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		
SBSZOO301 **ZOOLOGY PAPER I: Classification of Chordates & Developmental Biology**	**SBSZOO302** **ZOOLOGY PAPER II: Cell Biology & Genetics**	**SBSZOO303** **ZOOLOGY PAPER III: Research Methodology& Applied Zoology I**		**SBSZOO401** **ZOOLOGY PAPER I: Life Processes**	**SBSZOO402** **ZOOLOGY PAPER II: Biochemistry & Histology**	**SBSZOO403** **ZOOLOGY PAPER III: 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
Practical SBSZOOP3					**Practical SBSZOOP4**	

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

SEMESTER – III

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

SYBSC ZOOLOGY SYLLABUS – SEMESTER III

THEORY COURSE - SBSZOO301

CLASSIFICATION OF CHORDATES AND DEVELOPMENTAL BIOLOGY

Unit: 1 Chordate Classification **(15 Lectures)**

Objectives:

- *To introduce the concepts of classification of chordates and developmental biology*

Desired outcome:

- *Learner would understand the increasing complexity of chordates in the evolutionary hierarchy*

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)**

Objectives:

- *To introduce the concepts of human reproductive system and its hormonal control*

Desired outcome:

- *Learner would understand the complexity of the human reproductive system and its hormonal control*

- *Learner would understand the various methods of birth control, causes of infertility and assisted reproductive techniques*

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, Cryptochidism, 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)**

Objectives:

- *To introduce the concepts of developmental biology*

Desired outcome:

- *Learner would understand how embryological development takes place in animals*

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

Unit: 1 Cell Biology **(15 Lectures)**

Objectives:

- *To introduce the concepts of cell biology and the role played by cell organelles in a cell*

Desired outcome:

- *Learner would understand the interdependence between the various cell organelles*

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)**

Objectives:

- *To introduce the concepts of sex determination, sex linkage, and multiple alleles*

Desired outcome:

- *Learner would understand how genetics determines and influences the sex of an organism*
- *Learner would understand the concept of multiple alleles and linkages*

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)**

Objectives:

- *To introduce the learner to the classical experiments proving DNA as the genetic material.*
- *To introduce the learner the structure of nucleic acids*

Desired outcome:

- *Learner will understand the importance of nucleic acids as genetic material.*

- *Learner would acquire the knowledge about the structure and types of chromosomes*

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

Unit: 1 Research Methodology **(15 Lectures)**

Objectives:

- *To introduce the concepts of research methodology*

Desired outcome:

- *Learner would be able to the process of science and scientific writing*
- *Learner would gain knowledge of science ethics and plagiarism*

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)**

Objectives:

- *To introduce the concepts of parasitology*
- *To introduce the learner to life cycle, pathogenicity, control measures and treatment of different parasites*

Desired outcome:

- *Learner would understand the concept of host-parasite relationship and host specificity*
- *Learner would be familiarized with different parasites and their effect on human beings*

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 capittis*)

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)**

Objective:

- *To provide a panoramic view of impact of human activities leading to pollution and its on birds, animals etc.*

Desired Outcome:

- *The learners will be sensitized about the adverse effects of pollution and* the *impact on biodiversity and measures to control it.*

3.1 Air Pollution

3.1.1: Types and sources of air pollutant

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

3.2 Water Pollution

3.2.1: Types and sources of water pollutant

3.2.2: Effects of water pollution on organisms, 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

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, C*alotes*, 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 capittis*), 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 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 occulometer 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

Course Code	Unit	Title	Credits
SBSZOO401		**LIFE PROCESSES**	2 Credits (45 lectures)
	1	Nutrition and Excretion	15 lectures
	2	Respiration and Circulation	15 lectures
	3	Locomotion andControl and coordination	15 lectures
SBSZOO402		**BIOCHEMISTRY & HISTOLOGY**	2 Credits (45 lectures)
	1	Enzymology	15 lectures
	2	Molecular Biology	15 lectures
	3	Histology	15 lectures
SBSZOO403		**APPLIED ZOOLOGY- II**	2 Credits (45 lectures)
	1	Economic Entomology	15 lectures
	2	Fisheries	15 lectures
	3	Dairy Science	15 lectures
		PRACTICALS	
SBSZOOP4		Practicals based on both the courses	3 Credits

SYSBC ZOOLOGY SYLLABUS - SEMESTER IV

THEORY COURSE – SBSZOO401

LIFE PROCESSES

Unit 1: Nutrition, Excretion and Osmoregulation **(15 Lectures)**

Objectives:

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

Desired outcome:

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

1.1 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)**

Objectives:

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

Desired outcome:

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

2.1 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)**

Objectives:

- *To expose the learner to various locomotory structures of different classes of organisms.*
- *To introduce the concepts of control and coordination mechanism seen in invertebrates and vertebrates.*
-

Desired outcome:

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

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

Unit 1: Enzymology **(15 Lectures)**

Objectives:

- *To introduce to the learner the fundamental concepts of enzyme biochemistry*
- *To enable the learner, realize applications of enzymes in basic and applied sciences.*

Desired outcome:

- *Learner would understand fundamentals of enzyme classification and structure*
- *Learners would be able to comprehend the mechanism of enzyme action and its kinetics.*

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)**

Objectives:

- *To introduce the learner to the concept of central dogma of molecular biology.*
- *To familiarize the learner with the concept of gene expression and regulation.*
- *Learner will understand the molecular processes involved at gene level*
- *Learner would comprehend and appreciate the regulation of gene expressions*

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

Objective:

- *To introduce the learner to histological structure of some of the endocrine and exocrine glands*

Desired outcome:

- *Learner would understand the normal histology of some of the important glands*
- *Learner would be able to interpret changes cellular architecture in research studies like toxicology*

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

Unit1: Economic Entomology **(15 Lectures)**

Objectives:

- *To introduce the economic importance of Zoology*

Desired outcome:

- *Learner would understand the how the study of Zoology impacts the economic world*

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)**

Objectives:

- *To orient learners towards various types of Indian fisheries*
- *To impart knowledge regarding the scope of fishery as a resource in India.*

Desired Outcome:

- *Learner shall appreciate the scope of fishery in India, especially because Mumbai is a coastal region.*
- *Learner will gain information regarding various aspects of fishery industry and may explore this as a future entrepreneurial prospect.*

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 seiene, Lines and hooks

2.3 Fishery biology of commercially important fishes : Catla, Rohu, Catfish, Mackeral, 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)**

Objectives:

- *To comprehend the functioning of various aspects of dairy industry.*
- *To study different indigenous cattle breeds including buffalo breeds of India.*
- *To develop an understanding of the different aspects of dairy processing and dairy product.*

Desired Outcome:

- *Learner would gain knowledge on the functioning of various aspects of dairy industry, indigenous cattle and buffalo breeds in India.*
- *Learner will gain information regarding various aspects of dairy industry and may explore this as a future entrepreneurial prospect.*

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: SBSZOOP4

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, Mackeral, 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 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)
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 marks0
	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)