

SYLLABUS FOR CREDIT BASED SEMESTER SYSTEM



B.Sc. ZOOLOGY – JUNE - 2021

SEMESTER - I

GUJARAT UNIVERSITY CBCS BASED PROPOSED COURSE
(Effective from June 2021)

B.Sc. SEMESTER – I ZOOLOGY - 101 (Theory)

(Non Chordate Animal Diversity, Mammalian Anatomy, Histology and Physiology of Urinary system; Genetics and Economic Zoology)

Unit: 1 A. Non Chordate Animal Diversity :

- General characters of Invertebrate
 - Type study : **Paramecium**
 - Systematic position with salient features
 - External & Internal structure (Brief)
 - Locomotion
 - Food & feeding mechanism
 - Osmoregulation
 - Reproduction: Binary fission and Conjugation
- B. General Topics:** 1. Developmental stages in Platyhelminthes (Liver fluke, Tapeworm)
2. Parasitic adaptations in Platyhelminthes

Unit: 2 Mammalian Anatomy (Human): Histology & Physiology of the Urinary System

1. Structure of Urinary system of Mammals
2. Anatomy and Histology of the kidneys:
 - External and Internal Anatomy of the Kidneys
 - Overview of kidney functions
 - Blood Supply to Kidneys
3. The Nephron :
 - Parts of a Nephron
 - Histology of the Nephron and Collecting Duct
4. Renal Physiology
 - Glomerular Filtrations
 - The Filtration Membrane
 - Net Filtration Pressure
 - Tubular Reabsorption
 - Tubular Secretion
 - Hormonal Regulation in brief (Name of the Hormones and their function only)
5. Clinical Connection: (Brief introduction)
 - Proteinuria
 - Ketonuria
 - Dialysis

Unit III Genetics

1. Concept of Gene
2. Mendelian laws of Heredity
3. Incomplete dominance (e.g. *Mirabilis jalapa*)
4. Co-dominance (e.g. Roan cattle)
5. Multiple alleles e.g.- ABO blood groups in human
- Rh Factor- Erythroblastosis foetalis
6. Complementary genes (Flower colour in *Odoratus lathyrus*)
7. Epistasis (Dominant and Recessive)
8. Extra chromosomal inheritance (Kappa particles in *Paramecium* & Shell coiling in Snail)
9. Human pedigree analysis

Unit IV Economic Zoology

1. Brief account of Beneficial & Harmful Insects
 - Beneficial insects: Honey bee; Silkworm ; Lady bugs
 - Harmful insects: Mosquitoes; Bedbugs ; Aphids
2. Vermiculture and Vermicomposting Introduction, Definition, Scope and Importance of Vermitechnology, Suitable breeds, Construction of vermicompost pits (Outdoor & Indoor spaces), Properties and benefits of vermicompost.
3. Pearl Culture-Introduction, Formation & uses of Pearl, Pearl oyster farming (brief study)

Reference Books:

- 1) Textbook of Invertebrates, R.L. Kotpal, Rastogi publications, Meerut
 - 2) Invertebrate Zoology, Jordan and Verma, S.Chand & Company, Delhi
 - 3) Integrated Principles of Zoology, C.P.Hickman, JR., L. S. Roberts , A.Larsed
 - 4) The McGraw Hill Companies, New York
 - 5) Principles of Anatomy & Physiology, Tortora and Grabowski, Harper Collins College Pub.
 - 6) Animal Physiology and Related Biochem. H.R.Singh, Shobhan Lal Naginchand & Co. Edu. Pub., Jalandhar.
 - 7) Textbook of Animal Histology. A.K.Berry, Emkay Pub, New Delhi.
 - 8) Genetics, P.K.Gupta, Rastogi Publications, Meerut.
 - 9) Genetics, V.B.Rastogi, Kedarnath Ramnath, Meerut
 - 10) Introduction to Genetics, R.P.Meyyan, rastogi Publication, Meerut
 - 11) Economic Zoology, Sarkar, kundu & Chaki, New Central Book agency(P) Ltd. New Delhi
 - 12) Economic Zoology (5th edition), G.S Shukla, V. B. Upadhyay, Rastogi Publications, Meerut, New Delhi
 - 13) Applied Zoology, N. Arumugam, MuruganRajeswar & Prabhu, Saras Publication, Tamilnadu
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GUJARAT UNIVERSITY
CBCS BASED PROPOSED COURSE
(Effective from June 2021)
B.Sc. SEMESTER-I
ZOOLOGY - 102 (Practical)

1. Histology and Physiology of urinary system: (Charts / Photographs)
 - Frontal Section of kidney.
 - Renal corpuscle (Internal view)
 - Cortical and juxtamedullary nephron
 - Blood supply of kidney

 2. Analysis of Normal and Abnormal constituents of urine:
 - Physical analysis
Colour, Odour, Specific gravity (Urinometer), pH
 - Chemical analysis
Sugar, Protein, Bile Salts, Ketones, Urea, Creatinine
 - Microscopies (Photographs) : RBC; WBC; Platelets, Epithelial cells and phosphate crystals

 3. Study of Paramoecium : (Slides / Photographs)
 - Paramoecium (W.M.)
 - Locomotion by ciliary movement (slide preparation/video clip)
 - Reproduction : Binary fission (through permanent slide)
 - Conjugation (through permanent slide)

 4. Developmental stages of liverfluke (Miracidium, Sporocyst, Radia, Cercaria, Metacercaria & Adult)

 5. Developmental stages of Tapeworm (Cysticercus larva or bladder worm)

 6. Genetics:
 - a) Study of genetics through charts (example as per theory syllabus).
 - Monohybrid cross
 - Dihybrid cross
 - Incomplete dominance
 - Co-dominance
 - Multiple alleles
 - Complementary genes
 - Epistasis (Dominant and Recessive)
 - Extra chromosomal inheritance (Through chart)
 - Human pedigree analysis (through chart)
 - b) Genetics problems (as per Appendix)

 7. Economic Zoology (by photographs)
 - Economic importance of following insects (By photographs or by Permanent slides)
 - Beneficial insects : Honey bee; Silkworm ; Lady bugs
 - Harmful insects: Mosquitoes; Bedbugs ; Aphids
 - Vermiculture, Vermicomposting process, Indian Breeds of earthworm
 - Pearl Culture-Pearl oysters (*Pinctada fucta*, *Pinctada margaritifera*, *Pinctada maxima*), Structures used for pearl oyster farming.
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GUJARAT UNIVERSITY
CBCS BASED PROPOSED COURSE
B.Sc. SEMESTER – I
Zoology Practicals-102

Total Marks- 70

Q.1. Analyse the following properties of urine. (Physical analysis, Chemical analysis, Microscopies)	15
Q.2. Complete the nomenclature of given figure and describe about it. (Charts of Urinary system)	10
Q.3 Explain the given Paramoecium chart.	07
Q.4 Solve the given genetic problem.	06
Q.5 Identify the specimens as per instructions.	21
1. Identify and describe. (Beneficial & harmful insects)	
2. Identify and describe. (Genetics charts-Monohybrid cross / Dihybrid cross / Incomplete dominance / Co-dominance, Extra chromosomal inheritance/ pedigree chart)	
3. Identify and describe. (Genetics charts- Multiple alleles / complementary genes/ epistasis)	
4. Identify and describe. (Developmental stages of Liver fluke)	
5. Identify and describe. (Parasitic adaptation in Platyhelminthes, Cysticercus or bladder worm larva of tapeworm.)	
6. Identify and describe. (Economic zoology-Vermi culture)	
7. Identify and describe. (Economic zoology- Pearl culture)	
Q.6 Viva Voce	06
Q.7 Journal	05

Genetics problems: (Appendix for practical 4b)

1. In guinea pig a dominant gene B produces black and its recessive allele b produces white. What are the possible mating types ? What is the genotype and phenotype of the F1 offspring?

Solution Hint : Possible mating type : 1. $BB \times BB$; 2. $BB \times Bb$; 3. $BB \times bb$;

4. $Bb \times Bb$; 5. $Bb \times bb$; 6. $bb \times bb$

2. In rabbit, the colored coat (C) is dominant to albino coat (c). What type of offspring would you expect if cross a pure line colored rabbit, with an albino rabbit ? Show both genotypes in the first and second generations.

Solution Hint : P : $CC \times cc$ 1st generation : Cc- colored

2nd generation : CC -colored Cc-Colored ; cc - albino

3. Red fruit (R) is dominant to yellow (r) and tallness (T) is dominant over short (t) in plants. What phenotypic and genotypic ratio would result if one of the parent plants is red homozygous & tall homozygous and other is red heterozygous & tall heterozygous?

Solution Hint : P: $RRTT \times RrTt$; Result : Same Phenotype in all offspring, and
Genotype = $RRTT, RRTt, RrTT, RrTt$.

4. In the mouse the gene for colored coat (C) is dominant to the gene for albino (c) and the gene for straight whiskers (W) is dominant to the allele for bent whiskers (w). Find out the phenotypes of the following crosses.

1. $Ccww \times ccww$ 2. $ccww \times ccWw$ 3. $CcWw \times CcWw$

Solution Hint : 1st Cross : colored & bent whiskers

2nd Cross: albino & straight whiskers ; albino & bent whiskers

3rd cross : colored & straight whiskers ; colored & bent whiskers ;
albino & straight whiskers ; albino & bent whiskers

5. In four o'clock plants, red colour of flowers (R) is incompletely dominant over white (r), the heterozygous having pink flower color. What will be the offsprings in a cross between plants of red flowers and pink flowers?

Solution Hint : P – $RR \times Rr$ Offsprings : Red and Pink

6. A roan bull is bred to three cows. Cow A has the same genotype as the roan bull. Cow B is red and cow C is white. What proportions of roan progeny are expected from each of the above three crosses ?

Solution Hint : In all three crosses 50 % Roan cows are expected.

7. A couple preparing for marriage, a man has blood group B and woman has A. They ask you what type of blood group their children may have. What would you tell them and how would you explain your conclusions?

Solution Hint : - All four A, B, AB, & O types of blood groups are possible if both parents are heterozygous
- AB and A are possible if man is heterozygous and woman is homozygous.
- AB and B are possible if man is homozygous and woman is heterozygous.

8. Two white flowered varieties of pea plant when crossed produced purple flowered in F_1 progeny. Selfing of F_1 plants produced total 112 progeny of which 62 plants with purple flowers and 50 with white flowers. Find out (i) What type of interaction is involved? (ii) Give a phenotypic ratio approximated by the F_2 progeny. (iii) Give the genotype of the parents.

Solution Hint : (i) Complementary gene interaction; (ii) Phenotypic ratio - 9:7 ; (iii) P : CCpp \times ccPP

9. In a Plant, the gene for white fruit color (W) is epistatic to yellow (Y) which is dominant over green (y). Determine the fruit color of the offsprings of following crosses.

I. Wwyy \times wwyy ; II. wwYy \times wwyy ; III. WwYy \times WwYy

Solution Hint : 1st Cross : White & green ; 2nd Cross : Yellow & green ;

3rd Cross : White: Yellow : green (12:3:1)

10. When dogs from a true breeding brown coat line were mated to dogs from a true breeding white coat line, all F_1 progeny were with white coat color. Mating of F_1 progeny produced F_2 offsprings having phenotypes in the ratio of 132 white: 33 black: 11 brown. Explain results.

Solution Hint : Cross : BBII \times bbii Where B = Black; I=epistatic and bb= brown

Here dominant epistatic gene I inhibit the expression of associated genes.

SYLLABUS FOR CREDIT BASED SEMESTER SYSTEM



B.Sc. ZOOLOGY – JUNE - 2021

SEMESTER - II

GUJARAT UNIVERSITY
CBCS BASED PROPOSED COURSE
(Effective from June 2021)
B.Sc. SEMESTER – 2
Zoology-103 (Theory)

(Animal diversity (Chordates), Blood Physiology, Cytology and Animal biotechnology)

Unit I ANIMAL DIVERSITY (Chordates) – Type Study:

General structure & morphology with functional anatomy of the following animal:

Chondrichthyes: Type – **Shark** – (*Scoliodon sorrakowah*): Systemic position, Habits and habitat, Ext. characters, Digestive system, Heart, Arterial system, Venous system, Respiratory system, Nervous system (Brain & Cranial nerves), Urinogenital systems.

Unit II Blood Physiology:

1. Functions of blood
2. Composition of Human blood: (Blood plasma and formed elements)
 - a) RBC - Structure, Functions, Total counts.
 - Composition (Haemoglobin)
 - Effect of isotonic, hypotonic and hypertonic solutions.
 - Anaemias: - General symptoms and types (Nutritional, Pernicious, Hemorrhagic, Hemolytic, Aplastic and Sickle-cell (maxi. 5-6 sentences each))
 - b) WBC – Functions, Total count.
 - Types of WBCs (brief note)
 - Brief concept of Leukemia (maxi. 5-6 sentences)
 - c) Platelets - Structure, Total count, Functions.
3. Haemopoiesis
4. Blood coagulation - (Factors, Intrinsic & Extrinsic pathways)
 - Brief concepts of Thrombosis & Fibrinolysis
5. Groups and Blood Types:
 - ABO and Rh Blood Groups
 - Transfusions

Unit III: Cytology

Cytology:

Introduction

Study of eukaryotic cell organelles:

Nucleus:

- Occurrence and Position,
- Morphology
- Ultra structure-Nuclear membrane ,Nuclear pores, Origin of Nuclear membrane and Nuclear envelop, Function of Nuclear Membrane and Nuclear pores, Chromatin fibres; Nucleolus, Fine structure of Nucleolus, Chemistry of Nucleolus, Function of Nucleolus

Lysosome:

- Occurrence and Position,
- Morphology
- Ultra structure
- Functions

Microscope:

Structure, application and way of use of light (Dissecting and Compound) microscopes.

Unit –IV Animal biotechnology: (By Photographs)

1. Brief Introduction
2. Lab design and layout of small tissue culture laboratory
3. Some Lab facilities needed for setting up a tissue culture laboratory –
 - Cultural vessels (Choice of culture vessels, Multi well plates, Petri dishes, Culture flasks)
 - Laboratory Equipments (Autoclave, CO₂ Incubator, Centrifuge, Laminar Airflow)
4. Recombinant DNA Technology
 - Biological Tools (Restriction enzymes, Plasmid, Cosmid, Bacteriophage), Process and applications of Recombinant DNA Technology

Reference Books:

1. Textbook of Vertebrates, R. L. Kotpal, Rastogi Publication, Meerut.
2. Chordate Zoology, P. S. Dhami, and J. K. Dhami, S. Chand & Co., Delhi.
3. Introduction to Chordates, T. C. Majupuria, Pradeep Publication, Jalandhar.
4. Principles of Anatomy & Physiology, Tortora and Grabowski, Harper Collins College Pub
5. Animal Physiology And Related Biochem. H. R. Singh, Shobhan Lal Naginchand & Co. Edu. Pub., Jalandhar.
6. Textbook of Animal Histology. A. K. Berry, Emkay Pub, New Delhi.
7. Cytology, P. S. Verma, S. Chand & Co, Ltd., New Delhi
8. Cell Biology, C. B. Powar, Himalaya Books Pub.
9. Essentials of Cytology, C. B. Powar, Himalaya Books Pub
10. Elements of Biotechnology, P. K. Gupta. Rastogi pub, Meerut
11. Culture of Animal Cells: A Manual of Basic Technique. By R. Ian Freshney.
12. Genetic Engineering, N. Arumugam, Saras Publication

GUJARAT UNIVERSITY
CBCS BASED PROPOSED COURSE
ZOOLOGY

(Effective from June 2021)

B.Sc. SEMESTER-II

Zoology-103

SKELETAL QUESTION PAPER FOR THEORY EXAMINATION

		Total-70
Que.1 Unit 1 Type study Shark		(7)
	Or	
(A) Unit 1 Type study Shark		
(B) Unit 1 Type study Shark		(7)
	Or	
(B) Unit 1 Type study Shark		
Que.2 (A) Unit 2 Blood Physiology		(7)
	Or	
(A) Unit 2 Blood Physiology		
(B) Unit 2 Blood Physiology		(7)
	Or	
(B) Unit 2 Blood Physiology		
Que. 3 (A) Unit 3 Cytology		(7)
	Or	
(A) Unit 3 Cytology		
(B) Unit 3 Cytology		(7)
	Or	
(B) Unit 3 Cytology		
Que. 4 (A) Unit 4 Animal biotechnology		(7)
	Or	
(A) Unit 4 Animal biotechnology		
(B) Unit 4 Animal biotechnology		(7)
	Or	
(B) Unit 4 Animal biotechnology		
Que.5 Short 14 questions (each of 1 mark)		(14)
Que. 1 to 3- from unit 1		
Que. 4 to 6- from unit 2		
Que. 7 to 9- from unit 3		
Que. 10 to 12- from unit 4		
Que. 13 to 14- from any unit		

GUJARAT UNIVERSITY
CBCS BASED PROPOSED COURSE
(Effective from June 2021)
B.Sc. SEMESTER-II
ZOOLOGY – 104 (Practical)

1. ANIMAL DIVERSITY (Chordates):

Study of Shark:

1. Study of external characters.
2. Study of Digestive system, Arterial system, Venous system, Urinogenital systems, Brain.
3. Study of Placoid scales, Striated muscle fibres, Membranous Labyrinth, Ampulla of Lorenzini

2. Physiology of blood:

- a) Points for drawing blood by a syringe (Chart)
- b) Study of blood corpuscles by preparation of human blood smear using Leishman Stain.
(Demonstration only)
- c) Demonstration of determination of ABO blood grouping in humans.
- d) Demonstration of determination of blood clotting time. (BT, CT)
- e) Separation of plasma/serum from blood. (Chart)

3. Cytology: (Charts / Photographs)

1. Nucleus
2. Lysosome
3. Microscopes (Compound and Dissecting)

4. Animal biotechnology: (By Photographs)

1. Lab design – Layout
2. Culture vessels (Multi-well plates, Petri dishes, Culture flasks)
3. Lab Equipments (Autoclave, CO₂ Incubator, Centrifuge, Laminar Airflow)
4. Recombinant DNA Technology

GUJARAT UNIVERSITY
CBCS BASED PROPOSED COURSE
(Effective from June 2021)
B.Sc. SEMESTER-II
ZOOLOGY – 104

	Marks- 70
Q.1 Sketch, lable and describe _____ system of Shark.	12
Q.2 Sketch, lable and describe temporary mounting of _____ from Shark.	08
Q.3. Explain the following experiments	
a) Blood smear / Blood groups	08
b) BT and CT / Separation of serum from blood	08
Q.4. Identify the specimens as per instructions.	21
1. Identify and describe. (Any system of Shark)	
2. Identify and describe. (ABO blood group/ Points for drawing blood by a syringe)	
3. Identify and describe. (Cytology)	
4. Identify and describe. (Cytology)	
5. Identify and describe. (Biotechnology)	
6. Identify and describe. (Biotechnology)	
7. Identify and explain. (Biotechnology)	
Q.6 Viva Voce.	08
Q.7 Journal.	05

GUJARAT UNIVERSITY
rd
3 Semester B.Sc.
ZOOLOGY
(Effective from June 2022)

The syllabus is to be completed by assigning FOUR hours for each Theory Paper and a total of SIX hours for the Practicals, per week.

Pattern of Examination:

Theory (Ext. 140 marks & Int. 60marks)

Practicals (Ext. 70 marks & Int. 30marks)

Examination	Duration	External Marks	Internal Marks	Total Marks
Theory-Paper 201 (Animal diversity (nonchordates) and Parasitology)	3 hours	70	30	100
Theory-Paper 202 (Animal diversity (chordates) and Genetics & Animal biotechnology)	3 hours	70	30	100
Theory (Total)		140	60	200
Practical-Paper 203 (A) (Based on Theory Paper –201)	3 hours	35	15	50
Practical-Paper 203 (B) (Based on Theory Paper –202)	3 hours	35	15	50
Practicals (Total)		70	30	100

INSTRUCTIONS

1. Each theory paper comprises of FOUR UNITS. Each UNIT carries equal marks, i.e.14 marks (14 x5 =70) in the university examinations.
2. The theory question papers will have to be set according to the paper-style and the pattern of marks-distribution provided on page no. 4 & 7of this syllabus.
3. The paper-style & distribution of marks for the Practicals is also provided on page no. 9&12 of this syllabus.
4. In order to be qualified to appear in the University Practical Examination, the student must submit this/her duly certified journals during the examination.

ZOOLOGY SYLLABUS

SEMESTER-3

PAPER-201(Theory)

(ANIMAL DIVERSITY (nonchordates) and PARASITOLOGY)

Unit I ANIMAL DIVERSITY (Nonchordates) – Systematics:

Salient features and Classification of Invertebrates, starting from Kingdom upto Classes, giving reasons with examples (as per practical syllabus):

Phylum:

- | | |
|-----------------|--------------------|
| 1. Protozoa | 4. Platyhelminthes |
| 2. Porifera | 5. Nematelminthes |
| 3. Coelenterata | 6. Annelida |

(Classification as per-Textbook of invertebrates by R. L. Kotpal, Rastogi Publication, Meerut).

Unit II ANIMAL DIVERSITY (Nonchordates) – Type study:

General structure & morphology with functional anatomy of the following animal:

Earthworm (*Pheretima posthuma*)–Systematic position, Habits & Habitat, External characters, Body wall, Digestive system, Circulatory system, Excretory system, Nervous system, Reproductive systems & reproduction

Unit III GENERAL TOPICS:

1. Coelenterata : Coral reefs (Introduction, Formation, Types, Importance)
2. Types of Symmetry (Radial, Biradial, Bilateral, Spherical)
3. Types and significance of Coelom.
4. Types and significance of Metamerism.
5. Segmental organs in annelida - Coelomoducts and nephridia.
6. Adaptive radiation in polychaeta (Diversity according to habitat and feeding)

Unit IV PARASITOLOGY:

1. General Introduction: Parasite, Host, Host-parasite relationships
2. Types of Parasites: Endoparasites (Obligate, Facultative), Exoparasite
3. Types of Hosts: Definitive, Intermediate, Reservoir
4. Morphology, Life cycle, Pathogenesis and Prophylaxis of the following human parasites:
Protozoan Parasites: *Entamoeba histolytica*, *Leishmania donovani*
Helminthes Parasites: *Taenia solium*, *Wuchereria bancrofti*

Theory Paper-style and pattern of marks-distribution

PAPER – 201

(ANIMAL DIVERSITY(nonchordates) and PARASITOLOGY)

<u>Q.No.</u>	<u>UNITNO.</u>	<u>MARKS</u>
Q.1.	Unit-I	07
	OR Unit-I	
Q.1.	Unit-I	07
	OR Unit-I	
Q.2.	Unit-II	07
	OR Unit-II	
Q.2.	Unit-II	07
	OR Unit-II	
Q.3.	Unit-III	07
	OR Unit-III	
Q.3.	Unit-III	07
	OR Unit-III	
Q.4.	Unit-IV	07
	OR Unit-IV	
Q.4.	Unit-IV	07
	OR Unit-IV	
Q.5	14 objective questions of 1 mark each. 3 questions from each of the four Units And remaining 2 questions from any of the four Units.	14

PAPER–202 (Theory)

(ANIMAL DIVERSITY (chordates), GENETICS & ANIMAL BIOTECHNOLOGY)

Unit I ANIMAL DIVERSITY (Chordates) – Systematics:

Salient features & Classification, starting from Kingdom upto Orders, with reasons & examples as per practical syllabus: Protochordata, Cyclostomata, Pisces & Amphibia. (Classification as per text book of vertebrates by R. L. Kotpal, Rastogi Publication, Meerut).

Unit II ANIMAL DIVERSITY (Chordates) – Type Study:

General structure & morphology with functional anatomy of the following animal:
***Calotes versicolor* (Garden lizard):** Systematic position, Habits and Habitat, External characters, Digestive system, Respiratory system, Blood-vascular system (Heart, Arterial system, Venous system), Urinogenital system, Brain, Hyoid apparatus and Columella auris.

Unit III GENERAL TOPICS:

1. Comparison of chordates with non-chordates.
2. Comparison of Chondrichthyes with Osteichthyes.
3. Neoteny (Types and affecting factors)
4. Identification of venomous and non-venomous snakes of India
 - Venomous: Russel's viper, Krait, Cobra, King cobra, Marine snake.
 - Non-venomous: Boa, Pythons, Rat snake.
5. Poison apparatus and biting mechanism of Snakes.

Unit IV GENETICS & ANIMAL BIOTECHNOLOGY:

Genetics:

1. Pleiotropism
2. Duplicate genes (15:1 ratio, e.g. Fruit shape in Shepherel's purse)
3. Multiple genes (e.g. Biochem pathway of Tryptophan in *E. coli*)
4. Mutations :
 - Definition
 - Mutable & Mutator genes
 - Reverse mutation
 - Paramutations
 - Frame-shift mutations and its types
 - Mutagens (Radiation & Chemical agents)

Tools in Animal Biotechnology:

Equipments for animal cell culture laboratory, in brief:

1. Water bath.
2. Dry bath
3. Magnetic stirrer
4. Vortex mixture
5. Variable volume micropipettes
6. Cryostorage containers
7. Inverted microscope (Phase contrast).

Theory Paper-style and pattern of marks-distribution

PAPER – 202
(ANIMAL DIVERSITY (chordates), GENETICS and ANIMAL BIOTECHNOLOGY)

<u>Q.No.</u>	<u>UNIT NO.</u>	<u>MARKS</u>
Q.1	Unit-I OR Unit-I	07
Q.1.	Unit-I OR Unit-I	07
Q.2	Unit-II OR Unit-II	07
Q.2	Unit-II OR Unit-II :	07
Q.3	Unit-III OR Unit-III Unit-III	07
Q.3	Unit-III OR Unit-III	07
Q.4	Unit-IV OR Unit-IV Unit-IV	07
Q. 4	Unit-IV OR Unit-IV	07
Q.5	14 objective questions of 1 mark each. 3 questions from each of the four Units and remaining 2 questions from any of the four Units.	14

PAPER-203 (A) (Practicals)
(Based on Theory Paper 201)

1. ANIMAL DIVERSITY (Nonchordates)– Systematics: (a short description and habitat should also be written for each animal)

Identification & classification of invertebrates (Kingdom to Class):

1. Protozoa: Amoeba, Paramecium, Polystomella, Euglena, Vorticella.
2. Porifera : Leucosolenia, Euspongia, Grantia, Hyalonema.
3. Coelenterata : Hydra, Sea anemone, Physalia, Aurelia, Coral.
4. Platyhelminthes : Planaria, Liverfluke, Tapeworm.
5. Nematelminthes: Enterobius, Ascaris, Rhabditid.
6. Annelida : Nereis, Aphrodite, Amphitrite, Leech.

2. ANIMAL DIVERSITY (Non chordates):

A) Study of Earthworm:

1. Study of external characters.
2. Study of Digestive System, Circulatory System, Nervous system and Reproductive System.

B) Permanent slides/ charts of:

1. Setae, Bloodgland, Septal Nephridia, Ovary, Spermatheca
2. T.S. passing through pharynx, T.S. passing through gizzard, T.S. passing through typhlosole.

3. ANIMAL DIVERSITY (Non chordates):

Study through charts/models/slides:

1. Coelenterata : Kinds of coral reefs (Fringing, Barrier, Atoll)
2. Types of symmetry (As per theory syllabus)
3. Types and significance of Metamerism.
4. Segmental organs in annelida - Coelomoducts and nephridia.
5. Adaptive radiation in polychaeta (Vanadis, Owenia, Chaetopterus, Arenicola and Terebella)

4. PARASITOLOGY

Study of *Entamoeba histolytica*, *Plasmodium*, *Taenia solium*, *Wuchereria bancrofti* and their life stages through permanent slides / specimens / photographs.

GUJARAT UNIVERSITY

Semester-3 Zoology

(SKELETON QUESTION PAPER FOR PRACTICAL EXAMINATION)

PAPER-203 (A)

(Based on Theory Paper 201)

Date:

Marks : 35

Time :.....

- Q:1** Sketch, label and describe _____ system of Earthworm. **06**
- Q:2** Sketch, label and describe temporary mounting of Earthworm **04**
- Q:3** Identify the given figure of parasite and describe its life cycle **05**
- Q:4** Identify specimens 1 to 6 as per instructions: **12**
- Sp.1 Identify and classify upto Class, giving reasons.
 - Sp.2 Identify and classify upto Class, giving reasons.
 - Sp.3 Identify and describe.
 - Sp.4 Identify and describe.
 - Sp.5 Identify and describe.
 - Sp.6 Identify and state its pathogenicity.
- Q.5** Viva voce **04**
- Q.6** Journal. **04**

DETAILS FOR PRACTICAL EXAMINATION (Question wise)
Semester-3 Zoology

PAPER-203 (A)
(Based on Theory Paper 201)

- Q.1 Earthworm:** Digestive system, Circulatory, Nervous system, Reproductive System.
- Q.2 Charts/Permanent slides of Earthworm:** Setae, Bloodgland, Septalnephridia
Ovary, Spermatheca,
- Q.3 Parasitology:** *Entamoeba histolytica*, *Plasmodium*, *Taenia solium*, *Wuchereria bancrofti* and their life stages
- Q.4 Sp.1** Protozoa, Porifera, Coelenterata
Sp.2 Platyhelminthes, Nematelminthes, Annelida
Sp.3 Kinds of coral reefs/ Types of symmetry
Sp.4 Segmental organs in annelida/Adaptive radiation in polychaeta.
Sp.5 Study of T.S. passing through pharynx, T.S. passing through gizzard,
T.S. passing through typhlosole of earthworm.
Sp.6 Study of *Entamoeba histolytica*, *Plasmodium*, *Taenia solium*, *Wuchereria bancrofti* and their pathogenicity through permanent slides / specimens /photographs.
- Q.5** Syllabus of Theory Paper 201 and Practical Paper-203 (A) only.

PAPER-203 (B) (Practicals)
(Based on Theory Paper 202)

1. ANIMAL DIVERSITY (Chordates)– Systematics: (a short description and habitat should also be written for each animal)

Identification & Classification of following animals upto Orders, giving reasons:

1. Protochordata: Amphioxus, Salpa, Doliolum, Ascidian.
2. Cyclostomata : Lamprey, Hagfish.
3. Pisces: Sting ray fish, Electric ray fish, Exocetus, Sea horse, Sucker fish, Eel.
4. Amphibia: Ichthyophis, Salamander, Hyla.

2. IDENTIFICATION OF SNAKES:

Study by specimens (*only external characters*):

- Venomous: Russel's viper, Krait, Cobra, King cobra, Marine snake.
- Non-venomous: Boa, Python, Rat snake.

3. ANIMAL DIVERSITY (Chordates):

Study of Calotes:

1. Study of external characters. Digestive system, Arterial system, Venous system, Urinogenital systems, Brain.
2. Study of Hyoid apparatus and Columella auris.

4. GENETICS:

Study of genetics through charts:

1. Pleiotropism
2. Duplicate genes (15:1 ratio, e.g. Fruitshape in Shepherel' spurse)
3. Multiple genes (e.g. Biochem. pathway of Tryptophan in *E. coli*)
4. Mutations :Reverse mutation, Paramutations, Frame-shift mutations and its types

5. ANIMAL BIOTECHNOLOGY:

Study of tools in animal biotechnology through charts/specimens:

1. Water bath.
2. Dry bath
3. Magnetic stirrer
4. Vortex mixture
5. Variable volume micropipettes
6. Cryostorage containers
7. Inverted microscope (Phase contrast).

GUJARAT UNIVERSITY

Semester-3 Zoology

(SKELETONQUESTIONPAPERFORPRACTICALEXAMINATION)

PAPER-203(B)

(*Based on Theory Paper 202*)

Date:

Marks : 35

Time :

- | | | |
|------------|---|-----------|
| Q.1 | Sketch, label and describe _____ system of Calotes | 08 |
| Q.2 | Sketch, label and describe temporary mounting of Calotes | 05 |
| Q.3 | Identify specimens 1 to 7 as per instructions:
Sp.1 Identify and classify upto Order, giving reasons.
Sp.2 Identify and classify upto Order, giving reasons.
Sp.3 Identify and comment.
Sp.4 Identify and describe.
Sp.5 Identify and describe
Sp.6 Identify and describe
Sp.7 Identify and describe | 14 |
| Q.4 | Viva voce. | 04 |
| Q.5 | Journal. | 04 |

DETAILS FOR PRACTICAL EXAMINATION (Questionwise)
Semester-3 Zoology

PAPER-203(B)
(*Based on Theory Paper 202*)

Q.1 Calotes: External character, Digestive system, Arterial system, Urinogenital systems, Brain.

Q.2 Calotes : Hyoid apparatus and Columella auris

Q.3 Sp.1 Protochordata or Cyclostomata.

Sp.2 Pisces or Amphibia.

Sp.3 Venomous snake

Sp.4 Non-venomous snake

Sp.5 Genetics

Sp.6 Genetics

Sp.7 Biotechnology

Q.4 For viva Syllabus of Theory Paper-202 and Practical Paper-203 (B) only.

Note: *All examiners should take the viva sitting together and each examiner should give marks from 04 and then the average marks of all the examiners should be given to the candidate.*

Reference Books for 201, 202 and Practical 203 (A) and (B).

1. **Textbook of Invertebrates**, R. L. Kotpal, Rastogi Publishers, Meerut.
2. **Invertebrate Zoology**, Jordan and Verma, S. Chand & Company, Delhi.
3. **Invertebrate: Structure and Function**, E. J. W. Barrington.
4. **Text book of Vertebrates**, R. L. Kotpal, Rastogi Publication, Meerut.
5. **Text book of practical zoology - Invertebrates**, S. S. Lal Rastogi Publication, Meerut.
6. **Text book of practical zoology - Vertebrates**, S. S. Lal Rastogi Publication, Meerut.
7. **Chordate Zoology**, P. S. Dhama, and J. K. Dhama, S. Chand & Co., Delhi.
8. **A text book of Chordates**, N. Arumugam, Saras publication.
9. **Introduction to Chordates**, T. C. Majupuria, Pradeep Publication, Jalandhar.
10. **A Manual of Zoology**, E. K. Ayyer, Vol. I & II.
11. **Medical Parasitology**, **C. K. Jayram Paniker**, Jaypee Brothers Medical Publishers (P) Ltd., New Delhi
12. **Protozoa**, R. L. Kotpal, Rastogi Publications, Meerut.
13. **Helminthes**, R. L. Kotpal, Rastogi Publications, Meerut.
14. **An Introduction to Parasitology**, P.N.Sharma, L. S. Ratnu, S. Chand & Co. Ltd., New Delhi
15. **Text book of Genetics**, Veerbala Rastogi, Kedar Nath Ram Nath, Meerut.
16. **Genetics**, P. S. Verma & V. K. Agarwal, S. Chand & Company, Delhi.
17. **Fundamentals of Biotechnology**, P. K. Gupta, S. Chand & Company, Delhi.
18. **Culture of Animal Cells-A Manual of Basic Technique**, R. Ian Freshney, 5th Ed., A. John Wiley & Sons Inc. Pub.

GUJARAT UNIVERSITY
4th Semester B.Sc.
ZOOLOGY
(Effective from June 2022)

The syllabus has to be completed by assigning FOUR hours for each Theory Paper and a total of SIX hours for the Practicals, per week.

Pattern of Examination :

Theory (Ext. 140 marks & Int. 60marks)

Practicals (Ext. 70 marks & Int. 30marks)

Examination	Duration	External Marks	Internal Marks	Total Marks
Theory-Paper 204 (Animal diversity (nonchordates), Insect vectors, vector born diseases & Cytology)	3 hours	70	30	100
Theory-Paper 205 (Animal diversity (chordates), Fishery biology, Wildlife of India)	3 hours	70	30	100
Theory (Total)		140	60	200
Practical-Paper 206 (A) (Based on Theory Paper –204)	3 hours	35	15	50
Practical-Paper 206 (B) (Based on Theory Paper –205)	3 hours	35	15	50
Practicals (Total)		70	30	100

INSTRUCTIONS

1. Each theory paper comprises of FIVE UNITS. Each UNIT carries equal marks, i.e. 14 marks (14 x 5 = 70) in the university examinations.
2. The question papers will have to be set according to the paper-style and the pattern of marks-distribution provided on page no. 17 & 20 of this syllabus.
3. The paper-style & distribution of marks for each Practical is also provided on page no. 22 & 25 of this syllabus.
4. In order to be qualified to appear in the University Practical Examination, the student must submit this/her duly certified journals during the examination.

ZOOLOGY SYLLABUS

SEMESTER-4

PAPER-204 (Theory)

(ANIMAL DIVERSITY (nonchordates), INSECT VECTORS, VECTOR BORNE DISEASES & CYTOLOGY)

Unit I ANIMAL DIVERSITY (NonChordates)– Systematics:

Salient features and Classification of Invertebrates, starting from Kingdom upto Classes, giving suitable examples (as per practical syllabus):

Phylum:

1. Arthropoda
2. Mollusca
3. Echinodermata
4. Hemichordata

(Classification, as per the book–Text book of invertebrates by R. L. Kotpal, Rastogi Publication, Meerut).

Unit II ANIMAL DIVERSITY (Nonchordates)– Type Study & General Topics:

General structure & morphology with functional anatomy of the following animal:

Arthropoda: Type – **Cockroach** (*Periplaneta americana*) – Classification, Habits & Habitat, Ext. characters, Digestive system, Circulatory system, Excretory system, Reproductive systems, Nervous system, and Sense organ (only compound eyes).

General topics:

1. Metamorphosis (Incomplete & Complete), Hormonal Control
2. Mouth parts of: Honey bee, Housefly, Butterfly, Mosquito (*Anopheles* & *Culex*-male & female) and cockroach.

Unit III INSECTS VECTORS AND VECTOR-BORNE DISEASES

Introduction of Vectors (Mechanical & Biological)

Mosquitoes, Flies, Fleas, Ticks, Bugs, Lice, Mites, Cyclops, Cockroach as vectors

Study of Transmission, Symptoms, Control and Prophylactic measures of following diseases:

Mosquito-borne diseases- Malaria (*Anopheles*), Dengue (*Aedes*),

Chikungunia (*Aedes*), Filariasis (*Culex*)

Sand fly-borne diseases- Visceral Leishmaniasis, Flea-borne diseases- Plague

Tick-borne Encephalitis, Crimean-Congo haemorrhagic Fever (CCHF)

Bugs/Tsetse flies-Trypanosomiasis, Black fly-River blindness

Unit IV: *CYTOLOGY*

1. Cytoplasm (Physical nature of matrix, Chemical organization of matrix)
2. Cytoskeleton
3. Endoplasmic reticulum
4. Mitochondria
5. Mitosis

Theory Paper-style and pattern o fmarks - distribution

**PAPER – 204
(ANIMAL DIVERSITY (nonchordates), INSECT VECTORS, VECTOR-
BORNE DISEASES AND CYTOLOGY.)**

<u>Q.No.</u>	<u>UNITNO.</u>	<u>MARKS</u>
Q.1.	Unit-I OR Unit-I	07
Q.1.	Unit-I OR Unit-I	07
Q.2.	Unit-II OR Unit-II	07
Q.2.	Unit-II OR Unit-II :	07
Q.3.	Unit-III OR Unit-III	07
Q.3.	Unit-III OR Unit-III	07
Q.4.	Unit-IV OR Unit-IV	07
Q.4.	Unit-IV OR Unit-IV	07
Q.5	14 objective questions of 1 mark each. 3 questions from each of the four Units and remaining 2 questions from any of the four Units.	14

PAPER–205 (Theory)
(ANIMAL DIVERSITY (chordates), FISHERY BIOLOGY, WILDLIFE of India)

Unit I ANIMAL DIVERSITY (Chordates) – Systematics :

Salient features & Classification, starting from Kingdom upto Orders, with reasons with examples (as per practical syllabus) of Reptilia, Aves & Mammalia.

(Classification as per the book– Textbook of vertebrates by R.L. Kotpal, Rastogi Publication, Meerut).

Reference Books for Unit I:

1. **Textbook of Vertebrates**, R. L. Kotpal, Rastogi Publication, Meerut.
2. **Chordate Zoology**, P. S. Dhami, and J. K. Dhami, S.Chand & Co.,Delhi.
3. **Introduction to Chordates**, T.C. Majupuria, Pradeep Publication, Jalandhar.

Unit II FISHERY BIOLOGY:

1. Brief introduction and importance of studying Fishery Science. (*nottobeasked in exam*)
2. Study of fishing gears and crafts:
 - Nets : Stringed Cast net, Gill net, Drag net, Trawl net.
 - Boats : Dugout canoe, Machhawa, Flat-bottomed boat, Trawler.
3. Scales of fishes; Types of caudal fins
4. Identification & Classification of the following fishes upto Family
(*as per Day*):
 - Catla, Rohu, Mrigal, Hilsa, Dara, Ghol, Bombay duck and Pomfret.
5. Home Aquarium: Primary knowledge, Construction, General maintenance and popular aquarium fishes.

Unit III WILDLIFE OF INDIA:

1. Introduction: National Parks, Sanctuaries, Endangered, Vulnerable, Threatened Species.
2. Elementary knowledge of:
Marine National Park of Gujarat, Velavadar National Park, Gir National Park and Sanctuary, Wildass Sanctuary of Gujarat and Nalsarovar Bird Sanctuary, Conservation projects of Tiger, Wild Ass, Black buck, Lion.
3. Wildlife management tools: Compass, Binoculars, Cameras, Radio- transmitters/receivers, Spotting Scope, Tranquilizer gun/darts.
4. Some important wild fauna of India (*give scientific name & brief note on each*): Asiatic lion, Tiger, Leopard, Snow leopard, Black buck, Indian Bison, Indian wildass, Indian One-horned Rhino, Great Indian Bustard, Great Indian Hornbill, Peacock, Gangetic dolphin and Vultures.
5. Animal Evidences in the field: Pug marks, Hoofmarks, Scats, Nests, Antlers.

Unit IV ANIMAL DIVERSITY (Chordates)–General Topics:

Comp. anatomy of vertebrates–Aortic arches, Heart and Kidney.

Theory Paper-style and pattern of marks-distribution

PAPER – 205

(ANIMAL DIVERSITY (chordates), FISHERY BIOLOGY, WILDLIFE of India)

<u>Q.No.</u>	<u>UNITNO.</u>	<u>MARKS</u>
Q.1.	Unit-I OR Unit-I	07
Q.1.	Unit-I OR Unit-I	07
Q.2.	Unit-II OR Unit-II	07
Q.2.	Unit-II OR Unit-II :	07
Q.3.	Unit-III OR Unit-III	07
Q.3.	Unit-III OR Unit-III	07
Q.4.	Unit-IV OR Unit-IV	07
Q.4	Unit-IV OR Unit-IV	07
Q.5	14 objective questions of 1 mark each. 3 questions from each of the four Units and remaining 2 questions from any of the four Units.	14

PAPER-206 (A) (Practicals)
(Based on Theory Paper 204)

1. ANIMAL DIVERSITY (Non Chordates)– Systematics: (a short description and habitat should also be written for each animal)

Identification & classification of invertebrates (Kingdom to Class):

1. Arthropoda: Apus, Balanus, Prawn, Crab, Centipede, Butterfly, Scorpion.
2. Mollusca :Chiton, Dentalium, Pila, Unio, Octopus.
3. Echinodermata : Brittlestar, Sea urchin, Sea cucumber, Feather star, Starfish.

2. ANIMAL DIVERSITY (Nonchordates):

A) Study of Cockroach by Charts / Video / Photographs :

1. External characters. Study Digestive, Circulatory, Nervous systems, Reproductive system
2. Study of V.S. of Compound eye, W.M. of Salivary gland, T.S. of Gizzard, W.M of Leg

B) Study of mouthparts of:

Honey bee, Housefly, Butter fly, Mosquito (*Anopheles & Culex*, male & female) and Cockroach.

3. INSECTS VECTORS AND VECTOR-BORNE DISEASES:

Study of Arthropod Vectors through permanent slides / photographs (As per theory syllabus) Study of Vector Borne Diseases (As per theory syllabus)

4. CYTOLOGY

1. Cytoplasm (Physical nature of matrix, Chemical organization of matrix)
2. Cytoskeleton
3. Endoplasmic reticulum
4. Mitochondria
5. Mitosis

GUJARAT UNIVERSITY

Semester-4 Zoology

(SKELETON QUESTION PAPER FOR PRACTICAL EXAMINATION)

PAPER-206 (A)

(Based on Theory Paper 204)

Date:

Marks : 35

Time :

- | | |
|---|-----------|
| Q.1 Sketch, label and describe _____ system of Cockroach. | 06 |
| Q.2 Identify given figure of an arthropod vector and write brief description of its disease. | 05 |
| Q.3 Identify & describe the given mouth parts. | 04 |
| Q.4 Identify specimens 1 to 6 as per instructions: | 12 |
| Sp.1 Identify and classify upto Class, giving reasons. | |
| Sp.2 Identify and classify upto Class, giving reasons. | |
| Sp.3 Identify and classify upto Class, giving reasons. | |
| Sp.4 Identify and describe. | |
| Sp.5 Identify and comment. | |
| Sp.6 Identify and comment. | |
| Q.5 Viva voce | 04 |
| Q.6 Journal | 04 |

DETAILS FOR PRACTICAL EXAMINATION (Questionwise)
Semester-4 Zoology

PAPER-206(A)
(*Based on Theory Paper 204*)

- Q.1** Cockroach : External characters, Digestive, Circulatory, Nervous and Reproductive systems.
- Q.2** Vector and Vector-borne diseases (As per theory syllabus)
- Q.3** Honey bee, Housefly, Butterfly, Mosquito (*Anopheles* & *Culex*, male & female) and Cockroach.
- Q.4**
- Sp.1 Arthropoda
 - Sp.2 Mollusca
 - Sp.3 Echinodermata & Hemichordata
 - Sp.4 V.S. of Compound eye, W.M. of Salivary gland, T.S. of Gizzard, W.M of Leg
 - Sp.5 Cytology
 - Sp.6 Cytology
- Q.5** Syllabus of Theory Paper-204 & 205 and Practical Paper-206 (A) & (B) only.

Note: *All examiners should take the viva sitting together and each examiner should give marks from 04 and then the average marks of all the examiners should be given to the candidate.*

PAPER-206 (B) (Practicals)
(Based on Theory Paper 205)

1. ANIMAL DIVERSITY (Chordates)– Systematics: (a short description and habitat should also be written for each animal)

Identification & Classification of following animals with scientific names upto Orders, giving reasons :

1. Reptilia : Giant turtle, Tuatara, Common house lizard, Horned toad, Chameleon, Rat snake, Seasnake.
2. Aves : Stork, Pelican, Goose, Kite, Peacock, Crane, Cuckoo, Kingfisher, Woodpecker, Parakeet, Owl, Pigeon, Crow, Lapwing, Swift.
3. Mammalia : Hedgehog, Flying fox, Human, Dog, Blue whale, Donkey, Blue bull, Elephant, Dugong, Squirrel, Indian hare, Pangolin.

2. FISHERY SCIENCE:

1. Study of fishing gears:
 - Nets : Stringed Cast net, Gill net, Dole net, Drag net, Trawl net.
 - Boats : Dugout canoe, Machhawa, Flat-bottomed boat, Trawler.
2. Identification & Classification of the following fishes upto Family (*as per Dey*):
 - Catla, Rohu, Mrigal, Hilsa, Dara, Ghol, Bombay duck and Pomfret.
3. Types of Caudal fins
4. Scales of Fishes

3. WILDLIFE OF INDIA:

1. Study by photographs of some endangered fauna of India, along with scientific names(As per theory syllabus)
2. Field Observation Tools for Wildlife :
Compass, Spotting Scope, Binoculars, Cameras, Radio-transmitters/receivers, Tranquilizer gun/darts.
3. Study of Animal Evidences in the field by photographs.(As per theory syllabus)
4. National Park & Sanctuary (*as per theory syllabus*) spotting in map of Gujarat.

4. CYTOLOGY:

1. Cytoplasm (Physical nature of matrix, Chemical organization of matrix),
Cytoskeleton, Endoplasmic reticulum, Mitochondria,
2. Prepare temporary mounting of mitosis from Onion root tip.

GUJARATUNIVERSITY

Semester-4Zoology

(SKELETONQUESTIONPAPERFORPRACTICALEXAMINATION)

PAPER-206 (B)

(Based on Theory Paper 205)

Date:

Marks : 35

Time :

- Q.1** Identify and classify, giving reasons, the given two fishes. **08**
- Q.2** Prepare temporary mounting of mitosis from Onion root tip. **07**
- Q.3** Identify specimens 1 to6 as per instructions: **12**
- Sp.1. Identify and classify upto Order, giving reasons.
- Sp.2. Identify and classify upto Order, giving reasons.
- Sp.3. Identify and classify upto Order, giving reasons.
- Sp.4. Identify and describe.
- Sp.5. Identify, state its scientific name and comment on the given specimen.
- Sp.6. Identify and describe
- Q.4** Viva voce **04**
- Q.5** Journal. **04**

DETAILS FOR PRACTICAL EXAMINATION (Question wise)
Semester-4 Zoology

PAPER-206 (B)
(Based on Theory Paper 205)

Q.1 Catla, Rohu, Mrigal, Hilsa, Dara, Ghol, Bombay duck and Pomfret.

Q.2 Prepare temporary mounting of mitosis from Onion root tip.

Q.3 Sp.1 Reptilia

Sp. 2 Aves

Sp. 3 Mammalia

Sp.4 Nets / Boats / Types of Scales / Types of Caudal fins

Sp.5 Asiatic lion, Tiger, Leopard, Snow leopard, Black buck, Indian Bison, Indian wildass,
Indian One-horned Rhino, Great Indian Bustard, Great Indian Hornbill, Peacock,
Gangetic dolphin and Vultures.

Sp. 6 Compass, Spotting Scope, Binoculars, Cameras, Radio-transmitters/receivers,
Tranquilizer gun/darts, Pug marks, Hoof marks, Scats, Nests, Antlers.

Reference Books for 204, 205 and Practical 206 (A) and (B).

1. **Textbook of Invertebrates**, R. L. Kotpal, Rastogi Publishers, Meerut.
2. **Manual of Zoology**, E. K. Ayer, Vol. I & II.
3. **Invertebrate Zoology**, Jordan and Verma, S. Chand & Company, Delhi.
4. **Textbook of Vertebrates**, R. L. Kotpal, Rastogi Publication, Meerut.
5. **Chordate Zoology**, P. S. Dhami, and J. K. Dhami, S. Chand & Co., Delhi.
6. **Introduction to Chordates**, T. C. Majupuria, Pradeep Publication, Jalandhar.
7. **Text book of practical zoology - Invertebrates**, S. S. Lal Rastogi Publication, Meerut.
8. **Text book of practical zoology - Vertebrates**, S. S. Lal Rastogi Publication, Meerut.
9. **Entomology and Pest Management**. Pedigo L. P. (2002), Prentice Hall Publication.
10. **Integrated Vector Management: Controlling Vectors of Malaria and other Insect Vector borne Diseases**. Methews, G. (2011) Wiley-Blackwell
11. **Cytology**, P. S. Verma & V. K. Agarwal, S. Chand & Company, Delhi.
12. **Cell Biology**, C. B. Power, Himalaya Publishing House.
13. **Introduction to cytology**, Veer bala Rastogi, Kedarnath Ramnath, Meerut.
14. **Fish & Fisheries of India**, V. B. Jhingran, Hindustan Pub., Meerut.
15. **Fishery Science and Indian Fisheries**, Srivastav, Kitab Mahal Pub., Delhi.
16. **Fishes**, Chandy.
17. **Day volume-I & II**.
18. **Indian Wildlife, Srilanka, Nepal**, APA Publications.
19. **Wildlife of India**, Mark E. Trisch, Harper Collins Pub.
20. **Threatened Animals of India**, B.K. Tikader, ZSI, Calcutta.