



**UNIVERSITY OF MUMBAI**  
**SOPHIA COLLEGE (AUTONOMOUS)**  
**SYLLABUS FOR S.Y.B.Sc. COURSE (ZOOLOGY)**  
**(Academic year 2023-2024)**

**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: SBSZOO3**

**SEMESTER IV**

**Theory Course: SBSZOO401 –LIFE PROCESSES**

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

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

**Practical Course: SBSZOO4**

## **Programme Specific Objectives:**

- 1) To provide a holistic knowledge about animal biology such as taxonomy, comparative anatomy and physiology, behaviour, ecology and evolution.*
- 2) To develop experimental and research-oriented skills for future career in academia*
- 3) To gain field-based knowledge through experiential learning*
- 4) To get acquainted with the applied areas of zoology to promote employability and entrepreneurship*
- 5) To encourage understanding about the importance of biodiversity conservation, the threats facing ecosystems and the conservation measures used to preserve wildlife.*

## **Programme Specific Outcomes:**

By the end of the program, the learners will be able to:

- 1) Apply the field-based and the in-class knowledge of animal biology to identify and classify the animals in their natural habitat upto class level*
- 2) Identify the various types of animal behaviour, and animal interactions with the ecosystem*
- 3) Conduct basic research that involves application of critical thinking and experimental skills*
- 4) Get career opportunities in a variety of fields such as conservation, research, education, and animal management*

## 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 PAPER I: Classification of Chordates &amp; Developmental Biology</b>	<b>ZOOLOGY PAPER II: Cell Biology &amp; Genetics</b>	<b>ZOOLOGY PAPER III: Research Methodology &amp; Applied Zoology I</b>	<b>ZOOLOGY PAPER I: Life Processes</b>	<b>ZOOLOGY PAPER II: Biochemistry &amp; Histology</b>	<b>ZOOLOGY PAPER III: Applied Zoology II</b>
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 Chromosome s	Unit 3 Pollution	Unit 3 Locomotion & Control and Coordination	Unit 3 Histology	Unit 3 Dairy Science
<b>Practical SBSZOOP3</b>				<b>Practical SBSZOOP4</b>	

**Syllabus for S.Y.B.Sc. Course – ZOOLOGY**  
**(Academic Year 2023-2024)**

**SEMESTER – III**

Course Code	Unit	Title	Credits
<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>SBSZOO3</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 embryonic developmental*

##### Course Outcomes:

- 1) *The learners will be able to classify chordates*
- 2) *They will be able to relate between the sub-phyla and their classes*
- 3) *Learner would relate the complexity of the human reproductive system and its hormonal control*
- 4) *Learner would be able to evaluate the importance of various methods of birth control and assisted reproductive techniques*
- 5) *Learner would be able to 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:**

- 1) *Learner would be able to explain the ultrastructure and functions of various cell organelles*
- 2) *Learner would be able to evaluate the importance of linkage and crossing over during gamete formation*
- 3) *Learner would demonstrate the understanding of various inheritance patterns through examples*
- 4) *Learner will be able to recall the classical experiments proving DNA & RNA as the genetic material.*
- 5) *Learners will be able to 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 Linkage and 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**

(15 Lectures)

#### **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 would be able to

- 1) *Understand the difference 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 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**

**(15 Lectures)**

### **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

### **3.3 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**

### **Course Objectives:**

- 1) To impart skills for identification and classification of animals*
- 2) To give hands on training for experimental based on developmental biology, cell biology and pollution*
- 3) To impart experiential learning through field studies*

### **Course Outcomes:**

The learner will be able to:

- 1. Identify the animals based on their observations of the external characteristics*
- 2. Perform experiments based on developmental biology, cell biology and pollution*
- 3. Prepare field report based on observations done during field excursions*

## **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 oculometer (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

### **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 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: 150 marks which will be distributed into the following two examination sessions and conducted as per the given question paper pattern.**

## **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 II EXAMINATION**

**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**  
**(Academic year 2023-2024)**  
**SEMESTER –IV**

Course Code	Unit	Title	Credits
<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 would 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 would 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  $K_m$ ,  $V_{max}$
- 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 SBSZOOP3**

### **Course Objectives:**

- 1) *To impart knowledge of the various life processes*
- 2) *To give hands on training for experimental based on biochemistry, histology and dairy science*
- 3) *To impart experiential learning through field studies*

### **Course Outcomes:**

The learner will be able to:

- 1) *Compare the various life processes across the animal kingdom*
- 2) *Perform experiments based on biochemistry, histology and dairy science*
- 3) *Prepare field report based on observations done during field excursions*

## **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.

## **SCHEME OF EXAMINATION**

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

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

- (b) Internal assessment of total of Fifty (50) marks per course per semester
- (c) 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: 150 marks which will be distributed into the following two examination sessions and conducted as per the given question paper pattern.**

## **PAPER PATTERN OF PRACTICAL EXAMINATION SBSZOOP4**

### **PRACTICAL I EXAMINATION**

**Duration : 2 hours 30 min**

**Marks: 50**

**Major Question:**

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 insect

**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)

**06**

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 <ul style="list-style-type: none"> <li>● Fisheries (a &amp;b)</li> <li>● Crafts and gears (c &amp; d)</li> <li>● Breeds of cows and buffaloes (e)</li> <li>● Lac / insect pest (f)</li> </ul>	(18 marks)
Q4	Report submission based on study trip	(6 marks)
Q.5	Viva voce based on practicals	(5 marks)
Q.6	Certified Journal	(5 marks)