

**UNIVERSITY OF MUMBAI**  
**SOPHIA COLLEGE (AUTONOMOUS)**  
**SYLLABUS FOR F.Y. B.Sc. COURSE (ZOOLOGY)**  
**(With effect from academic year 2021-22)**

**SEMESTER I**

**Theory Course: SBSZOO101 - SYSTEMATIC CLASSIFICATION OF  
INVERTEBRATES AND ECOLOGY**

**Theory Course: SBSZOO102 - APPLIED BIOLOGY**

**Practical Course: SBSZOO P1**

**SEMESTER II**

**Theory Course: SBSZOO201 - BIODIVERSITY, EVOLUTION AND ETHOLOGY**

**Theory Course: SBSZOO202 - GENETICS AND BIOCHEMISTRY**

**Practical Course: SBSZOO P2**

## SEMESTERWISE SYLLABUS GRID FOR EACH PAPER

SEMESTER I		SEMESTER II	
<b>SBSZOO101</b>  <b>SYSTEMATIC CLASSIFICATION OF INVERTEBRATES AND ECOLOGY</b>	<b>SBSZOO102</b>  <b>APPLIED BIOLOGY</b>	<b>SBSZOO201</b>  <b>BIODIVERSITY, EVOLUTION AND ETHOLOGY</b>	<b>SBSZOO202</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
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 SBSZOOP1</b>		<b>Practical SBSZOOP2</b>	

**Syllabus for F.Y.B.Sc. Course –ZOOLOGY**  
**(With effect from Academic year 2021-22)**  
**SEMESTER – I**

Course Code	Unit	Title	Credits
<b>SBSZOO101</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>SBSZOO102</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>SBSZOOP1</b>		Practicals based on both the courses	2 Credits

# FYSBC ZOOLOGY SYLLABUS - SEMESTER I

## THEORY COURSE- SBSZOO101

### SYSTEMATIC CLASSIFICATION OF INVERTEBRATES AND ECOLOGY

#### Course Objectives:

- 1) *To understand the classification of Invertebrates through the general characteristics of phyla upto class level and specific characters of the respective organisms.*
- 2) *To impart knowledge of different components of ecosystem*
- 3) *To make students aware about significance of coexistence of human beings with all other living organisms.*
- 4) *To understand the dynamics of population ecology*

#### Course Outcomes:

*The learners will be able to:*

- 1) *Classify invertebrates.*
- 2) *Relate between the phyla through phylogenic comparison*
- 3) *Interpret the concept of ecosystem and its types*
- 4) *Evaluate the interdependence and interactions between abiotic and biotic factors in the environment*
- 5) *Relate the dynamics of population ecology with its various parameters*

#### Unit 1 - Classification of Animal Kingdom

**(15 Lectures)**

##### **1.1 Unicellular organization:** Kingdom Protista - Phylum Protozoa

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

1.2.1: Colonization level - Phylum Porifera

1.2.2: Division of labour – Phylum Cnidaria

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

1.3.1: Acoelomate organization – Phylum Platyhelminthes

1.3.2: Pseudocoelomate organization – Phylum Nematoda

##### **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)**

### **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)**

### **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

## **THEORY COURSE SBSZOO102**

### **APPLIED BIOLOGY**

#### **Course Objectives:**

- 1) *To make learners aware of good laboratory practices.*
- 2) *To understand the concepts of measurements*
- 3) *To understand applications of biostatistics*
- 4) *To acquaint learners to the modern developments in the field of animal biotechnology*
- 5) *To provide all learners a complete insight about the structure and working of different instruments used in Zoology*
- 6) *To impart hands on operational skills*

#### **Course Outcomes:**

*The learners will be able to:*

- 1) *Translate the good laboratory practices ensuring their safety and precision in the laboratory during practical sessions*
- 2) *Demonstrate the measurements in terms of micro and macro quantities of chemical concentrations*
- 3) *Apply biostatistical tools for data analysis*
- 4) *Relate the recent advances in biotechnology with their applications for the betterment of mankind*
- 5) *Translate the instrumentation principles through skills acquired by hands-on experiment*

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

**(15 Lectures)**

##### **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)

- 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 as the first cloned animal
- 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 & wild life conservation)
  - 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)

- 3.1: **Microscopy** - Construction, principle and applications of dissecting and compound microscope
- 3.2: **Colorimetry and Spectroscopy** - Principle and applications
- 3.3: **pH** – Buffer systems, Sorenson's pH scale, pH meter - principle and applications
- 3.3: **Centrifugation** - Principle and applications (clinical and ultra centrifuges)
- 3.4: **Chromatography** - Principle and applications (Partition and Adsorption), Basic principle and applications of column chromatography, affinity chromatography and HPTLC
- 3.5: **Electrophoresis** - Principle and applications (AGE and PAGE)

# PRACTICAL COURSE SBSZOOPI

## PRACTICAL I

### 1. Classification of Animal Kingdom

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

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

1.3: Cnidaria: *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. Study of mouthparts of insects – Biting and chewing, piercing and sucking, siphoning, sponging

7. Study of food webs and food chains in an ecosystem - Students to present their study through PPT / Chart presentations.

8. Report on study trip to Nature Park / Zoological garden.

## PRACTICAL II

1. Study of instruments used in the lab – Principle and working

- a) Compound microscope
- b) Dissecting microscope
- c) Colorimeter
- d) Centrifuge
- e) Spectrophotometer



f) pH meter

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 between the burners and also using Laminar flow.
4. Separation of pigments by adsorption chromatography using chalk.
5. Separation of amino acids using Paper Chromatography.
6. Separation of lipids by Thin Layer Chromatography (TLC).
7. Study of Beer- Lambert Law using different concentrations of a coloured solution.
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, Snuppy dog, cloned animals from India ) from photograph.
10. Application of DNA Fingerprinting in criminology and wild life conservation (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.

## MODIFIED SCHEME OF EXAMINATION

**Due to the current COVID Pandemic situation, examinations to be held through online mode (subject to the notification from the Govt. of Maharashtra and University of Mumbai from time to time)**

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

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

- (a) Internal assessment of total of Fifty (50) marks per course per semester
- (b) External assessment out of Fifty (50) marks per course per semester shall be conducted as semester end theory examination

**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 PRACTICAL EXAMINATION

#### SBSZOOP1

#### PRACTICAL I EXAMINATION

**Duration : 2 hrs30 min**

**Marks: 50**

Q. 1. Prepare the temporary mounting of foraminiferan shells and identify minimum three types. (09 Marks)

**OR**

Q.1. Prepare the temporary mounting of parapodium of *Nereis*. (09 Marks)

Q.2. Determine of population density of the given organism by sub-sampling method (06 Marks)

**OR**

Q.2. Demonstrate the observations of food vacuole, contractile vacuole and ciliary movement of *Paramoecium* from the given culture. (06 Marks)

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

Q.4. Presentation based on study of food web and food chains in an ecosystem (05 marks)

Q.5. Report on study trip and Viva voce based on it (10 Marks)

Q.6. Certified journal (05 Marks)

## PRACTICAL II EXAMINATION

**Duration: 2 hrs30 min**

**Marks: 50**

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

**OR**

Q.1. 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**

Q.2. Perform experiment for separation of mixture of amino acids by paper chromatography (10Marks)

**OR**

Q.2. 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**

Q.3. Demonstrate aseptic technique to transfer culture media/ solution from flask to test tube with the help of a pipette (5 Marks)

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

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

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

(With effect from Academic year 2021-22)

### SEMESTER – II

Course Code	Unit	Title	Credits
<b>SBSZOO201</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>SBSZOO202</b>		<b>GENETICS AND BIOCHEMISTRY</b>	2 Credits (45 lectures)
	1	Unit 1- Genetics	15 lectures
	2	Unit 2 – Biochemistry	15 lectures
	3	Unit 3- Nutrition and Public Health	15 lectures
		<b>PRACTICALS</b>	
<b>SBSZOOP2</b>		Practicals based on both the courses	2 Credits

## **THEORY COURSE SBSZOO201**

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

#### **Course Objectives:**

- 1) *To make learners aware of current status of wild life conservation in India*
- 2) *To introduce the concept of origin of life on earth*
- 3) *To gain knowledge about the animal behaviour and its types*

#### **Course Outcomes:**

*The learners will be able to:*

- 1) *Examine the scenario 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*
- 2) *Evaluate different processes of evolution through various theories and evidences*
- 3) *Analyze and compare different types of animal behaviour*

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

**(15 Lectures)**

**1.1 Concept of endangered and critically endangered** species using examples of Indian Wildlife with respect to National Parks and Wildlife Sanctuaries of India with reference to CITES, Red data book

- 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)**

**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)**

**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: Instrumental 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 SBSZOO202

### GENETICS AND BIOCHEMISTRY

#### Course Objectives:

- 1) *To introduce the learner to the basic terms and concepts of genetics*
- 2) *To understand Mendelian and other types of inheritance and applications of genetics*
- 3) *To gain knowledge about the structure and function of the biomolecules*
- 4) *To make learners understand the importance of balanced diet and essential nutrients of food at different stages of life*
- 5) *To become aware of the various national community health programs*

#### Course Outcomes:

*The learners will be able to:*

- 1) *Apply the principles of inheritance for various case studies*
- 2) *Assess the applications of genetics in real life situations*
- 3) *Recall the classification and structures of biomolecules and their clinical significance*
- 4) *Relate the concept of balanced diet with healthy dietary habits and importance of a healthy life style*
- 5) *Enlist the various benefits of the national health programs towards betterment of public health*

#### Unit 1- Genetics

(15 Lectures)

##### **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, screening for genetic disorders, 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)**

**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)**

**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:**

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

3.2.2: Physical, Psychological and Social health issues

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

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

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

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



## **PRACTICAL COURSE SBSZOO P2**

### **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 as per IUCN Red List
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. Instrumental learning
  - e. Learning to avoid enemies, mimicry
  - f. Learning to avoid sickness (antenna cleaning behavior of cockroach)
  - 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
  - d. Living Fossils – Limulus, Coelocanth
9. Report based on study trip.

## 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, Bradford's test, Folin-Lowry 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 be given and disorder to be identified).
  - a. Hyperglycemia, Hypoglycemia and Diabetes
  - b. Kwashiorkor, Marasmus
  - c. Obesity, Atherosclerosis
  - d. Thalassemia, 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.

## **MODIFIED SCHEME OF EXAMINATION**

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

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

- (c) Internal assessment of total of Fifty (50) marks per course per semester
- (d) External assessment out of Fifty (50) marks per course per semester shall be conducted as semester end theory examination

**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 PRACTICAL EXAMINATION**  
**SBSZOOP2**  
**PRACTICAL I EXAMINATION**

**Duration : 2 hrs30 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 based on ethology, eco tourism, biodiversity hotspots, evidences of evolution, fossils. (A-E) (10 marks)

Q.4. Field report & Viva voce based on it (10 marks)

Q.5. Viva voce based on practicals (5 marks)

Q.6. Journal (5 marks)

**PRACTICAL II EXAMINATION**

**Time: 2 hrs30 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. (5 marks)

Q.4. Submission of report on survey of BMI and viva on it (5 marks)

Q.5. PPT presentation on Clinical disorders (5marks)

Q.6. Viva voce based presentations of clinical disorders (5 marks)

Q.6. Journal (5 marks)

**UNIVERSITY OF MUMBAI**  
**SOPHIA COLLEGE (AUTONOMOUS)**  
**SYLLABUS FOR S.Y.B.Sc. COURSE (ZOOLOGY)**  
**(With effect from 2021-22)**

**SEMESTER III**

**Theory Course: SBSZOO301- CLASSIFICATION OF CHORDATES &  
DEVELOPMENTAL BIOLOGY**

**Theory Course: SBSZOO302 – CELL BIOLOGY & GENETICS**

**Theory Course: SBSZOO303 –RESEARCH METHODOLOGY&APPLIED  
ZOOLOGY - I**

**Practical Course: SBSZOOP3**

**SEMESTER IV**

**Theory Course: SBSZOO401 –LIFE PROCESSES**

**Theory Course: SBSZOO402 –BIOCHEMISTRY& HISTOLOGY**

**Theory Course: SBSZOO403–APPLIED ZOOLOGY - II**

**Practical Course: SBSZOOP4**

## SEMESTERWISE SYLLABUS GRID FOR EACH PAPER

SEMESTER III			SEMESTER IV		
<b>SBSZOO301</b>	<b>SBSZOO302</b>	<b>SBSZOO303</b>	<b>SBSZOO401</b>	<b>SBSZOO402</b>	<b>SBSZOO403</b>
<b>ZOOLOGY</b> <b>PAPER I:</b> Classification of Chordates & Developmental Biology	<b>ZOOLOGY</b> <b>PAPER II:</b> Cell Biology & Genetics	<b>ZOOLOGY</b> <b>PAPER III:</b> Research Methodology & Applied Zoology I	<b>ZOOLOGY</b> <b>PAPER I: Life</b> Processes	<b>ZOOLOGY</b> <b>PAPER II:</b> Biochemistry & Histology	<b>ZOOLOGY</b> <b>PAPER III:</b> Applied Zoology II
Unit 1 Classification of Chordates	Unit 1 Cell Biology	Unit 1 Research Methodology	Unit 1 Nutrition & Excretion	Unit 1 Enzymology	Unit 1 Economic Entomology
Unit 2 Human Reproduction	Unit 2 Genetics	Unit 2 Parasitology	Unit 2 Respiration & Circulation	Unit 2 Molecular biology	Unit 2 Fisheries
Unit 3 Developmental Biology	Unit 3 Nucleic Acids and Chromosomes	Unit 3 Pollution	Unit 3 Locomotion & Control and Coordination	Unit 3 Histology	Unit 3 Dairy Science
<b>Practical</b> <b>SBSZOOP3</b>				<b>Practical</b> <b>SBSZOOP4</b>	

**Syllabus for S.Y.B.Sc. Course – ZOOLOGY  
(With effect from 2021-22)**

**SEMESTER – III**

<b>Course Code</b>	<b>Unit</b>	<b>Title</b>	<b>Credits</b>
<b>SBSZOO301</b>		<b>Classification of Chordates &amp; Developmental Biology</b>	2 Credits (45 lectures)
	1	Classification of Chordates	15 lectures
	2	Human Reproduction	15 lectures
	3	Developmental Biology	15 lectures
<b>SBSZOO302</b>		<b>Cell Biology &amp; Genetics</b>	2 Credits (45 lectures)
	1	Cell Biology	15 lectures
	2	Genetics	15 lectures
	3	Nucleic Acids and Chromosomes	15 lectures
<b>SBSZOO303</b>		<b>Applied Zoology – I</b>	2 Credits (45 lectures)
	1	Research Methodology	15 lectures
	2	Parasitology	15 lectures
	3	Pollution	15 lectures
		<b>PRACTICALS</b>	
<b>SBSZOOP3</b>		Practicals based on all the three courses	3 Credits

## SYBSC ZOOLOGY SYLLABUS – SEMESTER III

### THEORY COURSE - SBSZOO301

#### CLASSIFICATION OF CHORDATES AND DEVELOPMENTAL BIOLOGY

##### Course Objectives:

- 1) *To understand the classification of Chordata through the general characteristics of sub-phyla and classes and specific characters of the respective organisms.*
- 2) *To introduce the concepts of human reproductive system and its hormonal control*
- 3) *To gain knowledge about infertility and assisted reproductive techniques*
- 4) *To introduce various processes of embryonic development*

##### Course Outcomes:

*The learners will be able to:*

- 1) *Classify chordates into their respective taxa*
- 2) *Relate between the sub-phyla and their classes*
- 3) *Relate the complexity of the human reproductive system and its hormonal control*
- 4) *Evaluate the importance of various methods of birth control and assisted reproductive techniques*
- 5) *Compare the different processes of development in various animals*

#### Unit: 1 Chordate Classification

(15 Lectures)

##### **1.1 Phylum Hemichordata - *Balanoglossus***

##### **1.2 Phylum Chordata**

1.2.1 Subphylum Urochordata

1.2.2 Subphylum Cephalochordata

1.2.3 Subphylum Vertebrata

##### **1.3 Superclass Agnatha – Class Cyclostomata**

##### **1.4 Superclass Gnathostomata**

1.1.1 Class Pisces

1.1.2 Class Amphibia

1.1.3 Class Reptilia

1.1.4 Class Aves

1.1.5 Class Mammalia



## **Unit: 2 Human Reproduction**

(15 Lectures)

### **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
- 2.1.3 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 Male infertility**

Causes – Testicular failure, Infection of epididymis, seminal vesicles or prostate, Hypogonadism, Cryptorchidism, Congenital abnormalities, Variocoele, Blockage, Azoospermia, Oligozoospermia, Teratozoospermia, Asthenozoospermia, Autoimmunity, Ejaculatory disorders, Idiopathic infertility.

### **2.5 Role of endocrine disruptors in male and female infertility.**

### **2.6 Treatment of infertility**

- 2.6.1 : Removal /reduction of causative environmental factors
- 2.6.2 : Surgical treatment

2.6.3 : Hormonal treatment- fertility drugs

2.6.4 : Assisted Reproductive Technology (ART) –*In vitro* 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).

2.6.5 : Sperm bank, cryopreservation of gametes and embryos

2.6.6 : Surrogacy

### **Unit: 3 Developmental Biology**

**(15 Lectures)**

**3.1** Types of Eggs - Based on amount and distribution of yolk

**3.2** Structure and Types of Sperm

**3.3** Types of Cleavage

**3.4** Types of Blastula

**3.5** Types of Gastrula

**3.6** Coelom -Formation and types

### **THEORY COURSE: SBSZOO302**

#### **CELL BIOLOGY AND GENETICS**

#### **Course Objectives:**

- 1) *To understand the cellular organization and the role played by various cell organelles*
- 2) *To introduce the concepts of sex determination, sex linkage, and multiple alleles and multiple genes*
- 3) *To gain knowledge about concept of linkage and crossing over*
- 4) *Learner will understand the composition and importance of nucleic acids as genetic material*
- 5) *Learner would acquire the knowledge about the structure and types of chromosomes*

#### **Course Outcomes:**

*Learners will be able to:*

- 1) *Explain the ultrastructure and functions of various cell organelles*
- 2) *Evaluate the importance of linkage and crossing over during gamete formation*
- 3) *Demonstrate the understanding of various inheritance patterns through*

*examples*

- 4) *Recall the classical experiments proving DNA & RNA as the genetic material.*
- 5) *Illustrate the structure of nucleic acids and chromosomes*

## **Unit: 1 Cell Biology**

**(15 Lectures)**

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

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

### **1.2 Nucleus**

Ultrastructure and functions of interphase nucleus

### **1.3 Plasma membrane**

- 1.3.1 Ultrastructure (Fluid Mosaic Model) and functions
- 1.3.2 Junctional complexes
- 1.3.3 Membrane receptors
- 1.3.4 Transport across plasma membrane: Passive and Active Transport: Diffusion and Osmosis, Endocytosis and Exocytosis

### **1.4 Endoplasmic reticulum (ER)**

- 1.4.1 General morphology of endomembrane system, ultrastructure and types of ER
- 1.4.2 Functions of Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER)

**1.5 Golgi complex:** Ultrastructure of Golgi complex, functions of Golgi complex

**1.6 Lysosomes:** Origin, occurrence, polymorphism and functions

**1.7 Peroxisomes:** Origin, morphology & functions

**1.8 Mitochondria:** Ultrastructure, chemical composition and functions of Mitochondria

## **Unit: 2 Genetics**

(15 Lectures)

### **2.1 Sex- determination**

2.1.1 : Chromosomal Mechanisms: XX-XO, XX-XY, ZZ-ZW

2.1.2 : Sex determination in Honey bees- Haplodiploidy

2.1.3 : Sex determination in *Drosophila*-Genic balance theory, Intersex, Gynandromorphs

2.1.4 : Parthenogenesis

2.1.5 : Hormonal influence on sex determination-Freemartin and Sex reversal.

2.1.6 : Role of environmental factors- *Bonelia* and Crocodile

2.1.7 : Barr bodies and Lyon hypothesis

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

2.2.1 : X-linked: *Drosophila*, Colour-blindness, Haemophilia

2.2.2 : Y-linked: Hypertrichosis

2.2.3 : Sex-influenced genes

2.2.4 : Sex-limited genes

### **2.3 Multiple Alleles and Multiple Genes**

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

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

2.3.3 : Concept of Pleiotropy

### **2.4 Linkage and Crossing Over**

2.4.1 Concept of Linkage

2.4.2: Concept of crossing over, Types of crossing over, Cytological basis of crossing over.

## **Unit: 3 Nucleic Acids and Chromosomes**

(15 Lectures)

### **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 Chromosomes**

3.2.1 : Types of Chromosomes–Autosomes and Sex chromosomes

3.2.2 : Chromosome structure - Heterochromatin, Euchromatin

3.2.3 : Classification based on the position of centromere

3.2.4 : Endomitosis, Giant chromosomes- Polytene and Lampbrush chromosomes and Significance of Balbiani rings

## **THEORY COURSE - SBSZOO303**

### **RESEARCH METHODOLOGY AND APPLIED ZOOLOGY- I**

#### **Course Objectives:**

- 1) To understand the concept of Scientific Research Methodology*
- 2) To gain knowledge about the elements of research methodology*
- 3) To understand the ethical guidelines pertaining to research and publication*
- 4) To introduce the learner to life cycle, pathogenicity, control measures and treatment of different parasites*
- 5) To make the learners aware of the different types of pollution, its impact on nature and abatement measures*

#### **Course outcomes:**

*Learners will be able to:*

- 1) Differentiate between research methods and research methodology*
- 2) Relate between the research and publication ethics*
- 3) Relate the host-parasite relationships through the study of different parasites*
- 4) Evaluate the adverse effects of pollution, its impact on biodiversity and its control measures.*

## **Unit: 1 Research Methodology**

(15 Lectures)

### **1.1 Process of science:**

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

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

1.1.3 : 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

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

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

### **1.2 Scientific writing:**

1.2.1 : 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

1.2.2: Peer reviewed and Indexed journals, Citation index and Role of citations, impact factor of a journal

### **1.3 Writing a review paper**

1.3.1 Structure and components of review paper

1.3.2 Report writing and types of report

1.3.3 Computer application: Plotting of graphs, Statistical analysis of data

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

#### **1.4 Ethics**

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

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

#### **1.5 Plagiarism and Conflict of interest**

### **Unit: 2 Parasitology**

(15 Lectures)

#### **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**

2.2.1 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. Tick (*Ixora*)

2.4.3 Bed bug (*Cimex lectularis*)

#### **2.5 Zoonosis**

Bird flu, Anthrax, Rabies, Toxoplasmosis, outbreaks of Nipah Virus and nCovid-19

### **UNIT3: Pollution and its effect on organisms**

(15Lectures)

#### **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, biomagnification, its control and abatement measures

#### **3.2 Soil Pollution**

3.3.1 : Types and sources of soil pollutant

3.3.2 : Effects of soil pollution on organisms, biomagnification, 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 with stress on plastic pollution**

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 SBSZOOP3**

### **PRACTICAL I**

1. Chordate classification
  - 1.1 Hemichordata : *Balanoglossus*
  - 1.2 Urochordata : *Herdmania*
  - 1.3 Cephalochordata : *Amphioxus*
  - 1.4 Cyclostomata: *Petromyzon*
  - 1.5 Pisces : Chondrichthyes: Shark, skate, sting ray/ electric ray  
Osteichthyes : *Sciaena*, flying fish, Puffer fish (poisonous)
  - 1.6 Amphibia :Frog, toad, caecilian, salamander
  - 1.7 Reptilia : Chameleon, *Calotes*, turtle, tortoise, venomous (Krait, Russell's Viper, Saw-scaled Viper, Cobra and King Cobra) and non-venomous (Python, Rat snake) snakes, alligator/crocodile
  - 1.8 Aves : Kite, kingfisher, duck
  - 1.9 Mammalia : Shrew, hedgehog, guinea pig, bat
2. Detection of pregnancy from given sample of urine
3. Study of birth control measures applicable to humans – IUD, condom and hormonal pills.
4. Study of the following permanent slides, museum specimens and materials
  - 4.1 Mammalian sperm and ovum
  - 4.2 Types of egg –fish, frog and hen
  - 4.3 Cleavage, blastula and gastrula (Amphioxus, Frog and Bird)
5. Study of development of zebrafish embryo upto 72 hours (only observation without disturbing larvae)
6. Study of development of chick embryo upto 72 hours
7. Study trip to observe flora and fauna and submission of its report

### **PRACTICAL II**

1. Study of permeability of cell through plasma membrane (osmosis in blood cells)
2. Measurement of cell diameter by occulometer (by using permanent slide)
3. Ultrastructure of cell organelles (Electron micrographs) of:
  - 3.1 Nucleus
  - 3.2 Endoplasmic reticulum (Smooth and Rough)

3.3 Mitochondria.

3.4 Golgi apparatus

3.5 Lysosomes

4. Study of Barr body from buccal epithelium cells.
5. Study of polytene chromosome
6. Study of mitosis- temporary squash preparation of Onion root tip
7. Chromosome morphology: (photograph to be provided)
8. Detection of blood groups and Rh factor
9. Problems in Genetics
  - a) X- linked inheritance
  - b) Multiple Alleles
10. Extraction and detection of DNA
11. Extraction and detection of RNA

### **PRACTICAL III**

1. Review writing based on programmes telecast by Doordarshan, Gyandarshan, UGC programmes or other media sources
2. Bibliography/ Abstract writing
3. Preparation of Power Point Presentation based on research paper.
4. Study of endoparasites: *Entamoeba histolytica*, *Fasciola hepatica*, *Taenia solium*, *Wuchereria bancrofti*
5. Study of ectoparasites: Head louse (*Pediculus humanus capitis*), Tick (*Ixodes* sp.), Bed bug (*Cimex lectularis*)
6. Parasitic adaptations: Scolex and mature proglottids of Tapeworm
7. Zoonosis - Bird flu, Anthrax, Rabies, Toxoplasmosis, Nipah virus disease, nCovid-19
8. Study of air microflora
9. Estimation of dissolved oxygen from the given water sample
10. Estimation of conductivity by conductometer from the given water sample
11. Study of physical properties of soil: moisture and texture
12. Study of chemical properties of soil: pH, organic matter
13. Study of sound pollution monitoring device

## **MODIFIED SCHEME OF EXAMINATION**

**Due to the current COVID Pandemic situation, examinations to be held through online mode (subject to the notification from the Govt. of Maharashtra and University of Mumbai from time to time)**

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

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

- (a) Internal assessment of total of Fifty (50) marks per course per semester
- (b) External assessment out of Fifty (50) marks per course per semester shall be conducted as semester end theory examination

**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 PRACTICAL EXAMINATION SBSZOOP3**

#### **PRACTICAL I EXAMINATION**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question**

**10**

Q.1 Observation of permanent slide of chick embryo and identify the stage of development

**Minor Question**

**07**

Q.2. Identify the stage of zebrafish development (photograph)

**OR**

Q.2. Comment on the pregnancy test given.

**Q.3. Identification**

**18**

Chordate classification (a, b and c)

Birth control measures (d)

Embryology slide (e and f)

Q.4. Report submission of study trip	05
Q.5. Viva voce based on practicals	05
Q.6. Certified Journal	05

**PRACTICAL ILEXAMINATION**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question** **13**

Q.1 Extraction and detection of DNA

**OR**

Q.1. Extraction and detection of RNA

**OR**

Q.1. Study of osmosis in RBCs.

**OR**

Q.1. Study of mitosis-Temporary squash preparation of Onion root tip

**Minor Question** **08**

Q.2 Study of Barr bodies / Study of Polytene chromosomes

**OR**

Q.2. Detection of blood groups and Rh factor

**OR**

Q.2. Measurement of cell diameter by oculometer using permanent slide

Q3. Problems based on Genetics (any two) **10**

Q4. Identification: **09**

Chromosome morphology (a)

Ultrastructure of cell organelles (b, c)

Q4. Viva voce based on practicals **05**

Q5. Certified Journal **05**

## **PRACTICAL III EXAMINATION**

**Time: 2 hrs 30 min**

**Marks: 50**

**Major Question**

**(12 marks)**

- Q.1 Estimation of dissolved oxygen from the given water sample.  
**OR**
- Q.1 Determination of organic matter from the given soil sample.  
**OR**
- Q.1 Estimation of conductivity by conductometer from the given water sample  
**OR**
- Q.1 Count the number of colonies on the given exposed culture plate and estimate the Microflora present in the total area.
- Q.2 Determine the pH of the given soil sample. (7 marks)  
**OR**
- Q.2 Determine the texture of the given soil sample.  
**OR**
- Q.2 Determine the moisture content of the given soil sample.
- Q.3. Identify and describe as per instructions (9 marks)  
Endoparasite (a)  
Ectoparasite (b)  
Parasitic adaptation / zoonosis / sound pollution monitoring device (c)
- Q.4 From the given article, prepare the bibliography/ abstract (6 marks)
- Q.5. Submission of Power Point presentation (6 marks)
- Q.6 Viva voce based on practicals (5 marks)
- Q.7 Certified Journal (5 marks)

**Syllabus for S.Y.B.Sc. Course –ZOOLOGY**  
**(With effect from Academic year 2021-22)**  
**SEMESTER –IV**

<b>Course Code</b>	<b>Unit</b>	<b>Title</b>	<b>Credits</b>
<b>SBSZOO401</b>		<b>LIFE PROCESSES</b>	2 Credits (45 lectures)
	1	Nutrition and Excretion	15 lectures
	2	Respiration and Circulation	15 lectures
	3	Locomotion and Control and coordination	15 lectures
<b>SBSZOO402</b>		<b>BIOCHEMISTRY &amp; HISTOLOGY</b>	2 Credits (45 lectures)
	1	Enzymology	15 lectures
	2	Molecular Biology	15 lectures
	3	Histology	15 lectures
<b>SBSZOO403</b>		<b>APPLIED ZOOLOGY- II</b>	2 Credits (45 lectures)
	1	Economic Entomology	15 lectures
	2	Fisheries	15 lectures
	3	Dairy Science	15 lectures
		<b>PRACTICALS</b>	
<b>SBSZOO4</b>		Practicals based on both the courses	3 Credits

# SYSBC ZOOLOGY SYLLABUS - SEMESTER IV

## THEORY COURSE – SBSZOO401

### LIFE PROCESSES

#### **Course Objectives:**

- 1) *To understand the concepts of physiology of nutrition, excretion and osmoregulation*
- 2) *To introduce the concepts of physiology of respiration and circulation*
- 3) *To gain knowledge about the mechanism of locomotion, control and coordination in different organisms*

#### **Course outcomes:**

*Learners will be able to:*

- 1) *Relate the increasing complexity of nutritional, excretory and osmoregulatory physiology in evolutionary hierarchy*
- 2) *Compare various respiratory and circulatory organs in different classes of organisms*
- 3) *Explain the mechanism of regulation of locomotion, control and coordination in various organisms*

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

**(15 Lectures)**

#### **1.1 Nutrition:**

- 1.1.1: Comparative study of nutritional apparatus (structure and function):  
Amoeba, Hydra, Cockroach, Amphioxus, Pigeon and Ruminants.
- 1.1.2: Physiology of digestion in man.

#### **1.2 Excretion and Osmoregulation:**

- 1.2.1: Comparative study of excretory and osmoregulatory structures and functions.
- a) Amoeba - Contractile vacuoles
  - b) Planaria - Flame cells
  - c) Cockroach - Malpighian tubules
- 1.2.2: Categorization of animals based on principle nitrogenous excretory products
- 1.2.3: Structure of kidney, uriniferous tubule and physiology of urine formation in man

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

**(15 Lectures)**

#### **2.1 Respiration:**

- 2.1.1: Comparative study of respiratory organs (structure and function):  
Earthworm, Spider, Any bony fish (Rohu/*Anabas/ Clarius*), Frog and Pigeon.
- 2.1.2: Structure of lungs and physiology of respiration in man

## **2.2 Circulation:**

2.2.1: Comparative study of circulation: (a) Open and Closed type, (b) Single and Double type.

2.2.2: Types of circulating fluids- Water, Coelomic fluid, Haemolymph, Lymph and Composition of blood

2.2.3: Comparative study of hearts (structure and function): Earthworm, Cockroach, Shark, Frog, Crocodile and Pigeon.

2.2.4: Structure and mechanism of working of heart in man.

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

(15 Lectures)

### **3.1 Movement and Locomotion:**

3.2.1: Locomotory organs - structure and functions of:

- a. Pseudopodia in Amoeba (Sol- Gel theory), Cilia in Paramecium
- b. legs in cockroach
- c. Tube feet in starfish
- d. Fins of fish
- e. Wings in birds

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

### **3.2 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.

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

3.1.3: Synaptic transmission

3.1.4: Neurotransmitters: Types of excitatory and inhibitory neurotransmitters and their functions (Acetylcholine, Epinephrine, Norepinephrine, Histamine, Glutamate, GABA, Serotonin, Dopamine)



**THEORY COURSE – SBSZOO402**

**BIOCHEMISTRY & HISTOLOGY**

**Course Objectives:**

- 1) *To understand the fundamental concepts of enzyme biochemistry and enzyme action*
- 2) *To gain knowledge about gene expression and regulation*
- 3) *To introduce the learner to histological structure of some of the endocrine and exocrine glands*

**Course outcomes:**

*Learners will be able to:*

- 1) *Classify the enzyme and compare their mode of action*
- 2) *Apply the concept of central dogma to the molecular processes involved protein biosynthesis*
- 3) *Recall the normal histology and interpret the histopathological changes in disease condition*

**Unit 1 : Enzymology**

**(15 lectures)**

**1.1 : Introduction and Nomenclature:** Definition; nomenclature and classification (based on IUB – Enzyme Commission) of enzymes; chemical nature of enzyme, co-factors and co-enzymes

**1.2 : Enzyme Action:**

1.2.1 : Mechanism: Fischer's lock and Key Model, Koshland's induced fit model

1.2.2 Factors affecting enzyme activity –substrate, pH and temperature.

**1.3 : Enzyme Kinetics:** Derivation of Michaelis-Menten equation and Lineweaver-Burk plot; Concept and significance of Km, Vmax

**1.4 : Enzyme Inhibition:** Competitive, non-competitive and uncompetitive inhibitors and their kinetics; allosteric regulation.

**Unit 2 : Molecular Biology**

**(15 lectures)**

**2.1 :** DNA Replication in a prokaryotic and eukaryotic cell

**2.2 :** Characteristics of Genetic code

**2.3 :** Transcription in a prokaryotic and eukaryotic cell

**2.4 :** Translation in a prokaryotic and eukaryotic cell

**Unit 3: Histology**

**(15 lectures)**

3.1 Liver: Normal histology and histopathological changes in hepatic toxicity

3.2 Kidney: Normal histology and histopathological changes in nephrotoxicity

3.3 Pancreas: Normal histology and histopathological changes in pancreatitis

3.4 Adrenal: Normal histology and histopathological changes in adrenopathy

3.5 Pituitary: Normal histology and histopathological changes in pituitary adenoma

3.6 Thyroid: Normal histology and histopathological changes in thyroid tumours

## **THEORY COURSE – SBSZOO403**

### **APPLIED ZOOLOGY-II**

#### **Course Objectives:**

- 1) *To gain knowledge about the economic importance of Zoology*
- 2) *To impart knowledge about various types of Indian fisheries and its scope*
- 3) *To gain knowledge about different indigenous cattle breeds of India and scope of dairy industry*

#### **Course outcomes:**

*Learners would be able to:*

- 1) *Evaluate the importance various economically important process such as apiculture, sericulture and lac culture.*
- 2) *Classify various types of insecticides and their mode of action*
- 3) *Recall and evaluate the scope of fishery in India with respect to fishing techniques, fishery biology and fish products*
- 4) *Classify various breeds of cattle and compare their milk production*
- 5) *Relate the knowledge of dairy industry with its scope in the Indian*

#### **Unit1: Economic Entomology**

**(15 Lectures)**

**1.1 Honeybee** – Social life and communication, life history, apiculture, pests, enemies, diseases, commercial importance

**1.2 Lac insect** – Life cycle, lac culture, composition and uses of lac

**1.3 Silk moth** – Life history, sericulture, Diseases and control measures, economic importance

**1.4** Life history and control measures of *Schistocerca gregaria*, Aphids, *Sitophilus oryzae*, *Tribolium confusum*

#### **1.5 Methods of insect control**

1.5.1 Chemical control by synthetic and natural chemicals

1.5.2 Biological control by *Bacillus thuringiensis*, Entomophagus insects and Parasitic insects

## **UNIT 2: Fisheries**

**(15Lectures)**

- 2.1** Introduction to fisheries in India – Freshwater, Marine, Brackish
- 2.2** Crafts & Gears used on Indian coasts:
  - 3.2.1: Crafts – Dugout, Outrigger, Masula, Catamaran, Satpati, Trawler
  - 3.2.2: Gears – Gill and drift net, Dol net, Cast net, Purse seine, Lines and hooks
- 2.3** Fishery biology of commercially important fishes : Catla, Rohu, Catfish, Mackerel, Sardine, Pomfret, Bombay duck
- 2.4** Fish Preservation, Processing and value addition
- 2.5** SONAR, GPS, Remote Sensing, Tidal and lunar pattern

## **UNIT 3: DAIRY SCIENCE**

**(15Lectures)**

- 3.1** Indian Cattle breeds – Origin, distribution, distinguishing characters and economic uses: Malvi, Hariyana, Deoni, Red Sindhi and Khillari
- 3.2** Indian buffalo breeds - Origin, distribution, distinguishing characters and economic uses: Nagpuri, Bhadawari, Murrah and Jafrabadi
- 3.3** Dairy Processing: Filtration, cooling, chilling, clarification, pasteurization, freezing
- 3.4** Milk and milk products: Composition of milk, Types of milk - . Buffalo milk & Cow milk (A1 and A2), Whole milk and toned milk, Milk products
- 3.5** Dairy development in India: Role of dairy development in rural economy, employment opportunities

## **PRACTICAL COURSE: SBSZOO4**

### **PRACTICAL I**

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. Air sacs of Pigeon
7. Study of locomotory organs (Amoeba, Cockroach, Starfish, Fish, and Bird)
8. Study of different types of heart (Cockroach, Shark, Frog, Garden lizard, Crocodile and Mammal)

### **PRACTICAL II**

1. Problems based on molecular biology
2. Effect of varying pH on activity of enzyme Acid Phosphatase
3. Effect of varying enzyme concentration on activity of enzyme Acid Phosphatase
4. Effect of varying substrate concentration on activity of enzyme Acid Phosphatase
5. Effect of inhibitor on the activity of enzyme Acid Phosphatase
6. Study of histology of glands: T.S. of pituitary, thyroid, liver, kidney, pancreas, adrenal (permanent slides)

7. Microtomy: Tissue preservation and fixation, dehydration, infiltration, paraffin embedding and block preparation, sectioning, staining.

### **PRACTICAL III**

1. Study of Honey Bee:
  - 1.1 Life Cycle of Honey Bee and Bee Hive
  - 1.2 Mouthparts of Honey Bee
  - 1.3 Legs of Honey Bee
  - 1.4 Sting Apparatus of Honey Bee
2. Life cycle of silk moth
3. Life cycle of lac insect and lac
4. Study of *Schistocerca gregaria*, Aphids, *Sitophilus oryzae*, *Tribolium confusum*
5. Study of crafts and gears
6. Study of commercially important fishery (Catla, Rohu, Catfish, Mackerel, Sardine, Pomfret, Bombay duck)
7. Extraction of casein from milk and its qualitative estimation
8. Preparation of paneer, rasgulla, milk chocolate from given milk sample
9. Measurement of density of milk using different samples by Lactometer
10. Breeds of Indian cows and buffaloes
11. Study trip to dairy farm / apiculture centre / fisheries institutes / docks to observe fish landing / aquaculture farms etc.

**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.

## **MODIFIED SCHEME OF EXAMINATION**

**Due to the current COVID Pandemic situation, examinations to be held through online mode (subject to the notification from the Govt. of Maharashtra and University of Mumbai from time to time)**

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

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

- (c) Internal assessment of total of Fifty (50) marks per course per semester
- (d) External assessment out of Fifty (50) marks per course per semester shall be conducted as semester end theory examination

**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 PRACTICAL EXAMINATION SBSZOOP4**

#### **PRACTICAL I EXAMINATION**

**Duration : 2 hours 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. Study of striated and non-striated muscle fibre

Q3. Identification (15 marks)

Nutritional apparatus (a & b)

Respiratory structure (c)

Locomotory organ (d)

Type of heart (e)

- Q4. Viva voce based on practicals (5 marks)  
Q5. Certified Journal (5 marks)

### **PRACTICAL II EXAMINATION**

**Duration : 2 hrs 30 min**

**Marks: 50**

**Major Question:**

- Q.1 Demonstrate the effect of (Substrate concentration / pH variation / Enzyme concentration / Inhibitor concentration) on the activity of acid phosphatase enzyme (15 marks)

**Minor Question:**

- Q.2 From the infiltrated tissue prepare block, trim and mount it on the block holder. (10 marks)

**OR**

- Q.2 Mount the ribbon on slide from the given block. (10 marks)

**OR**

- Q.2 Stain the given histological slide and identify the tissue. (10 marks)

- Q.3 Identify and describe (9 marks)  
a), b) and c) based on permanent slides of mammalian tissue histology

- Q.4 Problems based on Molecular biology (Two) (6 marks)

- Q.5 Viva voce based on practicals (5 marks)

- Q.6 Certified Journal (5 marks)

### **PRACTICAL III EXAMINATION**

**Duration : 2 hrs 30 min**

**Marks: 50**

**Major Question:**

(10 marks)

**Sketch and Label**

- Q.1 Life cycle of honey bee / Life cycle of silk moth / Life cycle of lac

**OR**

- Q.1 Mouth parts of honey bee

**OR**

- Q.1 Legs of honey bee  
**OR**
- Q.1 Sting apparatus of honey bee  
**Minor Question** (6 marks)
- Q.2 Extraction of casein from milk and its qualitative detection  
**OR**
- Q.2 Preparation of paneer from the given milk sample.  
**OR**
- Q.2 Measurement of density of different samples of milk by lactometer
- Q3 Identify and describe as per instructions (18 marks)
- Fisheries (a & b)  
Craft / gear (c)  
Breeds of cows and buffaloes (d & e )  
Lac / insect pest (f)
- Q4 Report submission based on study trip (6 marks)
- Q.5 Viva voce based on practicals (5 marks)
- Q.6 Certified Journal (5 marks)