

Jiwaji University, Gwalior, B. Sc. Honors 2019-22**ZOOLOGY Honors****Subject-Zoology****Year- 2019-2022**

Year	Type of Paper	Paper Code	Name of the Paper	Marks		
				CCE	Yearly Exam	Total
I Year	Pass Course I	BOZ-101	Animal Diversity, Animal Forms & Functions	10	40	50
	Pass Course II	BOZ -102	Fundamentals of Cell Biology	10	40	50
	Honor's Course-I	BOZ -103	Fundamental Anatomy of Non-Chordates and Chordates	10	40	50
	Practical-Pass Course	BOZ -104	Practical-I [Based on BOZ-101 & BOZ-102]	-	50	50
	Practical-Honors Course	BOZ -105	Practical-II [Based on BOZ-103]	-	25	25
II Year	Pass Course I	BOZ -201	Elementary Biochemistry	10	40	50
	Pass Course II	BOZ -202	Basic Genetics and Evolution	10	40	50
	Honor's Course-I	BOZ -203	Mammalian Physiology and Endocrinology	10	40	50
	Honor's Course-I	BOZ -204	Systematics, Evolution, Ecology and Animal Behaviour	10	40	50
	Practical-Pass Course	BOZ -205	Practical-I [Based on BOZ-201 & BOZ-202]	-	50	50
	Practical-Honors Course	BOZ -206	Practical-I [Based on BOZ-203 & BOZ-204]	-	50	50
III Year	Pass Course I	BOZ -301	Developmental Biology and Fundamental Endocrinology	10	40	50
	Pass Course II	BOZ -302	Economic Zoology	10	40	50
	Honor's Course-I	BOZ -303	Biochemistry, Molecular Biology and Bio-techniques	10	40	50
	Honor's Course-I	BOZ -304	Cell Biology, Genetics and Immunology	10	40	50
	Practical-Pass Course	BOZ -305	Practical-I [Based on BOZ-301 & BOZ-302]	-	50	50
	Practical-Honors Course	BOZ -306	Practical-I [Based on BOZ-303 & BOZ-304]	-	50	50

Relius Bivandani

Year-I Zoology

BOZ 101: Animal Diversity, Animal Form & Function

Unit-I

1. Criteria for classification of multicellular animals

- 1.1 Symmetry
- 1.2 Early development: spiral and radial cleavage Protostomes and Deuterostomes
- 1.3 Body cavities: acoelomates, pseudocoelomates, coelomates (schizo- and enterocoelomates)
- 1.4 Homology and analogy

Unit-II

2. Non Chordates: General characters and classification of the following up to classes with examples showing distinctive features -I

- 2.1 Protozoa
- 2.2 Porifera
- 2.3 Cnidaria
- 2.4 Ctenophora
- 2.5 Platyhelminthes

3. Non Chordates: General characters and classification of the following up to classes with examples showing distinctive features -II

- 3.1 Nematoda
- 3.2 Annelida
- 3.3 Arthropoda
- 3.4 Mollusca
- 3.5 Echinodermata

4. Hemichordates: General characters and classification up to sub-classes

Unit-III

5. Chordates: General characters and classification of the following up to Sub-classes/ orders with examples showing distinctive/adaptive features

- 5.1 Protochordates: Urochordates, Cephalochordates
- 5.2 Cyclostomes
- 5.3 Pisces
- 5.4 Amphibians
- 5.5 Reptiles
- 5.6 Aves
- 5.7 Mammals

Unit-IV

6. Mode of Feeding and Digestion

- 6.1 Feeding mechanisms: suspension, deposit, cropping and sucking (herbivorous) and raptorial (carnivorous)
- 6.2 Intracellular and extracellular digestion: food vacuole and gastro vascular cavity

7. Respiratory Organs and Pattern of Circulation

- 7.1 Structure and function of gills, trachea, book lungs and vertebrate lungs
- 7.2 Pattern of circulation in non chordates and chordates

8. Types of excretion and Mode of Excretion

- 8.1 Open tubular: metanephridia
- 8.2 Closed saccular: protonephridia, Malpighian tubules and kidney

Unit-V

9. Nervous system

- 9.1 Patterns of nervous system in non-chordates
- 9.2 Organization of nervous system in vertebrates: central and autonomic system

10. Receptors and sense organs

- 10.1 Phonoreception in fish and mammals
- 10.2 Photoreception in insects and mammals

11. Reproduction

- 11.1 Types of asexual reproduction: fission, regeneration and parthenogenesis
- 11.2 Sexual reproduction: primary and accessory sex organs and their functions

Books Suggested

1. Miller & Harley: Zoology (6th ed. 2005, Brown)
2. Purves et al: Life-the Science of Biology, (7th ed. 2004, Sinauer)
3. Campbell & Reece: Biology (7th ed. 2005, Pearson)
4. Dorit, Walker & Barnes: Zoology (1991, Saunders)
5. Taylor, Green & Stout : Biological Sciences (3rd ed. 2005, Cambridge)
6. Mader: Biology (9th ed. 2007, Brown)
7. Kotpal: Modern text book of Zoology: Invertebrates (11th ed. 2016 Rastogi)
8. Kotpal: Modern text book of Zoology: Vertebrates (4th ed. 2016 Rastogi)
9. Jordan & Verma: Invertebrate Zoology (Reprint 2014, S. Chand)
10. Jordan & Verma: Chordate Zoology (Reprint 2014, S. Chand)
11. Nigam: Biology of Non-chordates (1997, S Chand) 12 Nigam: Biology of Chordates (1997, S Chand)

BOZ 102: Fundamentals of Cell Biology

Unit-I

1. The Cell and Organization of cell

- 1.1 Comparison of a generalized pro- and eukaryotic cell
- 1.2 Elementary knowledge of structure and function of plasma membrane
- 1.3 Introduction to endo membrane system (endoplasmic reticulum, Golgi complex, lysosome), peroxisome
- 1.4 Introduction to cytoskeleton

Unit-II

2. Organization of cell

- 2.1 Structure and functions of mitochondria
- 2.2 Nuclear envelope, nucleolus and biogenesis of ribosome
- 2.3 Interphase chromatin and its compaction into metaphase chromosome
- 2.4 Introduction to polytene and lampbrush chromosomes
- 2.5 Methods in Cell biology: Elementary idea of microscopy and cell fractionation

Unit-III

3. Cell Reproduction

- 3.1 Basic features of cell cycle
- 3.2 Mitosis, mitotic spindle and chromosome movement
- 3.3 Process and phases of meiosis and its significance
- 3.4 Regulation of cell cycle

Unit-IV

4. Cell Surface

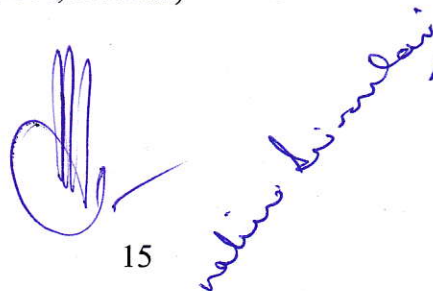
- 4.1 External environment of the cell
- 4.2 Extra Cellular Structure and Extra Cellular messengers
- 4.3 Cell receptors
- 4.4 General idea of Cell signaling molecules and signal transduction pathway (GPCR)

Unit-V

- 5.2 Cell Junctions
- 5.3 Cell Adhesion molecules and cell-cell Interaction
- 5.4 Apoptosis
- 5.5 Cell transformation, malignancy and Cancer

Books Suggested

1. Alberts et al: Molecular Biology of the Cell (2008, Garland)
2. Lodish et al: Molecular Cell Biology (2008, Freeman)


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BOZ 103: Fundamental Anatomy of Non-Chordate and Chordate

Unit-I

- 1. Protozoa:** Study of *Euglena* and *Monocystis* (locomotion, nutrition and reproduction)
- 2. Origin of Metazoans**
 - 2.1 Germ layers, diploblastic and triploblastic organization
- 3. Cnidaria and Ctenophora**
 - 3.1 Study of *Obelia* and *Aurelia* (Structure and reproduction)
 - 3.2 Salient features of ctenophores and comparison with cnidarians
- 4. Platyhelminthes:** *Fasciola* (Liver Fluke) and *Taenia* (Structure, reproduction, life-cycle and parasitic adaptations)
- 5. Nematelminths:** *Ascaris* (Structure, reproduction, life-cycle and parasitic adaptations)
- 6. Annelida**
 - 6.1 *Nereis*: Structural features and reproduction

Unit-II

- 7. Arthropoda:** *Palaemon* (structural features and reproduction), Types of metamorphosis in insects
- 8. Mollusca**
 - 8.1 *Unio*: Structural features and reproduction
 - 8.2 Torsion and distortion in gastropods
- 9. Echinodermata**
 - 9.1 *Asterias*: Structural features and hydrostatic system
 - 9.2 Larval forms of Echinoderms and their significance
- 10. Origin of vertebrates**

Unit-III

- 11. Integument and its derivatives**
 - 11.1 Structure of integument
 - 11.2 Scales, feathers, hair, claws, nails, hoofs, horns, antlers, glands
- 12. Endoskeleton**
 - 12.1 General plan of neuron cranium and dermato cranium.
 - 12.2 Jaw suspensorium
 - 12.3 Vertebrae
- 13. Digestive system**
 - 13.1 Modifications in relation to feeding habits:
length and surface area, internal folds and supplementary diverticular, ruminants stomach

13.2 Dentition in mammals

Unit-IV

14. Respiratory system

14.1 Aquatic respiration

- Cutaneous
- Branchial

14.2 Aerial respiration

- Accessory respiratory organs in fish
- Air-sacs in birds
- Lungs

15. Circulatory system

15.1 Aortic arches

15.2 Portal systems

15.3 Lymphatic system

Unit-V

16. Nervous system

16.1 Evolution of brain (cerebral hemispheres and cerebellum)

16.2 Neuromast organs of lower vertebrates

17. Urinogenital system

17.1 Excretory system

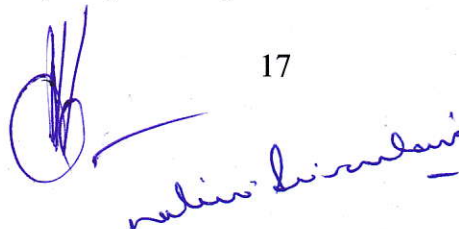
- Types and evolution of kidney tubules
- Urinary duct and bladder

17.2 Reproductive system

- General plan of gonads and urino-genital ducts
- Types of uterus

Books Recommended

1. Barnes: Invertebrate Zoology (4th ed. 1980, Holt-Saunders)
2. Barnes: The invertebrate (3rd ed. 2001 Blackwell)
3. Moore: An introduction to the invertebrates (2001 Cambridge)
4. Ekambaranath Aiyar: A manual of Zoology, Part I – Invertebrata, (1973, S. Vishwanatha)
5. Kotpal, Agarwal and Khetrapal: Modern Textbook of Zoology: Invertebrate, (1976, Rastogi)
6. Marshall: Parker and Haswell Textbook of Zoology, Vol. I (7th ed. 1972, Macmillan)
7. Nigam: Biology of Non-chordates (1985, S. Chand)
8. Jordon and Verma: Invertebrate Zoology (1995, S. Chand)
9. Millar and Harley: Zoology (6th ed. 2005, Brown)
10. Kardong: Vertebrates: Comparative Anatomy, Function, Evolution (Recent edition, Mcgraw Hill Education)
11. Kent: Comparative Anatomy of the Vertebrates (Recent edition, Mcgraw Hill Education)
12. Hildebrand: Analysis of Vertebrate Structure (1995, John Wiley)
13. Kotpal: Modern Text Book of Zoology Vertebrates (2003, Rastogi)
14. Nigam: Biology of Chordates (1983, S Chand)



15. Romer & Parsons: The vertebrate Body (6th ed. 1986, Saunders)
16. Walter & Sayles: Biology of the Vertebrates (1959, Macmillan)
17. Young: The Life of Vertebrates (1981 Clarendon)
18. Young: The Life of Mammals (1975 Clarendon)

BOZ 104: Lab. exercises based on Basic Paper (101 & 102)

1. Study of salient features and classification up to classes of the following non-chordates with special emphasis on their adaptive characters:
Amoeba, Euglena, Plasmodium, Paramecium, Euplectella, Physalia, Corallium, Hormiphora, Taenia, Ascaris (male and female), *Nereis* (including heteronereis stage), *Hirudinaria, Bonellia, Chiton, Mytilus, Octopus, Limulus, Eupagurus, Sacculina, Asterias, Echinus and Holothuria.*
2. Animal nutrition
 - Study and mounting of cephalic appendages of *Palaemon*
 - Dissection of digestive system of *Palaemon* and mounting of Hastate plate
 - Study of mouth parts of *Periplaneta americana*
 - Dissection of alimentary canal of *Periplaneta americana*
3. Study of ultra-structure of cell and different organelles from Electron Micrographs
4. Meiosis in Grasshopper testis
5. Mitosis in Onion root tips
6. Special type of Chromosomes (Polytene and Lamp brush)
7. Diversity of Eukaryotic cell methylene blue staining of buccal epithelium; Leishman staining of mammalian blood cells
8. Permeability of Plasma membrane: effect of isotonic, hypotonic and hypertonic solution on Mammalian RBC
9. Cell viability assay using Trypan blue

Practical Scheme: 104

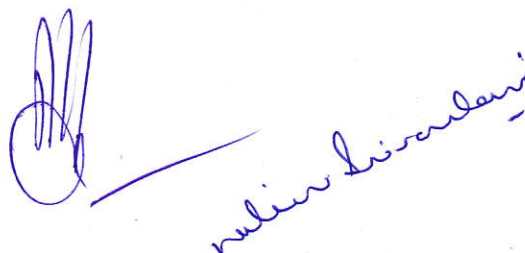
1. Dissection (Major)	10
2. Exercise based on chromosomal preparation from onion root tip/ Grasshopper testis to observed cell division stages.	08
3. Slide preparation of human blood smear to study different blood Cell types/ cell viability/ exercise on cell membrane transport.	06
4. Spotting	16
5. Viva-voce	06
6. Practical record	04
Total	50

BOZ 105: Lab. exercises based on Honor's Paper (103)

1. **Study of Museum specimens:** Non-Chordate and Chordate
2. **Histology:** Study of permanent slides of Non-Chordate and Chordate
3. **Dissection:**
Cockroach, External features, Salivary Glands, Reproductive System, Nervous System and Digestive System
Nervous System of Prawn and Pila
4. **Dissection of Fish:** Respiratory System, Reproductive System, Digestive System
5. **Bones:** Frog, Reptiles and Birds

Practical Scheme: 105

1. Major dissection	06
2. Minor dissection	3.5
3. Spotting	7.5
4. Viva-voce	05
5. Practical record	03
Total	25



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Year-II Zoology

BOZ 201: Elementary Biochemistry

UNIT-I

1. Introduction

- 1.1 Scope and importance of Biochemistry
- 1.2 Principle of biomolecular organization, configuration and conformation
- 1.3 Water as biological solvent
- 1.4 Water soluble and lipid soluble Vitamins

UNIT-II

2. Amino acid

- 2.1 Structure and classification
- 2.1 Properties of peptide bond

3. Proteins

- 3.1 Functions and diversity
- 3.2 Structural organization

UNIT III

4. Enzymes

- 4.1 General properties
- 4.2 Major classes of enzymes
- 4.3 Mechanism of enzyme action (ES complex and lowering of activation energy, concept of chemical catalysis)

5. Hormones: general properties and classification

6. Mechanism of hormone action

Unit-IV

7. Carbohydrates

- 7.1 Classification
- 7.2 Structure and conformation of monosaccharides
- 7.3 Reducing and non-reducing sugars
- 7.4 Oligo saccharides (disaccharides) and polysaccharides

8. Lipids

- 8.1 Biological significance and classification
- 8.2 Fatty acids: Types and nomenclature
- 8.3 Formation of lipid bilayer

Unit-V

9. Nucleic acids

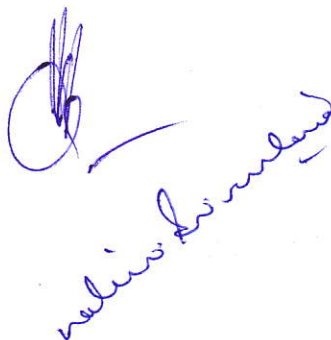
- 9.1 Bases, nucleosides and nucleotides
- 9.2 DNA structure: DNA double helix (Watson and Crick model)
- 9.3 DNA and RNA as genetic material
- 9.4 DNA replication
 - Semi-conservative replication
 - Basic mechanism (Prokaryotes)
- 9.5 Transcriptional unit and basic concept of transcription (Prokaryotes)
- 9.6 Genetic code and basic mechanism of translation (Prokaryotes)



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Books Recommended

1. Berg, Tymoczko, Stryer; Biochemistry (7th ed. 2012, Freeman)
2. Conn, Stumpf, Bruening & Doi: Principles of Biochemistry (5th ed. 1987, Wiley)
3. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth),
4. Zubay: Biochemistry (1998, McGraw-Hill)



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BOZ 202: Basic Genetics and Evolution

Unit- I

1. **Mendel's laws of inheritance**
2. **Extension of Mendelism**
 - Dominance relationships
 - Multiple allelism
 - Lethal alleles
 - Pleiotropy
 - Epistasis
 - Penetrance and expressivity
 - Phenocopy
 - Polygenic inheritance

Unit- II

3. **Application of laws of probability to Mendelian inheritance**
4. **Chromosomal basis of inheritance**
 - Cytoplasmic inheritance
 - Linkage and crossing over
5. **Sex chromosomes and sex-linkage**

Unit- III

6. **Chromosomal aberration**
Structural and Numerical changes in chromosomes
7. **Mutation**
Basis, Induction and types of mutation
8. **Genetic Disorders**

Unit- IV

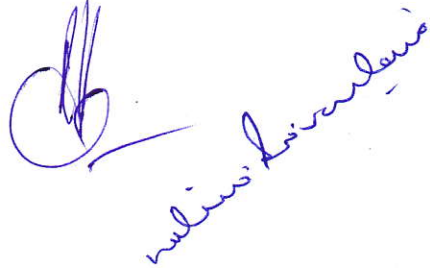
9. **Concept of organic evolution**
10. **Evidence of organic evolution** 4
 - Comparative anatomy
 - Comparative embryology
 - Paleontology
 - Biochemistry and genetics

Unit-V

11. **Theories of organic evolution** 4
 - Lamarckism
 - Darwinism
 - Development and concept of synthetic theory
 - Natural selection in action (industrial melanism, antibiotic and DDT resistance)
12. **Human evolution**

Books Recommended

1. Gardner et al: Principles of Genetics (2006, John Wiley)
2. Griffith et al: An Introduction to Genetic Analysis (Freeman, 2008)
3. Snustad & Simmons: Principles of Genetics (2012, John Wiley)
4. Futuyma: Evolutionary Biology (2005, Sinauer)
5. Hall and Hallgrímsson: Strickberger's Evolution (2008, Jones and Bartlet)
6. Hartl and Clark: Principles of Population Genetics (1989 & 1997, Sinauer)
7. Rastogi: Organic Evolution (2007, Kedarnath & Ramnath).



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BOZ 203: Mammalian Physiology and Endocrinology

Unit-I

1. Respiration

- Mechanism and regulation of breathing
- Transport of oxygen and carbon dioxide
- Respiratory quotient

2. Circulation

- Blood Circulation
- Introduction to Structure and function of Heart
- Cardiac cycle
- Introduction of ECG

3. Muscles

- Types
- Ultra-structure of skeletal muscle
- Muscle proteins

4. Chemistry of muscle contraction

Unit-II

5. Nutrition and Digestion

- Physiology of digestion in Mammals
- Protein Metabolism: Deamination, Decarboxylation, Transamination of amino acids, and ornithine cycle
- Carbohydrate Metabolism: Glycogenesis, Glycogenolysis, Glycolysis, Citric acid cycle and Gluconeogenesis
- Lipid Metabolism: Beta oxidation of fatty acids

6. Excretion

- Physiology of Excretion: Urea and Urine formation in Mammals
- Introduction of Nephron structure and function

7. Regulation of urine formation: Role of renin, ADH, aldosterone

Unit-III

8. Nervous System


- Types of neurons and glial cells
- Physiology of nerve impulse conduction
- Vision: Structure of Eye, retinal component and photoreceptors
- Hearing: Structure of ear and mechanoreceptors

Unit-IV

9. General mechanism of hormone action: Peptide and Steroid Hormone

10. Structure of Hypothalmo-Hypophysial system

11. Neuro and adinohypophysial Hormones and their Control



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12. Biosynthesis and regulation of: Thyroid, Parathyroid, Adrenal, Pancreas, Pituitary, and Gonadal Hormone

Unit-V:

13. Gastro intestinal Hormones

14. Hormonal disfunction

- Diabetes
- Goiter
- Tetany
- Addison's disease
- Cushing's syndrome

Books Recommended

1. Ganong: Review of Medical Physiology (22nd ed. 2005, Lange Medical)
2. Guyton and Hall: A text book of Medical Physiology (11th ed. 2006, Saunders).
3. Keele & Neil: Samson Wright's Applied Physiology (13th ed. 1989, Oxford)
4. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
5. Norris: Vertebrate Endocrinology, Fourth Edition, 2007, Academic Press



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BOZ 204: Systematic, Evolution, Ecology and Animal Behavior

Unit -I

- 1. Introduction to taxonomy and its relationship with Systematics**
- 2. Zoological nomenclature**
 - 4.1 Binominal
 - 4.2 Trinomial
- 3. Procedures: Taxonomic collections and Identification,**
- 4. Kinds of Taxonomic characters**
 - 4.1. Morphological
 - 4.2. Embryological
 - 4.3. Behavioral
 - 4.4. Ecological
 - 4.5. Cytogenetical
 - 4.6. Molecular taxonomy

Unit-II

- 5. Kinds of zoological classification**
- 6. Concept of species**
 - 6.1. Typological
 - 6.2. Biological
 - 6.3. Evolutionary
- 7. Speciation**
 - 9.1 Modes of Speciation: Allopatric and Sympatric
- 8. Isolating mechanisms**
- 9. Gene frequency in Mendelian population and Hardy-Weinberg equilibrium**

Unit-III

- 10. General Concepts:**
 - 10.1. Introduction to environmental biology
 - 10.2. Major ecosystems of the world
 - 10.3. Energy flow in ecosystem
 - 10.4. Productivity, Food chain and food web
 - 10.5. Ecological Succession

Unit-IV

- 11. Field Biology**
 - 11.1. Nature as a laboratory to study interaction among life forms
 - 11.2. Seasonal changes, habitat and diversity of life forms
 - 11.3. Association and role of human in the management of natural order
 - 11.4. Study biological rhythms in nature; cycle changes in life patterns of animals and plant in nature



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Unit-V

12. Concepts and patterned of Behavior
13. Environment and endocrine control of behaviors
14. Reproductive and social behavior
15. Biological rhythms
16. Migration: orientation and Navigation

Books Recommended

1. Alcock: Animal Behaviour: An Evolutionary Approach (10th ed 2015, Sinauer)
2. Drickamer, Vessey & Jakob: Animal Behaviour – Mechanisms, Ecology, Evolution (5th ed 2002, McGraw-Hill)
3. Dugatkin: Principles of animal behavior (3rd ed 2014, Norton & Company)
4. Manning & Dawkins (1998): An Introduction to Animal Behaviour (5th ed 1998, Cambridge)
5. Alcock: Animal Behaviour: An Evolutionary Approach (10th ed 2015, Sinauer)
6. Drickamer, Vessey & Jakob: Animal Behaviour – Mechanisms, Ecology, Evolution (5th ed 2002, McGraw-Hill)
7. Dugatkin: Principles of animal behavior (3rd ed 2014, Norton & Company)
8. Manning & Dawkins (1998): An Introduction to Animal Behaviour (5th ed 1998, Cambridge)



Relish Sivanlani

BOZ 205: Lab. exercises based on Basic Paper (201 & 202)

1. Ninhydrin test for α -amino acids
2. To demonstrate catalase activity and its inactivation by heat
3. Benedict's test for reducing sugars
4. Iodine test for starch
5. Determination of acid value of oil
6. Preparation of models of nitrogenous bases, nucleosides and nucleotides
7. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.
8. Familiarization with techniques of handling *Drosophila*, identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures.
9. Demonstration of law of segregation (monohybrid and test cross) sex-linked inheritance in *Drosophila* making a cross between white eyes dumpy winged or sepia eyed and wild type flies (cris- cross inheritance).
10. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides/photographs.
11. Adaptive modifications in feet of birds and mouth parts of insects
12. Natural Selection (Mimicry and Adaptations)
13. Trends in evolution (through charts)
14. Animal Interaction

Practical Scheme: 205

1. Qualitative and quantitative detection of carbohydrates /protein/lipid/Nucleic acid in given sample	10
2. Exercise based on genetic inheritance (Monohybrid/ dihybrid/ test cross)	10
3. Spotting	16
4. Viva-voce	08
5. Practical record	06
Total	50



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BOZ 206: Lab. exercises based on Honor's Paper (203 & 204)

1. Counting of red blood corpuscles
2. Counting of white blood corpuscles
3. Determination of hemoglobin content
4. Determination of blood groups
5. Prothoracic gland of Nymph
6. Study of histological slides of the following-
Pituitary, Thyroid and parathyroid, Endocrine pancreas, Adrenal, Testis,
Ovary, Uterus, Seminal vesicle
7. Collection, preservation and identification of some locally available insects
8. Identification of five locally available fishes on the basis of their morphological characters.
9. Problems on Hardy-Weinberg equilibrium
10. Physico-chemical characteristics of Water and Soil
11. Demonstration of Food chain, Food Web, Tropic level through chart
12. Phototactic and geotactic behavior of earth worm
13. Foraging behavior of birds in Honey bee
14. Chemo tactic behavior in Ants

Scheme: 206

1. Differential counting of blood cell (RBC/ WBC/ Hemoglobin percentage)	08
2. Dissection and demonstration of Prothoracic gland from Nymph	06
3. Estimation of Physico-chemical parameter of water/ soil	06
4. Exercise based on animal behavior	05
5. Spotting	16
6. Viva-voce	05
7. Practical record	04
Total	50



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Year-III Zoology

BOZ 301: Developmental Biology and Fundamental Endocrinology

Unit-I.

1. Historical perspective and Scope of developmental biology
2. Gametogenesis: Spermatogenesis and oogenesis
3. Fertilization: (Sea Urchin, and Mammals)
4. Cleavage and its types (pieces, amphibians, birds, mammals and insects)

Unit-II

5. Development of frog
 - 5.1 Blastulation
 - 5.2 Fate map and gastrulation in frog
 - 5.3 Concept of determination and differentiation
 - 5.4 Axis formation in frog
 - 5.5 Metamorphosis in frog

Unit-III

6. Concept of regeneration (Frog and Hydra)
7. Development of chick
 - 7.1 Blastulation
 - 7.2 Fate map construction and gastrulation
 - 7.3 Development of chick embryo upto formation of primitive streaks
 - 7.4 Extra embryonic membrane in chick

Unit-IV

8. **Introduction to endocrinology**
 - 8.1 Definition, classification and characteristics of chemical messengers (hormones, neurohormones, neurotransmitters)
 - 8.2 Hormone delivery: Endocrine, paracrine and auto crinemodes
 - 8.3 Hormone feedback mechanisms
9. **Endocrine glands in insects**
 - 9.1 Brain-corpora cardiaca and corpora allata complex
 - 9.2 Prothoracic gland

Unit-V

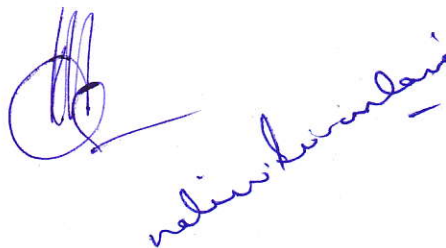
10. Structure and major functions of endocrine glands

- 10.1 Pituitary and Pineal
- 10.2 Thyroid
- 10.3 Parathyroid
- 10.4 Adrenal
- 10.5 pancreas
- 10.6 Testis
- 10.7 Ovary



Books Recommended

1. Balinsky: An Introduction to Embryology (1981, CBS)
2. Gilbert: Developmental Biology (8th ed., 2006, Sinauer)
3. Wolpert: Principles of Development (3rd ed. 2007, Oxford)
4. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
5. Norris: Vertebrate Endocrinology, Fourth Edition, 2007, Academic Press



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BOZ 302: Economic Zoology

Unit-I

Fish Culture

1. Introduction to fish culture, aims and goals
2. Fish species selected for culture & criteria for their selection
3. Construction and management of various ponds
4. Polyculture
5. Marketing of cultured fish species

Unit-II

Wildlife Tourism

6. Wildlife Tourism in India
7. Wildlife Tourism Activities: **Jungle Safari, Elephant Safari, Tiger Safari, Bird Watching, Wildlife Photography, Eco-tourism; code of practice for ecotourism operators**
8. Ecotourism as a tool for conservation; The impact of Ecotourism on environment; Environmental degradation and Ecotourism
9. Threats to Wildlife; Visitor guidelines; Wildlife Legislation
10. Wildlife Research techniques

Unit-III

Bee keeping

11. Basic concept, classification and culturable species of honey bees
12. Tools and equipment's for bee keeping
13. Food collection, hive or comb building
14. Pests and disease
15. Bee products and Uses

Unit-IV

Poultry farming

15. Introduction to poultry farming, aim and goals
16. Poultry housing and management
17. Techniques for poultry farming; feed and feeding
18. Integrated poultry; Extrinsic factors required for poultry farming
19. Poultry disease and health care

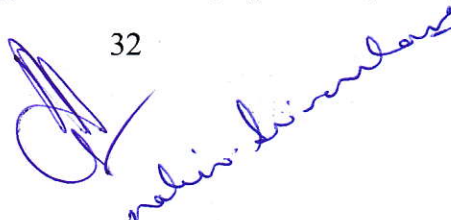
Unit-V

Sericulture and Lac Culture

20. Basic concept of sericulture: International status
21. Silk worm natural habitat, classification of Indian species of silk worm, & life cycle
22. Silk worm rearing and breeding
23. Silk reeling and spinning
24. Diseases and pests of silkworm and food plants

Books Recommended

1. Shukla and Upadhyaya : Economic Zoology (Rastogi Publishers, 1999-2000)
2. Mani: Insects, NBT, India, 2006.
3. Jabde: Text Book of Applied Zoology: Vermiculture, Apiculture, Sericulture, Lac culture,



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303: Biochemistry, Molecular Biology and Biotechnology

Unit-I

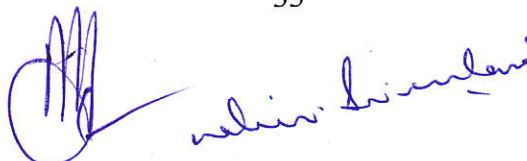
1. **Proteins:** Composition and organization
 - 1.1 Amino acids: Ionization, titration curve, pK and pI
 - 1.2 N-terminal analysis: Sanger and Edman's reactions
 - 1.3 Higher order organization
2. **Enzymes**
 - 2.1 Kinetics (determination of K_m and V_{max} using Michaelis-Menten and Lineweaver-Burkplots)
 - 2.2 Acid-base and covalent catalysis
 - 2.3 Concept of regulation of enzyme activity
 - 2.3.1 Inhibition
 - 2.3.2 Allosteric regulation
 - 2.3.3 Role of covalent modifications
 - 2.4 Ribozymes and concept of abzymes

Unit-II

3. **Carbohydrates**
 - 3.1. Polysaccharides
 - 3.1.1 Homopolymers
 - 3.1.2 Heteropolymers (peptidoglycans and glycosaminoglycans)
 - 3.2. Catabolism of carbohydrates and ATP production
 - 3.2.1 Glycolysis
 - 3.2.2 Krebs cycle
 - 3.2.3 Electron transport chain and ATP synthesis
4. **Lipids:** Structural and functional significance
 - 4.1 Triglycerides
 - 4.2 Phospholipids
 - 4.3 Sphingo lipids
 - 4.4 Cholesterol

Unit-III

5. **Nucleic acids**
 - 5.1 Conformation of DNA (A, B and Z)
 - 5.2 Structure of nucleosomes
 - 5.3 Mechanism of DNA replication
 - 5.4 Transcription
 - 5.4.1 Basic mechanism (prokaryotic model)
 - 5.4.2 Transcription initiation complex in eukaryotes
 - 5.4.3 Processing of RNA Pol II transcript
 - 5.4.4 Mechanism of translation



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6. Principles and application of analytical instruments

- 6.1 pH meter
- 6.2 UV-visible spectrophotometer
- 6.3 Centrifuges

Unit-IV

7. Separation techniques

7.1 Chromatography: Principle and Applications of

- 7.1.1 Paper chromatography
- 7.1.2 Thin layer chromatography
- 7.1.3 Gel-filtration chromatography

7.2 Electrophoresis: Principle and applications of

- 7.2.1 Agarose gel electrophoresis
- 7.2.2 SDS-PAGE

8. Tracer techniques: Principle and Applications

- 8.1 Unit of radioactivity, half life and measurement of radioactivity
- 8.2 Immunoassays
 - 8.2.1 RIA
 - 8.2.2 ERMA
 - 8.2.3 ELISA

Unit-V

9. Microtomy and microscopy

9.1 Tissue preparation for microtomy

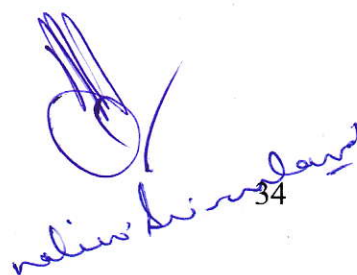
- 9.1.1 Fixation
- 9.1.2 Block preparation
- 9.1.3 Microtomy

9.2 Types of Microscope

- 9.2.1 Bright field
- 9.2.2 Dark-field
- 9.2.3 Phase contrast
- 9.2.4 Fluorescence
- 9.2.5 Confocal
- 9.2.5 Scanning and transmission electron microscopes

10. Cell and tissue culture techniques

- 10.1 Sterilization: laminar flow, media and glassware
- 10.2 Types of animal cell culture; Cell viability testing


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Books Recommended

1. Boyer: Modern Experimental Biochemistry (1993, Benjamin-Cummings,)
2. Pearse: Histochemistry - Theoretical and applied, Volume I-III (1980-1993, Churchill-Livingstones)
3. Plummer: An Introduction to Practical Biochemistry (1989, McGraw-Hill)
4. Wilson & Walker: Experimental Biochemistry (2006, Cambridge)
5. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth),
6. Berg, Tymoczko, Stryer; Biochemistry (7th ed. 2012, Freeman)
7. Zubay: Biochemistry (1998, McGraw-Hill)
8. Boyer: Modern Experimental Biochemistry (1993, Benjamin-Cummings,)
9. Pearse: Histochemistry - Theoretical and applied, Volume I-III (1980-1993, Churchill-Livingstones)
10. Plummer: An Introduction to Practical Biochemistry (1989, McGraw Hill)
11. Wilson & Walker: Experimental Biochemistry (2006, Cambridge)
12. Alberts et al: Molecular Biology of the Cell (2015, Garland)



A handwritten signature in blue ink, appearing to read 'Nalin Kumar', is written over the list of books. The signature is stylized and slanted.

BOZ 304: Cell Biology, Genetics and Immunology

Unit-I

1. Membrane transport

- 1.1 Principles of membrane transport, channel proteins, carrier proteins
- 1.2 Passive and active transport

2. Intracellular transport and protein sorting

- 2.1 Signal peptides and protein targeting
- 2.2 Entry and passage of proteins through endoplasmic reticulum
- 2.3 Processing and sorting of proteins in Golgi apparatus
- 2.4 Endosomes and lysosomes
- 2.5 Nuclear transport
- 2.6 Mitochondrial transport

Unit-II

3. Interphase nucleus and chromosome organization

- 3.1 Organization of interphase nucleus
- 3.2 Higher order organization of chromatin into chromosome
- 3.3 Centromere and telomere
- 3.4 Lampbrush and polytene chromosomes: structure and application in study of gene expression

4. Gene mapping

- 4.1 Conjugation in bacteria
- 4.2 Tetrad analysis in *Neurospora*
- 4.3 3-point test cross in *Drosophila*

5. Mutation and mutagenesis

- 5.1 Molecular basis of mutation
- 5.2 Spontaneous and induced mutations
- 5.3 DNA damage and repair

Unit-III

6. Genetic determination of sex

- 6.1 *Drosophila* and mammals

7. Gene expression and gene regulation

- 7.1 Inducible (*lac*) and repressible (*trp*) operones in *E. coli*
- 7.2 Regulation of gene activity in eukaryotes
- 7.3 Transcription unit
- 7.4 Regulation of transcription (initiation of transcription, concept of epigenetic modification)

8. Organization of human genome

Unit-IV

9. Human genetic disorders

- 9.1 Metabolic (Phenylketonuria)
- 9.2 Triplet repeat expansion (Huntington)
- 9.3 Multifactorial (Diabetes mellitus)

10. Elementary idea of genome, transcriptome and proteome

11. Cells and organs of immune system

- 11.1 Types of immune cells: lymphoid and myeloid
- 11.2 Primary and secondary lymphoid organs and lymphatic system

Unit-V

12. Humoral Immunity

- 12.1 Antigen
- 12.2 Immunoglobulins: types, structure and function
- 12.3 General introduction to Complement system

13. Cell mediated immunity

- 13.1 Structure and organization of Major Histocompatibility Complex and T cell interaction
- 13.2 Antigen processing and presentation

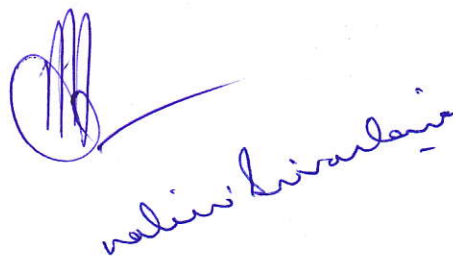
14. General Introduction to Immunological disorders

- 14.1 Autoimmunity
- 14.2 Immunodeficiency
- 14.3 Hypersensitivity

15. Concept of vaccination

Books Recommended

1. Alberts et al: Molecular Biology of the Cell (2015, Garland)
2. Karp: Cell and Molecular Biology (2010, John Wiley)
3. Lodish et al: Molecular Cell Biology (2016, Freeman)
4. Gardner et al: Principles of Genetics (2006, John Wiley)
5. Griffith et al: An Introduction to Genetic Analysis (Freeman, 2008)
6. Snustad & Simmons: Principles of Genetics (2012, John Wiley)
7. Immunology, 2nd ed. 2011, Kalyani Publishers, Ludhiana, Punjab.
8. Janeway's Immunobiology, 7th ed. 2008, Garland Science Publication.
9. Kubey *et al.*: Immunology, 6th ed. 2007, W.H. Freeman and Company Publication, New York.
10. Roitt and Delvis: Roitt's Essential Immunology, 6th ed. 2006, Blackwell Publication.



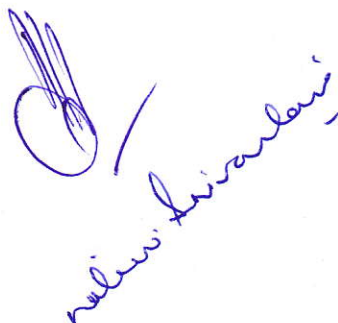
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BOZ 305: Lab. exercises based on Basic paper (301 & 302)

1. Study of eggs and tadpoles of frog from collected/preserved material
2. Study of frog development through models
3. Demonstration of chick embryonic development making window preparation of fertilized egg
4. Study of whole mount preparations of chick embryos of 16-18, 24-28, 33-36 and 42-48 hrs of development through permanent slides.
5. Dissection of fish for the demonstration of pituitary gland
6. Demonstration of endocrine glands in cockroach
7. Taxonomic characterization and identification of locally available fish
8. Hypophysation technique of fish for induced breeding
9. Survey of local govt. fish farm for study of culturable species
10. Tools use in frog culture practices
11. Study of life cycle of frog/ fish
12. Survey of govt. poultry farm for farming training
13. Tools and technique used in apiculture
14. Study of bee species used for culture practices
15. Physico-chemical properties of Honey
16. Study of classification of silkworm and its life cycle
17. Tools and technique used for sericulture and lac culture
18. Life cycle of lac insect
19. Captive behavior of wild animal (Zoo and Sanctuary)
20. Identification technique of wild animals (Bird counting/ Pugmark)

Practical Scheme: 305

1. Window preparation of hen egg	08
2. Dissection of fish pituitary/ endocrine gland in cockroach	08
3. Taxonomic character of fish/ hypophysectomy technique in fish/ Physico-chemical properties of honey	08
4. Spotting	16
5. Viva-voce	06
6. Practical record	04
Total	50



BOZ 306: Lab.

exercises based on honor's Paper (303 & 304)

1. Identification of amino acids in the mixture using paper chromatography and TLC
2. Estimation of protein by Lowry's method
3. Determination of the activity of enzyme (Urease):
 - 3.1. Effect of [S] and determination of K_m and V_{max}
 - 3.2. Effect of temperature
 - 3.3. Effect of time
4. Qualitative and quantitative tests for identification of sugars
5. Qualitative test for DNA & RNA
6. Separation of proteins using SDS-PAGE
7. Verification of laws of spectrophotometry
8. Demonstration of DNA Gel- electrophoresis
9. Demonstration of bright field, phase contrast, fluorescence, confocal and electron microscopes
10. Tissue fixation, paraffin block preparation, sectioning and stained slide preparation
11. Preparation of polytene chromosomes from *Drosophila* larvae
12. Constitutive heterochromatin(C-band)
13. Chromosome organization(G-banding)
14. Simulation of principles of segregation and independent assortment using colored beads.
15. Study of mutants in *Drosophila* (Bar eye, white eye, yellow body, sepia eye, curled wing, dumpy wing, vestigial wing and sepia eye-curved wing and curled wing-ebony body-sepia eye).
16. Dihybrid crosses in *Drosophila*.
17. Study of different lymphoid organs
18. Preparation of blood film for differential cell count.
19. Study of antigen-antibody interaction through Kit's

Practical Scheme: 306

1. Detection of amino acid/ proteins/ carbohydrate/ nucleic acid in the given sample	08
2. SDS PAGE/ Agarose Gel electrophoresis	06
3. Histological sectioning and slide preparation using paraffin blocks	06
4. Antigen- Antibody interaction	05
5. Spotting	16
6. Viva-voce	05
7. Practical record	04

Total

50

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Neelam Simla