – Measurement of height and weight (50 readings) and calculation of BMI and report submission based on analysis of the result obtained.

**N.B.** The practicals could be conducted by using specimens authorized by the wildlife and such other regulating authorities. However, adhering to the directions as given in the UGC Circular F14-4/2006 (CPP-II), the practicals will be taught by using photographs/audio-visual aids/simulations / models, etc. as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies.

## SCHEME OF EXAMINATION

**Maximum Marks allotted for each theory course per semester: 100 marks**

**This will have two components as follows:**

- (c) Internal assessment of total of twenty five (25) marks per course per semester shall be conducted as: out of 20 marks based on the test / project and out of 5 marks based on the active participation in the class.
- (d) External assessment out of seventy five (75) marks per course per semester shall be conducted as semester end theory examination as per the given question paper pattern.

**Maximum Marks allotted for the entire practical course per semester: 100 marks which will be distributed into the following two examination sessions and conducted as per the given question paper pattern:**

- (c) Practical I examination of fifty (50) marks shall be conducted at the end of every semester.
- (d) Practical II examination of fifty (50) marks shall be conducted at the end of every semester.

### PAPER PATTERN OF INTERNAL ASSESSMENT US.ZOO.2.01 &US.ZOO.2.02

**All Questions are compulsory  
Figures to the right indicate full marks**

**Time: 50 minutes**

**Total marks: 20**

Q.1.	*Objective type questions	05 marks
Q.2.	Answer in one sentence OR Define the following	05 marks
Q.3.	Answer any two out of three (05 marks each)	10 marks

\*For Question 1 objective type of questions such as –

- a) Match the column
- b) Give one word for
- c) Define the term
- d) MCQ
- e) True and False

**PAPER PATTERN OF THEORY EXTERNAL ASSESSMENT  
US.ZOO.2.01 &US.ZOO.2.02**

**All Questions are compulsory  
Figures to the right indicate full marks**

**Time: 2.5 hours**

**Total marks: 75**

Q.1.	Based on UNIT 1 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.2.	Based on UNIT 2 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.3.	Based on UNIT 3 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.4.	Based on all three units – two from each unit Answer any three out of six (5 marks each)	15 marks

**PAPER PATTERN OF PRACTICAL EXAMINATION  
US.ZOOP.2**

**PRACTICAL I EXAMINATION**

**Duration : 2 hrs 30 min**

**Marks: 50**

Q.1. Identify brand animals (Min. 4) and place them in their respective National parks/ Sanctuaries on the given map quoting reasons for their decline. (10 Marks)

**OR**

Mark National parks and Sanctuaries on the map of India and mention the name of their brand animals stating reason for their decline. (Min. 4) (10 Marks)

Q.2. Project report conservation efforts of wildlife conservation by the Indian government and viva based on it. (10 marks)

Q.3. Identification on ethology, evidences of evolution, fossils. (A-E) (10 marks)

Q.4. Field report & Viva (10 marks)

Q.5. Journal & Viva based on practicals (10 marks)

**PRACTICAL II EXAMINATION**

**Time: 2 hrs 30 min**

**Marks: 50**

Q.1. Perform the qualitative tests for carbohydrates. (15 marks)

**OR**

Q.1 Estimate the rancidity of given lipid sample by titrimetric method. (15 marks)

**OR**

Q.1. Perform the qualitative tests for protein and lipids. (15 marks)

Q.2. Solve the given genetics problems (5 marks)

Q.3. Analyze the given pedigree chart / construct the pedigree chart based on the information. (05 marks)

Q.4. Submission of report on survey of BMI and viva on it (05 marks)

Q.5. Identification (Clinical disorders) (10 marks)

Q.6. Journal & Viva based on practicals (10 marks)



# UNIVERSITY OF MUMBAI

## SOPHIA COLLEGE (AUTONOMOUS)

### SYLLABUS FOR S.Y.B.Sc. COURSE - ZOOLOGY

#### SEMESTER III

**Theory Course:US.ZOO.3.01 - FUNDAMENTALS OF GENETICS, CHROMOSOMES AND HEREDITY, NUCLEIC ACIDS**

**Theory Course: US.ZOO.3.02 - STUDY OF NUTRITION, EXCRETION, RESPIRATION, CIRCULATION, CONTROL AND COORDINATION, LOCOMOTION AND REPRODUCTION**

**Theory Course: US.ZOO.3.03 - ETHOLOGY, PARASITOLOGY, ECONOMIC ZOOLOGY**

**Practical Course: US.ZOOP.3**

#### SEMESTER IV

**Theory Course: US.ZOO.4.01 – ORIGIN AND EVOLUTION OF LIFE, POPULATION GENETICS AND EVOLUTION, SCIENTIFIC ATTITUDE, METHODOLOGY, SCIENTIFIC WRITING AND ETHICS IN SCIENTIFIC RESEARCH**

**Theory Course: US.ZOO.4.02- CELL BIOLOGY, ENDOMEMBRANE SYSTEM AND BIOMOLECULES**

**Theory Course: US.ZOO.4.03 - COMPARATIVE EMBRYOLOGY, ASPECTS OF HUMAN REPRODUCTION, POLLUTION AND ITS EFFECT ON ORGANISMS**

**Practical Course: US.ZOOP.4**

## SEMESTERWISE SYLLABUS GRID FOR EACH PAPER

<b>SEMESTER III</b>			<b>SEMESTER IV</b>		
<b>US.ZOO.3.02</b>	<b>US.ZOO.3.02</b>	<b>US.ZOO.3.03</b>	<b>US.ZOO.4.01</b>	<b>US.ZOO.4.02</b>	<b>US.ZOO.4.03</b>
<b>Unit 1</b> Fundamentals of Genetics	<b>Unit 1</b> Nutrition & Excretion	<b>Unit 1</b> Ethology	<b>Unit 1</b> Origin & Evolution of Life	<b>Unit 1</b> Cell Biology	<b>Unit 1</b> Comparative Embryology
<b>Unit 2</b> Chromosomes & Heredity	<b>Unit 2</b> Respiration & Circulation	<b>Unit 2</b> Parasitology	<b>Unit 2</b> Population Genetics & Evolution	<b>Unit 2</b> Endomembrane System	<b>Unit 2</b> Aspects of Human Reproduction
<b>Unit 3</b> Nucleic Acids	<b>Unit 3</b> Control and Coordination of Life Processes, Locomotion & Reproduction	<b>Unit 3</b> Economic Zoology	<b>Unit 3</b> Scientific Attitude, Methodology, Scientific Writing & Ethics in Scientific Research	<b>Unit 3</b> Biomolecules	<b>Unit 3</b> Pollution & its Effects on Organisms
<b>Practical</b> <b>US.ZOOP.3</b>			<b>Practical</b> <b>US.ZOOP.4</b>		

**Syllabus for S.Y.B.Sc. Course - ZOOLOGY**  
**To be implemented from Academic year 2018-19**

**SEMESTER –III**

<b>Course Code</b>	<b>Unit</b>	<b>Title</b>	<b>Credits &amp; Lectures</b>
<b>US.ZOO.3.01</b>		<b>Fundamentals of Genetics, Chromosomes and Heredity, Nucleic acids</b>	<b>2 Credits</b>
	1	Fundamentals of Genetics,	15 lectures
	2	Chromosomes and Heredity	15 lectures
	3	Nucleic acids	15 lectures
<b>US.ZOO.3.02</b>		<b>Study of Nutrition, Excretion , Respiration, Circulation, Control and coordination, Locomotion and Reproduction</b>	<b>2 Credits</b>
	1	Study of Nutrition and Excretion	15 lectures
	2	Study Respiration and Circulation	15 lectures
	3	Control and coordination, Locomotion and Reproduction	15 lectures
<b>US.ZOO.3.03</b>		<b>Ethology, Parasitology, Economic Zoology</b>	<b>2 Credits</b>
	1	Ethology	15 lectures
	2	Parasitology	15 lectures
	3	Economic Zoology	15 lectures
		<b>PRACTICALS</b>	
<b>US.ZOOP.3</b>		Practicals based on all three courses	<b>3 Credits</b>

**SYBSc ZOOLOGY SYLLABUS  
SEMESTER III**

**THEORY COURSE US.ZOO.3.01**

**Fundamentals of Genetics, Chromosomes and Heredity, Nucleic acids**

**Unit 1: Fundamentals of Genetics**

**(15 Lectures)**

**Objectives:**

- *To introduce basic terms of genetics.*
- *To develop conceptual clarity of Mendelian principles of inheritance and other forms and pattern of inheritance*

**Desired outcome:**

- *Learners would be able to comprehend and apply the principles of inheritance to study heredity.*
- *Learners will understand the concept of multiple alleles, linkage and crossing over.*

**1.1 Introduction to Genetics**

1.1.1: Definition, Scope and Importance of Genetics

1.1.2: Classical and Modern concept of Gene (Cistron, Mutton, Recon)

1.1.3: Brief explanation of the following terms: Allele, Wild type and Mutant alleles, Locus, Dominant and Recessive traits, Homozygous and Heterozygous, Genotype and Phenotype, Genome

**1.2 Mendelian Genetics**

1.2.1: Mendelian Genetics: Monohybrid & Dihybrid Cross, Test Cross, Back Cross, Mendel's Laws of Inheritance, Mendelian Traits in Man.

1.2.2: Exceptions to Mendelian inheritance: Incomplete dominance, Co-dominance, Lethal Genes, Epistasis - Recessive, Double recessive, Dominant and Double dominant.

1.2.3: Pedigree Analysis-Autosomal dominant and recessive, X-linked dominant, and recessive.

**1.3 Multiple Alleles and Multiple Genes**

1.3.1: Concept of Multiple Alleles, Coat colour in rabbit, ABO and Rh blood group system

1.3.2: Polygenic inheritance with reference to skin colour and eye colour in humans.

**1.4 Linkage and Crossing Over**

1.4.1: Morgan's data on linkage in *Drosophila*

1.4.2: Crossing over: Process of crossing over, cytological basis of crossing over, types of crossing over

## **Unit: 2: Chromosomes and Heredity**

**(15 Lectures)**

### **Objectives:**

- *To familiarize the learners with the structure, types and classification of chromosomes.*
- *To introduce the concept of sex determination and its types, sex influenced and sex-limited genes.*

### **Desired outcome:**

- *Learner will comprehend the structure of chromosomes and its types.*
- *Learner will understand the mechanisms of sex determination.*
- *Learner would be able to correlate the disorders linked to a particular sex chromosome.*

### **2.1 Chromosomes**

- 2.1.1: Types of chromosomes– Autosomes and Sex chromosomes
- 2.1.2: Chromosome structure, Heterochromatin, Euchromatin
- 2.1.3: Classification based on the position of centromere
- 2.1.4: Giant chromosomes- Endomitosis, Polytene and Lampbrush chromosomes and significance of Balbiani rings.

### **2.2 Sex- determination**

- 2.2.1: Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZO, ZZ-ZW.
- 2.2.2: Sex determination in *Drosophila* - Genic balance theory, intersex, gynandromorphs.
- 2.2.3: Sex determination in honey bees - Haplodiploidy,
- 2.2.4: Hormonal influence on sex determination-Freemartin and sex reversal
- 2.2.5: Role of environmental factors- Bonellia and Crocodile
- 2.2.6: Barr bodies and Lyon hypothesis

### **2.3 Sex linked, sex influenced and sex-limited inheritance.**

- 2.3.1: X-Linked: Colourblindness, Haemophilia
- 2.3.2: Y-linked: Hypertrichosis
- 2.3.3: Sex-influenced inheritance
- 2.3.4: Sex limited inheritance

## **Unit: 3 Nucleic acids**

**(15 Lectures)**

### **Objectives:**

- *To introduce the learner to the classical experiments proving DNA as the genetic material.*
- *To introduce the learner the structure of nucleic acids and the concept of central dogma of molecular biology.*
- *To familiarize the learner with the concept of gene expression and regulation.*

### **Desired outcome:**

- *Learner will understand the importance of nucleic acids as genetic material.*
- *Learner would comprehend and appreciate the regulation of gene*

*expressions.*

### **3.1 Genetic material**

- 3.1.1: Griffith's transformation experiments, Avery-Macleod and McCarty, Hershey Chase experiment of Bacteriophage infection
- 3.1.2: Chemical composition and structure of nucleic acids
- 3.1.3: Double helix nature of DNA, Solenoid model of DNA
- 3.1.4: Types of DNA – A, B, Z & H forms
- 3.1.5: DNA in Prokaryotes -Chromosomal and Plasmid
- 3.1.6: Extra nuclear DNA -Mitochondria and Chloroplast
- 3.1.7: RNA as a genetic material in viruses
- 3.1.8: Types of RNA: Structure and function

### **3.2 Flow of genetic information in a eukaryotic cell**

- 3.2.1: DNA Replication
- 3.2.2: Transcription of mRNA
- 3.2.3: Translation
- 3.2.4: Genetic code

### **3.3 Gene expression and regulation**

- 3.3.1: One gene-one enzyme hypothesis /one polypeptide hypothesis
- 3.3.2: Concept of Operon
- 3.3.3: Lac Operon

## **THEORY COURSE US.ZOO.3.02**

### **Nutrition and Excretion, Respiration and Circulation, Control and Coordination of Life Processes, Locomotion and Reproduction**

#### **Unit 1: Nutrition and Excretion**

**(15 Lectures)**

#### **Objectives:**

- *To introduce the concepts of physiology of nutrition, excretion and osmoregulation.*
- *To expose the learner to various nutritional apparatus, excretory and osmoregulatory structures in different classes of organisms.*

#### **Desired outcome:**

- *Learner would understand the increasing complexity of nutritional, excretory and osmoregulatory physiology in evolutionary hierarchy.*
- *Learner would be able to correlate the habit and habitat with nutritional, excretory and osmoregulatory structures.*

**1.1 Comparative study** of nutritional apparatus (structure and function): Amoeba, Hydra, Cockroach, Amphioxus, Pigeon, Ruminants.

**1.2 Physiology** of digestion in man.

**1.3 Comparative study** of excretory and osmoregulatory structures and functions.

- a) Amoeba - Contractile vacuoles

- b) Planaria - Flame cells
- c) Cockroach - Malpighian tubules
- 1.4 **Categorization of animals** based on principle nitrogenous excretory products
- 1.5 **Structure of kidney**, uriniferous tubule and physiology of urine formation in man

## **Unit: 2 Respiration and Circulation**

**(15 Lectures)**

### **Objectives:**

- *To introduce the concepts of physiology of respiration and circulation*
- *To expose the learner to various respiratory and circulatory organs in different classes of organisms.*

### **Desired outcome:**

- *Learner would understand the increasing complexity of respiratory and circulatory physiology in evolutionary hierarchy.*
- *Learner will be able to correlate the habit and habitat of animals with respiratory and circulatory organs.*

- 2.1 Comparative study of respiratory organs (structure and function): Earthworm, Spider, Any bony fish (Rohu/*Anabas/Clarius*), Frog and Pigeon.
- 2.2 Structure of lungs and physiology of respiration in man
- 2.3 Comparative study of circulation: (a) Open and Closed type, (b) Single and Double type.
- 2.4 Types of circulating fluids- Water, Coelomic fluid, Haemolymph, Lymph and Composition of blood
- 2.5 Comparative study of hearts (structure and function): Earthworm, Cockroach, Shark, Frog, Crocodile and Pigeon.
- 2.6 Structure and mechanism of working of heart in man.

## **Unit: 3 Control and Coordination, Locomotion and Reproduction**

**(15 Lectures)**

### **Objectives:**

- *To introduce the concepts of physiology of control and coordination and locomotion and reproduction.*
- *To expose the learner to various locomotory and reproductive structures in different classes of organisms.*

### **Desired outcome:**

- *Learner would understand the process of control and coordination by nervous and endocrine regulation.*
- *Learner would be amazed by various locomotory structures found in the animal kingdom.*
- *Learner would be acquainted with various reproductive strategies present in animals.*

### 3.1 Control and coordination

3.1.1: Irritability in Paramecium, nerve net in Hydra, nerve ring and nerve cord in earthworm.

3.1.2: Types of neurons based on the structure and function.

3.1.3: Conduction of nerve impulse: Resting potential, Action potential and Refractory period

3.1.4: Synaptic transmission

### 3.2 Movement and Locomotion

3.2.1: Locomotory organs- structure and functions of:

a. Pseudopodia in Amoeba (Sol- Gel theory), Cilia in Paramecium

b. Wings and legs in cockroach

c. Tube feet in starfish

d. Fins of fish

3.2.2: Structure of striated muscle fibre in human and sliding filament theory

### 3.3 Reproduction

3.3.1: Asexual Reproduction- Fission, Fragmentation, Gemmule formation and Budding

3.3.2: Sexual reproduction

a. Gametogenesis

b. Structure of male and female gametes in human

c. Types of fertilization

d. Oviparity, Viviparity, Ovo-viviparity

## **THEORY COURSE US.ZOO.3.03**

### **Ethology, Parasitology, Economic Zoology**

#### **Unit: 1 Ethology**

**(15 Lectures)**

#### **Objectives:**

- *To equip learner with a sound knowledge of how animals interact with one another and their environment.*
- *To enable the learner to understand different behavioural patterns.*

#### **Desired Outcome:**

- *Learner would gain insight into different types of animal behaviour and their role in biological adaptations.*
- *Learner would be sensitized to the feelings which are instrumental in social behaviour.*



## **1.1 Introduction to Ethology:**

1.1.1: Definition, History and Scope of Ethology

1.1.2: Animal behaviour : Innate and Learned behaviour

1.1.3: Types of learning: Habituation, Imprinting and Types of imprinting - Filial and sexual, Classical conditioning

1.1.4: Instrumental learning and insight learning.

## **1.2 Aspects of animal behaviour:**

1.2.1: Communication in bees and ants

1.2.2: Mimicry and colourations

1.2.3: Displacement activities, Ritualization

1.2.4: Migration in fish, schooling behaviour

1.2.5: Habitat selection, territorial behaviour.

## **1.3 Social behaviour:**

1.3.1: Social behaviour in primates-Hanuman langur

1.3.2: Elements of socio-biology: Altruism and Kinship

## **Unit: 2 Parasitology**

**(15 Lectures)**

### **Objectives:**

- *To acquaint the learner with the concepts of parasitism and its relationship in the environment.*
- *To introduce the learner to modes of transmission of parasites.*

### **Desired Outcome:**

- *Learner would understand the general epidemiological aspects of parasites that affect humans and take simple preventive measures for the same.*
- *Learner would comprehend the life cycle of specific parasites, the symptoms of the disease and its treatment.*

## **2.1 Introduction to Parasitology and Types of Parasites**

2.1.1: Definitions: Parasitism, Host, Parasite, Vector-biological and mechanical

2.1.2: Types of parasite: Ectoparasite, Endoparasite and their subtypes

2.1.3: Parasitic adaptations in Ectoparasites and Endoparasites

2.1.4: Types of host: Intermediate and definitive, reservoir

## **2.2 Host-parasite relationship and host specificity**

Different types of host – parasite relationships, structural specificity, physiological specificity and ecological specificity

## **2.3 Life cycle, pathogenicity, control measures and treatment**

2.3.1: *Entamoeba histolytica*,

2.3.2: *Fasciola hepatica*,

2.3.3: *Taenia solium*,

2.3.4: *Wuchereria bancrofti*

## **2.4 Morphology, life cycle, pathogenicity, control measures and treatment**

2.4.1: Head louse (*Pediculus humanus capitis*)

2.4.2: Mite (*Sarcoptes scabiei*)

2.4.3: Bed bug (*Cimex lectularis*)

## **2.5 Parasitological significance**

Zoonosis- Bird flu, Anthrax, Rabies and Toxoplasmosis

## **Unit 3 Economic Zoology**

**(15 Lectures)**

### ***Objectives:***

- *To disseminate information on economic aspects of animals like apiculture, vermiculture and dairy science.*
- *To encourage young learner for self-employment.*

### ***Desired Outcome:***

- *Learner would gain knowledge on animals useful to mankind and the means to make the most of it.*
- *Learner would learn the modern techniques in animal husbandry.*
- *Learner would pursue entrepreneurship as a career.*

## **3.1 Apiculture**

### **3.1.1: Methods of bee keeping and management**

- a. Introduction to different species of honey bees used in apiculture.
- b. Selection of flora and bees for apiculture.
- c. Advantages and disadvantages of traditional and modern methods of apiculture.
- d. Pests and Bee enemies- Wax moth, wasp, black ants, bee-eaters, king crow and disease control

### **3.1.2: Economic importance**

- a. Honey- Production, chemical composition and economic importance
- b. Bee wax- Composition and economic importance.
- c. Role of honey bee in pollination.

## **3.2 Vermiculture:**

### **3.2.1: Rearing methods, management and economic importance**

- a. Introduction to different species of earthworms used in vermiculture.
- b. Methods of vermiculture.
- c. Maintenance and harvesting
- d. Economic importance: advantages of vermiculture, demand for earthworms; market for vermicompost and scope for entrepreneurship.

### **3.3 Dairy science**

#### **3.3.1: Dairy development in India**

Role of dairy development in rural economy, employment opportunities

#### **3.3.2: Dairy Processing**

Filtration, cooling, chilling, clarification, pasteurization, freezing

#### **3.3.3: Milk and milk products**

a. Composition of milk

b. Types of milk: Buffalo milk, Cow milk (A1 and A2), Whole milk and toned milk

c. Milk products

## **PRACTICAL COURSE US.ZOOP.3**

### **PRACTICAL I**

- 1** Extraction and detection of DNA
- 2** Extraction and detection of RNA
- 3** Mounting of Barr bodies
- 4** Study of polytene chromosome
- 5** Study of mitosis- temporary squash preparation of Onion root tip
- 6** Detection of blood groups and Rh factor
- 7** Problems in Genetics
  - a) Monohybrid/ Dihybrid Cross, b) X- linked inheritance, c) Multiple Alleles
- 8** Chromosome morphology: (photograph to be provided)
- 9** Pedigree analysis
- 10** Problems based on molecular biology

## **PRACTICAL II**

- 1** Urine analysis—Normal and Abnormal constituents
- 2** Detection of ammonia excreted by fish from aquarium water
- 3** Detection of uric acid from excreta of birds
- 4** Study of striated and non-striated muscle fibre
- 5** Study of nutritional apparatus (Amoeba, Hydra, Earthworm, Pigeon and Ruminant stomach)
- 6** Study of respiratory structures:
  - a. Gills of bony fish and cartilaginous fish
  - b. Lungs of frog
  - c. Lungs of mammal
  - d. Accessory respiratory structure in *Anabas/ Clarius*
  - e. Air sacs of Pigeon
- 7** Study of locomotory organs (Amoeba, Bivalve, Cockroach, Starfish, Fish, and Bird)
- 8** Study of different types of heart (Cockroach, Shark, Frog, Garden lizard, Crocodile and Mammal)
- 9** Study of permanent slides on Reproduction: (a) Sponge gemmules  
(b) Hydra budding (c) T.S. of mammalian testis (d) T.S. of mammalian ovary

### **PRACTICAL III**

- 1** Extraction of casein from milk and its qualitative estimation
- 2** Preparation of paneer from given milk sample
- 3** Measurement of density of milk using different samples by Lactometer
- 4** Study of Honey Bee:
  - a) Life Cycle of Honey Bee and Bee Hive
  - b) Mouthparts of Honey Bee
  - c) Legs of Honey Bee
  - d) Sting Apparatus of Honey Bee
- 5** Study of ethological aspects:
  - a) Warning colouration
  - b) Animal instinct
  - c) Imprinting
  - d) Communication in animals: Chemical signals and Sound signals
  - e) Displacement activities in animals: Courtship and mating behaviour in animals and Ritualization
- 6** Study of Protozoan parasite:
  - a) *Trypanosoma gambiense*
  - b) *Giardia intestinalis*
- 7** Study of Helminth parasite:
  - a) *Ancylostoma duodenale*
  - b) *Dracunculus medinensis*
- 8** Parasitic adaptations: Scolex and mature proglottids of Tapeworm
- 9** Study of Ectoparasite:
  - a) Leech    b) Tick    c) Mite
- 10** Project- Suggested topics on economic zoology (e.g. Apiculture/ Sericulture/ Lac culture / Vermicompost technique / Construction of artificial beehives /Animal husbandry/ Aquaculture/ Any other)

**N.B.** The practicals could be conducted by using specimens authorised by the wildlife and such other regulating authorities. However, adhering to the directions as given in the UGC Circular F14-4/2006 (CPP-II), the practicals will be taught by using photographs/audio-visual aids/simulations / models, etc. as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies.

## **SCHEME OF EXAMINATION**

**Maximum Marks allotted for each theory course per semester: 100 marks**

**This will have two components as follows:**

- (a) Internal assessment of total of twenty five (25) marks per course per semester shall be conducted as: out of 20 marks based on the test / project and out of 5 marks based on the active participation in the class.
- (b) External assessment out of seventy five (75) marks per course per semester shall be conducted as semester end theory examination as per the given question paper pattern.

**Maximum Marks allotted for the entire practical course per semester: 150 marks which will be distributed into the following two examination sessions and conducted as per the given question paper pattern:**

- (a) Practical I examination of fifty (50) marks shall be conducted at the end of every semester.
- (b) Practical II examination of fifty (50) marks shall be conducted at the end of every semester.
- (c) Practical III examination of fifty (50) marks shall be conducted at the end of every semester.

**PAPER PATTERN OF INTERNAL ASSESSMENT**  
**US.ZOO.3.01 , US.ZOO.3.02, US.ZOO.3.03**

**All Questions are compulsory**  
**Figures to the right indicate full marks**

**Time: 50 minutes**

**Total marks: 20**

Q.1.	*Objective type questions	05 marks
Q.2.	Answer in one sentence OR Define the following	05 marks
Q.3.	Answer any two out of three (05 marks each)	10 marks

\*For Question 1 objective type of questions such as –

- a) Match the column
- b) Give one word for
- c) Define the term
- d) MCQ
- e) True and False



**PAPER PATTERN OF THEORY EXTERNAL ASSESSMENT**  
**US.ZOO.3.01, US.ZOO.3.02, US.ZOO.3.03**

**All Questions are compulsory**  
**Figures to the right indicate full marks**

**Time: 2.5 hours**

**Total marks: 75**

Q.1.	Based on UNIT 1 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.2.	Based on UNIT 2 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.3.	Based on UNIT 3 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.4.	Based on all three units – two from each unit Answer any three out of six (5 marks each)	15 marks

**PAPER PATTERN OF PRACTICAL EXAMINATION**  
**US. ZOOP.3**

**PRACTICAL I EXAMINATION**

**Duration : 2 hrs 30 min**

**Marks: 50**

**Major Question**

**(15 marks)**

Q1. Extraction and detection of DNA

**OR**

Q1. Extraction and detection of RNA

**Minor Question**

**(07 marks)**

Q2. Mounting of Barr bodies / Polytene chromosomes

**OR**

Q2. Study of mitosis-Temporary squash preparation of Onion root tip

**OR**

Q2. Detection of blood groups and Rh factor

Q3. Problems based on Genetics and Molecular biology

(Transcription /Genetic code) (01 problem each)

**(10 marks)**

Q4. Identification

**(08 marks)**

A. Chromosome morphology

B. Pedigree analysis

Q5. Viva

**(05 marks)**

Q.6 Journal

**(05 marks)**

**PRACTICAL II EXAMINATION**

**Duration : 2 hrs 30 min**

**Marks: 50**

**Major Question**

**(15 marks)**

Q1. Urine analysis—Normal and abnormal constituents

**Minor Question**

**(10 marks)**

Q2. Detection of ammonia excreted by fish in aquarium water

**OR**

Q2. Detection of uric acid from excreta of Birds

**OR**

Q2. Mounting of striated and non-striated muscle fibre

Q3. Identification

**(15 marks)**

a. Nutritional apparatus

b. Respiratory structures

c. Locomotory organs

d. Study of hearts

e. Permanent slides on reproduction

Q4. Viva

**(05 marks)**

Q5. Journal

**(05 marks)**

### PRACTICAL III EXAMINATION

**Duration : 2 hrs 30 min**

**Marks : 50**

**Major Question**

**(12 marks)**

Q1. Extraction of casein from milk and its qualitative detection

OR

Q1. Preparation of paneer from the given milk sample.

OR

Q1. Measurement of density of different samples of milk by lactometer

**Minor Question (Sketch and label)**

**(08 marks)**

Q2. Life cycle of honey bee

OR

Q2. Mouthparts of honey bee

OR

Q2. Legs of honey bee

OR

Q2. Sting apparatus of honey bee

Q3. Identify and describe as per instructions

**(15 marks)**

- a. Ethology
- b. Protozoan parasite
- c. Helminth parasite
- d. Ectoparasite
- e. Parasitic adaptation

Q4. a) Project submission

**(06 marks)**

b) Viva based on project

**(04 marks)**

Q5. Journal

**(05 marks)**

# Syllabus for S.Y.B.Sc. Course - ZOOLOGY

To be implemented from Academic year 2018-19

## SEMESTER –IV

Course Code	Unit	Title	Credits & Lectures
<b>US.ZOO.4.01</b>		<b>Origin and Evolution of Life, Population Genetics and Evolution, Scientific Attitude, Methodology, Scientific Writing and Ethics in Scientific Research</b>	<b>2 Credits</b>
	1	Origin and Evolution of Life	15 lectures
	2	Population Genetics and Evolution	15 lectures
	3	Scientific Attitude, Methodology, Scientific Writing and Ethics in Scientific Research	15 lectures
<b>US.ZOO.4.02</b>		<b>Cell Biology, Endomembrane System and Biomolecules</b>	<b>2 Credits</b>
	1	Cell Biology	15 lectures
	2	Endomembrane System	15 lectures
	3	Biomolecules	15 lectures
<b>US.ZOO.4.01</b>		<b>Comparative Embryology, Aspects of Human Reproduction, Pollution and its effect on organisms</b>	<b>2 Credits</b>
	1	Comparative Embryology	15 lectures
	2	Aspects of Human Reproduction	15 lectures
	3	Pollution and its Effect on Organisms	15 lectures
<b>US.ZOOP.4</b>	<b>PRACTICALS</b>		<b>3 Credits</b>
	Practicals based on all three courses		

# SYBSc ZOOLOGY SYLLABUS SEMESTER IV

## THEORY COURSE US.ZOO.4.01

### Origin and Evolution of Life, Population Genetics and Evolution, Scientific Attitude, Methodology, Scientific Writing and Ethics in Scientific Research

#### Unit 1: Origin and Evolution of Life

(15 Lectures)

##### **Objective:**

- *To impart scientific knowledge about how life originated on our planet*

##### **Desired outcome:**

- *Learner will gain insights into the origin of life.*
- *Learner will analyse and critically view the different theories of evolution.*

#### **1.1 Introduction**

1.1.1: Origin of the Universe

1.1.2: Chemical evolution - Miller-Urey experiment, Haldane and Oparin theory

1.1.3: Origin of life

1.1.4: Origin of eukaryotic cell

#### **1.2 Evidences in favour of organic evolution**

Evidences from geographical distribution, palaeontology, anatomy, embryology, physiology and genetics

#### **1.3 Theories of organic evolution**

1.3.1: Theory of Lamarck

1.3.2: Theory of Darwin and Neo- Darwinism

1.3.3: Mutation Theory

1.3.4: Modern synthetic theory

1.3.5: Weismann's Germplasm theory

#### Unit 2: Population Genetics and Evolution

(15 Lectures)

##### **Objective:**

- *To develop an understanding of genetic variability within a population and learn as to how the change in the gene pool leads to evolution of species*

##### **Desired outcome:**

- *Learner would understand the forces that cause evolutionary changes in natural populations*
- *Learner would comprehend the mechanisms of speciation*
- *Learner will be able to distinguish between microevolution, macroevolution and megaevolution*

## 2.1 Introduction to Population genetics

Brief explanation of the following terms: Population, Gene pool, Allele frequency, Genotype frequency, Phenotype frequency, Microevolution

## 2.2 Population genetics

2.2.1: Hardy- Weinberg Law

2.2.2: Factors that disrupt Hardy Weinberg equilibrium: Mutation, Migration (gene flow), Non-random mating (inbreeding, inbreeding depression, assortative mating(positive and negative), disassortative mating, Genetic drift (sampling error, fixation, bottleneck effect and founder effect)

2.2.3: Natural Selection: Patterns of Natural Selection-Stabilizing selection, Directional selection (examples: peppered moth, antibiotic resistance in bacteria, pesticide resistance) and Disruptive selection

## 2.3 Evolutionary genetics

2.3.1: Genetic variation: Genetic basis of variation-mutations and recombination (crossing over during meiosis, independent assortment of chromosomes during meiosis and random union of gametes during fertilization)

2.3.2: Nature of genetic variations: Genetic polymorphism, Balanced polymorphism, Mechanisms that preserve balanced polymorphism-Heterozygote advantage and frequency dependent selection,

2.3.2: Neutral variations

2.3.3: Geographic variation (Cline)

2.3.4: Species concept: Biological species concept and evolutionary species concept

2.3.5: Speciation and Isolating mechanisms:Definition and modes of speciation (allopatric, sympatric, parapatric and peripatric)

2.3.6: Geographical isolation

2.3.7: Reproductive isolation and its isolating mechanisms (prezygotic and postzygotic)

## 2.4 Macroevolution and megaevolution:

2.4.1: Concept and Patterns of macroevolution: stasis, preadaptation /exaptation, mass extinctions, adaptive radiation and coevolution

2.4.2: Megaevolution

## **Unit: 3 Scientific Attitude Methodology, Scientific Writing and Ethics in Scientific Research**

**(15Lectures)**

### **Objective:**

➤ *To inculcate scientific temperament in the learner*

### **Desired outcome:**

➤ *The learner would develop qualities such as critical thinking and analysis*

➤ *The learner will imbibe the skills of scientific communication and he/she will understand the ethical aspects of research*

### **3.1 Process of science:**

3.1.1: A dynamic approach to investigation: The Scientific method, Deductive reasoning and inductive reasoning, Critical thinking, Role of chance in scientific discovery (serendipity)

3.1.2: Scientific research: Definition, difference between method and methodology, characteristics, types

3.1.3: Steps in the Scientific method: Identification of research problem, formulation of research hypothesis, testing the hypothesis using experiments or surveys, preparing research/study design including methodology and execution (appropriate controls, sample size, technically sound, free from bias, repeat experiments for consistency), documentation of data, data analysis and interpretation, results and conclusions

3.1.4: Dissemination of data: Reporting results to scientific community (publication in peer-reviewed journals, thesis, dissertation, reports, oral presentation, poster presentation)

3.1.5: Application of knowledge: Basic research, Applied and Translational research

### **3.2 Scientific writing:**

Structure and components of a research paper: preparation of manuscript for publication of research paper- title, authors and their affiliations, abstract, keywords and abbreviations, introduction, material and methods, results, discussion, conclusions, acknowledgement, bibliography; figures, tables and their legends

### **3.3 Writing a review paper**

3.3.1: Structure and components of review paper

3.3.2: Report writing and types of report

3.3.3: Computer application: Plotting of graphs, Statistical analysis of data.

3.3.4: Internet and its application in research- Literature survey, online submission of manuscript for publication

### **3.4 Ethics**

3.4.1: Ethics in animal research: The ethical and sensitive care and use of animals in research, teaching and testing, approval from Dissection Monitoring Committee (DMC)

3.4.2: Ethics in clinical research: Approval from clinical research ethics committee or/and informed consent

### **3.5 Plagiarism**



## **THEORY COURSE US.ZOO.4.02**

### **Cell Biology, Endomembrane System and Biomolecules**

#### **Unit 1: Cell Biology**

**(15Lectures)**

##### **Objective:**

- *To study the structural and functional organization of cell with an emphasis on nucleus, plasma membrane and cytoskeleton.*

##### **Desired outcome:**

- *Learner would acquire insight into the composition of the transport mechanisms adopted by the cell and its organelles for its maintenance and composition of cell*

#### **1.1 Introduction to cell biology**

- Definition and scope
- Cell theory
- Generalized prokaryotic, eukaryotic cell: size, shape and structure

#### **1.2 Nucleus**

- Size, shape, number and position
- Structure and functions of interphase nucleus
- Ultrastructure of nuclear membrane and pore complex
- Nucleolus: general organization, chemical composition & functions
- Nuclear sap/ nuclear matrix
- Nucleocytoplasmic interactions

#### **1.3 Plasma membrane**

- Fluid Mosaic Model
- Junctional complexes
- Membrane receptors
- Modifications: Microvilli and Desmosomes

#### **1.4 Transport across membrane**

- Diffusion and Osmosis
- Transport: Passive and Active
- Endocytosis and Exocytosis

#### **1.5 Cytoskeletal structures**

- Microtubules: Composition and functions
- Microfilaments: Composition and functions

#### **Unit: 2: Endomembrane System**

**(15 lectures)**

##### **Objective:**

- *To acquaint the learner with ultrastructure of cell organelles and their functions*

**Desired outcome:**

- *Learner would appreciate the intricacy of endomembrane system.*
- *Learner would understand the interlinking of endomembrane system for functioning of cell*

- 2.1 Endoplasmic reticulum (ER):** General morphology of endomembrane system, ultrastructure, types of ER and biogenesis of ER
- Functions of Rough Endoplasmic Reticulum(RER) and Smooth Endoplasmic Reticulum(SER)
- 2.2 Golgi complex:** Ultrastructure of Golgi complex, functions of Golgi complex (protein glycosylation, lipid and polysaccharide metabolism, protein sorting and secretion, Golgi Anti-Apoptotic Protein -GAAP)
- 2.3 Lysosomes:** Origin, occurrence, polymorphism and functions;  
Peroxisomes: Origin, morphology & functions
- 2.4 Mitochondria:** Ultrastructure, chemical composition, functions of mitochondria and bioenergetics (Chemical energy & ATP, Krebs's cycle, respiratory chain and oxidative phosphorylation)

**Unit: 3 Biomolecules**

**(15 lectures)**

**Objective:**

- *To give learner insight into the structure of biomolecules and their role in sustenance of life.*

**Desired outcome:**

- *The learner will realize the importance of biomolecules and their clinical significance.*

- 3.1 Biomolecules:** Concept of micromolecules and macromolecules
- 3.2 Carbohydrates:**
- Definition classification, properties and isomerism, glycosidic bond
  - Structure of Monosaccharides (glucose and fructose); Oligosaccharides (lactose and sucrose); Polysaccharides (cellulose, starch, glycogen and chitin)
  - Biological role and clinical significance
- 3.3 Amino Acids and Proteins:**
- Basic structure, classification of amino acids,
  - Essential and Non-essential amino acids, Peptide bond,
  - Protein conformation: Primary, Secondary, Tertiary, Quaternary
  - Types of proteins – Structural (collagen) and functional proteins (haemoglobin)
  - Biological role and clinical significance
- 3.4 Lipids:**
- Definition, classification of lipids with examples, ester linkage
  - Physical and chemical properties of lipids
  - Saturated and unsaturated fatty acids

- Essential fatty acids; Triacylglycerols; Phospholipids (lecithin and cephalin); Steroids (cholesterol)
- Biological role and clinical significance

### 3.5 Vitamins:

- Water soluble vitamins(e.g. Vit C, Vit B<sub>12</sub>)
- Lipid soluble vitamins (e.g. Vit A, Vit D)
- Biological role and clinical significance

## **THEORY COURSE US.ZOO.4.03**

### **Comparative Embryology, Aspects of Human Reproduction, Pollution and its effect on organisms**

#### **UNIT 1: Comparative Embryology**

(15Lectures)

**Objective:**

- *To acquaint the learner with key concepts of embryology.*

**Desired Outcome:**

- *Learner will be able to understand and compare the different types of eggs and sperms*
- *Learner will be able to understand and compare the different pre-embryonic stages*

- 1.1 Types of Egg- Based on amount and distribution of yolk
- 1.2 Structure and Types of Sperm
- 1.3 Types of Cleavage
- 1.4 Types of Blastula
- 1.5 Types of Gastrula
- 1.6 Coelom -Formation and types

#### **UNIT 2: Aspects of Human Reproduction**

(15Lectures)

**Objectives:**

- *To acquaint the learners with different aspects of human reproduction.*
- *To make them aware of the causes of infertility, techniques to overcome infertility and the concept of birthcontrol*

**Desired Outcome:**

- *Learners will be able to understand human reproductive physiology*
- *Learners will become familiar with advances in ART and related ethical issues.*

**2.1 Human reproductive system and hormonal regulation**

- 2.1.1: Anatomy of human male and female reproductive system
- 2.1.2: Hormonal regulation of reproduction and impact of age on reproduction - menopause and andropause

**2.2 Contraception & birth control**

- 2.2.1: Difference between contraception and birth control

2.2.2: Natural Methods: Abstinence, rhythm method, temperature method, cervical mucus or Billings method, coitus interruptus, lactation, amenorrhea

2.2.3: Artificial methods : Barrier methods, hormonal methods, intrauterine contraceptives, sterilization, termination, abortion

### 2.3 Female infertility:

2.3.1: Causes: Failure to ovulate; production of infertile eggs; damage to oviducts (oviduct scarring and Pelvic inflammatory disease -PID, TB of oviduct), Uterus (TB of uterus and cervix)

2.3.2: Infertility associated disorders: Endometriosis, Polycystic Ovarian Syndrome (PCOS), Primary ovarian failure(POF), Sexually Transmitted Infections (STIs) - gonorrhoea, chlamydia, syphilis and genital herpes; Antibodies to sperm; Genetic causes- recurrent abortions

### 2.4 Treatment of infertility

2.4.1: Removal /reduction of causative environmental factors

2.4.2: Surgical treatment

2.4.3: Hormonal treatment- fertility drugs

2.4.4: Assisted Reproductive Technology (ART) -

*Invitro* fertilization (IVF); Embryo transfer (ET); Intra-Fallopian transfer (IFT), Gamete Intra-Fallopian Transfer (GIFT) & Intra-Zygote Transfer (ZIFT); Intra-cytoplasmic Sperm Injection (ICSI) with ejaculated sperm and sperm retrieved from testicular biopsy; Testicular sperm extraction (TESE).

2.4.5: Sperm bank, cryopreservation of gametes and embryos

2.4.6: Surrogacy

## UNIT3: Pollution and its effect on organisms

(15 Lectures)

### Objective:

➤ *To provide a panoramic view of impact of human activities leading to pollution and its implications.*

### Desired Outcome:

➤ *The learners will be sensitized about the adverse effects of pollution and measures to control it.*

### 3.1 Air Pollution

3.1.1: Types and sources of air pollutant

3.1.2: Effects of air pollution on organisms, its control and abatement measures

### 3.2 Water Pollution

3.2.1: Types and sources of water pollutant

3.2.2: Effects of water pollution on organisms, its control and abatement measures

### 3.3 Soil Pollution

3.3.1: Types and sources of soil pollutant

3.3.2: Effects of soil pollution on organisms, its control and abatement measures

**3.4 Sound pollution**

3.4.1: Different sources of sound pollution

3.4.2: Effects of sound pollution on organisms, its control and abatement measures

**3.5 Pollution by radioactive substances**

**3.6 Pollution by solid wastes**

3.6.1: Types and sources

3.6.2; Effects of solid waste pollution, its control and abatement measures

**3.7 Pollution leading to Climate Change and Global Warming**

# **PRACTICAL COURSE US.ZOOP.4**

## **PRACTICAL I**

- 1** Study of population density by Line transect method & Quadrant method and calculate different diversity indices.
  - Index of Dominance
  - Index of frequency
  - Rarity Index
  - Shannon Index
  - Index of species diversity
- 2** Study of prokaryotic cells (bacteria) by Crystal violet staining technique
- 3** Study of eukaryotic cells (WBCs) from blood smear by Leishman's stain
- 4** Identification and study of fossils:
  - Arthropods: Trilobite
  - Mollusca: Ammonite
  - Aves: Archaeopteryx
- 5** Identification of
  - Allopatric speciation (Cyprinodont species)
  - Sympatric speciation (Hawthorn fly and Apple maggot fly)
  - Parapatric speciation (Snail)
- 6** Bibliography/ Abstract writing
- 7** Preparation of Power Point Presentation based on research paper.

## PRACTICAL II

- 1 Study of permeability of cell through plasma membrane (osmosis in blood cells)
- 2 Measurement of cell diameter by oculometer (by using permanent slide)
- 3 Qualitative tests for carbohydrates (Molisch's test, Benedicts test, Barfoed's test, Anthrone test)
- 4 Qualitative tests for protein (Ninhydrin test, Biuret test, Millon's test, Xanthoproteic test)
- 5 Qualitative test for lipids (Solubility test, Sudan III test)
- 6 Study of rancidity of lipids by titrimetric method
- 7 Ultrastructure of cell organelles (Electron micrographs) of:
  - Nucleus
  - Endoplasmic reticulum (Smooth and Rough)
  - Mitochondria.
  - Golgi apparatus
  - Lysosomes
8. Study of clinical disorders due to carbohydrates, proteins and lipid imbalance (Photograph to be provided / symptoms to be given and disorder to be identified):
  - Hyperglycemia
  - Hypoglycemia
  - Anaemia
  - Kwashiorkar
  - Marasmus
  - Fatty liver

### **PRACTICAL III**

- 1** Study of air microflora
- 2** Estimation of dissolved oxygen from the given water sample
- 3** Estimation of salinity by refractometer from the given water sample
- 4** Estimation of conductivity by conductometer from the given water sample
- 5** Study of physical properties of soil: temperature, moisture and texture
- 6** Study of chemical properties of soil- pH, organic matter
- 7** Study of sound pollution monitoring device
- 8** Detection of pregnancy from given sample of urine
- 9** Study of birth control measures applicable to humans – IUD, condom and hormonal pills.
- 10** Study of the following permanent slides, museum specimens and materials
  - a. Mammalian sperm and ovum
  - b. Types of egg –fish, frog and hen
  - c. Cleavage, blastula and gastrula (Amphioxus, Frog and Bird)
- 11** Review writing based on programmes telecast by Doordarshan, Gyandarshan, UGC programmes or other media sources
- 12** Study of natural ecosystem and field report of the visit

**N.B.:** The practicals could be conducted by using specimens authorized by the wildlife and such other regulating authorities. However, adhering to the directions as given in the UGC Circular F14-4/2006 (CPP-II), the practicals will be taught by using photographs/audio-visual aids/simulations / models, etc. as recommended by the UGC and as envisaged in the regulations of the relevant monitoring bodies.



## SCHEME OF EXAMINATION

**Maximum Marks allotted for each theory course per semester: 100 marks**

**This will have two components as follows:**

- (c) Internal assessment of total of twenty five (25) marks per course per semester shall be conducted as: out of 20 marks based on the test / project and out of 5 marks based on the active participation in the class.
- (d) External assessment out of seventy five (75) marks per course per semester shall be conducted as semester end theory examination as per the given question paper pattern.

**Maximum Marks allotted for the entire practical course per semester: 150 marks which will be distributed into the following two examination sessions and conducted as per the given question paper pattern:**

- (d) Practical I examination of fifty (50) marks shall be conducted at the end of every semester.
- (e) Practical II examination of fifty (50) marks shall be conducted at the end of every semester.
- (f) Practical III examination of fifty (50) marks shall be conducted at the end of every semester.

### PAPER PATTERN OF INTERNAL ASSESSMENT

US.ZOO.4.01 , US.ZOO.4.02, US.ZOO.4.03

**All Questions are compulsory**

**Figures to the right indicate full marks**

**Time: 50 minutes**

**Total marks: 20**

Q.1.	*Objective type questions	05 marks
Q.2.	Answer in one sentence OR Define the following	05 marks
Q.3.	Answer any two out of three (05 marks each)	10 marks

\*For Question 1 objective type of questions such as –

- a) Match the column
- b) Give one word for
- c) Define the term
- d) MCQ
- e) True and False

**PAPER PATTERN OF THEORY EXTERNAL ASSESSMENT**  
**US.ZOO.4.01, US.ZOO.4.02, US.ZOO.4.03**

**All Questions are compulsory**  
**Figures to the right indicate full marks**

**Time: 2.5 hours**

**Total marks: 75**

Q.1.	Based on UNIT 1 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.2.	Based on UNIT 2 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.3.	Based on UNIT 3 a. Answer any one of the two (10 marks) b. Answer any two out of the four (5 marks each)	20 marks
Q.4.	Based on all three units – two from each unit Answer any three out of six (5 marks each)	15 marks

**PAPER PATTERN OF PRACTICAL EXAMINATION**  
**US. ZOOP.4**

**PRACTICAL I EXAMINATION**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question**

Q1. Study Population density by Line transect or Quadrant method and calculate Biodiversity

Indices. (Any 2) **(12 marks)**

**Minor Question**

**(08 marks)**

Q2. Prepare a smear to show prokaryotic cell.

**OR**

Q2. Prepare a smear to show eukaryotic cell.

Q3. Identify and describe as per instructions **(08 marks)**

a) Fossil            b) Speciation

Q4. From the given article, prepare the bibliography/ abstract. **(06 marks)**

Q5. Submission of Power point presentation. (06 marks)

Q6. Viva. (05 marks)

Q7. Journal. 05

### **PRACTICAL II EXAMINATION**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question (15 marks)**

Q1. Study of osmosis in RBCs.

OR

Q1. Measurement of cell diameter by occulometer using permanent slide.

**Minor Question (10 marks)**

Q2. Qualitative tests for carbohydrates (Molisch's test, Benedicts test, Fehling's test, Anthrone test)

OR

Q2. Qualitative tests for protein (Ninhydrin test, Biuret test, Millon's test, Xanthoprotein test)

OR

Q2. Qualitative test for lipid (Solubility test, Sudan III test)

OR

Q2. Estimation of rancidity of lipids by titrimetric method

Q3. Identify and describe as per instructions (15 marks)

- Ultrastructure of cell organelles (a, b & c)
- Clinical disorders (d & e)

Q4. Viva (05 marks)

Q5. Journal (05 marks)

### PRACTICAL III EXAMINATION

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question**

**(12 marks)**

Q1. Estimation of Dissolved Oxygen from the given water sample.

OR

Q1. Detection of pregnancy from given sample of urine.

OR

Q1. Determination of organic matter from the given soil sample.

**Minor Question**

**(08 marks)**

Q2. Estimation of salinity by refractometer from the given water sample.

OR

Q2. Estimation of conductivity by conductometer from the given water sample.

OR

Q2. Determination the pH of the given soil sample.

OR

Q2. Determine the texture of the given soil sample.

Q3. Identify and describe as per instructions

**(15 marks)**

- Permanent slides on embryology (a &b)
- Birth control measure (c)
- Fishery (d & e)

Q4. a) Field report submission

**(06 marks)**

b) Viva based on field report

**(04 marks)**

Q5. Journal

**(05 marks)**