

Hindi Vidya Prachar Samiti's

# **Ramniranjan Jhunjhunwala College of Arts, Science and Commerce**

**(Autonomous)**

**Affiliated to University of Mumbai**



## **Syllabus for F.Y.B.Sc.**

### **Semester I & II**

### **Program: B.Sc.**

### **Course: Zoology**

**(CBS 2019-20)**

**F.Y.B.SC. ZOOLOGY SYLLABUS**  
**DISTRIBUTION OF TOPICS AND CREDITS**

**SEMESTER I**

Course code	Paper and Title	Unit	Topic	Credits
RJSUZOO101	Paper I Animal Diversity-I, Ecology- I and Biodiversity & Conservation	I	Levels of organization and classification of animal kingdom-I	02
		II	Ecology-I	
		III	Biodiversity and Conservation	
RJSUZOO102	Paper II Biomolecules-I, Basic Biotechnology and Laboratory safety & Measurement	I	Biomolecules-I	02
		II	Basic Biotechnology	
		III	Laboratory safety, Units and Measurement	
RJSUZOOP101 & 102.			Practicals based on Paper I and II	02

**SEMESTER II**

Course code	Title	Unit	Topic	Credit
RJSUZOO201	Paper I Animal Diversity II, Ecology-II & Ethology	I	Classification of Animal kingdom-II	02
		II	Ecology-II	
		III	Basics of ethology	
RJSUZOO202	Biomolecules-II, Health ,Hygiene and Health Hazards & Instrumentation	I	Biomolecules-II	02
		II	Health, Hygiene and Health hazards	
		III	Instrumentation	
RJSUZOOP201 & 202			Practicals based on Paper I and II	02

**F.Y.B.Sc ZOOLOGY -SEMESTER I (THEORY)**

**PAPER I- ANIMAL DIVERSITY-I, ECOLOGY- I AND BIODIVERSITY & CONSERVATION**

**COURSE CODE: RJSUZOO101**

**Total Credits-02**

**Course Objectives:**

1. *To introduce the basic structural organization and classification of living organisms.*
2. *To understand the concepts of ecology.*
3. *To familiarize the learners with the biodiversity and strategies of conservation.*

**Expected Outcome:**

1. *The learners will be able to identify and associate the phylum with specific structural organization.*
2. *Learners will understand the interaction and effects of various biotic and abiotic factors.*
3. *Learners will perceive the significance of biodiversity and its conservation.*

**UNIT I: Levels of organization and classification of Animal kingdom-I (15 lectures)**

**1.1: Levels of organization**

- 1.1.1: Unicellularity vs. multicellularity: Colonization and organization of germ layers (diploblastic and triploblastic condition).
- 1.1.2: Division of labour and organization of tissues (brief fate of ectoderm, mesoderm and endoderm).
- 1.1.3: Development of coelom: acoelomate, pseudocoelomate and eucoelomate.
- 1.1.4: Types of symmetry: Asymmetry, Radial and bilateral symmetry.
- 1.1.5: Segmentation and cephalization.

**1.2: Salient features with examples of phyla, subphyla and classes mentioned below**

- 1.2.1: Multicellular organization: Colonization level- Phylum Porifera.
- 1.2.2: Multicellular organization: Division of labour (cell differentiation)-Phylum Coelenterata.
- 1.2.3: Acoelomate organization - Phylum Platyhelminthes.
- 1.2.4: Pseudo coelomate organization - Phylum Nematelminthes.
- 1.2.5: Triploblastic coelomate organization
  - a) Animals with metameric segmentation- Phylum Annelida.
  - b) Animals with jointed appendages- Phylum Arthropoda.
  - c) Animals with mantle- Phylum Mollusca.
  - d) Animals with enterocoel-Phylum Echinodermata.

**UNIT II: Ecology-I**

**(15 lectures)**

**2.1 Overview of Ecology**

**2.2 Physical Factors:**

2.2.1 Edaphic: Soil formation, Components of Soil, Types of soil and Soil Profile.

2.2.2 Light: Relation to terrestrial and aquatic habitat, photoperiodism, diurnal migration, adaptations of animals to dark.

2.2.3 Temperature: range, tolerance, Bergman's Principle, Allen's Rule, effects of temperature on living organisms.

2.2.4 Biogeochemical Cycles: oxygen, carbon, sulphur, nitrogen, phosphorus, human activities affecting biogeochemical cycles.

**UNIT III: Biodiversity and Conservation**

**(15 lectures)**

**3.1: Introduction to Biodiversity** - Definition, Concept and Scope.

**3.2: Levels of Biodiversity** -Genetic, Species and Ecosystem Biodiversity.

**3.3: Biodiversity Hotspots**- Western Ghats and Indo-Burma Border.

**3.4: Threats to Biodiversity** - Habitat loss and Man-Wildlife conflict.

**3.5: Biodiversity Conservation and Management:**

3.5.1: Conservation strategies: *in situ*, *ex-situ*, National parks, Sanctuaries and Biosphere reserves.

3.5.2: International efforts : Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN), United Nations Environment Program - World Conservation Monitoring Centre (UNEP-WCMC).

**PAPER II- BIOMOLECULES-I, BASIC BIOTECHNOLOGY AND LABORATORY SAFETY & MEASUREMENT**

**COURSE CODE: RJSUZOO102**

**Total Credits-02**

**Course Objectives:**

1. *To appreciate the structure and function of biomolecules.*
2. *To introduce the concept of biotechnology and the techniques involved in transgenesis and cloning.*
3. *To introduce the basic laboratory techniques and biostatistics.*

**Expected Outcome:**

1. *The learners will understand the structure- function relationship.*
2. *Learners will comprehend the methods of transgenesis and various ethical issues associated with it. They will get familiarized with the applications of biotechnology.*
3. *Learners will understand the importance of accuracy, precision and reproducibility in experiments. Use of different statistical methods of representation of biological data*

**UNIT I: Biomolecules-I**

**(15 lectures)**

**1.1: Basic biochemistry:** Concept of monomers & polymers, Role and significance of carbon, types of chemical bonds. Water- role as universal solvent, properties of water.

**1.2: Carbohydrates**

1.2.1: Nomenclature and isomerism.

1.2.2: Glycosidic bond.

1.2.3: Classification of carbohydrate.

a. Monosaccharides- galactose & fructose

b. Disaccharides- sucrose & lactose

c. Polysaccharides- Starch, cellulose, glycogen, chitin

1.2.4: Biological role of carbohydrates.

**1.3:Nucleic Acids**

1.3.1: Structure (structure of purine & pyrimidine bases, hydrogen bonding between nitrogenous bases in DNA, structure of nucleosides, nucleotides and polynucleotides) & functions of nucleic acids.

1.3.2: Properties and types of DNA (A, B, & Z) & RNA.

1.3.3: Differences between DNA and RNA.

## **UNIT II: Basic Biotechnology**

**(15 lectures)**

### **2.1: Concept of Biotechnology**

2.1.1: Definition

2.1.2: An overview of achievements and scope (fishery, animal husbandry, medical, industrial, agricultural).

### **2.2: Transgenesis and cloning**

2.2.1 Methods of transgenesis: Retroviral method, nuclear transplantation method, DNA micro injection method and embryonic stem cell method.

2.2.2. Animal Cloning (Dolly experiment).

2.2.3 Ethical issues of transgenic and cloned animals.

### **2.3: Applications of Biotechnology**

2.3.1 Forensic biotechnology: DNA fingerprinting; Technique in brief and its application in forensic science (Crime Investigation).

2.3.2: Enzyme Technology:

a. Bio-detergents

b. Concept of enzyme immobilization.

c. Enzymes as meat tenderizer.

2.3.3: Medical biotechnology:

a. Recombinant DNA in medicines (recombinant insulin).

b. Gene therapy: Ex-vivo and *In vivo*, Severe Combined Immunodeficiency (SCID), Cystic Fibrosis.

2.3.4: Environmental Biotechnology:

a. Bioremediation: Concepts and applications.

b. Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and petrochemicals.

## **UNIT III: Laboratory safety, Units and Measurement**

**(15 lectures)**

### **3.1: Introduction to good laboratory practices.**

**3.2: Use of safety symbols:** meaning, types of hazards and precautions.

### **3.3: Units of measurement:**

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

3.3.2: Temperature: Celsius, Fahrenheit, Kelvin.

3.3.3: Concentrations: percent solutions, ppt, ppm, ppb dilutions, normality, molarity and molality.

**3.4: Biostatistics:** Introduction and scope, sampling and its types, central tendencies (mean, median, and mode), graphical representations (histograms, bar diagrams, pie diagrams).

**PRACTICAL SYLLABUS FOR SEMESTER I**

**Total Credits: 02**

**Course Objectives:**

1. To study the animal classification.
2. To perform soil and water analysis of selected parameters.
3. To understand the significance of qualitative estimation. To get trained in sterilization techniques.

**Expected Outcome:**

1. The learners should identify and classify the animals based on their external features into phylum and class.
2. The learners will develop the analytical thinking and calculation skills.
3. A short excursion will inculcate the discipline and experience of field work.

**Course Code: RJSUZOOP101 PRACTICAL I (Based on Paper I)**

1. Levels of organization in Animal kingdom
  - A) Symmetry: i) Asymmetric organization: *Amoeba*  
ii) Radial symmetry: Sea anemone, *Aurelia*  
iii) Bilateral symmetry: *Planaria*
  - B) Acoelomate: T.S. of *Planaria*
  - C) Pseudocoelomate: T.S. of *Ascaris*
  - D) Coelomate : T.S. of Earthworm
  - E) Segmentation i) Pseudosegmentation: Tapeworm  
ii) Metamerism: Earthworm  
iii) Specialization of body parts for division of labour: Head, thorax and abdomen - Insect
  - F) Cephalization i) Cockroach – Head  
ii) Prawn/ crab – Cephalothorax
2. Animal Diversity -I
  - Porifera: *Leucosolenia*, Bath sponge
  - Coelenterate: *Hydra*, *Obelia* colony, *Aurelia*, Sea anemone and coral (any one)
  - Platyhelminthes: *Planaria*, Liver fluke and Tapeworm
  - Nematelminthes: *Ascaris*- male and female
  - Annelida: *Nereis*, Earthworm and Leech
  - Arthropoda: Lobster, *Lepisma*, Beetle, Butterfly, Moth, Spider, Centipede, Millipede
  - Mollusca: *Chiton*, *Dentalium*, *Pila*, Bivalve, *Sepia* and *Nautilus*
  - Echinodermata: Starfish, Brittle star, Sea urchin, Sea cucumber, Feather star.
3. Determination of soil pH: by pH meter, universal indicator, pH paper.
4. Estimation of salinity by refractometer.
5. Study of Biodiversity hotspots using world map.
6. Study of peculiar animals found in the world biodiversity hotspots.
7. Field visit and report submission.

**Course Code: RJSUZOOP102      PRACTICAL II (Based on Paper II)**

1. Qualitative tests for carbohydrates.
2. Extraction and qualitative detection of nucleic acids:
  - DNA (SDS-NaCl extraction),
  - RNA (Phenol extraction)
3. Aseptic techniques: Packaging of test tubes, pipettes, petriplates and conical flask.
4. Aseptic transfer of liquids between burners. (Demonstration)
5. Assay of immobilized invertase from immobilised yeast cells by DNSA method (visual observation for comparative colour intensity in test tube)
6. To demonstrate fermentation of grape juice/sugar cane juice or any fruit juice – (Detection of alcohol generated during fermentation by benzoic acid).
7. Effect of Papain (raw papaya extract) as a meat tenderizer.
8. Study of central tendencies and plotting of Bar diagram, histogram and pie diagram.
9. Problem based on concentrations: percent solutions, normality, molarity, molality.

**SEMESTER II (THEORY)**  
**PAPER I-ANIMAL DIVERSITY II, ECOLOGY II & ETHOLOGY**

**COURSE CODE: RJSUZOO201**

**Total Credits-02**

**Course Objectives:**

1. To understand taxonomy of higher and lower chordates.
2. To introduce concepts of population ecology.
3. To familiarize the learners with basics of ethology.

**Expected Outcome:**

1. The learners will be able to identify and associate the phylum with specific structural organization.
2. Learners will understand the significance of population dynamics.
3. Learners will appreciate the evolution of behavior and its various types.

**UNIT I: Classification of Animal kingdom-II**

**(15 lectures)**

**1.1: Phylum Hemichordata**

**1.2: Phylum Chordata**

1.2.1: Subphylum: Urochordata

1.2.2: Subphylum: Cephalochordata

1.2.3: Subplylum: Vertebrata

I. Division: Agnatha; Class Cyclostomata

II. Division: Gnathostomata

A. Super class: Pisces

i. Class Chondrichthyes

ii. Class Osteichthyes

B. Super class: Tetrapoda

i. Class Amphibia

ii. Class Reptilia

iii. Class Aves

iv. Class Mammalia

**UNIT II: Ecology-II**

**(15 lectures)**

**2.1: Concepts of Ecosystem:**

Components of ecosystem, energy flow in ecosystem, food chain and food web, energy pyramids.

**2.2: Population Ecology:**

Concept, Factors influencing population dynamics: natality, mortality, migration, density, age structure and sex ratio, fecundity, growth curves and survivorship curves.

**2.3: Animal Interactions:** Concept, Positive and negative interactions, ecological significance.

**UNIT III: Basics of Ethology**

**(15 lectures)**

**3.1: Development of Behaviour:**

Ontogeny of behaviour, sensitive periods during development e.g bird song development.

**3.2: Innate behaviour:** Fixed Action Plan, orientation, taxes, irritability.

**3.3: Learned behaviour:** Conditioned reflex, habituation, sensitization, instrumental learning and operant behaviour.

**3.4: Protective behaviour:** Camouflage, warning colouration, Mimicry- Batesian & Mullerian, adaptive & evolutionary significance of mimicry.

**PAPER II-BIOMOLECULES-II, HEALTH, HYGIENE AND HEALTH HAZARDS & INSTRUMENTATION**  
**COURSE CODE: RJSUZOO202 Total Credits-02**

**Course Objectives:**

1. *To appreciate the structure and function of biomolecules.*
2. *To comprehend various health problems arising due to unhygienic conditions.*
3. *To introduce the principle of laboratory instruments their use and maintenance.*

**Expected Outcome:**

1. *The learners will understand the structure function relationship of lipids and proteins.*
2. *Learners will inculcate good personal and public sanitary habits. They will be aware of effects of excessive use of gadgets.*
3. *Learners will know the use of various instruments in a scientific inquiry.*

**UNIT I: Biomolecules-II**

**(15 lectures)**

**1.1: Lipids**

1.1.1: Classification of Lipids

1.1.2: Types of Fatty Acids (Saturated & Unsaturated)

1.1.3: Biological roles of lipids

1.1.4: Overview of Phospholipids, Glycerides (mono, di & tri)

**1.2: Proteins**

1.2.1: Amino acids- basic structure, types based on carboxylic, amino & aromatic groups, essential, semi-essential & non-essential amino acids, amino acid pool.

1.2.2: Peptide bond.

1.2.3- Structure of protein- primary, secondary, tertiary and quaternary

1.2.4- Biological role of proteins

**1.3: Vitamins**

1.3.1: Types & Classification (water soluble & lipid soluble).

1.3.2: Functions of vitamins.

**UNIT II: Health, Hygiene & Health Hazard**

**(15 lectures)**

**2.1: Health**

2.1.1: Definition of Health, need for health education.

2.1.2: Physical, psychological and social health issues.

2.1.3: Water and water supply, standards of potable water.

2.1.4: Purification of water: small scale, medium scale and large scale (rapid sand filters)

2.1.5: Water footprint: concept, brief account and significance.

## **2.2: Hygiene**

2.2.1: Hygiene and health factors at home.

2.2.2: Personal hygiene, oral hygiene and sex hygiene.

## **2.3: Health Hazards**

2.3.1: Radiation risk: Mobile cell tower and electronic gadgets (data of recommended level, effects and precaution).

2.3.2: Ill-effects of self-medication.

## **UNIT III: Instrumentation**

**(15 lectures)**

**3.1: Microscope** (dissecting and compound): Principle, SOP and applications.

**3.2: Analytical balance:** Principle, SOP and applications.

**3.3: Colorimetry and spectroscopy:** Principle, SOP and applications.

**3.4: pH meter:** Principle, SOP and applications.

**3.5: Centrifuge** (clinical and ultra-centrifuge): Principle, SOP and applications.

**3.6: Electrophoresis** (AGE, PAGE): Principle, SOP and applications.

**3.7: Instruments for sterilization:** Autoclave, Incubator, Laminar overflow: Principle, SOP and applications.

**3.8: Chromatography** (paper, TLC, adsorption): Principle and applications.

**PRACTICAL SYLLABUS FOR SEMESTER II**

**Total Credits: 02**

**Course Objectives:**

1. To classify animals into different phyla and class based on external morphology.
2. To introduce methods used in population density.
3. To identify different associations of animals.
4. To get hands on training on basic laboratory instruments.
5. To familiarize the learners with chromatography techniques.

**Expected Outcome:**

1. The learners will identify the animals and classify them.
2. Learners will be able to calculate basic parameters used in population studies.
3. Learners will know the use of various instruments used in a scientific inquiry.
4. Learners will know the use and application of different chromatography techniques.

**Course Code: RJSUZOOP201      PRACTICAL I (Based on Paper 1)**

**1. Animal Diversity-II**

- a) Hemichordata: *Balanoglossus*
- b) Urochordata: *Herdmania*
- c) Cephalochordata: *Amphioxus*
- d) Cyclostomata: *Petromyzon*
- e) Pisces: Chondrichthyes: Shark, Sting ray  
Osteichthyes: *Sciaena*, *Synagris*
- f) Amphibia: *Caecilian*, Salamander, Frog, Toad,
- g) Reptilia: Turtle, Chameleon, Cobra, Crocodile.
- h) Aves: Kite, Kingfisher, Duck
- i) Mammalia: Platypus, Kangaroo, Shrew, Dolphin, Bat

**2. Determination of population density;**

- a. Subsampling method using *Daphnia*.
- b. Capture-recapture method using rice weevil.

**3. Interpretation of the given graphs/ tables and comment on pattern of population nature:**

- a) Survivorship curve
- b) Age structure
- c) Sex ratio

**4. Calculation of natality, mortality, fecundity w.r.t. population studies.**

**5. Interpretation of Growth curves (Sigmoid and J shaped).**

6. Study of animal interaction:

- a) Commensalism: Hermit crab and sea anemone, *Echinus* and shark
- b) Mutualism: Termite and *Trichonympha*
- c) Antibiosis: Effect of antibiotic on bacterial growth on a petri plate
- d) Parasitism: Ectoparasite – head louse and bed bug  
Endoparasite: *Trichinella spiralis*
- e) Predation: Praying mantis and spider

7. Study of Mimicry: Leaf insect, stick insect, Dead leaf butterfly (*Kallima*), Monarch butterfly and common tiger butterfly (Danais)

8. Study of Warning Colouration in animals: Coral snake, strawberry poison dart frog, chameleon, honey badger, blue ring octopus.

**Course Code: RJSUZOOP202 PRACTICAL II (Based on Paper 2)**

- 1. Qualitative tests for proteins.
- 2. Separation of amino acids by paper chromatography.
- 3. Thin layer chromatography of lipids
- 4. Adsorption (Column) chromatography using chalk to separate mixture of dye.
- 5. Qualitative tests for lipids.
- 6. Qualitative estimation of Vitamin C by Iodometric method
- 7. Study of Microscope: Use, care and functions of its components.
- 8. Study of microbial flora of water by Gram's staining.
- 9. Estimation of total hardness of water.
- 10. Handling of common laboratory equipment: Burner, balance, homogenizer, colorimeter, pH meter, centrifuge.
- 11. Sterilization techniques: Autoclave, Oven, Laminar air flow.
- 12. Electrophoresis apparatus: AGE, PAGE.

**SCHEME OF EXAMINATION (FOR BOTH SEMESTERS)**

**Internal examination**

The first internal class test comprising of 20 marks shall consist of 20 multiple choice questions with equal weightage.

The second class test also comprising of 20 marks shall consist of 20 multiple choice questions with equal weightage.

**External theory paper pattern**

**Total: 60 marks**

**Q.1 Based on Unit I..... 15M**

a. 8 M

b. 7 M

**OR**

a. 5 M

b. 5M

c. 5M

**Q.2 Based on Unit II.....15M**

a. 8 M

b. 7 M

**OR**

a. 5 M

b. 5M

c. 5M

**Q.3 Based on Unit III.....15M**

a. 8 M

b. 7 M

**OR**

a. 5 M

b. 5M

c. 5M

**Q.4 Short notes (mixed on all units).....15M (5marks each)**

a or a (Unit I)

b or b (Unit II)

c or c (Unit III)

**QUESTION PAPER FOR PRACTICAL EXAMINATION  
SEMESTER I**

**PRACTICAL I**

**Total marks: 50**

<b>Q.1 Major experiment-</b> Soil pH/ Salinity of water	08M
<b>Q.2 Identify and comment on the level of organization.</b> (symmetry /coelom/segmentation/cephalization)	03M
<b>Q.3 Identify and Classify with reasons.</b>	15M
a. One specimen from Porifera/Coelenterata	
b. One specimen from Platyhelminthes/Nemathelminthes	
c. One specimen from Annelida/Arthropoda	
d. One specimen from Mollusca	
e. One specimen from Echinodermata	
<b>Q.4 Identification of Biodiversity hotspots using map/peculiar animals of hotspots.</b>	04M
<b>Q.5 Field report</b>	10M
<b>Q.6 Viva</b>	05M
<b>Q.7 Journal</b>	05M

**PRACTICAL II**

**Total marks: 50**

<b>Q.1 Major experiment-</b> Extraction of DNA/RNA/ Assay of immobilized enzyme	12M
<b>Q.2 Minor experiment-</b> Fermentation/Papain as meat tenderizer/aseptic techniques	08M
<b>Q.3 Problems based on biostatistics</b>	10M
a. Central tendency	
b. Graphical presentation of data	
<b>Q.4 Problems based on concentration calculations</b>	10M
a. % solutions	
b. Normality/ Molarity/molality	
<b>Q.5 Viva</b>	05M
<b>Q.6 Journal</b>	05M

**QUESTION PAPER FOR PRACTICAL EXAMINATION**

**SEMESTER II**

**PRACTICAL I**

**Total marks: 50**

**Q.1 Major experiment**

09M

Estimation of population density of *Daphnia*/ Rice weevil

**Q.2 Identify and classify with reasons.**

12M

- Any one specimen from Hemichordata/Urochordata/Cephalochordata
- Any one specimen from Cyclostomata/ Pisces
- Any one specimen from Amphibia/ Reptilia
- Any one specimen from Aves/Mammalia

**Q.3 Identify and Comment on**

09M

- One specimen from mimicry
- One specimen from warning colouration
- One specimen from animal interaction.

**Q.4 Problems based on population ecology (2 problems)**

10M

(Natality/Mortality/Fecundity/Sex ratio)

**Q.5 Viva**

05M

**Q.6 Journal**

05M

**PRACTICAL II**

**Total marks: 50**

**Q.1 Major experiment– Paper chromatography/ Grams staining/Hardness**

12M

**Q.2 Minor experiment**

a. Chromatography (Column/TLC)

07M

b. Qualitative tests (Lipids/Vitamin C/Proteins)

05M

**Q.3 Identify and describe the principle/working/uses.**

16M

a, b, c & d (Any 4 instruments studied in practical)

**Q.4 Viva**

05M

**Q.5 Journal**

05M

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